WEST COMMUNITY ELEMENTARY SCHOOL (23-H)

16100 Persimmon Boulevard
Westlake, FL 33470
SDPBC Project No. 0222-8462

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School District of Palm Beach County

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NOVEMBER 2025

Phase III 100% Construction Document Submission
Bid Set for CM

Bid Set Note: Unedited District Master Specs included as noted in the Table of Contents for all non-revised sections to assist Construction Manager

TECHNICAL SPECIFICATIONS
VOLUME 2 - DIVISIONS 21-33

ZYSCOVICH
A Stratus Team Company

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Section Number	*Specification Title*	*Status*	*Version Date*	*Responsible Designer*	*Edited for This Project*	*Edited Sections Latest Revision*
DIVISION 0 - ADDITIONAL INFORMATION						
00 01 07	List of Professionals	Zyscovich	NA	Architectural		Nov-25
00 31 32	Geotechnical Report	Radise	NA	Geotech		Nov-25
DIVISION 0 - TOC						
00 01 02	Table of Contents	Master Spec	2023	Architectural	Yes	Nov-25
DIVISION 1- GENERAL CONDITIONS						
01 11 00	Summary of Work Contractor Conduct	Master Spec	2023	Architectural	Yes	Nov-25
01 23 00	Alternates	Zyscovich	NA	Architectural		Nov-25
01 26 00	Contract Modification Procedures	Master Spec	2023	Architectural		
01 29 76	Procedures for Payment	Master Spec	2023	Architectural		
01 31 00	Project Management & Coordination	Master Spec	2023	Architectural	Yes	Nov-25
01 32 17	Network Analysis Schedule	Master Spec	2023	Architectural		
01 33 00	Submittal Procedures	Master Spec	2023	Architectural	Yes	Nov-25
~~01 35 16~~	~~Alteration Project Procedures~~	~~Master Spec~~	~~2023~~	~~Architectural~~		
01 40 00	Quality Control	Master Spec	2023	Architectural		
01 41 00	Regulatory Requirements	Master Spec	2023	Architectural		
01 45 00	Testing Laboratory Services	Master Spec	2023	Architectural		
01 50 00	Temporary Construction Facilities	Master Spec	2023	Architectural		
01 56 00	Security Barriers & Enclosures	Master Spec	2023	Architectural		
01 57 00	Temporary Controls	Master Spec	2023	Architectural		
01 60 00	Material Equipment and Approved Equals	Master Spec	2023	Architectural		
01 72 29	Cutting and Patching	Master Spec	2023	Architectural		
01 75 00	Starting and Adjusting Systems	Master Spec	2023	Architectural		
01 77 00	Contract Closeout	Master Spec	2023	Architectural		
01 78 23	Operation and Maintenance Data	Master Spec	2023	Architectural		
01 78 36	Warranties	Master Spec	2023	Architectural		
01 83 16	Exterior Enclosure Performance Requirements	Zyscovich	NA	Architectural		Nov-25
01 91 00	Commissioning	Master Spec	2023	Architectural	Yes	Nov-25
DIVISION 2 - EXISTING CONDITIONS						
~~02 41 13~~	~~Selective Demolition~~	~~Master Spec~~	~~2023~~	~~Architectural~~		
~~02 41 16~~	~~Building Demolition~~	~~Master Spec~~	~~2023~~	~~Architectural~~		
DIVISION 3 - CONCRETE						
03 11 00	Concrete Formwork	Master Spec	2023	Structural		
03 20 00	Concrete Reinforcement	Master Spec	2023	Structural		
~~03 24 00~~	~~Fibrous Reinforcing~~	~~Master Spec~~	~~2023~~	~~Structural~~		
03 30 00	Cast-in-place Concrete	Master Spec	2023	Structural	Yes	Nov-25
03 30 06	Waterproofing Admixture for Cast-in-Place Concrete	Zyscovich	N/A	Architectural		Nov-25
03 35 00	Concrete Floor Finishing	Master Spec	2023	Structural	Yes	Nov-25
03 36 00	Polished Concrete Floor	Master Spec	2023	Structural	Yes	Nov-25
~~03 41 00~~	~~Structural Precast Concrete~~	~~Master Spec~~	~~2023~~	~~Structural~~		
03 45 00	Precast Architectural Concrete Elements	Zyscovich	N/A	Architectural		Nov-25
03 47 13	Tilt-up Concrete	Master Spec	2023	Structural	Yes	Nov-25
03 52 16	Lightweight Insulating Concrete	Master Spec	2023	Structural	Yes	Nov-25

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03 54 00	Self-Leveling Underlayment	Zyscovich	N/A	Architectural		Nov-25
DIVISION 4 - MASONRY						
04 05 13	Masonry, Mortar and Grout	Master Spec	2023	Structural		
04 20 00	Masonry Units	Master Spec	2023	Structural		
04 20 10	Reinforced Masonry Units	Master Spec	2023	Structural		
~~04 23 00~~	~~Glass Unit Masonry~~	~~Master Spec~~	~~2023~~	~~Structural~~		
DIVISION 5 - METALS						
05 12 00	Structural Steel	Master Spec	2023	Structural		
05 21 00	Steel Joists and Joist Girders	Master Spec	2023	Structural		
05 31 00	Steel Deck	Master Spec	2023	Structural		
05 40 00	Structural Cold Formed Metal Framing	Master Spec	2023	Structural		
05 50 00	Metal Fabrications	Master Spec	2023	Structural	Yes	Nov-25
05 51 00	Metal Stairs	Master Spec	2023	Structural	Yes	Nov-25
05 52 00	Metal Railings	Master Spec	2023	Structural	Yes	Nov-25
~~05 53 10~~	~~Metal Gratings and Floor Plates~~	~~Master Spec~~	~~2023~~	~~Structural~~		
DIVISION 6 - WOODS, PLASTICS & COMPOSITES						
06 10 00	Rough Carpentry	Master Spec	2023	Architectural		
06 41 00	Custom Casework	Master Spec	2023	Architectural	Yes	Nov-25
DIVISION 7 - THERMAL & MOISTURE PROTECTION						
~~07 01 00~~	~~Preparation For Re-Roofing~~	~~Master Spec~~	~~2023~~	~~Architectural~~		
~~07 01 50~~	~~Elastomeric Roof Repair and Restoration~~	~~Master Spec~~	~~2023~~	~~Architectural~~		
~~07 11 13~~	~~Bituminous Dampproofing~~	~~Master Spec~~	~~2023~~	~~Architectural~~		
07 13 00	Sheet Membrane Waterproofing	Master Spec	2023	Architectural	Yes	Nov-25
~~07 14 00~~	~~Fluid Applied Waterproofing~~	~~Master Spec~~	~~2023~~	~~Architectural~~		
07 18 00	Fluid Applied Waterproofing (Exposed)	Zyscovich	N/A	Architectural		Nov-25
07 19 00	Water Repellent Penetrant	Master Spec	2023	Architectural		
07 21 13	Polyisocyanorate Board Insulation	Master Spec	2023	Architectural		
~~07 21 14~~	~~Extruded Polystyrene Board Insulation~~	~~Master Spec~~	~~2023~~	~~Architectural~~		
07 21 16	Batt Insulation	Master Spec	2023	Architectural		
07 21 19	Foamed-in-Place Insulation	Master Spec	2023	Architectural		
07 26 00	Vapor Retarders	Master Spec	2023	Architectural	Yes	Nov-25
07 27 00	Air Barriers	Zyscovich	N/A	Architectural		Nov-25
~~07 31 13~~	~~Asphalt Shingles~~	~~Master Spec~~	~~2023~~	~~Architectural~~		
~~07 32 16~~	~~Concrete Roofing Tiles~~	~~Master Spec~~	~~2023~~	~~Architectural~~		
~~07 42 13~~	~~Metal Wall Panels~~	~~Master Spec~~	~~2023~~	~~Architectural~~		
07 4213.23	Metal Composite Material Wall Panels	Zyscovich	N/A	Architectural		Nov-25
07 52 00	Modified Bitumen Membrane Roofing	Master Spec	2023	Architectural	Yes	Nov-25
~~07 61 13~~	~~Metal Roof Panels~~	~~Master Spec~~	~~2023~~	~~Architectural~~		
07 62 00	Flashing, Gutters, Downspouts and Other Accessories	Master Spec	2023	Architectural	Yes	Nov-25
07 72 33	Roof Hatches	Master Spec	2023	Architectural	Yes	Nov-25
07 81 16	Cementitious Fireproofing	Master Spec	2023	Architectural		
07 84 00	Firestop System	Master Spec	2023	Architectural		
07 92 00	Joint Sealants	Master Spec	2023	Architectural		
07 95 13	Expansion Joint Cover Assemblies	Master Spec	2023	Architectural		

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DIVISION 8 - OPENINGS						
08 11 00	Metal Doors and Frames	Master Spec	2023	Architectural	Yes	Nov-25
08 14 00	Wood Doors	Master Spec	2023	Architectural		
08 31 00	Access Doors and Frames	Master Spec	2023	Architectural	Yes	Nov-25
08 33 13	Coiling Counter Doors	Master Spec	2023	Architectural	Yes	Nov-25
08 33 23	Overhead Coiling Doors	Master Spec	2023	Architectural	Yes	Nov-25
~~08 33 26~~	~~Overhead Coiling Grilles~~	~~Master Spec~~	~~2023~~	~~Architectural~~		
08 43 13	Aluminum-Framed Storefronts	Zyscovich	N/A	Architectural		Nov-25
08 51 13	Aluminum Windows	Master Spec	2023	Architectural	Yes	Nov-25
08 71 00	Door Hardware	Master Spec	2023	Architectural	Yes	Nov-25
08 71 00A	Door Hardware Groups	Allegion	N/A	Architectural		Nov-25
08 80 00	Glazing	Master Spec	2023	Architectural	Yes	Nov-25
08 91 19	Fixed Louvers	Master Spec	2023	Architectural	Yes	Nov-25
DIVISION 9 - FINISHES						
09 05 61	Common Work Results for Flooring Preparation	Zyscovich	N/A	Architectural		Nov-25
09 22 14	Metal Furring and Lathing	Master Spec	2023	Architectural	Yes	Nov-25
09 22 16	Non-Structural Metal Stud Framing	Master Spec	2023	Architectural	Yes	Nov-25
09 24 00	Portland Cement Plaster	Master Spec	2023	Architectural		
09 26 00	Veneer Plaster	Master Spec	2023	Architectural		
~~09 26 13~~	~~Gypsum Veneer Plaster~~	~~Master Spec~~	~~2023~~	~~Architectural~~		
09 29 00	Gypsum Board System	Master Spec	2023	Architectural	Yes	Nov-25
09 30 13	Ceramic ~~and Quarry~~ Tile	Master Spec	2023	Architectural	Yes	Nov-25
09 51 00	Acoustical Ceilings	Master Spec	2023	Architectural		
~~09 54 23~~	~~Linear Metal Ceiling~~	~~Master Spec~~	~~2023~~	~~Architectural~~		
~~09 64 00~~	~~Wood Flooring~~	~~Master Spec~~	~~2023~~	~~Architectural~~		
09 65 00	Resilient Flooring	Master Spec	2023	Architectural	Yes	Nov-25
09 67 00	Fluid Applied Epoxy Flooring	Master Spec	2023	Architectural		
~~09 68 13~~	~~Tile Carpet~~	~~Master Spec~~	~~2023~~	~~Architectural~~		
09 72 00	Wall Covering	Zyscovich	N/A	Architectural		Nov-25
09 84 33	Acoustical Wall and Ceiling Panels	Master Spec	2023	Architectural	Yes	Nov-25
09 91 13	Exterior Painting	Master Spec	2023	Architectural	Yes	Nov-25
09 91 23	Interior Painting	Master Spec	2023	Architectural	Yes	Nov-25
DIVISION 10 - SPECIALTIES						
10 11 00	Marker Boards and Tack Boards	Master Spec	2023	Architectural		
10 12 00	Display Cases	Master Spec	2023	Architectural	Yes	Nov-25
10 14 00	Signage	Master Spec	2023	Architectural	Yes	Nov-25
10 14 16	Plaque	Master Spec	2023	Architectural		
~~10 14 33~~	~~Exterior Marquee Sign~~	~~Master Spec~~	~~2023~~	~~Architectural~~		
10 14 63	Digital Exterior Marquee Sign	Master Spec	2023	Architectural		
10 21 00	Toilet Compartments	Master Spec	2023	Architectural		
10 21 23	Cubicle Curtains	Master Spec	2023	Architectural		
10 22 13	Wire Mesh Partitions	Master Spec	2023	Architectural		
~~10 22 26~~	~~Operable Partitions~~	~~Master Spec~~	~~2023~~	~~Architectural~~		
10 26 00	Door and Wall Protection	Master Spec	2023	Architectural	Yes	Nov-25
10 28 00	Toilet Accessories	Master Spec	2023	Architectural	Yes	Nov-25

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10 43 00	Emergency Aid Specialties	Zyscovich	N/A	Architectural		Nov-25
10 44 00	Fire Protection Specialties	Master Spec	2023	Architectural		
10 51 00	General Corridor Lockers	Master Spec	2023	Architectural		
~~10 51 10~~	~~Athletic Lockers~~	~~Master Spec~~	~~2023~~	~~Architectural~~		
10 56 13	Metal Shelving	Master Spec	2023	Architectural		
10 71 13.43	Fixed Sun Screens	Zyscovich	N/A	Architectural		Nov-25
10 73 26	Walkway Coverings	Master Spec	2023	Architectural	Yes	Nov-25
10 75 00	Flagpoles	Master Spec	2023	Architectural		
DIVISION 11 - EQUIPMENT						
~~11 13 13~~	~~Loading Dock Bumpers~~	~~Master Spec~~	~~2023~~	~~Architectural~~		
11 16 16	Safes	Master Spec	2023	Architectural		
11 31 00	Residential Appliances	Master Spec	2023	Architectural	Yes	Nov-25
11 40 00	Food Service Equipment	Real Food	N/A	Food Service		Nov-25
~~11 51 23~~	~~Library Stack Systems~~	~~Master Spec~~	~~2023~~	~~Architectural~~		
11 52 13	Projection Screens	Master Spec	2023	Architectural		
11 57 00	Wire Management - Cord Reels	Zyscovich	N/A	Architectural		Nov-25
11 61 53	Stage Curtains	Master Spec	2023	Architectural		
11 65 00	Athletic Equipment	Master Spec	2023	Architectural	Yes	Nov-25
~~11 66 53~~	~~Gymnasium Dividers~~	~~Master Spec~~	~~2023~~	~~Architectural~~		
11 95 05	Kilns	Master Spec	2023	Architectural	Yes	Nov-25
DIVISION 12 - FURNISHINGS						
~~12 21 16~~	~~Vertical Louver Blinds~~	~~Master Spec~~	~~2023~~	~~Architectural~~		
12 24 13	Roller Window Shades	Master Spec	2023	Architectural		
~~12 35 53~~	~~Laboratory Casework & Equipment~~	~~Master Spec~~	~~2023~~	~~Architectural~~		
12 48 13	Entrance Floor Mats	Master Spec	2023	Architectural	Yes	Nov-25
~~12 61 00~~	~~Fixed Auditorium Seating~~	~~Master Spec~~	~~2023~~	~~Architectural~~		
~~12 66 00~~	~~Telescoping Bleachers~~	~~Master Spec~~	~~2023~~	~~Architectural~~		
DIVISION 13 - SPECIAL CONSTRUCTION						
13 31 00	Playground Shade Structure	Master Spec	2023	Architectural		
~~13 34 00~~	~~Fabricated Engineered Structures~~	~~Master Spec~~	~~2023~~	~~Architectural~~		
~~13 34 16.01~~	~~Home Side Grandstand Seating System~~	~~Master Spec~~	~~2023~~	~~Architectural~~		
~~13 34 16.02~~	~~Visitor Side Aluminum Seating System~~	~~Master Spec~~	~~2023~~	~~Architectural~~		
~~13 34 16.03~~	~~Modular Press Box~~	~~Master Spec~~	~~2023~~	~~Architectural~~		
~~13 34 16.04~~	~~Portable Exterior Bleachers~~	~~Master Spec~~	~~2023~~	~~Architectural~~		
~~13 60 00~~	~~Spray Painting Booth~~	~~Master Spec~~	~~2023~~	~~Architectural~~		
DIVISION 14 - CONVEYING EQUIPMENT						
~~14 21 00~~	~~Electric Traction Elevators~~	~~Master Spec~~	~~2023~~	~~Architectural~~		
14 24 23	Hydraulic Elevators - Passenger	Master Spec	2023	Architectural	Yes	Nov-25
~~14 42 13~~	~~Wheelchair Lift~~	~~Master Spec~~	~~2023~~	~~Architectural~~		
~~14 45 00~~	~~Automobile Lift System~~	~~Master Spec~~	~~2023~~	~~Architectural~~		
DIVISION 21 - FIRE SUPPRESSION						
21 00 00	Fire Suppression	Master Spec	2023	Mechanical	Yes	Nov-25

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DIVISION 22 - PLUMBING						
22 05 00	Basic Plumbing Requirements	Master Spec	2023	Mechanical		
~~22 05 10~~	~~Minor Plumbing Demolition~~	~~Master Spec~~	~~2023~~	~~Mechanical~~		
22 05 29	Hangers and Supports Plumbing Piping	Master Spec	2023	Mechanical		
22 05 53	Identification for Plumbing, Piping and Equipment	Master Spec	2023	Mechanical		
22 05 93	Tests - Plumbing Piping Systems	Master Spec	2023	Mechanical		
22 07 19	Plumbing Piping Insulation	Master Spec	2023	Mechanical		
22 10 00	Plumbing Piping	Master Spec	2023	Mechanical		
22 11 00	Facility Water Distribution	Master Spec	2023	Mechanical		
22 13 00	Facility Sanitary Drainage	Master Spec	2023	Mechanical		
22 14 00	Facility Storm Drainage	Master Spec	2023	Mechanical		
22 20 00	Plumbing Specialties	Master Spec	2023	Mechanical		
22 30 00	Plumbing Equipment	Master Spec	2023	Mechanical		
22 40 00	Plumbing Fixtures	Master Spec	2023	Mechanical		
DIVISION 23 - HEATING, VENTILATION & AIR CONDITIONING						
23 05 00	Basic HVAC Requirements	Master Spec	2023	Mechanical		
~~23 05 10~~	~~Minor HVAC Demolition~~	~~Master Spec~~	~~2023~~	~~Mechanical~~		
23 05 13	Motor Requirements for HVAC	Master Spec	2023	Mechanical		
23 05 19	Meters, Gages and Thermometers for HVAC Piping	Master Spec	2023	Mechanical		
23 05 29	Curbs, Hangers and Supports for HVAC Piping	Master Spec	2023	Mechanical		
23 05 48	HVAC Vibration Control	Master Spec	2023	Mechanical		
23 05 53	Identification for HVAC Piping & Equipment	Master Spec	2023	Mechanical		
23 05 83	Tests - HVAC Piping Systems	Master Spec	2023	Mechanical		
23 05 93	HVAC Testing, Adjusting & Balancing	Master Spec	2023	Mechanical	Yes	Nov-25
23 07 13	Ductwork Insulation	Master Spec	2023	Mechanical	Yes	Nov-25
23 07 16	HVAC Equipment Insulation	Master Spec	2023	Mechanical		
23 07 19	HVAC Piping Insulation	Master Spec	2023	Mechanical		
23 08 00	Commissioning of HVAC Systems	Master Spec	2023	Mechanical		
23 09 00	Energy Management and Control System	Master Spec	2023	Mechanical		
23 21 13	Hydronic Piping	Master Spec	2023	Mechanical		
23 21 16	Hydronic Specialties	Master Spec	2023	Mechanical		
23 21 23	Hydronic Pumps	Master Spec	2023	Mechanical		
23 23 00	Refrigeration Piping	Master Spec	2023	Mechanical		
23 25 00	HVAC Water Treatment	Master Spec	2023	Mechanical		
23 29 23	Variable Frequency Motor Controls	Master Spec	2023	Mechanical		
23 31 00	Ductwork	Master Spec	2023	Mechanical		
23 33 00	Air Duct Accessories	Master Spec	2023	Mechanical		
23 34 23	HVAC Power Ventilators	Master Spec	2023	Mechanical		
23 36 16	Variable Air Volume Units	Master Spec	2023	Mechanical		
23 37 13	Grilles, Registers & Diffusers	Master Spec	2023	Mechanical		
23 40 00	HVAC Air Filters	Master Spec	2023	Mechanical		
23 63 13	Air Cooled Refrigerant Condensers	Master Spec	2023	Mechanical		
~~23 64 10~~	~~Air Cooled Water Chillers~~	~~Master Spec~~	~~2023~~	~~Mechanical~~		
23 64 16	Centrifugal Water Chillers	Master Spec	2023	Mechanical		
~~23 64 26~~	~~Rotary Screw Water Chillers~~	~~Master Spec~~	~~2023~~	~~Mechanical~~		
23 65 00	Cooling Tower	Master Spec	2023	Mechanical		
23 70 00	Air Handling Units	Master Spec	2023	Mechanical		

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23 81 00	Decentralized HVAC Equipment	Master Spec	2023	Mechanical		
23 82 19	Electric Resistance Duct Heaters	Master Spec	2023	Mechanical		
DIVISION 25 - INTEGRATED AUTOMATION						
25 50 00	Energy Mangement and Control System	Master Spec	2023	Electrical		
DIVISION 26 - ELECTRICAL						
26 00 00	Electrical Requirements	Master Spec	2023	Electrical		
26 05 00	Electrical Materials and Methods	Master Spec	2023	Electrical		
26 05 13	Electrical Wire and Cable	Master Spec	2023	Electrical		
26 05 19	Equipment Wiring Systems	Master Spec	2023	Electrical		
26 05 26	Grounding and Bonding of Electrical Systems	Master Spec	2023	Electrical		
26 05 29	Hangers and Supports for Electrical Systems	Master Spec	2023	Electrical		
26 05 33	Electrical Raceways and Boxes	Master Spec	2023	Electrical		
26 05 36	Cable Tray	Master Spec	2023	Electrical		
~~26 05 40~~	~~Electrical Connections of Relocatable Classrooms~~	~~Master Spec~~	~~2023~~	~~Electrical~~		
26 05 53	Electrical Identification	Master Spec	2023	Electrical		
26 08 00	Work Included	Master Spec	2023	Electrical		
26 09 00	Electrical Instrumentation & Control	Master Spec	2023	Electrical		
26 10 00	Electrical Utility Services	Master Spec	2023	Electrical		
26 22 10	Dry Type Transformers	Master Spec	2023	Electrical		
26 23 10	Disconnect Switches	Master Spec	2023	Electrical		
26 24 13	Switchboards	Master Spec	2023	Electrical		
26 24 16	Panelboards	Master Spec	2023	Electrical		
26 27 16	Electrical Cabinets and Enclosures	Master Spec	2023	Electrical		
26 27 23	Indoor Service Poles	Master Spec	2023	Electrical		
26 27 26	Wiring Devices	Master Spec	2023	Electrical		
26 28 13	Fuses (600 Volt & Below)	Master Spec	2023	Electrical		
26 28 16	Enclosed Switches and Circuit Breakers	Master Spec	2023	Electrical		
26 28 39	Motor Control	Master Spec	2023	Electrical		
26 29 10	Electric Controls and Relays	Master Spec	2023	Electrical		
26 35 13	Gas Engine Drive Generator Assembly	Master Spec	2023	Electrical		
26 36 00	Transfer Switches	Master Spec	2023	Electrical		
26 41 00	Lightning Protection for Structures	Master Spec	2023	Electrical		
26 43 00	Transient Voltage Suppression	Master Spec	2023	Electrical		
26 51 00	Interior Lighting	Master Spec	2023	Electrical		
26 52 00	Emergency Lighting	Master Spec	2023	Electrical		
26 55 61	Theatrical Lighting	Master Spec	2023	Electrical		
26 56 29	Exterior Lighting	Master Spec	2023	Electrical		
26 58 68	Exterior Athletic Lighting	Master Spec	2023	Electrical		
DIVISION 27 - COMMUNICATIONS						
27 10 00	Communication System (Data & Voice)	Master Spec	2023	Electrical		
27 24 10	Projector System	Master Spec	2023	Electrical		
27 41 00	Master Television System (MTS)	Master Spec	2023	Electrical		
27 51 16	Public Address Systems	Master Spec	2023	Electrical		
~~27 51 23~~	~~Intercom Systems (Existing Schools)~~	~~Master Spec~~	~~2023~~	~~Electrical~~		
27 51 24	Intercom Systems (New and Modernized Schools)	Master Spec	2023	Electrical		

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27 53 10	Emergency Radio Communications Systems	Master Spec	2023	Electrical		
27 53 11	Facility Radio Repeater Systems	Master Spec	2023	Electrical		
27 53 13	GPS Wireless Clock Systems	Master Spec	2023	Electrical		
27 60 00	Open Wiring	Master Spec	2023	Electrical		
DIVISION 28 - ELECTRONIC SAFETY AND SECURITY						
28 13 00	Access Control	Master Spec	2023	Electrical		
28 16 00	Intrusion Detection	Master Spec	2023	Electrical		
28 31 00	Fire Alarm and Smoke Detection Systems	Master Spec	2023	Electrical		
28 33 00	Video Surveillance System	Master Spec	2023	Electrical		
DIVISION 31 - EARTH WORK						
31 10 00	Site Clearing	Master Spec	2023	Civil		
31 20 00	Earth Moving	Master Spec	2023	Civil		
31 31 16	Termite Control	Master Spec	2023	Architectural		
DIVISION 32 - EXTERIOR IMPROVEMENTS						
32 12 16	Asphalt Paving	Master Spec	2023	Civil		
32 13 13	Concrete Paving	Master Spec	2023	Civil		
~~32 13 13.29~~	~~Pervious Concrete Pavement~~	~~Master Spec~~	~~2023~~	~~Civil~~		
~~32 14 13.19~~	~~Permeable Interlocking Concrete Pavement~~	~~Master Spec~~	~~2023~~	~~Civil~~		
32 17 13	Parking Bumpers	Master Spec	2023	Civil		
32 17 23	Pavement Marking	Master Spec	2023	Civil		
32 18 16	Playgrounds	Master Spec	2023	Architectural		
~~32 18 23~~	~~Athletic Surfacing~~	~~Master Spec~~	~~2023~~	~~Civil~~		
32 30 00	Exterior Athletic Equipment & Field Markings	Master Spec	2023	Architectural	Yes	Nov-25
32 31 13	Chain Link Fencing and Gates	Master Spec	2023	Architectural		
32 31 19	Decorative Metal Fencing & Gates	Master Spec	2023	Architectural		
32 33 13	Site Bicycle Racks	Zyscovich	N/A	Architectural		Nov-25
32 84 23	Underground Irrigation System	Master Spec	2023	Landscape		
32 92 23	Sodding	Master Spec	2023	Landscape		
32 93 00	Trees, Plants & Ground Cover	Master Spec	2023	Landscape		
DIVISION 33 - UTILITIES						
33 11 00	Water Distribution System	Master Spec	2023	Civil		
~~33 21 16~~	~~Irrigation Water Well~~	~~Master Spec~~	~~2023~~	~~Landscape~~		
33 30 00	Sanitary Sewerage Utilities	Master Spec	2023	Civil		
33 32 19	Waste Water Pump Station	Master Spec	2023	Civil		
33 40 00	Storm Drainage Utilities	Master Spec	2023	Civil		
~~33 49 23~~	~~Cistern Systems~~	~~Master Spec~~	~~2023~~	~~Architectural~~		
35 51 13	Gas Piping	Master Spec	2023	Civil		
33 56 16	Underground LP Storage & Distribution	Master Spec	2023	Civil		
33 71 19	Electrical Utility Manholes	Master Spec	2023	Civil		

END TOC

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NOTE: Refer to SDPBC on-line Master Specifications as noted in the Table of Contents (TOC) for all non-revised sections. These sections are included by reference and the Contractor shall be solely responsible for obtaining the specifcation version listed in the TOC.

SECTION 00 01 02 - TABLE OF CONTENTS

Section Number	*Specification Title*	*Status*	*Version Date*	*Responsible Designer*	*Edited for This Project*	*Edited Sections Latest Revision*
Digital Signature Section						

Firm:
Name:

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SECTION 21 00 00

FIRE SUPRESSION

PART 1 GENERAL

1.1 SCOPE

A. The work under this section of the specifications consists of furnishing all materials, equipment, labor, testing, appurtenances, engineering and performing all operations in conjunction with all fire protection work indicated on drawings and specified herein.

B. This is a performance based specification with the Sprinkler Contractor providing professional design services for an Engineer.

1. The intent of the information in this Section is solely to set forth the minimum engineering, material and installation requirements used as basic prerequisites applied to the work in this Section.

1.2 RELATED DOCUMENTS

A. The other Contract Documents complement the requirements of this Section. The General Requirements apply to the work of this Section.

1.3 REFERENCES, CODES AND REGULATIONS

A. Sprinkler system design, equipment, materials, devices, and installation shall conform to NFPA Codes and Requirements of Governmental Bodies and Bureaus as listed below.

1. ANSI B16.3 – Malleable Iron Threaded Fittings: Classes 150 and 300
2. ANSI B16.4 – Gray Iron Threaded Fittings Classes 125 and 250
3. ANSI B16.9 – Factory-Made Wrought Buttwelding Fittings
4. ASTM A53/A53M _ Standard Specification for Pipe, Steel, Black and Hot Dipped, Zinc Coated Welded and Seamless
5. ASTM A135/A135M – Standard Specification for Electrical Resistance Welded Steel Pipe
6. ASTM A395/A395M – Standard Specification for Ferritic Ductile Iron Pressure Retaining Casting for Use at Elevated Temperatures
7. ASTM A449 – Standard Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use
8. ASTM A536 – Standard Specification for Ductile Iron Castings
9. ASTM A795/A795M _ Standard Specification for Black and Hot Dipped Zinc Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use
10. NFPA 13 – 2019, Standard for Installation of Sprinkler Systems
11. NFPA 14 – 2019, Standard for the Installation of Standpipes and Hose Systems
12. ~~NFPA 20 – Standard for the Installation of Stationary Pumps for Fire Protection~~
12. NFPA 24 – Standard for the Installation of Private Fire Service Mains and Their Appurtenances
13. NFPA 25 – 2020, Standard for the Inspection, Testing and Maintenance of Water-Based Fire Protection Systems
14. NFPA 72 – National Fire Alarm and Signaling Code

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15. UL - Underwriters Laboratory
16. FM - Factory Mutual
17. Department of Professional Regulation, State of Florida, Law and Rules, Chapter 471, Florida Statutes and Rules Chapter 61G15, Florida Administrative Code
18. FBC - Florida Building Code
19. FFPC - Florida Fire Protection Code.

1.4 SUBMITTALS

A. Prior to commencing the work, the Sprinkler Contractor shall submit a complete set of detailed signed and sealed working drawings prepared by an Engineer in accordance with NFPA 13, showing equipment, underground fire service lines, risers, piping, and heads.
   1. These drawings shall be coordinated with structural steel, mechanical ductwork, and piping shop drawings prior to submission.
   2. Drawings shall indicate cut length of piping, elevation of lines, location of piping from columns, and/or other fixed building elements.
   3. If using grooved couplings show the joint coupling and fittings on drawings and provide product submittals, specially identified with the applicable manufacturer' style number.

B. The Engineer shall prepare and submit a complete set of signed and sealed hydraulic calculations for each riser.
   1. Where risers serve areas with different hazard classifications, provide a separate calculation for each hazard.
   2. Provide graph sheets with plotted water supply curve, sprinkler system demand curve and hose demand.

C. Sprinkler drawings shall be coordinated with the mechanical, electrical, and the reflective ceiling plans.
   1. The Sprinkler Contractor shall locate the sprinkler heads to avoid interference with such items as lighting, ductwork, and air outlets.
   2. Locations for mechanical and electrical items shall have priority over sprinkler piping and head locations.
   3. When installing the sprinkler heads in modular ceiling panels, locate in a symmetrical pattern acceptable to the Architect.
   4. The Contractor shall include in his base bid the cost of providing such material and labor as required coordinating his work with that of the other trades and providing same at no additional cost to the Owner.

D. Identify sprinklers on drawings, submittals, and other documentation, by the sprinkler identification and Model number as specifically published in the appropriate agency listing approval.
   1. Do not use trade names or other abbreviated designations.

E. Submit material and equipment data sheets, test certificates, instructions, and similar information to demonstrate compliance with the specification.

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1.5 TESTS AND CERTIFICATION

A. Sprinkler Contractor shall test system in accordance with NFPA 13, NFPA 14, and NFPA 24.

1. Conduct tests in the presence of the authority having jurisdiction and the Owners' representative.
2. The Contractor shall have available at the site, a copy of the prescribed test.
3. Contractor shall give ample notice as to time for conducting tests.

B. Should any component of the system fail the prescribed test, Contractor shall replace such component of increased strength as required to withstand test.

C. Upon completion of installation and test, Contractor shall prepare "Contractor's Material and Test Certificate for Aboveground Piping", as prescribed in NFPA 13, and "Contractor's Material and Test Certificate for Private Fire Service Mains" as prescribed in NFPA 24.

1. Contractor and Owners' representative shall sign the certificate.
2. Contractor shall furnish copies of the signed Certificate to the Owner, and Project Consultant.

~~D. Where a fire pump is required, perform fire pump/controller test in accordance with Chapter 11 of NFPA 20.~~

~~1. Conduct test in the automatic mode of operation on normal and emergency power sources.~~

~~2. Provide a Pump Acceptance Test Data form, similar to the example in the Appendix of NFPA 20.~~

1.6 WIRING

A. The Contractor shall coordinate power wiring and connection to the fire alarm system for signal and alarm devices furnished under this section of the specifications.

B. Furnish motors, controllers, contactors, and disconnects with their respective pieces of equipment.

1. Controllers and contactors shall have a maximum of 120V control circuits, and auxiliary contacts for use with the controls furnished.
2. When motors and equipment furnished are larger than sizes indicated, the cost of providing additional electrical service and related work shall be included under this section.

1.7 INSTRUCTION

A. Furnish typed instructions relative to sprinkler controls, alarm device operations, and emergency procedures.

B. Encase the instructions in a metal frame with glass or Lucite cover and shall be permanently secured by chain to the sprinkler riser at each controlling alarm valve of the hydraulically designed automatic sprinkler system.

C. The following information shall be included on each placard where applicable:

1. Area of water application _____ sq. ft.
2. Minimum rate of water application (density) _____ gpm/sq. ft.
3. Area per sprinkler _____ sq. ft.
4. Allowance for inside hose and outside hydrants _____ gpm

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1.8 SCOPE

A. The entire facility shall be fully sprinklered with head spacing and locations in accordance with NFPA 13 including equipment rooms, closets, and similar locations.

1.9 DESIGN CRITERA

A. Hydraulically design the sprinkler system.

B. If constructing the project in phases, size the sprinkler system to serve the completed and future phases.

C. The general sprinkler system design parameters are as follows:

1. Administrative and Classrooms: Consider as light hazard occupancy minimum application density of 0.10 gpm/sq. ft. over 1500 square feet.
2. Kitchen/Food Service Area/Mechanical Rooms: Ordinary Hazard, Group I minimum application density of 0.15 gpm/sq. ft. over 1500 square feet.
3. ~~Stage Area~~Storage Room/Platform: Consider as Ordinary Hazard, Group II minimum application density of 0.20 gpm/sq. ft. over 1500 square feet. In addition to the sprinkler system, a Class III standpipe system shall be provided at the stage required by NFPA 101.
4. Generator Room (if located within the sprinkled building): Extra Hazard Group I minimum application density of 0.30 gpm/sq.ft. over the square footage of the generator room. Calculate using the room method, to facilitate the use of the room method the generator room shall be enclosed by a 2 hour fire rating.

D. Hose: 100 gpm for light hazard, 250 gpm for ordinary hazard, 500 gpm for extra hazard.

E. Coverage: maximum 400 square feet per head for extended coverage heads and maximum 225 square feet per head for standard coverage heads for light hazard areas, maximum 130 square feet per head for ordinary hazard areas.

F. The flow information is as follows:

1. Static Pressure: _____psi
2. Residual Pressure _____psi
3. Flow at Residual Pressure _____gpm
4. Date of Test: _____
5. Taken by: Palm Beach County Fire & Rescue

PART 2 PRODUCTS

2.1 PIPE MATERIAL

A. All pipe materials and fittings shall be of a domestic manufacture.

B. Provide underground piping as shown and specified in civil drawings.

C. Interior Piping:

1. Branch piping up to 2" in size shall be Schedule 40 black steel ASTM A135/A135M, ASTM A53/A53M, or ASTM A795/A795M with screwed, welded, or cut grooved ends.
2. Main piping 2½" and larger shall be Schedule 10, ASTM A135/A135M, ASTM A53/A53M, or ASTM A795/A795M, with welded or roll grooved ends.

D. Screwed fittings shall be cast iron Class 125 ANSI B16.4, or malleable iron conforming to ANSI B16.3, 150 pound.

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E. Flanged fittings shall be Cast iron, 175-psi cold-water pressure, ANSI B16.1, butt weld fittings ANSI B16.9.

F. Grooved fittings shall be cast of ductile iron (ASTM A395/A395M and A536) forged steel (ASTM A-234) or fabricated from carbon steel pipe (ASTM A53/A53M) approved for use by the coupling manufacturer with flow characteristics equal to or better than standard fittings equal to Grinnell, Starr, or Victaulic.

G. Mechanical couplings shall be UL listed and FM Global approved for fire protection service, ductile or iron housing, rust inhibiting no-lead painted coating, zinc electroplated heat treated bolts and heavy hex carbon steel nuts meeting ASTM A 449 equal to Grinnell, Starr, or Victaulic.

1. Rigid type shall provide system rigidity; use coupling housings cast with offsetting, angle-pattern bolt pads, support, and hang in accordance with NFPA 13, Victaulic 005 or 07.
2. Flexible type, use in locations where vibration attenuation and stress relief are required.
    a. May use flexible couplings in lieu of flexible connectors at equipment connections.
    b. Place three couplings in close proximity to the vibration source, Victaulic Style 75 or 77.
3. Flange adapters shall be flat face, for direct connection to ANSI Class 125 or 150-flanged components, Victaulic Style 744.

H. Locking Lug Fittings: UL listed and FM Global approved for fire protection service, ductile iron housings with self-contained synthetic rubber gaskets, internal pipe stop, plated ¼-turn positive locking lugs with externally visible locked position indicator.

I. Hangers shall be UL listed and FM approved plated or galvanized finish equal to Grinnell, B-Line, or Michigan Hanger.

J. Do not use Non-grooved products such as “Pressfit,” “Snap-Let” outlets or “Fit” plain end products.

K. Bolted branch outlets (Victaulic style 920/920N and similar) when approved by the Engineer and the District.

L. Do not use adjustable nipples using an O-ring design.

1. Head outlets shall be pre-formed tee pipefittings, welded, thread-o-lets or grooved couplings, similar or equal to Victaulic Style 073.

M. Do not use reducing bushings/couplings.

N. Exterior piping:

1. Branch piping up to 2” shall be schedule 40 Hot-Dipped Zinc Coated (Galvanized) ASTM A135/A135M, ASTM A53/A53M, or ASTM A795/A795M with screwed, welded, or rolled grooved ends.
2. Main piping 2 ½” and larger shall be schedule 10 Hot-Dipped Zinc Coated (Galvanized) ASTM A135/A135M, ASTM A53/A53M or ASTM A795/A795M with welded or rolled grooved ends.
3. Main piping at DDCV, PIV and FDC shall be per civil water distribution specification.

2.2 EQUIPMENT

A. All equipment listed herein shall be Grinnell, Central, Star, Reliable, or Viking, System Sensor, or Victaulic, all components shall be UL listed and FM Global approved.

B. Provide vane type flow switch waterflow detector with two SPDT switches and adjustable time delay similar to or equal to Grinnell Model VSR-F (wet pipe system) or System Sensor Model WFD.

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C. Siamese Fire Department connection with two 2½" polished brass inlet hose connections, 4" outlet pipe, with red enamel finish, cast iron wall plate labeled "Automatic Sprinkler Fire Department Connection", cast iron ease-off caps and automatic brass ball drip connection, equal to Star.

1. Provide wall or freestanding yard mounting as appropriate to the installation.
2. Where applicable, install a 90° elbow with drain connection at each Siamese Fire Department connection equal to Victaulic 10-DR.

D. 3½" Diameter Pressure Gauges with ¼" gauge cocks on both sides of the riser check valve, at pumps and where otherwise required or indicated.

E. 2" angle valve drain connection, bronze body, 175 lb. working pressure, screw bonnet, integral seat, renewable disc, Nibco Model T-301-W or equal.

F. Riser shut-off valves, OS&Y pattern gate valve or butterfly, with tamper.

1. OS&Y valves shall be iron body, rising stem, solid wedge, 175 lb. working pressure, similar to Nibco Model F-607-OTS.
2. Butterfly valves shall be ductile iron body, gear operator with indicator, resilient liner, similar to Nibco Model #LD3510-2 or GD 1765-4, or Victaulic Series 705W.

G. Riser and Siamese swing-check valves shall be swing type, ductile iron body, brass seat, rubber-faced clapper, and class 150 with a maximum working pressure of 250 psi.

1. Provide Viking Model D-1, G-1, F520, or "easy-riser swing check valve" or Engineer approved equal.
2. Spring-assisted check valves shall consist of ductile iron body, aluminum bronze or elastomer encapsulated ductile iron disc, stainless steel spring and shaft, grooved ends.
3. Provide automatic drip valve where required for drainage.

~~H. Fire Pump (where required)~~

~~1. Pump shall be UL listed/FM approved, single-stage, centrifugal type with split cast iron casing, electric motor drive.~~

~~a. Maximum pump and motor speed shall not exceed 3600 RPM.~~

~~2. The impeller shall be double suction type, made of cast bronze, balanced hydraulically and dynamically, keyed to the shaft and securely retained in an axial position by positive mechanical means.~~

~~a. Mount the pump on a steel or cast iron base.~~

~~b. Pumps shall include a motor coupling with guard.~~

~~3. Suction and discharge connections shall be located to allow removal of the rotating element without disturbing the system piping connections.~~

~~4. Provide the following accessories:~~

~~a. Suction eccentric reducer, with the flat side on top, at the pump inlet; reducer shall be cast iron or wrought steel with flanged connections.~~

~~b. Automatic air release valve with threaded inlet and discharge connections, to vent air from the pump casing.~~

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c. Casing relief valve, non-adjustable bronze-type, set above the design pressure anticipated but below the combined suction pressure and shut-off head pressure, to discharge water from the system to avoid pump overheating, conforming to NFPA 20.

d. Pump discharge test header, number of valves in accordance with NFPA 20.

5. The fire pump manufacturer, of the electrical characteristics indicated, shall provide electric motor drive.

a. Motor shall be open drip proof (ODP), 1.15 service factor and be sized such that the pump motor is not operating in the service factor by more than 5 % at the design conditions, and/or as required for UL listing/FM approval.

b. Number of motor leads shall be coordinated with the fire pump controller.

I. Pressure Maintenance Jockey Pump (where required)

1. Provide centrifugal type jockey pump, rated to 230 psi, having a drain and gauge tapings.

a. Pump impeller shall be hydraulically balanced, non-vapor-binding type, mechanically keyed to the shaft.

b. Pump shall have replaceable bronze impeller (casing) wear rings, threaded connections, mechanical seal, and sealed cast iron cartridge roller ball bearings, close-coupled to an open-drip proof motor.

c. Arrange pump to draw water from the suction supply side of the gate valve of the fire pump(s) and discharge it into the system on the downstream side of the pump discharge gate-valve.

2. Jockey Pump Controller shall be completely factory assembled, wired, and tested.

a. The unit shall be complete with across-the-line magnetic starter equipped with overload protection, 3-pole fusible disconnect switch, H-O-A selector switch, 10-300 psi bourdon tube pressure regulator with independent high and low set points, pump running light, and NEMA 1 enclosure with lockable handle, automatic stop function, minimum run time timer, and contacts for remote restart.

b. Provide an adjustable relay (0-60 minute) with a Form "C" NO/NC alarm contact such that if the jockey pump cycles off and then restarts before the expiration of the relay timer, the alarm contact energizes and sends an excessive cycling alarm to the fire alarm panel.

c. Start/stop pressure settings shall exceed those of the main fire pump(s).

d. Also, include a run timer to ensure the jockey pump runs for the minimum time as recommended by the manufacturer of the jockey pump motor.

J. Electric Fire Pump Controller/Automatic Transfer Switch

1. The fire pump controller shall meet NFPA 20 and NFPA 70 requirements for fire pump service and are UL listed.

2. The fire pump controller/automatic transfer switch shall be of the combined automatic and manual reduced voltage, soft-start, solid-state, full wave controlled open loop type.

3. The fire pump controller shall have a single handle for operating both the isolating switch and then the solid-state microprocessor-type circuit breaker in sequence.

a. Provide a reduced voltage, soft-start, solid-state NEMA rated starter sized for the motor load.

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b. Controls to be furnished shall include.

i. A built-in 10-300 psi bourdon tube-type pressure switch with independent high and low set points piped to the cabinet exterior.

ii. An automatic and manual start and manual soft stop and emergency stop pushbuttons.

iii. An adjustable minimum run timer, power available light, and power monitoring sensing all phases for loss of any phase, under voltage, or phase reversal.

c. Fire pump controller shall provide three signals to the facility fire alarm control panel per NFPA 20 and NFPA 72.

d. Provide dry contacts for signaling loss of input power; phase reversal; pump running; and provide contacts for remote start.

e. Provide voltage surge arresters between each line terminal of the controller isolating switch and ground, to suppress voltage surges above rated motor voltage tolerance.

f. The reduced voltage acceleration ramp shall be adjustable between 0.5 and 10 seconds, with a bypass contactor to energize at full speed or upon overheating of the solid-state starter.

g. Stop sequence shall also be initiated through the solid-state starter and include an adjustable deceleration ramp.

h. House all indicated controls and a dry-type control transformer in steel NEMA 2 enclosure with lockable handle, which is factory assembled and tested prior to shipment.

4. The automatic transfer switch shall withstand current rating of at least 22,000 RMS symmetrical Amps and be capable of manual mechanical operation by means of a readily accessible handle.

a. It shall provide for transfer of the soft/start controller to an emergency power source upon failure of the normal power source and return to the normal power when restored.

b. Provide electrically operated transfer switch, which is mechanically held, and listed by U.L. for fire pump service.

5. Provide a controller assembly rated to withstand the maximum available fault current of the normal and emergency isolating switches.

a. Voltage and horsepower rating shall be as scheduled.

6. Provide an audible alarm.

7. Provide a safety mechanical link between the emergency isolating switch and the normal isolating switch mechanically open the emergency isolating switch when the normal isolating switch is open.

a. It should also have a safety interlock to prevent the isolating switch from being either opened, or closed when the circuit breaker is closed.

b. Provide a visual indication of the switch position.

8. Controller shall be service entrance labeled by U.L.

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~~9. Provide remote alarm panel for 120-volt input with power on light, pump run light, pump power failure light, remote fire pump start switch, press-to-test switches, and audible alarm with alarm silence.~~

2.3 SPRINKLER HEADS

A. Sprinkler heads shall be UL listed, FM Global approved, and from a single manufacturer, equal to ~~Grinnell~~ Tyco, Star, Viking, Reliable ~~Central~~ or Victaulic of the following types:

1. Provide sprinkler heads of the ordinary temperature range, 155ºF, except where subject to high temperatures caused by unit heaters, hot pipes, radiant ceiling, kilns, or other heat source, and then provide heads of high temperature type, ~~250ºF~~286°F.
2. For areas with finished ceilings, provide heads of semi-recessed pedant type, chrome finish with escutcheon, glass bulb tube.
    a. Body shall be die cast brass, with hex-shaped wrench boss cast into the body to facilitate installation and reduce the risk of damage during installation.
3. For areas without ceilings: heads shall be of upright style, brass finish, glass bulb tube.
4. In gymnasiums, dry storage rooms, walk-in freezers, and other spaces where heads are subject to damage provide wire guards.
5. For areas subject to freezing (walk-in freezers and coolers): dry type semi-recessed pendant style, chrome finish, with escutcheon, glass bulb type.
6. Heads shall be nominal ½" orifice type unless otherwise required by hydraulic calculations.
7. Provide escutcheons and guards listed, supplied, and approved for use with the sprinkler by the sprinkler manufacturer.

2.4 SPRINKLER HEAD CABINET

A. For each building provide a wall-mounted sprinkler head cabinet with a minimum of 6 heads of each type used or as required by NFPA 13, together with required wrenches for replacing heads.

2.5 ALARM SYSTEM

A. Install in riser a water flow indicator of the vane type with two sets of contacts, automatic reset and instant recycling retard and circuit closer, for connection to the fire alarm system under Division 28.

B. Install on riser OS&Y (or butterfly) shut-off valve, a tamper switch to indicate whether the valve is open or closed for connection to the fire alarm under Division 28.

2.6 WALL PENETRATION

A. Protect penetrations of fire rated partitions using a UL listed fire rated wall penetration assembly.
    1. Rating shall be equal to or greater than the wall rating.

B. Protect penetrations of floor slabs using a Schedule-40 pipe sleeve, with the space between the pipe and sleeve sealed with mastic.

PART 3 EXECUTION

3.1 DESIGN

A. Provide services of a Professional Engineer Licensed in the State of Florida to design a complete wet pipe sprinkler system in accordance with NFPA 13, NFPA 24 and other applicable code requirements.

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B. Engineers shall provide signed and sealed engineering documents suitable for fabrication including cut lengths of pipe.

C. Engineer shall provide signed and sealed hydraulic calculations for each riser and for each hazard classification.

3.2 INSTALLATION

A. Install new fire service line and sprinkler system generally as indicated and coordinate with work of other trades.

1. Exact requirements and installation shall be in accordance with working shop drawings.

B. Hydrostatically pressure test above ground piping for two hours at pressure as required by NFPA-13 and 14, with no observable leakage allowed.

1. Pressure test below ground piping in accordance with NFPA 24, with leakage not to exceed that allowed by NFPA 24.

C. Label drain piping, inspectors test stations, main drain, electric gong, and similar system components.

1. Locate inspectors test station in a non-student occupied space.

2. Inspectors test station and main drain piping shall discharge outdoors onto a splash block.

~~D. Test system in presence of Owner in accordance with NFPA 13 and NFPA 24 requirements.~~

~~1. Provide a fire-pump acceptance test in accordance with NFPA 20 requirements to include both automatic and manual modes of operation on regular and emergency power sources.~~

~~E.~~D. Paint exposed piping red.

1. Provide red head guards for heads subject to damage.

~~F.~~E. Provide rigid couplings at connection to valves in riser, use flexible couplings at building expansion joints and similar locations subject to movement.

~~G.~~F. Provide auxiliary drains for trapped sections of piping.

~~H.~~G. Install hangers at branch and main line locations as required by NFPA 13.

1. Securely fasten hangers to the structure-utilizing offset or center loading beam clamps, or "C" clamps with retainer clip.

2. Provide miscellaneous support steel where required to span across structural members.

3. Attach hangers to concrete structures using drilled-in concrete inserts or self-tapping studs.

4. Use power driven studs only with the permission of the project structural engineer.

a. If approved, test a minimum of four studs at four times the applied piping load.

b. Do not use power driven studs if any of the studs fail the load test.

~~I.~~H. Provide heads above ceilings where combustible construction is present.

~~J.~~I. Label exposed piping with snap-on type plastic labels at no less than 20 feet on-center, but at least one label on each exposed section of piping.

~~K. Post operating instructions for the fire pump to include system operation, resetting trouble conditions and cautionary warnings.~~

~~L. Provide training for the Owners staff as to proper operation and maintenance of the fire pump system.~~

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~~M.~~J. Grooved Joints:

1. All grooved couplings, fittings, valves, and specialties shall be the products of a single manufacturer, and the grooving tools shall be of the same manufacturer.
2. Use gaskets molded and produced by the groove-coupling manufacturer.
3. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove.
4. Grooved coupling manufacturer's factory trained representative shall provide on-site training for contractor's field personnel in the proper use of grooving tools, application of groove, and installation of grooved piping products.
5. Factory trained representatives shall periodically inspect the product installation.
6. Contractor shall remove and replace any improperly installed products.
7. Contractor shall certify the Pipe for use with the manufacturer's system.

~~N.~~K. Locking Lug Joints:

1. Pipe ends shall be square cut and thoroughly clean on the outside edge for 1" from the pipe end to remove pipe coatings, mill scale, rust and raised weld beads.
2. Remove all burrs and sharp edges on the pipe inside and outside edge.
3. Pipe shall be marked 1 ½" from the end and pipe end configuration shall be in conformance with manufacturer's specifications.

3.3 DEMONSTRATION AND TRAINING

A. Training of the Owner's operation and maintenance personnel is required in cooperation with the Owner's Representative.

1. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems.
2. Schedule the instructions in coordination with the Owner's Representative after submission and approval of formal training plans.
3. Refer to Section 01 91 00, Commissioning, for further contractor training requirements.

~~B. Demonstration and training shall be provided for the following equipment and systems:~~

~~1. Fire Protection System: General overview, including zoning.~~

~~2. Fire Pump~~

~~3. Fire Pump Controller and Automatic Transfer Switch~~

~~4. Jockey Pump~~

~~5. Jockey Pump Controller~~

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SECTION 15000 (22 05 00)
BASIC PLUMBING REQUIREMENTS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including General Conditions, General Requirements, and Division 1 of the Specifications, apply to all Sections of Division 22.

B. Other Contract Documents complement the requirements and apply to the work of Division 22.

1.2 SCOPE OF WORK

A. The work of this Section shall include the furnishing of systems, equipment and materials specified in this Division, and as called for in the Plumbing Drawings.

1. All facilities, supervision, coordination, transportation, handling, labor and methods for the fabrication, installation, interconnections, painting and other finishes, start-up, tests, adjustments, clean-up and other necessary work for the complete and satisfactory systems and equipment, ready for operation and use, shall be included.
2. Whenever the words "Contractor" appear in this Division, they refer to the Contractor responsible for work specified in that Section.
3. The Contractor shall examine all Contract Documents including all drawings, all sections of the Specifications, plumbing and fire-protection design requirements and system design details.
    a. The Contractor is responsible for ascertaining the extent all those documents, drawings, sections of specifications, design requirements, and system design details affect work herein specified.
4. Report all errors, omissions, conflicts or code violations to Architect and Owner prior to commencement of work.

B. Drawings for the work are diagrammatic, intended to convey the scope of the work and indicate the general arrangement and locations of the work, follow as closely as actual construction and as other work permits.

1. Because of the scale of the drawings, not all basic items such as necessary duct and pipe offsets, pipefittings, access panels and sleeves may be on the plans.
2. Contract documents show design basis equipment.
3. Plumbing Contractor shall be responsible for selecting the District approved equipment of equal quality, capacity, performance, efficiency, weight, physical size, and configuration to fit in the space provided for the design basis equipment.
4. If the Contractor selects equipment other than the design basis, he is responsible for the necessary design modifications and for coordination with other trades to meet all intended requirements of the original design documents.
5. The location and the sizes of equipment, duct and pipefittings, access panels, sleeves, inserts, and other basic items required by code or other Sections shall be coordinated and included for the proper installation of the Work.

C. The Contractor shall make any required changes from the Contract Documents to make this work conform to the building construction or the work of other trades at no additional cost to the Owner and shall not impact the project's time schedule.

1. The Contractor shall indicate all changes from the Contract Documents on the shop drawings.
2. Submit the shop drawings to the Architect, Engineer, and Owner for approval before commencing the work.

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3. Failure to follow the approval procedure may result in the forced removal of all work, performed prior to approval.
4. Final “as build” documents shall include all changes.

D. Equipment specification may not deal individually with the minor items required such as components, parts, controls, and devices that may be required to produce the equipment performance specified or as required to meet the equipment design performance and warranties.
1. The equipment supplier shall include such required items whether or not specifically called for in the Contract Documents and the Contractor shall properly install them.

E. Contractor shall verify with the supplier of the equipment the requirements for the complete installation to insure proper operation of the equipment furnished under Division 22 of the Specifications.

F. Contract Documents may call for Plumbing Contractor to install specific equipment furnished by others, including Owner purchased equipment.

G. Consider the specifications and drawings as complimentary one to the other.
1. Where equipment items, material and labor are specified, indicated, called for or implied by either the drawings or the specifications, they shall be deemed as specified by both and included as part of the contract.
2. Should conflicts occur between the drawings and the Division 22 Specifications, the more stringent requirements shall apply and take precedent.

1.3 DEFINITION OF THE WORK

A. Plumbing work including Plumbing and Fire Protection work is specified in the following applicable sections of the Division 22:

22 05 00	Basic Plumbing Requirements
22 05 10	Minor Plumbing Demolition
22 05 29	Hangers and Supports, Plumbing Piping
22 0553	Plumbing Identification
22 07 19	Plumbing Pipe Insulation
22 11 00	Facility Potable Water Distribution
22 13 00	Facility Sanitary Distribution
22 14 00	Facility Storm Drainage
22 10 00	Plumbing Piping
22 20 00	Plumbing Specialties
22 40 00	Plumbing Fixtures
22 30 00	Plumbing Equipment
21 00 00	Fire Protection
22 05 93	Tests - Piping

B. Additional Associated Sections from Division 25

25 50 00	Energy Management and Control System (Automated Logic)

1.4 QUALITY ASSURANCE

A. Codes and Standards: All work shall be in compliance with, of all applicable Laws, Codes, Standards and Regulations of Governmental Bodies having jurisdiction over work performed for or on behalf of the SDPBC, and over the applicable job site
1. See Section 01 41 00 - Regulatory Requirements
2. The following documents developed for and approved by the SDPBC:
   a. Educational Specifications
   b. District Design Criteria
   c. District Master Specifications

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d. Typical plumbing and fire-protection details
e. If there should be conflicting requirements between above referenced codes than the following rules shall apply:
1. School District Building Official shall provide final code interpretations and resolutions of conflicts
2. The code that affords the greatest degree of life safety shall take precedent.

B. Contractor shall request the A/E for clarification of any part of the contract documents, which may be in conflict with the above codes and regulations.
1. Contractor shall prepare proposed changes for review and approval by A/E and Owner.

1.5 ACTIVE SERVICES
A. Protect any existing active services: water, gas, sewer, and electric, against damage.
B. Do not prevent or disturb operation of active services that are to remain.
C. When encountering services requiring temporary interruption or relocation, request procedural information from authority having jurisdiction and coordinate work with the utility service users.
D. Where abandoning an existing service, terminate in conformance with the Utility or Municipality having jurisdiction, and shown termination points on “as-built” construction plans.

1.6 SITE INSPECTION
A. Contractor shall carefully inspect the site to be familiar with conditions that affect the work.
1. Contractor shall verify points of connection of utilities, routing of outside piping to include required clearances from any existing structures, trees or other obstacles.
2. Contractor shall verify available space in the existing structure and accessibility required for the installation of work under this contract and inform the A/E to conditions, which may be detrimental or will prevent proper execution of the work.
B. The submittal of a bid is an acknowledgement that the Contractor performed the site inspection and has no conflicts with performing the work.
1. If a conflict arises do to an observable condition the Contractor should have seen in the pre-bid site visit, the District is under no obligation to authorize any additional payments.
C. Submittal of bid shall indicate that the Contractor has included all required allowances in the bid.
1. The District shall not make allowances for any code violations or errors resulting from Contractor's failure to visit job site and review all contract documents, applicable codes, and standards.

1.7 COMMISSIONING
A. Commissioning of a system or systems specified in this section is part of the construction process.
B. Documentation and testing of these systems, as well as training of the Owner’s operation and maintenance personnel, is required in cooperation with the Owner's Representative and the Commissioning Authority.
C. Project Closeout is dependent on successful completion of all documentation, and issue closure, see Section 01 77 00 - Contract Closeout, for substantial completion details.
D. Refer to Section 01 91 00 - Commissioning, for detailed commissioning requirements

PART 2 MATERIALS

2.1 GENERAL
A. Each system component installed by Contractor shall meet or exceed the performance specification requirements listed in the Contract Documents including drawings, specifications, Plumbing and Fire Protection Design Requirements and Design Details.

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1. Components with a lesser degree of performance or quality as determined by the Owner, Building Department, design A/E or documented as inferior shall be replaced with no additional charge to Owner.

B. Materials and equipment shall be new, unused, standard current products from manufacturers regularly engaged in the production of such equipment and shall bear label of the Underwriters' Laboratory for the intent use or shall be materials approved by the code-enforcing agency.

C. Where two or more units of the same class of equipment or material are required, these shall be the product of a single manufacturer throughout entire project and shall fit in the allocated spaces provided, complying with all clearances and codes.

D. All hardware and accessory fittings shall be a type designed, intended or appropriate for use, be compatible, and compliment the item with which they are used.
   1. They shall have corrosion protection suitable for atmosphere they are installed.
   2. All such hardware shall be U.S. standard size.

E. All materials including insulation, jackets, and adhesives shall have a Flame Spread Rating not exceeding 25, and Smoke Developed Rating not exceeding 50, when tested in accordance with NFPA 255, "Methods of Test of Surface Burning Characteristics of Building Materials".
   1. Submittal data shall specifically indicate those ratings.

F. Use materials and equipment fabricated in the United States of America and labeled accordingly, when possible, for all piping materials:
   1. Provide documentation from a U.S. testing laboratory, certified by Florida Engineer that the product delivered to the site meets the DMS requirements (ASTM standards).
   2. AS an alternative form of verification:
      a. To verify that piping delivered to the project site meets the DMS requirements (ASTM standards); a random sample of each size pipe on each delivery to the project.
      b. Contractor under the direct supervision of the District Senior Project Administrator or the Project Coordinator shall cut off a 12” to 24” wide section of the pipe either at the end or near the middle (Size depends on what Testing Labs requires).
      c. The Contractor shall identify the pipe section with a label or stamp having the following information; project name, pipe size, date, and names/signatures of the Contractor and District Representative handling that piece of pipe.
      d. The District project representative shall then send the sample to District approved laboratory for testing to verify the pipe meets the Specification.
      e. All testing cost is at the Contractors expense.
      f. If pipe sample does not meet specifications, the contractor at no extension of time or additional cost shall replace the bad pipe with pipe with the specification.
         i) Before replacing the suspected pipe, Contractor at his cost and with no addition time extension may have at a minimum five-other piece of pipe tested for compliance with the specifications.

G. All equipment and piping supports shall be hot dipped galvanized except as otherwise noted in Contract Documents.
   1. Hangers for copper pipe shall be vinyl coated.
   2. Do not use copper clad hangers.

H. Plumbing and fire protection system components shall conform to federal, state, and local sound emission and vibration isolation guidelines.
   1. Objectionable noise or excessive vibration created in any part of the building by operation of any equipment under this contract is not permitted.

I. Follow installations directions and recommendations of material and equipment manufacturers.

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PART 3 EXECUTION

3.1 GENERAL

A. Licensed Contractors shall perform construction work as required by FS Chapter 489.
   1. The Contractor shall not work outside the scope of his license.
   2. Any person who is not licensed must work under direct supervision of a person who has a license required by the state law and by the county or municipal licensing ordinances.
   3. The District may request the change of the job supervisor.
   4. Workers skilled and competent in the type of work involved shall accomplish the installation.
   5. Workmanship throughout shall correspond to the standards of the best trade practices.

B. Contractor shall install all systems and equipment in accordance with the Contract Documents, and equipment or material manufacturer recommendations and instructions.

C. Work lines and established grades shall be in strict accordance with the Contract Documents.
   1. The Contractor shall furnish to all trades, in ample time, any information they need to construct all equipment bases, trenches, pits, chases, and openings in floors, walls, and finishes to provide required working clearances.
   2. The contractor shall set all sleeves, anchor bolts, or inserts to fasten equipment before pouring of adjacent concrete.

D. Coordinate location of all Division 21 & 22 work with Division 23, 25, 26, 27 & 28.
   1. Do not run piping, and similar Division 21 & 22 work in NEC dedicated service areas for electrical equipment, including above panel boards, starters, communication panels, control panels, telephone backboards, data panels, and similar electrical elements.
   2. Do not install water piping directly above electrical equipment.
   3. In electrical rooms with required piping, provide drain pan(s) to protect the electrical equipment.
   4. Refer questionable locations to the A/E for resolution prior to installation and correct non-conforming installed work at no additional cost to the Owner.

E. Cap or plug all piping systems (hot water, potable water, pneumatic piping,) at the end of each workday until system is complete to prevent contamination.

3.2 COORDINATION OF WORK AND DRAWINGS

A. Each contractor and subcontractor shall be responsible for coordinating the installation of his equipment/labor with the General Contractor and work of other Contractors and trades.
   1. The contractor shall coordinate the work of different trades to prevent interference between piping, ductwork, equipment, and structural work.

B. Recommend each contractor prepare their shop drawings at 1/4" to 1'-0" scale clearly indicating all applicable components and coordinate the same with other trades.
   1. Recommend shop coordination drawings show in detail the space conditions of all concerned trades, and be reviewed and accepted by the A/E.
   2. Contractor’s failure to coordinate work between trades using coordination shop drawings or other means will not cause for any additional cost changes to the Owner, and/or changes to the project schedule.
   3. If the contractor installs his work before coordinating with other trades or causes interference with work of other trades, the contractor shall make necessary changes in the work to correct the condition, at no additional cost to the Owner, and/or changes to the project schedule.

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3.3 SUBMITTALS

A. Method or procedures for submitting shop drawings and submittal data shall comply with the General Conditions.

B. Prior to ordering equipment and material, the Contractor shall submit 3 copies of the manufacturer's cut sheets to the Engineer for review and acceptance
   1. Submittal data shall consist of shop drawings and/or catalog cuts showing technical data necessary to evaluate the material or equipment.
   2. Including dimensions, required service and maintenance clearances, wiring diagrams, performance curves, ratings, control sequence.
   3. Layout plan showing the arrangement of the equipment with piping, and other data necessary to describe fully the item proposed and its operating characteristics.

C. Other submittals shall include, but not be limited to:
   1. Valves
   2. Pipe insulation
   3. Controls
   4. Thermometers and gauges

3.4 SUBSTITUTIONS

A. Contractor shall follow the contract drawings and specifications, unless he submits written request for a substitution and receives written acceptance from the Engineer and SDPBC.
   1. Owner’s representative shall review the request and either approve or deny the in writing.

B. All approval procedures regarding proposed substitutions as “approved equal” or “Engineer and Owner approved” shall meet the requirements of Section 01 60 00.

3.5 ACCESS PANELS

A. Contractor shall provide required access panels or doors for all serviceable equipment in concealed locations whether or not called for on the drawings.

3.6 CUTTING AND PATCHING

A. Coordinate the placing of openings in the existing or new structures as required for installation of the Plumbing Work.

B. Any additional patching and finish work required for unnecessary openings due to failure to inspect and coordinate work, is at no additional cost to the Owner.

C. Any additional cutting and patching of the structure necessary due to failure to install piping, ducts, sleeves or equipment on schedule, or due to failure to furnish, on schedule, the information required for leaving of openings, is at no additional cost to the Owner.

D. Provide cutting and patching, surface finishing and painting in the existing structure, as required for the installation of work, and furnish lintels and supports as required for openings.
   1. Do not cut structural members without written prior approval of the A/E.
   2. Minimize cutting by using core drills, power saws, or other machines that will provide neat, minimum openings.
   3. Patching shall match adjacent materials and surfaces and be performed by artisans skilled in the respective craft.

3.7 SLEEVES

A. Sleeves are required for all piping passing through masonry or concrete partitions (walls, floors ceilings, roofs) and through concrete beams, foundations, and footings.
   1. Position sleeves in formwork prior to placement of concrete.
   2. Provide concrete reinforcing around sleeves.

B. Sleeves for piping passing through non-load bearing or non-fire or smoke rated walls and partitions may be required if included in the design documents by the Engineer.

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1. When required, sleeves shall be galvanized sheet steel with lock seam joints of minimum gauges as follows: pipes 2½" and smaller - 24 gage; 3" to 6" - 22 gage; over 6" - 20 gage.

C. Sleeves for piping passing through load bearing walls, concrete beams, foundations, footings and waterproof floors shall be Schedule 40 galvanized steel pipe or 18 gage galvanized sheet steel.

D. Sleeves for insulated piping shall be of sufficient internal diameter to take pipe and insulation and allow free movement of pipe due to expansion and contraction.
1. Provide for continuous insulation wrapping.
2. Waterproof sleeves shall be of sufficient internal diameter for pipe and waterproofing material.

E. In finished areas where pipes are exposed, terminate sleeves flush with wall, partitions, and ceilings, and shall extend ½" above finished floor level.
1. Extend sleeves 1" above finished floors in areas likely to entrap water.
2. Caulk floor sleeves.

F. Flash sleeves passing through waterproofing membrane as required by Division 7.

G. Protect pipe penetrations through fire-rated partitions (walls, floors, or ceilings) in per with FBC.
1. Protected penetration shall retain the original integrity of the fire rated partition.
2. Unprotected penetrations through fire-rated partitions not allowed.
3. All materials, products, and procedures used to complete the fire stopping assemblies shall be tested, listed, and approved by testing laboratories such as U.L. or Factory Mutual and comply with requirements of ASTM-E-119.
4. Securely fasten sleeves to the partition that are part of the required approved fire stopping.
5. Close off annular spaces between sleeves, pipes, and between penetrating item and adjacent work with UL listed and approved fire stopping materials and caulk airtight.
6. Insulation and coverings shall not penetrate the fire-rated partition unless it is part of the approved U.L or Factory Mutual fire-stopping assembly.
7. Provide close fitting metal collar or escutcheon covers at both sides of penetration.

3.8 ESCUTCHEONS

A. Provide chrome-plated escutcheons at each sleeve opening into finished spaces.

B. Escutcheons shall fit around insulation or around pipe when not insulated; outside diameter shall cover sleeve.

C. Where sleeve extends above finished floor, escutcheon shall be high cap type and shall clear sleeve extension.

D. Secure escutcheons or plates to sleeve but not to insulation with setscrews or other approved devices.

3.9 PROTECTION

A. Take special care for the protection of equipment and materials furnished.
1. Store and completely protect all materials from damage.
2. Keep materials and equipment clean and dry, free from deterioration by weather elements, painting, plaster, etc., until the project is completed.
3. Do not install damaged or defective materials.
4. Touch up any damage from rust, paint, etc., and scratched or marred finishes on equipment to match original finish or completely refinished to restore equipment to original condition.

B. Provide protect of any previously finished area from mars or other damage when an installation or connection of equipment requires work in areas previously finished by other Contractors.,
1. The Contractor shall provide drop cloths, or any other materials necessary to protect floors, walls, furniture, equipment, etc. from soil or damage.

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C. Contractor shall arrange with other Contractors for promptly repairing and refinishing any damage to the building or its contents incurred by the installation or testing of the systems installed at no charge to the Owner.
D. Where insulated piping extends to exposed areas, or to weather exposed areas, provide finish or jacket as specified in section 22 07 19.
E. Contractor may weld in the existing buildings under an approved fire watch and other required safety measures.
    1. Contractor's work, and construction means, methods, materials, and equipment used shall not compromise the building fire safety, as well as safety and welfare of coworkers and building occupants.

3.10 PLUMBING IDENTIFICATION

A. Identification of plumbing systems shall be as specified in Section 22 05 53 PLUMBING IDENTIFICATION.

3.11 WIRING AND ELECTRICAL WORK FOR PLUMBING EQUIPMENT

A. All electrical work, equipment, and wiring shall comply with NEC.
B. The Plumbing Contractor, unless specified otherwise, shall furnish all Division 22 equipment.
C. Division 26 shall provide power services for equipment furnished by Plumbing Contractor to include safety disconnect switches, wiring, and final connections.
D. The Plumbing Contractor shall check all electrical service and control connections to ensure proper operation of equipment and systems installed under work in Division 22.

3.12 EXCAVATING TRENCHING AND BACKFILLING

A. Provide excavation necessary for water supply, sanitary, and storm piping, etc., and backfill such trenches and excavations after the installation, testing, and approval of work.
    1. Take care in excavating, that walls and footings and adjacent load bearing soils are not disturbed, except where lines must cross under a wall footing.
    2. Where a line must pass under footing, make the crossing by the smallest possible trench to accommodate the pipe.
    3. Keep excavation free from water by pumping if necessary.
    4. Do not open any greater length of trench, in advance of pipe or utility installation, than that authorized.
B. Trenches for piping and utilities located inside foundation walls and five-foot outside of the wall shall be at less than 16" but no more than 24" wider than the outside diameter of the pipe.
    1. Site conditions shall govern the width of trenches for piping and utilities located more than five-feet outside of building foundation walls, except for sewers.
C. Excavate trenches for sanitary and storm pipe may be laid at the proper alignment and depth and the maximum trench width at the outside top of the pipe is less than 24".
    1. Other trench widths governed by site conditions.
D. Shape the trench bottom so that when pipe is in place the lower fourth of the circumference for the full length of the barrel is supported on compacted-fill.
    1. Dig bell holes so that no part of the weight of the pipe is supported by the bell, and not larger than necessary for proper jointing.
    2. Excavate all piping requiring excavation below the compacted fill required for the structure to at least 6" below pipe invert.
E. Make trenches true to grade by means of substantial and accurately set batter-boards.
F. Immediately after testing and/or inspection, carefully backfill the trench with earth free from clods, brick, etc., to a depth one-half the pipe diameter and then firmly puddle and tamp in such a manner as not to disturb the alignment or joints of the pipe.

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1. Thereafter, puddle and tamp the every vertical foot.

G. Burial depth of gravity drain lines shall have precedence over non-gravity systems.
   1. Offset chilled water and domestic water lines as required to coordinate with gravity lines.

H. The Contractor shall coordinate exact location, depth, and scope of underground piping, electrical conduits, and similar utilities.
   1. Routing shown on drawings is schematic coordinate actual routing with field conditions, grades, and work of other trades, then document in “as-built” drawings.

3.13 ANCHORING EQUIPMENT

A. Securely anchor all equipment designed for permanent mounting to its supporting surface in compliance with FBC.

B. A minimum of two bolts are required per each piece of equipment.
   1. Bolts shall be of sufficient size to prevent equipment from overturning or moving from original mounting position.

3.14 CORROSION

A. Make provisions to prevent corrosion due to contact of metallic pipe and equipment with moisture or dissimilar materials.

B. When joining a pipe with another pipe, valve, fitting, or piece of equipment constructed of dissimilar metal install an insulated joint to prevent formation of galvanic couple.

C. Pipe hangers and supports of dissimilar metal shall be isolated from contact with pipe.

D. Metal pipe and equipment shall be isolated from direct contact with concrete or other corrosive materials and soils.

3.15 TESTS

A. Test all materials, equipment, and systems that require testing by these specifications or by any applicable regulation or code, in the presence of owner or authority having jurisdiction.
   1. Test all items requiring pressure or leakage tests before concealing from view.
   2. Rectify all defects disclosed by tests and the repeat the tests.
      a. Continue process until installation passes all required test.
   3. The Contractor shall provide all labor, materials, and equipment used in tests.

B. Contractors' tests shall be scheduled and documented in accordance with the commissioning requirements.
   1. Refer to Section 01 91 00, Commissioning, for further details.

3.16 COMPLETION OF WORK

A. Prior to acceptance of the installation and final payment of the Contract, the Contractor shall provide and complete the following:

B. CLEANING: as required by Special Conditions applicable to this Division of the work.
   1. At the conclusion of the construction, the site and structure shall be cleaned thoroughly of all debris and unused materials remaining from the plumbing construction.
      a. Clean all areas and temporary storage spaces of all packing boxes, wood frame members and other waste materials used in the plumbing construction.
   2. Clean the entire piping system and equipment internally.
   3. Drain all tanks fixtures and pumps and prove free of sludge and accumulated matter.
   4. Remove all temporary labels, stickers, etc. from all fixtures and equipment.
      a. (Do not remove permanent nameplates, equipment model numbers, ratings, etc.).

C. OPERATION AND MAINTENANCE MANUALS
   1. Refer to Section 01 91 00 – Commissioning for Operations and Maintenance Data requirements.

D. AS-BUILT PRINTS:

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1. Requirements and methods of preparing and procedure for submitting project record as-built prints shall be in accordance with Division 1.
2. Contractor shall keep day-to-day records of all changes (redline drawings), and upon completion of the work, shall submit the redline drawings to the A/E to incorporate these changes into the original ACAD drawing files in order to create the record drawings (as-built drawings).
    a. Provide copies of all as-built drawing files in both ACAD and PDF format to the Owner at the date of substantial completion.
3. The drawings shall show:
    a. All equipment and piping (including underground).
    b. The fire protection sprinkler system layout with dimensions and reference points.
    c. All other concealed non-accessible work,
        i) Branching arrangement and valve location for piping systems.
        ii) The locations of all water hammer arrestors and potable water shutoff valves in system.
        iii) The locations of control system sensors and other control devices.
        iv) Work of change orders not shown on contract documents.

E. WARRANTY
1. The warranty for all plumbing equipment (whether manufacturer's or contractor's warranty) shall comply with Section 01 78 00.
2. All equipment and systems, unless specified otherwise, shall have a manufacturer’s warranty for a period of one year from the date of substantial completion.
    a. This warranty shall be against defective materials, design, and workmanship.
3. The plumbing contractor shall repair or replace any component of the Division 22 work under warranty, which proves to be defective, at no cost to the Owner.
4. The Contractor upon receipt of notice from the Owner of a failure during the warranty period shall respond the same day and complete warranty service work in a timely manner.
5. During warranty period, document all responses to warranty calls made by the Contractor by leaving a copy of the mechanics service ticket with the school Principal upon completion of the warranty work, prior to leaving the site.
    a. Without proper documentation, the Owner cannot acknowledge repairs are complete.
6. Required optional extended manufacturer or vendor warranties for specific items, their performance, or expected durability will be explicitly included in Division 22 Specifications.
    a. Manufacturer or vendor shall repair or replace any defective component under extended warranty at no cost to the Owner.

3.17 DEMONSTRATION AND TRAINING

A. Training of the Owner’s operation and maintenance personnel is required in cooperation with the Owner's Representative.
B. Provide competent, factory-authorized personnel to provide instruction to Facilities Service personnel concerning the location, operation, and troubleshooting of the installed systems.
C. Schedule the instruction in coordination with the Owner's Representative after submission and approval of formal training plans.
D. Refer to Section 01 91 00, Commissioning, for further contractor training requirements.

END OF SECTION

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SECTION 22 05 29
HANGERS and SUPPORTS for PLUMBING PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES:
- A. Pipe and equipment hangers and supports
- B. Equipment bases and supports
- C. Sleeves and seals
- D. Flashing and sealing equipment and pipe stacks

1.2 REFERENCES
- A. ASME B31.1 - Power Piping
- B. ASME B31.2 - Fuel Gas Piping
- C. ASME B31.9 - Building Services Piping
- D. ASTM F708 – Standard Practice for Design and Installation of Rigid Pipe Hangers
- E. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation
- F. NFPA 13 – Standard for the Installation of Sprinkler Systems
- G. NFPA 14 – Standard for the Installation of Standpipes and Hose Systems
- H. UL 203 - Pipe Hanger Equipment for Fire Protection Services

1.3 SUBMITTALS
- A. Submit under provisions of Section 01 33 00.
- B. Shop Drawings shall indicate system layout with location and detail of trapeze hangers.
- C. Product Data provide manufacturers catalog data including load capacity.
- D. Design Data indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.
- E. Manufacturer Installation Instructions: Indicate special procedures and assembly of components.

1.4 REGULATORY REQUIREMENTS
- A. Conform to applicable code for support of plumbing and hydronic piping
- B. Supports for Sprinkler Piping: In conformance with NFPA 13
- C. Supports for Standpipes: In conformance with NFPA 14

PART 2 PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS
- A. Fire Protection Piping:
  1. Conform to NFPA 13 and NFPA 14
  2. Hangers for pipe sizes 2 to 1½” use carbon steel, adjustable swivel split ring.
  3. Hangers for pipe sizes 2” and over, use carbon steel, adjustable, clevis.
  4. Multiple or trapeze hangers, use steel channels with welded spacers and hanger rods.
  5. Wall support for pipe sizes to 3”, use cast iron hook.
  6. Wall support for pipe sizes 4” and over, use welded steel bracket and wrought steel clamp.
  7. Vertical support, use steel riser clamps.
  8. Floor support use cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
  9. Copper pipe support, use carbon steel ring, adjustable, copper plated.

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B. Plumbing Piping - DWV:
   1. Conform to ASME B31.9, ASTM F708, and MSS SP-58
   2. Hangers for pipe sizes 2 to 1½", use carbon steel adjustable swivel split ring.
   3. Hangers for pipe sizes 2" and over, use carbon steel adjustable clevis.
   4. Multiple or trapeze hangers, use steel channels with welded spacers and hanger rods.
   5. Wall support for pipe sizes to 3", use cast iron hook.
   6. Wall support for pipe sizes 4" and over, use welded steel bracket and wrought steel clamp.
   7. Vertical support use steel riser clamp.
   8. Floor support, use cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
   9. Copper pipe support, use vinyl coated carbon steel ring, adjustable.
      a. Do not use copper plated or copper clad hangers.

C. Plumbing Piping - Water:
   1. Conform to ASME B31.9, ASTM F708, and MSS SP-58.
   2. Hangers for pipe sizes 2 to 1½" use carbon steel adjustable swivel split ring.
   3. Hangers for cold pipe sizes 2" and over, use Carbon steel adjustable clevis.
   4. Hangers for hot pipe sizes 2 to 4", use carbon steel adjustable clevis.
   5. Hangers for hot pipe sizes 6" and over, use adjustable steel yoke cast iron roll double hanger.
   6. Multiple or trapeze hangers, use steel channels with welded spacers and hanger rods.
   7. Multiple or trapeze hangers for hot pipe sizes 6" and over, use steel channels with welded spacers and hanger rods, cast iron roll.
   8. Wall support for pipe sizes to 3" use cast iron hook.
   9. Wall support for pipe sizes 4" and over, use welded steel bracket and wrought steel clamp.
   10. Wall support for pipe sizes 6" and over, use welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.
   11. Vertical support use steel riser clamp.
   12. Floor support for cold pipe any size, use cast iron adjustable pipe saddle, lock nut nipple, floor flange, and concrete pier or steel support.
   13. Floor support for hot pipe sizes 4", use cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
   14. Floor supports for hot pipe sizes 6" and over, use adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
   15. Copper pipe support use vinyl coated carbon steel ring, adjustable.
      a. Do not use copper plated or copper clad hangers.

2.2 ACCESSORIES

A. Hanger Rods shall be mild steel threaded both ends, threaded one end, or continuous threaded.

2.3 INSERTS

A. Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms, size inserts to suit threaded hanger rods.

2.4 FLASHING

A. Metal flashing shall be 26-gage galvanized steel.

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B. Metal Counter-flashing shall be 22-gage galvanized steel.
C. Lead Flashing:
   1. Waterproofing, 5-lb/sq ft sheet lead
   2. Soundproofing, 1-lb/sq ft sheet lead
D. Flexible Flashing, 47-mil thick butyl sheet; compatible with roofing
E. Caps, steel 22-gage minimum; 16-gage at fire resistant elements

2.5 EQUIPMENT CURBS
A. Fabrication, welded 18-gage galvanized steel shell and base, mitered 3" cant, variable step to match roof insulation, factory installed wood nailer.

2.6 SLEEVES
A. For materials, refer to Section 01 50 00, Item 3.7.

PART 3 EXECUTION

3.1 INSTALLATION
A. Install in accordance with manufacturer's instructions.

3.2 INSERTS
A. Provide inserts for placement in concrete formwork.
B. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4".
D. Where concrete slabs form-finished ceiling, locate inserts to be flush with slab surface.
E. Where inserts are omitted, drill through concrete slab from below, and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

3.3 PIPE HANGERS AND SUPPORTS
A. Support horizontal and vertical piping in accordance with FBC Plumbing.
B. Install hangers to provide minimum 2" space between finished covering and adjacent work.
C. Place pipe hanger within 12" of each turn or elbow.
D. Use hangers with 1½” minimum vertical adjustment.
E. Support horizontal cast iron pipe adjacent to each hub, with 5' maximum spacing between hangers.
F. Support vertical piping at every floor.
   1. Support vertical cast iron pipe at each floor at hub.
G. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
H. Support riser piping independently of connected horizontal piping.
I. Provide vinyl coated carbon steel hangers and supports.
   1. Do not use copper plated or copper clad hangers.
   2. Avoid contact of dissimilar metals.
J. Design hangers for pipe movement without disengagement of supported pipe.
K. Prime coat exposed steel hangers and supports.
   1. Refer to Section 09 90 00.
   2. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not exposed.

3.4 EQUIPMENT BASES AND SUPPORTS
A. Provide housekeeping pads of concrete, minimum 4" thick and extending 6" beyond supported equipment.

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1. Refer to Section 03 30 00.

B. Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.

C. Construct supports of steel members.
   1. Brace and fasten with flanges bolted to structure.

D. Provide rigid anchors for pipes after installing vibration isolation components.

3.5 FLASHING

A. Provide flexible flashing and metal counter-flashing where piping and ductwork penetrate weather or waterproofed walls, floors and roofs.

B. Flash vent and soil pipes projecting 3" minimum above finished roof surface with lead worked one-inch minimum into hub, 8" minimum clear on sides with 24” x 24” sheet size.
   1. For pipes through outside walls, turn flanges back into wall and caulk, metal counter-flash, and seal.

C. Flash floor drains in floors with topping over finished areas with lead; 10" clear on sides with minimum 36" x 36" sheet size.
   1. Fasten flashing to drain clamp device.

D. Seal floor, shower, and mop sink drains watertight to adjacent materials.

E. Provide acoustical lead flashing around ducts and pipes penetrating equipment rooms, installed in accordance with manufacturer's instructions for sound control.

F. Provide curbs for mechanical roof installations 8" minimum high above roof surface.
   1. Flash and counter flash with sheet metal, seal watertight.
   2. Attach counter flashing mechanical equipment and lap base flashing on roof curbs.
   3. Flatten and solder joints.

G. Adjust storm collars tight to pipe with bolts; caulk around top edge.
   1. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

3.6 SLEEVES

A. For construction and execution, refer to Section 01 50 00, item 3.7.

END OF SECTION

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Project Name:
SDPBC Project No.:

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SECTION 15190 (22 05 53)
IDENTIFICATION for PLUMBING PIPING and EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES
- A. Nameplates
- B. Tags
- C. Stencils
- D. Pipe Markers
- E. Pipe Color Coding

1.2 REFERENCES
- A. ASME A13.1 - Scheme for the Identification of Piping Systems

1.3 SUBMITTALS
- A. Submit under provisions of Section 01 33 00.
- B. Submit list of wording, symbols, letter size, and color-coding for plumbing identification.
- C. Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- D. Product Data: Provide manufacturer's catalog literature for each product required.
- E. Manufacturer Installation Instructions: Indicate special procedures and installation.

1.4 PROJECT RECORD DOCUMENTS
- A. Submit under provisions of section 01 77 00.
- B. Provide a written record of the actual locations of tagged valves.

PART 2 PRODUCTS

2.1 NAMEPLATES
- A. Description, provide a laminated 3-layer plastic with engraved black letters on light contrasting background color.

2.2 TAGS
- A. Plastic Tags, provide a laminated 3-layer plastic with engraved black letters on light contrasting background color, tag size minimum 1½" diameter.
- B. Metal Tags, provide brass with stamped letters; tag size minimum 1½" diameter with smooth edges.
- C. Chart, provide a typewritten letter size list in anodized aluminum frame.

2.3 STENCILS
- A. Stencils, with clean cut symbols and letters of following size:

OUTSIDE DIAMETER OF INSULATION OR PIPE	LENGTH OF COLOR FIELD	SIZE OF LETTERS
¾" - 1¼"	8"	½"
1½" - 2"	8"	¾"
2½" - 6"	12"	1-1/4"
8" - 10"	24"	2½"
Over 10"	32"	3½"
Ductwork and Equipment	---	2½"

- B. Stencil Paint, as specified in Section 09 90 00, semi-gloss enamel, with colors conforming to ASME A13.1.

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2.4 PIPE MARKERS:
- A. Color shall conform to ASME A13.1.
- B. Plastic Pipe Markers:
  1. Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering.
  2. Minimum information indicating direction of flow arrow and identification of fluid conveyed.
- C. Plastic Tape Pipe Markers provide flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.
- D. Underground Plastic Pipe Markers shall be bright colored continuously printed plastic ribbon tape, minimum 6" wide by 4-mil thick, manufactured for direct burial service.

2.5 COLOR STICK-ONS ON CEILING GRID
- A. Install self-adhesive color ¾" squares on ceiling grid or on access panels to designate locations of concealed plumbing equipment, color code as follows:
  1. Green - Plumbing water valves
  2. Blue – HVAC equipment
  3. Red – HVAC piping specialties, valves, gauges, etc.
- B. Self-adhesive color ¾" diameter dots shall be installed on ceiling grid or on access panels to designate locations of concealed equipment color coded as follows:
  1. Purple – energy management and control systems
  2. Colors for other trades - see Section 26 05 53

2.6 PIPE COLOR CODING
- A. Paint all exposed HVAC piping in finished areas the appropriate color in accordance with specification sections 09 91 13 or 09 91-23 Painting, and 22 10 00 Plumbing Piping, 21 00 00 Fire Suppression.
- B. The piping colors code is as follows:
  1. Fire Sprinkler Piping – Red
  2. Gas Piping – Yellow
  3. Compressed Air - Orange

PART 3 EXECUTION

3.1 PREPARATION
- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces in accordance with Section 09 90 00 for stencil painting.

3.2 INSTALLATION
- A. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive.
  1. Apply with sufficient adhesive to ensure permanent adhesion.
- B. Install tags with corrosion resistant chain.
- C. Apply stencil painting in accordance with Section 09 90 00.
- D. Install plastic pipe markers in accordance with manufacturer's instructions.
- E. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.
- F. Install underground-metalized plastic pipe markers 6 to 8" below finished grade, directly above buried pipe.
- G. Identify air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates.
  1. Contractor may identify small devices, such as in-line pumps, with tags.
- H. Identify control panels and major control components outside panels with plastic nameplates.

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I. Identify valves in main and branch piping with tags.
J. Identify piping, concealed or exposed, with stenciled painting.
    1. Use tags on piping ¾" diameter and smaller.
    2. Identify service, flow direction, and pressure.
    3. Install in clear view and align with axis of piping.
    4. Locate identification not to exceed 20' on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.
    5. Paint gas-piping yellow for the entire length of the piping above ground.
K. Provide color-coded ceiling stick-on to locate valves above T-bar type panel ceilings.
    1. Locate stick-on, on ceiling grid T-bars closest to equipment.
L. Paint all exposed plumbing piping with appropriate color.

END OF SECTION

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SECTION 22 05 93
TESTS – PLUMBING PIPING SYSTEMS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. The other Contract Documents complement the requirements of this section.
B. The General Requirements apply to the work of this section.

1.2 SCOPE

A. Provide labor, materials, and supervision necessary to perform all piping tests of systems:
   1. Domestic Water Systems
   2. Sanitary and Storm Systems
B. Additional tests as specified in other sections.
   1. Perform these tests in addition to those specified in this section.
C. If a governing body requires tests over and above those specified herein, the Contractor shall perform the test and provide certification for approval by such governing body or agency.
D. Perform additional tests as may be required by utility companies or agencies supplying the particular service such as city water, natural gas, medical gases, etc.
E. Provide certified test reports for all systems.

1.3 EQUIPMENT

A. Contractor shall provide all devices, equipment, gases, etc., necessary conduct the required tests.
   1. Do not use devices installed in the work for test purposes.
B. Materials are subject to standard test by manufacturer before shipment.

1.4 GENERAL REQUIREMENTS

A. Make test during installation and after completion.
   1. Tests are at expense of Contractor.
B. Conduct and obtain approval of all piping concealed in building construction, chases, etc., prior to concealment.
   1. Contractor failing to make such tests must assume all costs of removing and replacing defective piping and must pay all costs of cutting and repairing building construction made necessary by this neglect to end of guarantee period.
C. Make tests prior to insulating piping or backfilling of underground work.
   1. Make hydrostatic tests with cold water, the minimum duration shall be four hours.
D. Test in presence of Owner's representative, who may direct Contractor to perform tests in presence of some other appointed witness.
   1. The Engineer, Owner's representative, and/or permitting agency shall witness all Contractor performed test without exception.
   2. Contractor is responsible for correct testing, observation of results, and corrections as necessary.
E. The Contractor shall make provisions for the thorough inspection of the installation and in no case hide any part of construction from the inspector.
F. Do not apply test pressures to a hot valve.
   1. In event, such testing is necessary, install temporary block ahead of valve.
   2. Final test of connection against hot valve shall be by examination under service pressure.
G. Disconnect and protect from damage any system device not designed for the test pressure.
H. All parts of system under test must be under constant supervision with authority to bleed off excess pressure that may develop.
   1. No tests shall remain on work unless continuously attended.

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2. Use care so that excess pressure does not develop because of temperature changes.

I. Work shall be completely leak free at any joint, fittings, accessory, or attachment.
   1. If repairs are necessary, re-test work after correction.
   2. Correct defects made manifest by these tests before proceeding with other work.

1.5 CERTIFIED TEST REPORTS

A. For each system tested, provide a certificate testifying that the system was tested as specified and provide the following data:
   1. Identification of system tested referencing specific equipment connected to system.
   2. Date tested
   3. Test pressure and duration of test
   4. Recorded test pressure at end of test
   5. Media used for testing
   6. List necessary repairs made before the system passed the leak test
   7. Signature of Contractor
   8. Signature of witness
   9. Other data as required by the system specification

1.6 DOMESTIC WATER SYSTEMS

A. Perform a hydrostatic test at 125-psig minimum for minimum 4-hour duration.
B. After test, blow clean with potable water; leave lines clean of all sediment and debris.
C. Sterilize all lines with chlorine as specified.

1.7 SANITARY, STORM AND ACID WASTE SYSTEMS

A. Inspect lines over entire length for obstructions with illumination and by rodding entire length.
B. Perform hydrostatic test of the building system, work to maximum head of water possible by plugging outlet and filling system to maximum height.
C. Keep infiltration into gravity sewers to minimum.
   1. May require proof through a test on completed project immediately after rain of sufficient intensity to saturate soil, or by other means.

PART 2 PRODUCTS

2.1 Not Used

PART 3 EXECUTION

3.1 Not Used

END OF SECTION

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SECTION 22 07 19)
PLUMBING PIPING INSULATION

PART 1 GENERAL

1.1 REFERENCES

A. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
B. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
C. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation
D. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
E. ASTM C921 - Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation
F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials

1.2 SUBMITTALS

A. Submit under provisions of Section 01 33 00
B. Product Data: For each product used in this project, provide catalog data for insulation, jackets and accessories, and installation instructions.
C. Samples: Not required

1.3 QUALITY ASSURANCE

A. Materials shall meet a flame spread/smoke developed rating of 25/50 or less in accordance with ASTM E84.
B. Applicator shall be a company specializing in performing the work of this section with minimum 3-years of experience.

1.4 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
B. Store insulation in original wrapping, and protect from weather and construction traffic.
C. Protect insulation against dirt, water, chemical and mechanical damage.

PART 2 PRODUCTS

2.1 RIGID FIBER GLASS INSULATION

A. Provide molded, heavy density, noncombustible; one-piece pipe insulation made from inorganic glass fibers bonded with a thermosetting resin K-value shall be a minimum of 0.25 at 75°F per ASTM C547.
B. Provide factory installed all service jacket of white kraft paper bonded to aluminum foil and reinforced with glass fibers and self-sealing lap for longitudinal seam and butt strips for circumferential joints per ASTM C921.
C. Provide 18-ga, Type 304 stainless steel tie wire with twisted ends on 24" centers but not less than two-tie wires per insulation section.
D. For fittings and valves, provide one-piece, molded, 20-mil thick, PVC covers with fiberglass inserts.
    1. Use pressure sensitive, color matching vinyl tape to seal PVC fitting covers to jacket of insulation per ASTM C921

2.2 FLEXIBLE FIBER GLASS INSULATION

A. Provide flexible, noncombustible, blanket insulation made from highly resilient, inorganic glass fibers bonded by a thermosetting resin.

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1. Density shall be 1.0 lb/cu ft. K-value shall be a minimum of 0.25 at 75°F per ASTM C553

B. Provide factory applied, foil-scrim-kraft vapor barrier with 2" wide stapling flange.
1. Secure seams with outward clinching staples on 6" centers.
2. Seal seams with two coats of vapor barrier mastic reinforced with 4" wide, open weave glass fabric per ASTM C921.

2.3 CELLULAR FOAM INSULATION
A. Provide flexible, closed-cell, slit tubing form, elastomeric pipe insulation.
1. For large diameter pipe, provide sheet form.
2. K-value shall be a minimum of 0.27 at 75°F.
3. Use contact adhesive to seal longitudinal seams and circumferential joints per ASTM C534/C534M.
B. For fittings and valves, fabricate insulation from mitered-cut tubular form using contact adhesive to seal joints.
C. If necessary, provide two layers of insulation to obtain specified thickness, staggering the longitudinal and circumferential joints.

2.4 ALUMINUM JACKET
A. For pipes, provide 16-mil thick, stucco embossed pattern finish, Type-1100 aluminum jacket, ASTM B209 and for horizontal pipe, locate longitudinal lap on bottom.
B. For fittings, provide 24-mil thick, die shaped, smooth finish, Type-1100 aluminum jacket, ASTM B209.
C. Provide 0.5" wide, 20-mil thick, Type-3003 aluminum bands on maximum 24" centers but not less than two bands per jacket section.

2.5 SHIELDS AND INSERTS
A. At all pipe hangers or pipe supports, provide 12" long, 180°-arc, galvanized sheet metal shields matching the insulation outside dimension.
B. For pipes larger than 2" diameter, provide 12" long, 180°-arc, cellular glass insulation inserts.

PART 3 EXECUTION

3.1 EXAMINATION
A. Before applying insulation, verify the following:
1. The inspection, testing, and approval of piping are complete.
2. The surfaces are clean (all foreign material removed) and dry.

3.2 INSTALLATION
A. Install materials in accordance with manufacturer's instructions.
B. On exposed insulation provide jacket or finish, and locate longitudinal seams in least visible locations.
1. Where insulated piping extends to weather exposed areas, provide specified aluminum sheet metal jacket.
C. Piping insulation or covering shall not penetrate fire-rated assembly unless the specific material has been tested an approved as part of the fire-rated assembly.
D. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe.
E. For above grade applications, maintain 0.5" air space on all sides of the insulation.
F. Finish insulation at supports, protrusions, and interruptions.
G. Storm Water Pipe (Interior and Above Grade Applications)
1. For roof drain bodies, provide 2" thick, flexible fiberglass insulation.
2. For horizontal drains, provide 1" thick, rigid fiberglass insulation.

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3. For vertical leaders, insulation is not required.
4. Seal all seams with vapor barrier mastic.
5. Insulate all fittings per Article 2.1.D.

H. Domestic Hot Water Pipe (Interior and Above Grade Applications): For hot water supply and return pipes, provide 1" thick, rigid fiberglass insulation.

I. Domestic Cold Water Pipe: Insulation is not required.

J. Condensate Pipe (Interior and Above Grade Applications): Provide ¾" thick, cellular foam insulation.

END OF SECTION

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SECTION 22 10 00
PLUMBING PIPING

PART 1 GENERAL

1.1 SCOPE

A. Work consists of all plumbing work indicated on drawings and specified herein.
B. Included are requirements for fees/permits for installation and inspection of all plumbing work.
C. Also see "Instructions to Bidders," "General Conditions," "Supplementary General-Conditions," "Special Conditions," and "General Requirements for Mechanical and Electrical Work" which are hereby made part of this section and govern in the event there is a conflict with this section.

1.2 SECTION INCLUDES

A. Pipe and pipe fittings
B. Valves
C. Sanitary sewer piping system
D. Domestic water piping system
E. Storm water piping system
F. Natural gas piping system

1.3 REFERENCES

A. ASME B16.18 – Cast Copper Alloy Solder Joint Pressure Fittings
B. ASME B16.22 – Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings
C. ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings - DWV
D. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder-Joint Drainage Fittings DWV
E. ASME B16.3 - Malleable Iron Threaded Fittings Classes 150 and 300
F. ASME BPVC Section IX - Welding and Brazing Qualifications
G. ASME - Boiler and Pressure Vessel Code
H. ASTM B32 – Standard Specification for Solder Metal
I. ASTM D2466 – Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fitting, Schedule 40
J. AWS D1.1/D1.1M - Structural Welding Code
K. ASTM A53/A53M – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless
L. ASTM A74 – Standard Specification for Cast Iron Soil Pipe and Fitting
M. ASTM A234/A234M – Standard Specifications for Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
N. ASTM A395/A395M – Standard Specification for Ferritic Ductile Iron Pressure Retaining Castings for Use at Elevated Temperatures
O. ASTM A536 – Standard Specification for Ductile Iron Castings
P. ASTM A861 – Standard Specification for High Silicon Iron Pipe and Fittings
Q. ASTM B88 – Standard Specification for Seamless Copper Water Tube
R. ASTM B306 – Standard Specification for Copper Drainage Tube (DWV)
S. ASTM C564 – Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings
T. ASTM D635 – Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in A Horizontal Position
U. ASTM D1784 – Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
V. ASTM D1785 – Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120

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W. ASTM D2235 – Standard Specification for Solvent Cement for Acrylonitrile Butadiene Styrene (ABS) Plastic Pipe and Fittings
X. ASTM D2241 – Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure Rated Pipe (SDR Series)
Y. ASTM D2467 – Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
Z. ASTM D2513 – Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing and Fittings
AA. ASTM D2665 – Standard Specification for Poly(Vinyl Chloride) PVC Plastic Drain, Waste, and Vent Pipe and Fittings
BB. ASTM D2680 – Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite Sewer Piping
CC. ASTM D2683 – Standard Specification for Socket Type Polyethylene Fillings for Outside Diameter-Controlled Polyethylene Pile and Tubing
DD. ASTM D2729 – Standard Specification for Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
EE. ASTM D2751 – Standard Specification for Acrylonitrile Butadiene Styrene (ABS) Sewer Piping and Fittings
FF. ASTM D2855 – Standard Practice for The Two-Step (Primer and Solvent) Method of Joining Poly(Vinyl Chloride) (PVC) or Chlorinated Poly(Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets
GG. ASTM D3034 –Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
HH. ASTM D3261 Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
II. ASTM D3350 – Standard Specification for Polyethylene Plastic Pipe and Fittings Materials
JJ. ASTM D4101 – Standard Specification for Polypropylene injection and Extrusion Materials
KK. ASTM F477 – Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
LL. ASTM F493 – Standard Specification for Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings
MM. ASTM F1055 – Standard Specification for Electrofusion Type Polyethlene Fittings for Outside Diameter Controlled Polyethylene and Crosslinked Polyethylene (PEX) Pipe and Tubing
NN. AWS A5.8M/A5.8 – Specification for Filler Metals for Brazing and Braze Welding
OO. AWWA - Standard Methods for the Examination of Water and Wastewater
PP. AWWA C105 – Polyethylene Encasement for Ductile-Iron Pipe Systems
QQ. AWWA C606 – Grooved and Shouldered Joints
RR. CISPI 301 – Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
SS. NSF-372 NSF 372 - Drinking Water System Components – Lead Content.

1.4 QUALITY ASSURANCE

A. Valves, Manufacturer's name and pressure rating marked on valve body.
B. Welding Materials and Procedures, Conform to ASME and applicable state labor regulations
C. Provide Welder Certification in accordance with ASME BPVC Section IX.
D. All grooved couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.
E. All castings used for couplings housings, fittings, or valve and specialty bodies shall be date stamped for quality assurance and traceability.

1.5 SUBMITTALS

A. Submit product data under provisions of Section 01 33 00.

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B. Include data on pipe materials, pipefittings, valves, and accessories.
C. Grooved joint couplings and fittings shall be shown on drawings and product submittals, and be specifically identified with the applicable manufacturer's model number.

PART 2 PRODUCTS

2.1 SANITARY SEWER PIPING, BURIED WITHIN 5-FEET OF BUILDING
- A. See section 22 05 00 part 2.1 f for additional material requirements.
- B. Cast Iron Pipe, ASTM A74 service weight
  1. Fittings, Cast iron
  2. Joints, Hub-and-spigot, CISPI HSN 85 compression type with ASTM C564 neoprene gaskets
- C. Copper Tubing, ASTM B306, DWV
  1. Fittings, ASME B16.3, cast bronze, or ASME B16.29, wrought copper
  2. Joints, ASTM B32, solder, Grade 50B
- D. PVC Pipe, ASTM D2665
  1. Fittings, PVC
  2. Joints, ASTM D2855, solvent weld

2.2 SANITARY SEWER PIPING, ABOVE GRADE
- A. Cast Iron Pipe, ASTM A74 service weigh
  1. Fittings, Cast iron
  2. Joints, Hub-and-spigot, CISPI HSN compression type with ASTM C564 neoprene gaskets
- B. Cast Iron Pipe, CISPI 301, Hubless service weight
  1. Fittings, Cast iron
  2. Joints, Neoprene gaskets and stainless steel clamp-and-shield assemblies
- C. Copper Pipe, ASTM B306, DWV
  1. Fittings, ASME B16.3, cast bronze, or ASME B16.29, wrought copper
  2. Joints: ASTM B32, solder, Grade 50B
- D. PVC Pipe, ASTM D2665
  1. Fittings, PVC
  2. Joints, ASTM D2855, solvent weld (Not allowed in plenums)

2.3 WATER PIPING, BURIED WITHIN 5-FEET OF BUILDING
- A. Copper Tubing
  1. ASTM B88, Type K, hard drawn
  2. Fittings
     a. Soldered, ASME B16.29, wrought copper
     b. Pressed, ASME B16.18 or ASME B16.22, copper press fitting with EPDM O-ring
  3. Joints
     a. Soldered, ASTM B32, solder Grade 95TA
     b. Pressed, ASME B16.18 or ASME B16.22, copper press fitting with EPDM O-ring

2.4 WATER PIPING, ABOVE GRADE
- A. Copper Tubing, ASTM B88, Type L, hard drawn
  1. Fittings
     a. Soldered, ASME B16.18 - bronze sand casting, /ASME B16.22 - wrought copper, ASME B16.23 - cast brass, or ASME B16.29 - wrought copper.
     b. Pressed, ASME B16.18 or ASME B16.22, copper press fitting with EPDM O-ring
     c. Grooved, ASME B16.18 - bronze sand casting, /ASME B16.22 - wrought copper, manufactured to copper-tube dimensions. (Flaring of tube or fitting ends to accommodate alternate sized couplings is not permitted.) Basis of Design: Victaulic Copper Connection.

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2. Joints
    a. Soldered, Grooved joints or ASTM B32, solder, Grade 95TA
    b. Pressed, ASME B16.18 or ASME B16.22, copper press fitting with EPDM O-ring

2.5 STORM WATER PIPING, BURIED WITHIN 5-FEET OF BUILDING

A. Cast Iron Pipe, ASTM A74 service weight
    1. Fittings, Cast iron
    2. Joints, Hub-and spigot, CISPI HSN compression type with ASTM C564 neoprene gaskets
B. Cast Iron Pipe, CISPI 301, Hubless, service weight
    1. Fittings, Cast iron
    2. Joints, Neoprene gaskets and stainless steel clamp-and-shield assemblies
C. PVC Pipe
    1. ASTM D2665
    2. Fittings, PVC
    3. Joints, ASTM D2855, solvent weld

2.6 STORM WATER PIPING, ABOVE GRADE

A. Cast Iron Pipe
    1. ASTM A74 service weight
    2. Fittings, Cast iron
    3. Joints, Hub-and spigot, CISPI HSN compression type with ASTM C564 neoprene gaskets
B. Cast Iron Pipe
    1. CISPI 301, Hubless, service weight
    2. Fittings, Cast iron
    3. Joints, Neoprene gaskets and stainless steel clamp-and-shield assemblies
C. PVC Pipe, ASTM D2665
    1. Fittings, PVC
    2. Joints, ASTM D2855, solvent weld (Not allowed in plenums)

2.7 GAS PIPING, BURIED BEYOND 5-FEET OF BUILDING

A. Steel Pipe, ASTM A53/A53M, Schedule 40 black
    1. Fittings, ASTM A234/A234M forged steel welding type, with AWWA C105 polyethylene jacket or double layer, half-lapped 10-mil polyethylene tape.
    2. Joints, AWS D1.1/D1.1M, welded
B. Plastic Tubing, ASTM D2513 Thermoplastic Gas Pressure Tubing
    1. Fittings, ASTM D3350 Polyethylene
    2. Joints, ASTM D2683; or ASTM D3261, or ASTM F1055

2.8 NATURAL GAS PIPING, BURIED WITHIN 5-FEET OF BUILDING

A. Steel Pipe, ASTM A53/A53M, Schedule 40 black
    1. Fittings, ASTM A234/A234M forged steel welding type, with AWWA C105 polyethylene jacket or double layer, half-lapped 10-mil polyethylene tape.
    2. Joints, AWS D1.1/D1.1M, welded

2.9 NATURAL GAS PIPING, ABOVE GRADE

A. Steel Pipe, ASTM A53/A53M, Schedule 40 black
    1. Fittings, ASME B16.3, malleable iron, or ASTM A234/A234M, forged steel welding type.
    2. Joints, Screwed for pipe 2" and under, AWS D1.1/D1.1M, welded, for pipe over 2".
B. Copper Tubing, ASTM B88, Type L, hard drawn
    1. Fittings, ASME B16.23, cast brass, or ASME B16.29, wrought copper
    2. Joints, ASTM B32, solder, grade 95TA

2.10 FLANGES, UNIONS, AND COUPLINGS

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A. Pipe Size 2" and under: 150 psig malleable iron unions for threaded ferrous piping; bronze unions for copper pipe, soldered joints.
B. Pipe Size Over 2": 150 psig forged steel slip-on flanges for ferrous piping; bronze flanges for copper piping; neoprene gaskets for gas service; 1/16" thick preformed neoprene bonded.
C. Grooved and Shouldered Pipe End Couplings: Ductile iron housing clamps to engage and lock, where required, designed to permit some angular deflection, contraction, and expansion; center-leg gasket with pipe stop to ensure proper groove engagement, alignment, and pipe insertion depth, pressure responsive synthetic rubber sealing gasket conforming to ANSI/NSF-61 and NSF-372; ASTM A449 compliant steel bolts, nuts and washers; galvanized couplings for galvanized pipe.
    1. IPS Steel Piping:
        a. Rigid Type, use coupling housings cast with offsetting, angle-pattern bolt pads confirming proper assembly upon visual confirmation of bolt pad contact with no torque requirement and to provide system rigidity and support and hanging in accordance with ANSI B31.1, ANSI B31.9, and NFPA 13. Installation-Ready, for direct stab installation without field disassembly. Basis of Design: Victaulic Style 107N.
        b. Flexible Type, use in locations where vibration attenuation and stress relief are required. Basis of Design: Victaulic Installation-Ready Style 177 or Style 77.
            i) May use flexible couplings in lieu of flexible connectors at equipment connectors.
            ii) Place couplings in close proximity to the vibration source.
        c. Flange Adapters, flat face, for direct connection to ANSI Class 125 or 150 flanged components. Basis of Design: Victaulic Style 741.
    2. Hard Copper Tube: Housings cast with offsetting angle-pattern bolts pads confirming proper assembly upon visual confirmation of bolt pad contact with no torque requirement.
        a. Housings coated with copper colored alkyd enamel.
        b. Manufacture to copper tube dimensions including center-leg gasket with pipe stop to ensure proper groove engagement, alignment, and pipe insertion depth.
        c. Installation-Ready, for direct stab installation without field disassembly.
        d. Basis of Design: Victaulic Style 607.
D. Dielectric Connections:
    1. Union or waterway with galvanized or plated steel threaded end, copper solder end, steel or ductile iron grooved end, and water impervious isolation barrier.
    2. Waterway fittings shall be a copper-silicon casting conforming to UNS C87850, and UL classified in accordance with ANSI / NSF-61 for potable water service. Fittings shall have threaded ends, grooved ends, or a combination. Basis of Design: Victaulic Style 647.

2.11 GATES VALVES

A. Up to 2" use, bronze body, inside screw, single wedge, or disc, threaded ends, valves in copper pipe to have soldered joint ends.
B. Over 2"use, iron body, bronze trim, rising OS&Y, single wedge, flanged ends.

2.12 GLOBE VALVES

A. Up to 2" use bronze body, rising stem and hand wheel, inside screw, renewable composition disc, screwed ends, with back seating capacity.
B. Over 2" use iron body, bronze trim, rising stem and hand wheel, OS&Y, plug-type disc, flanged ends.

2.13 BALL VALVES

A. Up to 2"
    1. Bronze body, stainless steel ball with Teflon seats and stuffing box ring, lever handle.
    2. Valves in copper pipe use soldered joint ends or end compatible with piping system.

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B. Over 2"
   1. Cast steel body; chrome plated steel ball, Teflon seat and stuffing box seals, lever handle.
   2. Ductile iron body; chrome plated carbon steel ball and stem, Teflon seat, lever handle.

2.14 GAS COCKS
A. Up to 2" use bronze body, bronze tapered plug, non-lubricated, Teflon packing, threaded ends.
B. Over 2" use cast iron body and plug, non-lubricated, Teflon packing, flanged ends.

2.15 SWING CHECK VALVES
A. Up to 2" use bronze 45° swing disc with solder screwed ends.
B. Over 2" use iron body, bronze trim, 45° swing disc, renewable disc, and seat, flanged ends.
C. 2" through 4" use ductile iron, stainless steel trim, swing disc, stainless steel clapper, grooved ends.

2.16 SPRING LOADED CHECK VALVES
A. Iron body, bronze trim, spring loaded, renewable composition disc, screwed, wafer, or flanged ends.
B. Ductile iron body, stainless steel trim, spring-assisted, aluminum bronze, or elastomer encapsulated ductile iron disc, grooved ends.

2.17 RELIEF VALVES
A. Bronze body, Teflon seat, steel stem, and springs, automatic, direct pressure actuated capacities ASME certified and labeled.

2.18 ACID WASTE PIPING, BURIED
A. High Silicon Iron Pipe, ASTM A861
   1. Fittings use bell and spigot joints with acid resistant sealant.
B. Polypropylene Pipe, ASTM D2467, D4101
   1. Fittings use Polypropylene ASTM D1785
   2. Joints shall be Thermofused
D. CPVC Pipe, ASTM D1784
   1. Fittings shall be CPVC
   2. Joints shall be ASTM F493 Solvent weld (acid grade solvent with yellow die)

2.19 ACID WASTE PIPING, ABOVE GRADE
A. High Silicon Iron Pipe, ASTM A861
   1. Fittings use bell and spigot joints with acid resistant sealant.
B. Fire Resistant Polypropylene Pipe, ASTM D2467, D4101
   1. Fittings use polypropylene ASTM D1785 and joints use Thermofused
C. CPVC Pipe, ASTM D1784
   1. Fittings, CPVC and Joints ASTM F493 Solvent weld (acid grade solvent with yellow die).
D. Borosilicate Glass Pipe Fittings, Plastic ASTM D4101, or Glass Fittings: Compression

PART 3 EXECUTION

3.1 PREPARATION
A. Ream pipe and tube ends, and remove burrs.
B. Remove all scale and dirt on inside and outside of pipe and connectors before assembly.
C. Prepare piping connections to equipment with flanges or unions.

3.2 INSTALLATION
A. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
B. Route piping in orderly manner and maintain gradient.
C. Install piping to conserve building space and not interfere with use of space.

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D. Group the piping at a common elevation and location whenever practical.
E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
F. Provide clearance for installation of insulation and access to valves and fittings.
G. Provide access where valves and fittings are not exposed.
H. Arrange water piping to drain at low points.
I. Establish elevations of buried piping outside the building to ensure not less than ft of cover.
    1. Slope piping and arrange to drain at low points.
J. When welding pipe support members to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to weld.
K. Prepare pipe, fittings, supports, and accessories not prefinished, ready for finish painting.
L. Install bell and spigot pipe with bell end upstream.
M. Install valves with stems upright or horizontal, not inverted.
N. Install a hose bibb on one lavatory (minimum) per group restroom.
O. Paint all LP and natural gas piping yellow and provide identification label.
P. Fire Sprinkler Piping:
    1. All grooved couplings, fittings, valves, and specialties shall be the products of a single manufacturer, and the grooving tools shall be of the same manufacturer.
    2. Use gaskets molded and produced by the groove-coupling manufacturer.
    3. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove.
    4. Grooved coupling manufacturer’s factory trained representative shall provide on-site training for contractor’s field personnel in the proper use of grooving tools, application of groove, and installation of grooved piping products.
    5. Factory trained representative shall periodically inspect the product installation.
    6. Contractor shall remove and replace any improperly installed products.
    7. Use pipe certified for use with the manufacturer's system.

3.3 APPLICATION

A. Use an approved mechanical couplings and fasteners only in accessible locations or as approved by engineer.
B. Install unions or grooved joint couplings downstream of valves at equipment or apparatus connections.
C. Install gate or ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.
D. Install globe or ball valves for throttling, bypass, or manual flow control services.
E. Provide spring loaded check valves on discharge of water pumps.

3.4 DISINFECTION OF POTABLE WATER PIPING SYSTEM

A. Prior to starting work, verify system is complete, flushed, and clean.
B. Ensure PH of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).
C. Inject disinfectant, free chlorine in liquid, powder, tablet, or gas form, throughout system to obtain 50-to 80-mg/L residual.
D. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15% of outlets.
E. Maintain disinfectant in system for 24-hours.
F. If final disinfectant residual tests less than 25-mg/L, repeat treatment.
G. Flush disinfectant from system until residual equal to that of incoming water of 1.0-mg/L.
H. Take samples no sooner than 24-hours after flushing, from 5% of outlets and from water entry, and analyze in accordance with AWWA C601.

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END SECTION

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SECTION 22 11 00
FACILITY POTABLE WATER DISTIBUTION

PART 1 GENERAL

1.1 RELATED DOCUMENTS
- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.
- B. Division22 & 23 Basic Mechanical Materials and Methods sections apply to work of this section.

1.2 DESCRIPTION OF WORK
- A. The drawings, schedules, and specifications indicate the extent of potable water systems work.
- B. Refer to other Section 22 07 19 for insulation required in conjunction with potable water piping; not work of this section.
- C. The trenching and backfill requirements in conjunction with exterior water piping are in other Division 22 & 23 sections, and included as work of this section.
- D. The trenching and backfill requirements in conjunction with potable water piping inside of building foundations are in other Division 22 & 23 sections, and included as work of this section.

1.3 QUALITY ASSURANCE
- A. Manufacturer's Qualifications, firms regularly engaged in manufacture of potable water systems products, of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than 5-years.
- B. Codes and Standards
  1. Plumbing Code Compliance, comply with applicable portions of the Florida Building Code pertaining to selection and installation of plumbing materials and products.

1.4 SUBMITTALS
- A. Product Data, submit manufacturer's technical product data and installation instructions for potable water systems materials and products.
- B. Show grooved joint couplings and fittings on drawings and product submittals, and specifically identify with the applicable manufacturer's style number.

PART 2 PRODUCTS

2.1 MATERIALS AND PRODUCTS
- A. General
  1. Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, temperature ratings, and capacities as indicated.
  2. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements.
  3. Provide materials and products complying with plumbing code where applicable.
  4. Provide sizes and types matching piping and equipment connections; provide fittings of materials that match pipe materials used in potable water systems.
  5. Where indicating more than one type of material or product, selection is Installer's option.

2.2 BASIC IDENTIFICATION
- A. General, provide identification complying with Division - 23 Basic Mechanical Materials and Methods section "Mechanical Identification".

2.3 BASIC PIPES AND PIPE FITTINGS
- A. General

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1. Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, and capacities as indicated in section 22 10 00.
2. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements.
3. Provide sizes and types matching piping and equipment connections; provide fittings of materials, which match pipe materials used in potable water systems.
4. Where indicating more than one type of material or product, selection is Installer's option.

2.4 BASIC PIPING SPECIALTIES

A. General, provide piping specialties complying with Section 22 20 00, in accordance with the following listing:
   1. Pipe escutcheons
   2. Low-pressure Y-type pipeline strainers
   3. Dielectric unions
   4. Mechanical sleeve seals
   5. Fire Barrier penetration seals
   6. Water hammer arresters
   7. Pipe sleeves
   8. Sleeve seals

2.5 BASIC SUPPORTS AND ANCHORS

A. General, provide supports and anchors complying with Section 22 02 29, in accordance with the following listing:
   1. Adjustable steel clevises and adjustable pipe saddle supports for horizontal piping hangers and supports.
   2. Two-bolt riser clamps for vertical piping supports.
   3. Concrete inserts, C-clamps, and steel brackets for building attachments.
   4. Protection shields for insulated piping support in hangers.

2.6 BASIC VALVES

A. General, provide valves complying with Section 22 10 00, in accordance with the following listing.
   1. Sectional Valves
      a. 2" and Smaller, ball valves
      b. 2½ " and Larger, gate valves
   2. Shutoff Valves
      a. 2" and Smaller, ball valves
      b. 2½" and Larger, gate valves
   3. Drain Valves
      a. 2" and Smaller, gate valves or ball valves
      b. 2½" and Larger, gate valves
   4. Check Valves
      a. All Sizes, swing check valves

2.7 BALANCE COCKS

A. Threaded Ends 2" and Smaller, class 125, bronze body, bronze plug, screw driver operated, straight or angle pattern.
B. Soldered Ends 2" and Smaller, class 125, bronze body, bronze plug, screw driver operated, straight or angle pattern.

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C. Manufacturer shall be subject to compliance with requirements, provide balance cocks of one of the following.
   1. Bell & Gossett ITT; Fluid Handling Div
   2. Hammond Valve Corp
   3. Milwaukee Valve Co., Inc
   4. Spirax Sarco
   5. Taco, Inc

D. Automatic Flow Control Valve for Drinking Water Applications: ½ and ¾" [15 and 20mm], NSF/ANSI 61-G rated for commercial hot water service (temperature rated to 180F), and certified by the NSF with all wetted parts stainless steel; lead-free construction in compliance with ANS/NSF-372; Series 300 stainless steel body, nickel plated brass union nut, and tamper-resistant flow cartridge 300 series stainless steel. Basis of Design: Victaulic "ICSS" Series 76X.

2.8 RELIEF VALVES

A. General, 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.

B. Combined Pressure Temperature Relief Valves, provide bronze body, test lever, thermostat, complying with ANSI Z21.22 listing requirements for temperature discharge capacity. Provide temperature relief at 210°F (99°C), and pressure relief at 150 psi.

C. Manufacturer shall be subject to compliance with requirements, provide relief valves of one of the following.
   1. Cash Acme formerly Cash (A.W.) Valve Mfg. Corp
   2. Conbraco Industries, Inc
   3. Watts Regulator Co
   4. Zurn Industries, Inc

PART 3 EXECUTION

3.1 INSPECTION

A. General
   1. Examine installation areas and conditions under which potable water systems.
   2. Do not proceed with work until unsatisfactory conditions are corrected and acceptable to Installer.

3.2 INSTALLATION OF BASIC IDENTIFICATION

A. General, install mechanical identification in accordance with Division- 23 Basic Mechanical Materials and Methods section "Mechanical Identification".

3.3 INSTALLATION OF POTABLE WATER DISTRIBUTION PIPING

A. General, install water distribution piping in accordance with Section 22 10 00.
   1. Install piping level and plumb, unless specified otherwise.

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

C. Electrical Equipment Rooms, do not run piping thru electrical equipment rooms or above electric panels.

3.4 INSTALLATION OF PIPING SPECIALTIES

A. Install piping specialties in accordance with Section 22 20 00.

3.5 INSTALLATION OF SUPPORTS AND ANCHORS

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A. Install supports, anchors, and seals in accordance with Section 22 05 29.

3.6 INSTALLATION OF VALVES

A. Install valves in accordance with Section 22 10 00.
B. 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.
C. Shutoff Valves, install on inlet of each plumbing equipment item, and on inlet of each plumbing fixture, and elsewhere as indicated.
D. Drain Valves
    1. Install on each plumbing equipment item located that completely drains equipment for service or repair.
    2. Install at base of each riser, at base of each rise or drop in piping system, and as indicated or required to completely drain potable water system.
E. Check Valves, install on discharge side of each pump, and elsewhere as indicated.
F. Balance Cocks, install in each hot water recirculating loop, and elsewhere as indicated.

3.7 EQUIPMENT CONNECTIONS

A. Piping Run outs to Fixtures, provide hot and cold water piping run outs to fixtures of sizes and indicated, but in no case smaller than required by the plumbing code.
B. Mechanical Equipment Connections, connect hot and cold water piping system to mechanical equipment as indicated, and comply with equipment manufacturer's installation instructions.
    1. Provide shutoff valve and union for each connection, provide drain valve on drain connection.
        a. Where grooved joint piping systems are utilized, unions are not required, grooved joint couplings shall serve as unions.

3.8 FIELD QUALITY CONTROL

A. TESTING
    1. Flush Out the piping systems with clean water before proceeding with required tests.
        a. Inspect each run of each system for completion of joints, supports, and accessory items.
    2. Hydraulically pressure test each section or segment of the system prior to backfilling, encasing, enclosing or otherwise preventing visual observation of the section or segment being tested.
        a. Backfill the underground systems, only after passing the required test
        b. Exposing joints only, permitted on all systems and required on systems having a pressure test exceeding 30 psig.
    3. Water test potable water system at 150% of design pressure, (100 psig minimum) for a period of 4 hours using a gage with a 0 psi to 200 psi and a minimum of 4 2 " dial.
    4. Disinfect potable water system: See “Plumbing Piping” for disinfection specification.

3.9 SPARE PARTS

A. Furnish to Owner, with receipt, one valve key for each key operated hydrant, bibb, or faucet installed.

END OF SECTION

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SECTION 22 13 00
FACILITY SANITARY DRAINAGE

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
B. -Section 22 05 00 Basic Plumbing Requirements sections apply to work of this section.
C. See Section 14 24 23 part 1.2 J & M on elevator hoist way, sump pit, and pump requirements.

1.2 DESCRIPTION OF WORK

A. The drawings, schedules, and specification indicate the extent of soil and waste systems work.
B. The exterior sanitary sewer system specifications are in applicable Division-33 sections.
C. Refer to appropriate Division-33 sections for exterior sanitary sewer system required in conjunction with soil and waste systems; not work of this section.
D. The installation for soil and waste systems specifications are in applicable Division-22 sections, and included as work of this section.
E. The trenching and backfilling in conjunction with underground building drain piping specifications are in applicable Division-22 sections, and included as work in this section.

1.3 QUALITY ASSURANCE

A. Manufacturers Qualifications: Firms regularly engaged in manufacturer of soil and waste systems products of types, materials and sizes required, whose products have been in satisfactory use in similar service for not less than 5-years.
B. Codes and Standards
    1. Plumbing Code Compliance: Comply with applicable portions of the FBC pertaining to plumbing materials, construction, and installation of products.
    2. ANSI Compliance: Comply with applicable ANSI standards pertaining to materials, products, and installation of soil and waste systems.
    3. ASSE Compliance: Comply with applicable ASSE standards pertaining to materials, products, and installation of soil and waste systems.
    4. PDI Compliance: Comply with applicable PDI standards pertaining to products and installation of sanitary systems.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data for soil and waste systems materials and products.
B. Record Drawings: At project closeout, submit record drawings of installed soil and waste systems, in accordance with requirements of Division 1.
C. Maintenance Data
    1. Submit maintenance data and parts lists for soil and waste systems materials and products.
    2. Include this data, product data, shop drawings, and record drawings in maintenance manual, in accordance with requirements of Division 1.

PART 2 PRODUCTS

2.1 MATERIALS AND PRODUCTS

A. Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, and capacities as indicated in section 22 10 00.

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B. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements.
C. Provide sizes and types matching piping and equipment connections; provide fittings of materials that match pipe materials used in soil and waste systems.
D. Where more than one type of material or product is indicated, selection is Installer's option.

2.2 BASIC DESCRIPTION
A. General: Provide identification complying with sections 22 05 00 and 22 05 53.

2.3 BASIC PIPING SPECIALTIES
A. Provide piping specialties complying with section 22 05 00, in accordance with the following listing
1. Pipe Escutcheons
2. Mechanical Sleeve Seals
3. Fire Barrier Penetration Seals
4. Pipe Sleeves
5. Sleeve Seals

2.4 BASIC SUPPORTS AND ANCHORS
A. Provide supports and anchors complying with sections 22 05 00 and 22 05 29 in accordance with the following listing.
1. Adjustable steel clevis hangers, steel pipe clamps, and pipe saddle supports for horizontal piping hangers and supports.
2. Two-bolt riser clamps for vertical piping supports. Concrete inserts, C-clamps, and steel brackets for building attachments.

PART 3 EXECUTION

3.1 INSPECTION
A. Examine installation of substrates and conditions of soil and waste systems.
B. Do not proceed with work until any unsatisfactory conditions are corrected and acceptable to Installer.

3.2 INSTALLATION OF BASIC IDENTIFICATION
A. Install mechanical identification in accordance with sections 22 05 00 and 22 05 53.

3.3 INSTALLATION OF ABOVE GROUND PIPING
A. Install soil and waste piping in accordance with sections 22 05 00, 22 10 00, and with FBC.
B. Do not install drain piping over electrical equipment rooms.
C. Do not install PVC piping in HVAC air plenums.

3.4 INSTALLATION OF BUILDING DRAIN PIPING
A. Install underground building drains as indicated and in accordance with FBC.
1. Lay underground building drains beginning at low point of systems, true to grades and alignment indicated with unbroken continuity of invert.
2. Place bell ends of piping facing upstream.
B. Install required gaskets in accordance with manufacturer's recommendations for use of lubricants, cements, and other special installation requirements.
1. Clean interior of piping of dirt and other superfluous material as work progresses.
2. Maintain swab or drag in line and pull past each joint as it is completed.
3. Place plugs in ends of uncompleted piping at end of day or whenever work stops.
C. Install soil and vent piping pitched to drain at minimum slope of ¼" per foot (2%) for piping 2" and smaller, and 1/8" per foot (1%) for piping 3" and larger.

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3.5 INSTALLATION OF PIPING SPECIALTIES
- A. Install piping specialties in accordance with sections 22 05 00 and 22 20 00.

3.6 INSTALLATION OF SUPPORTS AND ANCHORS
- A. Install supports and anchors in accordance with sections 22 05 00 and 22 05 29.

3.7 INSTALLATION OF DRAINAGE PIPING PRODUCTS
- A. Cleanouts
  1. Install in above ground piping and building drain piping as indicated, as required by FBC.
  2. Install floor and wall cleanout covers for concealed piping, select type to match adjacent building and provide a finish, which is flush with the building surface.
- B. Flashing Flanges, install a flashing flange and clamping device on each stack and cleanout passing through a waterproof membrane.
- C. Vent Flashing Sleeves
  1. Plumbing Contractor shall supply the vent flashing sleeves and the Roofing Contractor shall install.
  2. See Architectural specifications and details for type of flashing required.

3.8 INSTALLATION OF FLOOR DRAINS
- A. Install floor drains in accordance with manufacturer's written instructions and in locations indicated.
- B. Coordinate flashing work with work of waterproofing and adjoining substrate work.
- C. Coordinate with soil and waste piping as necessary to interface floor drains with drainage piping systems.
- D. Install floor drains at lowest point of surface areas to be drained, or as indicated.
  1. Set tops of drains flush with finished floor.
- E. Install drain-flashing collar or flange so that no leakage occurs between drain and adjoining flooring.
  1. Maintain integrity of waterproof membranes, where penetrated.
- F. Position drains so that they are accessible and easy to maintain.
- G. Floor drains should be required in all mechanical rooms, HW heater rooms and rooms with washing machine hook ups.

3.9 INSTALLATION OF TRAP PRIMERS
- A. Install trap primers as indicated, and in accordance with manufacturer's installation instruction.
- B. Pitch piping towards drain trap, a minimum of 1/8" per foot (1%).
- C. Adjust trap primer for proper flow.

3.10 EQUIPMENT CONNECTIONS
- A. Piping Run outs to Fixtures: Provide soil and waste piping run outs to plumbing fixtures and drains, with approved trap, of sizes indicated; but in no case smaller than required by FBC.
- B. Locate piping run outs as close as possible to bottom of floor slab supporting fixtures or drains.

3.11 FIELD QUALITY CONTROL
- A. TESTING
  1. Flush out piping systems with clean water before proceeding with required tests.
     a. Inspect each run of each system for completion of joints, support, and accessory items.
  2. Hydraulically pressure test each section or segment of the system prior to backfilling, encasing, enclosing, or otherwise preventing visual observation, or the section or segment being tested.

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a. Contractor shall backfill the underground piping systems after passing the testing.
b. Exposing joints only, permitted on all systems and required on systems having a pressure test exceeding 30 psig.

3. Water test soil, waste and vent system at 10' of head for 4 hours.
   a. The test stand pipe shall be a minimum of 10' above the highest point or section tested.

B. PROTECTION
1. Protect drains during remainder of construction period, to avoid clogging with construction materials and debris, and to prevent damage from traffic and construction work.

END OF SECTION

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SECTION 22 14 00
FACILITY STORM DRAINAGE

PART 1 GENERAL

1.1 RELATED DOCUMENTS
- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this Section.
- B. Division-22 Basic Plumbing Requirements sections apply to work of this section.

1.2 DESCRIPTION OF WORK
- A. The drawings, schedules, and this section define the extent of storm water systems work.
- B. The trenching and backfill requirements in conjunction with underground building drain piping are in applicable Division-22 sections, and included as work in this section.

1.3 QUALITY ASSURANCE
- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of storm water systems products of types, materials, and sizes required whose products have been satisfactory use in similar service for not less than 5-years.
- B. Installer Qualifications: Firms with at least 3-years of successful installation experience on projects with storm water systems work similar to that required for project.
- C. Codes and Standards
  1. Plumbing Code Compliance: Comply with applicable portions of FBC pertaining to plumbing materials, construction, and installation of products.
  2. ANSI Compliance: Comply with applicable ANSI Standards pertaining to materials, products, and installation of storm water systems.

1.4 SUBMITTALS
- A. Submit manufacturer's technical products data for storm water systems, materials, and products.
- B. At project closeout, submit record drawings of installed storm water systems, in accordance with requirements of Division 1.
- C. Submit maintenance data and parts lists for storm water systems materials and products. Include this data, product data, shop drawings, and record drawings in maintenance manual, in accordance with requirements of Division 1.

PART 2 PRODUCTS

2.1 MATERIALS AND PRODUCTS
- A. Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, and capacities as indicated in section 22 10 00.
- B. Where not indicated, the Installer makes proper selection in per installation requirements.
- C. Provide sizes and types matching piping and equipment connections; provide fittings of materials, which match pipe materials used in storm water systems.
- D. Where more than one type of materials or products is indicated, selection is Installer's option.

2.2 BASIC IDENTIFICATION
- A. Provide identification complying with sections 22 05 00 and 22 05 53.

PART 3 EXECUTION

3.1 INSPECTION
- A. Examine substrate and conditions for installation of storm water system being.
- B. Do not proceed with work until all conditions are in an acceptable condition to Installer.

3.2 INSTALLATION OF BASIC IDENTIFICATION

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A. Install mechanical identification in accordance with sections 22 05 00 and 22 05 53.

3.3 INSTALLATION OF BUILDING DRAIN PIPING

A. Install storm-building drains as indicated and in accordance with Florida Building Code.
B. Lay storm-building drains beginning at low point of systems, true to grade and alignment indicated with unbroken continuity of invert.
C. Place bell ends of piping facing upstream.
D. Install required gaskets in accordance with manufacturer's recommendations for use lubricants, cements, and other special installation requirements.
E. Clear interior of all pipes form dirt and other superfluous material as work progresses.
F. Maintain swab or drag in line and pull past each joint as it is completed.
G. Place plugs in ends of uncompleted piping at end of day or whenever work stops.
H. On HVAC condensate drains connected to system, provide check valves to prevent water flow reversal from entering the building mechanical room.

3.4 INSTALLATION OF ABOVE GRADE STORM DRAINS

A. Do not install roof drains of piping above electrical equipment.
B. Insulate all horizontal roof drain, including secondary drains.

3.5 FIELD QUALITY CONTROL

A. TESTING
    1. Flush-out piping systems with clean water before proceeding with required tests.
        a. Inspect each run of each system for completion of joints, supports, and accessory items.
    2. Hydraulically pressure test each section or segment of system prior to backfilling, encasing, enclosing or otherwise preventing visual observation of the section or segment being tested.
        a. Contractor shall backfill the underground systems.
        b. Exposing joints only, permitted on all systems and required on systems having a pressure test exceeding 30 psig.
    3. Water test storm water system at 10' of head for 4 hours.
        a. The test standpipe shall be a minimum of 10' above the highest point of section tested.

3.6 PROTECTION

A. Protect roof drains during remainder of construction period, to avoid clogging with construction materials and debris, and to prevent damage from traffic and construction work.

END OF SECTION

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SECTION 22 20 00
PLUMBING SPECIALTIES

PART 1 GENERAL

1.1 SCOPE
- A. Work consists of all plumbing work indicated on drawings and specified herein.
- B. Also included are all fees and permits for installation and inspection of all plumbing work.
- C. Direct attention to "Instructions to Bidders", "General Conditions", "Supplementary General Conditions", "Special Conditions", and "General Requirements for Mechanical and Electrical Work" which are hereby made part of this section and shall govern in the event there is a conflict with this section.

1.2 SECTION INCLUDES
- A. Roof and floor drains
- B. Cleanouts
- C. Backflow preventers
- D. Water hammer arrestors
- E. Hose bibs hydrants
- F. Trap Primers
- G. Mixing valve
- H. Clothes washer hook-up
- I. Oil Water Separators

1.3 REFERENCES
- A. ANSI/ASSE 1012 – Performance Requirements for Backflow Preventors with Immediate Atmospheric Vent
- B. ANSI/ASSE 1011 – Performance Requirements for Hose Connection Vacuum Breakers
- C. ASSE 1013 – Performance Requirements for Reduced Pressure Principle Backflow Preventors and Reduced Pressure Principle Fire Protection Backflow Preventers
- D. PDI WH-201 - Water Hammer Arrestors
- E. FBC- Florida Building Code

1.4 QUALITY ASSURANCE
- A. For each product specified, provide components by same manufacturer throughout.

1.5 SUBMITTALS FOR REVIEW
- A. Submit shop drawings and product data under provisions of Section 01 33 00.
- B. Include component sizes, rough-in requirements, service sizes, and finishes.

PART 2 PRODUCTS

2.1 ROOF DRAINS
- A. Only if shown on plans, require prior approval of District.
- B. Roof Drains shall have a PVC body with sump and threaded inserts, removable cast aluminum dome strainer, flashing collar with integral gravel stop.
  1. JR Smith Manufacturing Series 102 or approved equal.

2.2 FLOOR DRAINS
- A. See schedule on drawings for manufacturer and model.

2.3 CLOTHES WASHER HOOK-UP
- A. Provide connections for hot and cold water hook-ups for clothes washer, as well as sanitary line connection in areas as indicated on the plans.

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2.4 CLEANOUTS

A. Exterior Surfaced Areas: Zurn Series EZ1, PVC with threaded tapered plug or approved equal.
B. Exterior Unsurfaced Areas: Zurn Series EZ1, PVC with threaded tapered plug or approved equal. with 24" x 24" x 4" concrete surround.
C. Interior Finished Floor Areas: Zurn Series EZ1, PVC with threaded tapered plug or approved equal round with scoriated cover in service areas and square with depressed cover to accept floor finish in finished floor areas.
D. Interior Finished Wall Areas: Line type with PVC body and round gasketed cover, and round stainless steel access cover secured with machine screw.
E. Interior Unfinished Accessible Areas Threaded types provide stack cleanouts on vertical rainwater leaders.

2.5 BACKFLOW PREVENTERS

A. Reduced pressure backflow preventers, size to service and provide two gate valves.
    1. SPC 606.5 - ball valves 2" and smaller ball or gate 22 or larger.
    2. Reduced Pressure Backflow Preventors:
        a. ASSE 1013 bronze body with bronze and plastic internal parts and stainless steel springs.
        b. Two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve which opens under back pressure in case of diaphragm failure.
        c. Non-threaded vent outlet; assembled with two gate valves, strainer, and four test cocks.
        d. The above based on the Series 900 as manufactured by Watts.
B. Pipe drains to the exterior: Provide backflow device on all make up water lines for mechanical equipment.

2.6 WATER HAMMER ARRESTORS

A. Size in accordance with PDI WH-201, precharged suitable for operation in temperature range -100 to 300°F and maximum 250-psi working pressure.
B. Acceptable Manufacturers
    1. J. R. Smith Series 5000
    2. Josam Series 75000
    3. Zurn “Shoktrol”

2.7 WALL HYDRANTS

A. ANSI/ASSE 1011, vandal-proof cast bronze, mild-climate recessed wall hydrant with satin face, self-opening locking cover removable key, ¾” HPT outlet, integral vacuum breaker; recessed stainless steel box.
B. Acceptable Manufacturers
    1. J. R. Smith #5509QT-SAP
    2. Josam #71000
    3. Zurn #Z-1320

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2.8 HOSE BIBS
- A. ANSI/ASSE 1011, cast bronze hose bib with laceable hexagonal disc, ¾" HPT outlet, vacuum breaker.
- B. Acceptable Manufacturers
  1. J. R. Smith #5609QT-SAP
  2. Josam #71070
  3. Zurn #Z-1310

2.9 THERMOSTATIC MIXING VALVE
- A. Mixing valve rated at 8-10 GPM at 45-PSI differential pressure with check valve, volume control shutoff on outlet and strainer stop check on inlet.
- B. Acceptable Manufacturers
  1. Leonard #TM-554-15
  2. Powers
  3. Symmons

2.10 TRAP PRIMER
- A. Automatic ½" trap primer systems for all interior floor drains.
- B. Acceptable Manufacturers
  1. J. R. smith Series 2699
  2. Josam #88250
  3. Zurn #Z-1022
  4. PP1
- C. Trap primers connected to sink waste, lavatory waste and water closet tail piece are permitted.

2.11 VENT CAP
- A. Stainless Steel dome secured with recessed allen-socket head set screw.
- B. Acceptable Manufacturers
  1. J. R. Smith #1748
  2. Josam #26700
  3. Zurn #Z-193

2.12 VALVE BOX
- A. Provide an underground valve box with traffic cover.
- B. Acceptable Manufacturer
  1. Brooks Products, Inc.

2.13 OIL WATER SEPARATOR
- A. Non well field locations; Fiberglass, corrosion resistant metal or coated metal, single wall, double compartment, minimum 2" inlet with baffle and internal distribution pipe, minimum 2"outlet with oil retention baffle, internal drop leg, and outlet weir, 1"drain with plug, 2" oil outlet. All pipe connections shall have an external pipe stub.
- B. Well field locations; Fiberglass, corrosion resistant metal or coated metal, double wall, double compartment, minimum 2" inlet with baffle and internal distribution pipe, minimum 2"outlet with oil retention baffle, internal drop leg and outlet weir, 1"drain with plug, 2" oil outlet. All pipe connections shall have an external double wall containment pipe stub.

PART 3 EXECUTION

3.1 PREPARATION
- A. Coordinate cutting and forming of roof and floor construction to receive drains to required invert elevations.

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3.2 INSTALLATION AND APPLICATION

A. Install specialties in accordance with manufacturer's instructions to permit intended performance.
B. Install a trap primer on each floor drain.
C. Install traffic type round covers on all grease interceptors serving food service areas.
D. Extend cleanouts to finished floor or wall surface.
    1. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil.
    2. Ensure clearance at cleanout for rodding of drainage system.
E. Encase exterior cleanouts in 24 x 24 x 4 inches concrete flush with grade.
F. Install cleanouts at the base of each vertical stack.
G. Install cleanouts at each change of direction of horizontal run.
H. Install cleanouts at 50-foot intervals of horizontal runs.
I. Install cleanouts on all garbage disposals.
J. Install water hammer arrestors to be accessible complete with a means of isolation by either the branch isolation valve or a dedicated accessible isolation valve.
K. Install ¾" hose bibs/hydrants with vacuum breaker and gate valve on the exterior of all buildings with a maximum spacing of 150 feet.
L. Install one ¾" hose bib/hydrant with vacuum breaker in each group restroom.
M. Route oil-water separator effluent to the sanitary sewer system, and route the oil from the oil-water separator outlet pipe to a storage container for proper reuse or disposal of waste oil.

3.3 DEMONSTRATION AND TRAINING

A. Training of the Owner's operation and maintenance personnel is required in cooperation with the Owner's Representative.
    1. Provide competent, factory-authorized personnel to provide instruction to FS personnel concerning the location, operation, and troubleshooting of the installed systems.
    2. Schedule the instruction in coordination with the Owner's Representative after submission and approval of formal training plans.
    3. Refer to Section 01 91 00, Commissioning, for further contractor training requirements.
B. Demonstration and Training shall be provided for the following equipment:
    1. Double Check Backflow Preventors
    2. Thermostatic Mixing Valves

END OF SECTION

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SECTION 22 30 00
PLUMBING EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES
- A. Water heaters
- B. Packaged water heating systems
- C. Water storage tanks
- D. Water softeners
- E. Pumps
- F. Circulators

1.2 REFERENCES
- A. ASHRAE 90-1 - Energy Standard for Building Except Low-Rise Residential Buildings
- B. ASME BPVC-VIII – ASME Boiler & Pressure Vessels Codes
- C. NFPA 30 - Flammable and Combustible Liquids Code
- D. NFPA 54 - National Fuel Gas Code
- E. NFPA 58 - Storage and Handling of Liquefied Petroleum Gases
- F. NFPA 70 - National Electrical Code
- G. UL 174 - Household Electric Storage Tank Water Heaters
- H. UL 1453 - Electric Booster and Commercial Storage Tank Water Heaters
- I. FBC Florida Building Code

1.3 SUBMITTALS FOR REVIEW
- A. Section 01 33 00 – Submittals Procedures
- B. Product Data
  1. Provide dimension drawings of water heaters indicating components and connections to other equipment and piping.
  2. Indicate pump type, capacity, and power requirements.
  3. Provide certified pump curves showing pump performance characteristics with pump and system operating point plotted.
     a. Include NPSH curve when applicable.
  4. Provide electrical characteristics and connection requirements.
- C. Shop Drawings
  1. Indicate heat exchanger dimensions, size of tapings, and performance data.
  2. Indicate dimensions of tanks, tank lining methods, anchors, attachments, lifting points, tapings, and drains.

1.4 SUBMITTALS FOR INFORMATION
- A. Section 01 33 00 – Submittals Procedures, procedures for submittals.

1.5 SUBMITTALS AT PROJECT CLOSEOUT
- A. Section 01 77 00 - Contract Closeout, procedures for submittals.
- B. Operation and Maintenance Data: Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.
- C. Submit manufacturer’s warranty in Owner's name and registered with manufacturer.

1.6 QUALITY ASSURANCE
- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- B. Provide pumps with manufacturer's name, model number, and rating/capacity identified.

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C. Ensure products and installation of specified products are in conformance with recommendations and requirements of the following organizations:
   1. American Gas Association (AGA)
   2. National Sanitation Foundation (NSF)
   3. American Society of Mechanical Engineers (ASME)
   4. National Board of Boiler and Pressure Vessel Inspectors (NBBPVI)
   5. National Electrical Manufacturers' Association (NEMA)
   6. Underwriters Laboratories (UL)
   7. American National Standards Institute (ANSI)
      a. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation; operate within 25% of midpoint of published maximum efficiency curve.

1.7 REGULATORY REQUIREMENTS
- A. Conform to AGA, NFPA 54, NFPA 70, UL 174, UL 1453 requirements for water heaters.
- B. Conform to ASME BPVC_VIII for manufacture of pressure vessels for heat exchangers.
- C. Conform to ASME BPVC_VIII for tanks.
- D. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.8 DELIVERY, STORAGE, AND HANDLING
- A. Section 01 60 00 - Material Equipment and approved equals: Transport, handle, store, and protect products.
- B. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.9 WARRANTY
- A. Section 01 78 00 - Warranties.
- B. Provide 5-year manufacturer parts and labor warranty for domestic water heaters, packaged water heating systems.

1.10 MAINTENANCE PRODUCTS
- A. Section 01 78 00 - Operation and Maintenance Data.

PART 2 PRODUCTS

2.1 MANUFACTURER
- A. All manufacturers shall be a United States based company doing business in the U.S. for at least 10-years.

2.2 RESIDENTIAL GAS FIRED WATER HEATER
- A. Type: Automatic natural gas fired vertical storage.
- B. Performance
  1. Input per design documents.
  2. Minimum recovery rate per design documents with 100°F temperature rise.
  3. Maximum working pressure is 150 psig.
  4. Provide certification: CGA P.3.
- C. Tank: Glass lined welded steel single flue passage, flue baffle and draft hood; thermally insulated with glass fiber and encased in corrosion-resistant steel jacket; baked-on enamel finish; floor shield and legs.
- D. Controls: Automatic water thermostat and built-in gas pressure regulator; temperature range adjustable from 120° to 170°F, cast iron or sheet metal burner, safety pilot and thermocouple.
- E. Accessories

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1. Brass water connections, dip tube, drain valve, magnesium anode, thermometer, and ASME temperature, and pressure relief valve.
2. ANSI rated vacuum relief valve if required, expansion tank if required.

2.3 COMMERCIAL GAS FIRED WATER HEATER

A. Type: Automatic natural gas fired split system (heater and unfired vertical storage tank) with capacity in accordance with design documents.

B. Performance

1. Input maximum of 400,000 BTUH per heater and with the use of multiple heaters for demand exceeding this limit. Maximum water temperature of 210 deg F.
2. Minimum recovery rate per design documents with 100°F temperature rise.
3. Maximum working pressure: 150 psig.

C. Tank: 120 gallon maximum capacity, glass lined welded steel ASME certified HLW stamped, thermally insulated with minimum 2" glass fiber, encased in corrosion-resistant steel jacket; baked-on enamel finish.

D. Accessories

1. Brass water connections, dip tube, drain valve, high-density magnesium anode, thermometer, and ASME rated temperature and pressure relief valve.
2. ANSI rated vacuum relief valve if required, expansion tank if required.

2.4 Approval shall be per AGA as automatic storage water-heater operating at 180°F.

A. Automatic water thermostat with temperature range adjustable from 120° to 180°F, automatic reset high temperature limiting thermostat factory set at 195°F, gas pressure regulator, multi-ribbon or tubular burner, 100% safety shut-off pilot and thermocouple, flue baffle and draft hood.

2.5 RESIDENTIAL ELECTRIC WATER HEATER

A. Type: Automatic electric fired vertical storage.

B. Performance

1. Minimum recovery rate per design documents with 100°F temperature rise.
2. Maximum working pressure is 150 psig.

C. Tank: Glass lined welded steel, thermally insulated with 1-inch thick glass fiber encased in corrosion-resistant steel jacket; baked-on enamel finish.

D. Controls

1. An automatic water thermostat with adjustable temperature range from 120° to 170°F, flanged or screw-in nichrome elements, enclosed controls, electrical junction box, and operating light.
2. Wire double element units so elements do not operate simultaneously.

E. Accessories

1. Brass water connections, dip tube, drain valve, magnesium anode, thermometer, and ASME rated temperature and pressure relief valve.
2. ANSI rated vacuum relief valve if required, expansion tank if required.
3. Emergency drain pan.

2.6 COMMERCIAL ELECTRIC WATER HEATERS

A. Type: Factory-assembled and wired electric vertical storage.

B. Performance

1. Minimum recovery rate per design documents with 100°F temperature rise.
2. Maximum working pressure is 150 psig.

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C. Tank: Glass lined welded steel; 4" diameter inspection port, thermally insulated with minimum 2 inches glass fiber encased in corrosion-resistant steel jacket; baked-on enamel finish, ASME HLW stamped.
D. Controls: Provide an automatic immersion water thermostat with externally adjustable temperature controls ranging from 60° to 180°F, a flanged or screw-in nichrome element, and a high temperature limit thermostat.
E. Accessories
   1. Brass water connections, dip tube, drain valve, magnesium anode, thermometer, and ASME rated temperature and pressure relief valve.
   2. ANSI rated vacuum relief valve if required, expansion tank if required.

2.7 PACKAGED WATER HEATING SYSTEMS
A. System: Gas-fired direct heating boiler, circulating pump, controls, piping, and valving as indicated.
B. Boiler
   1. Type: Gas fired water tube boiler with copper finned tube heat exchanger, steel jacket, and glass fiber insulation.
   2. Boiler Trim: Gas burner, thermometer and pressure gauge, immersion thermostats for operating and high limit protection, 100% safety shut-off electric gas valve with transformer, electronic safety pilot and pilot burner, gas pressure regulator, manual gas shut-off, low water cut off, ASME rated temperature and pressure relief valve, draft invertor.
   3. Performance
      a. Gross input: BTUH per design documents, at sea level.
      b. Gross output: BTUH per design documents, at sea level.
C. Vertical or Horizontal storage tank:
   1. Working pressure: 150 psi ASME labeled.
   2. Lining: 15 mils thick epoxy lining extended through flanges and couplings.
   3. Support: Two welded tank saddles not less than 4" wide by ¼" thick, mounted on 2" pipe stand with minimum four cross braced legs; sheet teflon isolation strip between tank and saddle; dielectric unions between tank and piping system.
   4. Insulation: Provide 3" glass fiber insulation with aluminum jacket.
D. Pump
   1. Type: All bronze, in-line circulation pump controlled by tank mounted immersion thermostat set at 140°F.
E. Thermostatic Valve: Three-way, self-contained, full line size, bronze body 2 to 2" size, iron body 2½" inches and over, set at 140°F.

2.8 TANKLESS WATER HEATERS
A. Gas: Natural gas or LP, digital setpoint temperature display and control to 1°F increments, range 80°F to 140°F, energy star qualified, stainless steel heat exchanger, ultra-low NOx emmissions <20ppm, internal flow meter with 0.3 gpm activation point.
B. Electric: Copper emersion heating element, digital setpoint temperature display and control to 1°F increments, range 80°F to 140°F, internal flow meter with 0.3 gpm activation point.

2.9 WATER SOFTENERS
A. Softener Tank: Glass fiber reinforced plastic tank.
B. Brine Tank: Glass fiber reinforced plastic tank.
C. Control: Brass control valve cycled to regenerate after adjustable metered quantity of water flow.

2.10 IN-LINE CIRCULATOR PUMPS

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A. Casing: Bronze rated for 125 psig working pressure with stainless steel rotor assembly.
B. Impeller: Bronze or stainless steel
C. Shaft: Stainless steel.
D. Seal: Carbon rotating against a stationary ceramic seat.
E. Drive: Flexible coupling.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install water heaters and water softeners in accordance with manufacturer's instructions.
   1. In addition, install water heaters to applicable AGA, ANSI, NFPA 54, UL requirements.
B. Coordinate with plumbing piping and related fuel piping, gas venting and electrical work to achieve operating system.
C. Domestic Water Heater Exchangers:
   1. Install domestic water heater exchangers with clearance for tube bundle removal without disturbing other installed equipment or piping.
   2. Support unit on pipe stand.
   3. Pipe relief valves and drains to nearest floor drain.
   4. Connect steam branch line from top of main.
      a. Pipe in flexible manner pitched with steam flow and with a pipe union connection.
      b. Provide steam pressure gauge at exchanger inlet.
   5. Provide steam traps and valves as indicated.
   6. Pitch shell for condensate drain to traps.
D. Domestic Hot Water Storage Tank:
   1. Provide support, independent of building structural framing members.
   2. Clean and flush tank, then seal until pipe connection is complete.
   3. Provide 4” thick concrete housekeeping pad for floor mounted tanks.
E. Pump
   1. Ensure shaft length allows sump pumps to be located minimum 24" below lowest invert into sump pit and minimum 6" clearance from bottom of sump pit.
   2. Provide air cock and drain connection on horizontal pump casings.
   3. Provide line sized isolating valve and strainer on suction and line sized soft-seated check valve and balancing valve on discharge.
   4. Decrease from line size with long radius reducing elbows or reducers.
      a. Support piping adjacent to pump such that the pump casings carry no weight.
      b. Provide supports under elbows on pump suction and discharge line sizes 4" and over.
   5. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitations, are non-overloading in parallel or individual operation, and operate within 25% of midpoint of published maximum efficiency curve.
   6. Align and verify alignment of base mounted pumps prior to start up.

3.2 DEMONSTRATION AND TRAINING

A. Training of the Owner’s operation and maintenance personnel is required in cooperation with the Owner's Representative.
   1. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems.

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2. Schedule the instruction in coordination with the Owner's Representative after submission and approval of formal training plans.
3. Refer to Section 01 91 00, Commissioning, for further contractor training requirements.

B. Demonstration and Training shall be provided for the following equipment:
1. Domestic Hot Water Heaters
2. Packaged Water Heating Systems
3. Water Softeners

END OF SECTION

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SECTION 22 40 00
PLUMBING FIXTURES

PART 1 GENERAL

1.1 RELATED DOCUMENTS
- A. The other Contract Documents complement the requirements of this section. The General Requirements apply to the work of this section.

1.2 SCOPE
- A. Provide fixtures, trim, accessories, labor, and supervision necessary for the plumbing fixture installation.

1.3 FIXTURE SCHEDULE
- A. Fixtures, trim and accessories shall be of type and model numbers as scheduled on the drawings.

1.4 SUBMITTALS
- A. Submit catalog cuts giving manufacturer's model numbers, fixtures and rough-in dimensions and construction material for each type of fixture, trim, and accessory scheduled.
- B. Submit to the construction manager cutout trim plates for sinks, installed in counter tops.

PART 2 PRODUCTS

2.1 MANUFACTURER
- A. All manufacturers shall be a United States based company doing business in the U.S. for at least 10-years.

2.2 VITREOUS AND CAST IRON FIXTURES
- A. Vitreous ware shall be non-absorbent, even color, unwrapped, two-fired vitreous china, grade "A" as rated by the Bureau of Standards.
- B. Enameled cast iron fixtures shall have the enamel fused with the iron to provide a hard acid-resisting enameled finish.
- C. Vitreous and enamel fixtures shall be white, except where other colors are called for in schedule.
- D. Vitreous China and Cast Iron Enameled Fixtures
  1. Vitreous china and cast iron enameled fixtures by American Standard, Elkay, Kohler, or Toto,
  2. Use low flow urinals.
  3. Use duel flush or low flow water closets in new and existing construction.

2.3 STAINLESS STEEL SINKS
- A. Provide stainless steel sinks fabricated from 18-gauge stainless steel, except laboratories where they shall be type 316, with satin finish, and sound deadening treatment.
- B. When a non-self-rimming sink is specified, furnish sinks with mounting hardware and rim.
- C. Stainless Steel Sinks
  1. Stainless steel sinks acceptable manufacturers are American Standard, Elkay, Kohler or approved equal.

2.4 TRIM
- A. Trim for conventional fixtures shall include supply pipes, stop valves, faucets, tailpieces, strainers, wastes, traps, floor and wall escutcheon plates, which shall be brass.
  1. Exposed trim shall be chrome plated.
  2. Braided stainless steel flexible supply hoses shall not be used.
- B. Stop valves shall be compression type with loose key or screwdriver control.
- C. P-traps shall be adjustable chrome plated.

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D. Faucets shall contain standardized interchangeable operating units for both hand closing and self-closing types, closing with the pressure of the water.
E. Faucets for lavatories shall be 0.5-gpm maximum flow rate.
F. Omit supply side trim for waterless urinals.
G. Trim, brass trim by American Standard, Elkay, Kohler or approved equal.

2.5 DRINKING FOUNTAINS, WATER COOLERS AND BOTTLE FILLERS
A. Acceptable manufacturers are Elkay, Oasis or approved equal.
B. Non-filtered option shall be used unless known contaminants in the water supply at the point of use exceed the allowable maximum contaminant level defined by the EPA National Drinking Water Regulations (NPDWR).

2.6 FLOOR DRAINS
A. Floor drains acceptable manufacturers are Josam, J. R. Smith, Wade, Sioux Chief, or Zurn.

2.7 CLINIC EYEWASH
A. Bradley Model S19-435EFW
B. Haws Model 8905
C. Guardian G5046
D. Approved equal

2.8 FLUSH VALVES
A. Provide and install either duel flush models or low flow as indicated on plumbing plans.
B. Acceptable manufacturers are Moen, Sloan, Zurn or approved equal.

2.9 HAND WASHING FAUCET
A. Provide and install models as indicated on plumbing plans.
B. Provide vandal resistant spray head with 0.5gpm flow rate.
C. Acceptable manufacturers are Chicago Faucet, Moen, Sloan, Zurn or approved equal.

PART 3 EXECUTION

3.1 INSTALLATION
A. Install fixtures, then make water supply, waste and vent connections.
B. Set fixtures in center of stalls, between partitions where required, verify dimensions for spacing.
C. Setting shall be absolutely tight and rigid on proper ground.
1. Use tube caulk under all setting surfaces.
2. Grout water closets.
3. Seal final seam with anti-fungal or silicone caulk.
D. Cover the fixtures with cardboard taped in place after they are set to prevent damage during the balance of construction.
1. At the conclusion of the work, remove the cardboard and properly clean the fixtures
E. This section shall be responsible for the protection of the fixtures until acceptance by Owner. Replace damaged fixtures at no additional cost to the Owner.
F. Floor mount all mop sinks in custodial closets or areas.
G. Install lavatory carriers on all lavatories in toilet rooms.

3.2 DEMONSTRATION AND TRAINING
A. Training of the Owner’s operation and maintenance personnel is required in cooperation with the Owner's Representative.
1. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems.

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2. Schedule the instruction in coordination with the Owner's Representative after submission and approval of formal training plans.
3. Refer to Section 01 91 00, Commissioning, for further contractor training requirements.

B. Provide Demonstration and Training for the following equipment.
1. Drinking Fountains and Water Coolers

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SECTION 23 05 00
BASIC HVAC REQUIREMENTS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including General Conditions, General Requirements, and Division 1 of the Specifications, apply to all Sections of Division 23.

B. Other Contract Documents complement the requirements and apply to the work of Division 23.

1.2 SCOPE OF WORK

A. The work of this Section shall include the furnishing of systems, equipment and materials specified in this Division, and as called for in the Mechanical Drawings.

1. All facilities, supervision, coordination, transportation, handling, labor and methods for the fabrication, installation, interconnections, painting and other finishes, start-up, tests, adjustments, clean-up and other necessary work for the complete and satisfactory systems and equipment, ready for operation and use, shall be included.
2. Whenever the words "Contractor" appear in this Division, they refer to the Contractor responsible for work specified in that Section.
3. The Contractor shall examine all Contract Documents including all drawings, all sections of the Specifications, HVAC, Plumbing, Fire Protection System Design Details, and Energy Management Controls shall be responsible for ascertaining to what extent all those documents, drawings, sections of specifications, design requirements, and system design details affect work herein specified.
4. Report all errors, omissions, conflicts or code violations to Architect and Owner prior to commencement of work.

B. Drawings for the work are diagrammatic, intended to convey the scope of the work and indicate the general arrangement and locations of the work, follow as closely as actual construction and as other work permits.

1. Because of the scale of the drawings, not all basic items such as necessary duct and pipe offsets, pipefittings, access panels and sleeves may be on the plans.
2. Contract documents show design basis equipment.
3. Mechanical Contractor shall be responsible for selecting the District approved equipment of equal quality, capacity, performance, efficiency, weight, physical size, and configuration to fit in the space provided for the design basis equipment.
4. If the Contractor selects equipment other than the design basis, he is responsible for the necessary design modifications and for coordination with other trades to meet all intended requirements of the original design documents.
5. The location and the sizes of equipment, duct and pipefittings, access panels, sleeves, inserts, and other basic items required by code or other Sections shall be coordinated and included for the proper installation of the Work.

C. The Contractor shall make any required changes from the Contract Documents to make this work conform to the building construction or the work of other trades at no additional cost to the Owner and shall not affect the project's time schedule.

1. The Contractor shall clearly indicate and list all changes from the Contract Documents on the shop drawings and submit them to the Architect, Engineer, and Owner for approval before commencing the work.
2. Failure to follow the approval procedure may result in the forced removal of all work, performed prior to approval.
3. Final “as built” documents shall include all changes.

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D. Equipment specification may not deal individually with the minor items required such as components, parts, controls, and devices that may be required to produce the equipment performance specified or as required to meet the equipment design performance and warranties.
   1. The equipment supplier shall include such required items whether or not specifically called for in the Contract Documents and the Contractor shall properly install them.

E. Contractor shall verify with the supplier of the equipment the requirements for the complete installation to insure proper operation of the equipment furnished under Division 25 of the Specifications.

F. Contract Documents may call for Mechanical Contractor to install specific equipment furnished by others, including Owner purchased equipment.

G. Consider the specifications and drawings as complimentary one to the other.
   1. Where equipment items, material and labor are specified, indicated, called for or implied by either the drawings or the specifications, they shall be deemed as specified by both and included as part of the contract.
   2. Should conflicts occur between the drawings and the Division 25 Specifications, the more stringent requirements shall apply and take precedent.

1.3 DEFINITION OF THE WORK

A. Mechanical work including Heating, Ventilation, and Air Conditioning (HVAC) work as specified in the following applicable sections of the Division 23.

23 05 00	Basic HVAC Requirements
23 05 10	Minor HVAC Demolition
23 05 19	Meters and Gages for HVAC Piping
23 05 29	Curbs, Hangers & Supports for HVAC Equipment
23 05 13	Motor Requirements for HVAC Equipment
23 05 53	HVAC Piping & Equipment Identification
23 05 48	HVAC Vibration Control
23 07 19	HVAC Piping Insulation
23 07 16	HVAC Equipment Insulation
23 07 13	Ductwork Insulation
23 21 13	Hydronic Piping
23 21 16	Hydronic Specialties
23 23 00	Refrigeration Piping
23 21 23	Hydronic Pumps
23 63 13	Air Cooled Refrigerant Condensers
23 64 10	Air Cooled Water Chillers
23 64 16	Centrifugal Water Chillers
23 64 26	Rotary Screw Water Chillers
23 65 00	Cooling Towers
23 29 23	Variable Frequency Motor Controls
23 81 00	Decentralized HVAC Equipment
23 25 00	HVAC Water Treatment
23 82 19	Electric Resistance Duct Heaters
23 70 00	Air Handling Units
23 34 23	HVAC Power Ventilators
23 40 00	HVAC Air Filters
23 31 00	Ductwork
23 33 00	Air Ductwork Accessories
23 09 00	Energy Management and Control System

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23 36 16 Variable Air Volume Units
23 37 13 Grilles Registers, Diffusers
23 08 00 Commissioning of HVAC Systems
23 05 93 HVAC Testing, Adjusting and Balancing
23 05 93 Tests HVAC Piping Systems

B. Additional Associated Sections from Division 26
25 50 00 Energy Management and Control System

C. DEFINITIONS
1. PIPING - As used in these documents, means pipe, fittings, valves, flanges, unions, specialties, accessories and appurtenances necessary for, or incidental to, a complete system.
2. DUCTWORK - As used in these documents, means all air delivery and recirculation and exhaust ducts whether of sheet metal or other material, and includes all connections, accessories and appurtenances necessary for and incidental to a complete system.
3. PROVIDE - As used in these documents, means to furnish and install. The words "furnish" "include" or "install" used in the Specifications or on the Drawings, means to deliver to the job site or to install and test complete and ready for operation systems and items mentioned. The word “install” shall also apply to equipment furnished by others, including Owner purchased equipment. Any item indicated in the Specification or on the Drawings shall be included in the Work.
4. CONCEALED WORK - As used herein refers to piping, ductwork, and accessories above solid material ceilings and within walls, partitions, shafts, service spaces, underground, or not normally exposed to view and enclosed on all sides by finish materials. Access to piping and ductwork would demolish finish materials.
5. CONCEALED BUT ACCESSIBLE - As used in these documents, refers to piping, ductwork, and accessories accessible above or through suspended ceilings, in walls at access panels or in chases with access doors.
6. EXPOSED WORK - Refers to ductwork, piping, or equipment normally exposed to view within rooms or open area. Consider ductwork, piping, or equipment in mechanical or electrical equipment rooms as “Exposed Work”, unless noted otherwise on the plans.

1.4 QUALITY ASSURANCE

A. Codes and Standards: All work shall be in compliance with, of all applicable Laws, Codes, Standards and Regulations of Governmental Bodies having jurisdiction over work performed for or on behalf of the SDPBC, and over the applicable job site
1. See Section 01 41 00 - Regulatory Requirements
2. The following documents developed for and approved by the SDPBC:
a. Educational Specifications
b. District Design Criteria
c. District Master Specifications
d. Typical HVAC, plumbing and fire-protection details
e. If there should be conflicting requirements between above referenced codes than the following rules shall apply:
1. School District Building Official shall provide final code interpretations and resolutions of conflicts.
2. The code that affords the greatest degree of life safety shall take precedent.

B. Contractor shall request the A/E for clarification of any part of the contract documents, which may be in conflict with the above codes and regulations.
1. Contractor shall prepare proposed changes for review and approval by A/E and Owner.

1.5 FEES, PERMITS AND INSPECTIONS

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A. Contractor shall pay all fees, obtain required permits, and coordinate inspections as are required by the Authorities having jurisdiction over the site.

1.6 ACTIVE SERVICES

A. Protect any existing active services: water, gas, sewer, and electric, against damage.
B. Do not prevent or disturb operation of active services that are to remain.
C. If contractor encounters active services requiring temporary interruption or relocation, the contractor shall contact the authorities having jurisdiction for procedures and coordination of work with the utility service users.
D. Where abandoning existing utility services terminate them in conformance with the Utility or Municipality having jurisdiction and shown the termination points on “as-built” construction plans.

1.7 SITE INSPECTION

A. Contractor shall carefully inspect the site to be familiar with conditions that affect the work.
   1. Contractor shall verify points of connection of utilities, routing of outside piping to include required clearances from any existing structures, trees or other obstacles.
   2. Contractor shall verify available space in the existing structure and accessibility required for the installation of work under this contract and inform the A/E to conditions, which may be detrimental or will prevent proper execution of the work.
B. The submittal of a bid is an acknowledgement that the Contractor performed the site inspection and has no conflicts with performing the work.
   1. If a conflict arises do to an observable condition the Contractor should have seen in the pre-bid site visit, the District is under no obligation to authorize any additional payments.
C. Submittal of bid shall indicate that the Contractor has included all required allowances in the bid.
   1. The District shall not make allowances for any code violations or errors resulting from Contractor's failure to visit job site and review all contract documents, applicable codes, and standards.

1.8 COMMISSIONING

A. Commissioning of a system or systems specified in this section is part of the construction process.
B. Documentation and testing of these systems, as well as training of the Owner’s operation and maintenance personnel, is required in cooperation with the Owner's Representative and the Commissioning Authority.
C. Project Closeout is dependent on successful completion of all commissioning procedures, documentation, and closure of all issues; refer to Section 01 77 00 - Contract Closeout, for substantial completion details.
D. Refer to Section 01 91 00, Commissioning, for detailed commissioning requirements

PART 2 MATERIALS

2.1 GENERAL

A. Each system component installed by Contractor shall meet or exceed the performance specification requirements listed in the Contract Documents including drawings, and specifications.
   1. Components with a lesser degree of performance or quality as determined by the Owner, Building Department, design A/E or documented as inferior in the final Test and Balance Report is not acceptable, and Contractor shall replace with no additional charge to Owner.
B. Materials and equipment shall be new, unused, standard current products from manufacturers regularly engaged in the production of such equipment and shall bear label of the Underwriters' Laboratory for the intent use or shall be materials approved by the code-enforcing agency.

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C. Facility Services pre-approved remanufactured equipment used for repair/replacement work in existing structures.
D. Where two or more units of the same class of equipment or material are required, these shall be the product of a single manufacturer throughout entire project and shall fit in the allocated spaces provided, complying with all clearances and codes.
E. All hardware and accessory fittings shall be a type designed, intended or appropriate for use, be compatible, and compliment the item with which they are used.
    1. They shall have corrosion protection suitable for atmosphere they are installed.
    2. All such hardware shall be U.S. standard size.
F. All materials including insulation, jackets, and adhesives shall have a Flame Spread Rating not exceeding 25, and Smoke Developed Rating not exceeding 50, when tested in accordance with NFPA 255, "Methods of Test of Surface Burning Characteristics of Building Materials".
    1. Submittal data shall specifically indicate those ratings.
G. Use materials and equipment fabricated in the United States of America and labeled accordingly, when possible, for all piping materials.
H. All equipment and piping supports shall be hot dipped galvanized except as otherwise noted in Contract Documents.
    1. Hangers for copper pipe shall be vinyl coated.
    2. Do not use copper clad hangers.
I. Air conditioning system components shall conform to federal, state, and local sound emission and vibration isolation guidelines.
    1. Objectionable noise or excessive vibration created in any part of the building by operation of any equipment under this contract is prohibited.
    2. Contractor shall attenuate noise, and isolate various items of equipment from the building structure and take all steps that may be necessary to eliminate objectionable noise or excessive vibration produced by Division 23 equipment.
    3. If noise attenuation or vibration isolation measures do not produce, satisfactory results replace all components, which prove to be in violation at no additional cost to the Owner, to comply with codes and ordinances having jurisdiction at the job site.
J. Follow installations directions and recommendations of material and equipment manufacturers.

PART 3 EXECUTION

3.1 GENERAL

A. The Mechanical Contractor must be in good standing with the SDPBC.
B. Florida Licensed Contractors shall perform construction work.
    1. The Contractor shall not work outside the scope of his license.
    2. Any person who is not licensed must work under direct supervision of a person who has a license required by the state law and by the county or municipal licensing ordinances.
    3. The job supervisor must speak English and must have 10-years experience of installing the tonnage of HVAC equipment specified in the contract documents.
    4. The District may request the change of the job supervisor.
    5. Workers skilled and competent in the type of work involved shall accomplish the installation.
    6. Workmanship throughout shall correspond to the standards of the best trade practices.
C. Work other than interior work shall commence as soon as the building has sufficiently advanced in construction layout.
    1. No interior work shall be installed until the building roof is in place and watertight and the building is completed to a stage, that in opinion of the A/E, is acceptable and not detrimental to work to be installed.

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D. Contractor shall install all systems and equipment in accordance with the Contract Documents, and equipment or material manufacturer recommendations and instructions.
   1. Contractor shall commission, prepare, and adjust HVAC and other mechanical systems prior to Owner's independent test & balancing work.
E. Work lines and established grades shall be in strict accordance with the Contract Documents.
   1. The Contractor shall furnish to all trades, in ample time, any information they need to construct all equipment bases, trenches, pits, chases, and openings in floors, walls, and finishes to provide required working clearances.
   2. The contractor shall set all sleeves, anchor bolts, or inserts to fasten equipment before pouring of adjacent concrete.
F. Coordinate location of all Division 23 work with Divisions 25, 26, 27, and 28.
   1. Do not run piping, ductwork and similar Division 23 work in NEC dedicated service areas for electrical equipment, including above panel boards, starters, communication panels, control panels, telephone backboards, data panels, and similar electrical elements.
   2. Do not install chilled water potable water (hot or cold), or condensate drain piping directly above electrical equipment.
   3. In electrical rooms with required piping, provide drain pan(s) to protect the electrical equipment.
   4. Refer questionable locations to the A/E for resolution prior to installation and correct non-conforming installed work at no additional cost to the Owner.
G. Cap or plug all piping systems (chilled water, hot water, potable water, refrigerant piping, pneumatic piping,) at the end of each workday until system is complete to prevent contamination.
H. Provide a schematic wiring diagram for each component of HVAC system including controls.
   1. Diagrams shall be located in mechanical rooms and mounted on wall at eye level.
I. Provide a schematic duct diagram indicating room numbers and component locations.
J. Locate the diagram for each air handler in mechanical room, mounted on wall at eye level.

3.2 COORDINATION OF WORK AND DRAWINGS

A. Each contractor and subcontractor shall be responsible for coordinating the installation of his equipment/labor with the General Contractor and work of other Contractors and trades.
   1. The contractor shall coordinate the work of different trades to prevent interference between piping, ductwork, equipment, and structural work.
B. Recommend each contractor prepare their shop drawings at 1/4" to 1'-0" scale clearly indicating all applicable components and coordinate the same with other trades.
   1. Shop coordination drawings shall show in detail the space conditions of all concerned trades and follow the equipment orientation outlined in the contract drawing unless approved by the A/E. Shop drawings shall be reviewed and accepted by the A/E of record and the District Commissioning Agent
   2. Contractor’s failure to coordinate work between trades using coordination shop drawings or other means will not cause for any additional cost changes to the Owner, and/or changes to the project schedule.
   3. If the contractor installs his work before coordinating with other trades or causes interference with work of other trades, the contractor shall make necessary changes in the work to correct the condition, at no additional cost to the Owner, and/or changes to the project schedule.

3.3 SUBMITTALS

A. Method or procedures for submitting shop drawings and submittal data shall comply with the General Conditions.

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B. Prior to ordering equipment and material, the Contractor shall submit 3 copies of the manufacturer's cut sheets to the Engineer for review and acceptance
   1. Submittal data shall consist of shop drawings and/or catalog cuts showing technical data necessary to evaluate the material or equipment.
   2. Including dimensions, required service and maintenance clearances, wiring diagrams, performance curves, ratings, control sequence.
   3. Layout plan showing the arrangement of the equipment with piping and ductwork, and other data necessary to describe fully the item proposed and its operating characteristics.

C. Other submittals shall include, but not be limited to:
   1. Valves
   2. Pipe insulation
   3. Vibration isolation
   4. Controls
   5. Hydronic specialties
   6. Thermometers and gauges

3.4 SUBSTITUTIONS

A. Contractor shall follow the contract drawings and specifications, unless he submits written request for a substitution and receives written acceptance from the Engineer and SDPBC.
   1. Owner’s representative shall review the request and either approve or deny the in writing.

B. All approval procedures regarding proposed substitutions as “approved equal” or “Engineer and Owner approved” shall meet the requirements of Section 01 60 00.

3.5 ACCESS PANELS

A. Contractor shall provide required access panels or doors for all serviceable equipment in concealed locations whether or not called for on the drawings.

3.6 ACCESS AND SERVICE SPACE

A. Provide clearances, service space, and access to appliances and equipment in rooms, attics, under floors, on roofs or elevated structures or on sloped roofs in accordance with FBC-M Section 306.

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3.7 CUTTING AND PATCHING

A. Coordinate the placing of openings in the existing or new structures as required for installation of the HVAC Work.
B. Any additional patching and finish work required for unnecessary openings due to failure to inspect and coordinate work shall restore walls, floors, or ceilings to appropriate fire ratings, at no additional cost to the Owner.
C. Any additional cutting and patching of the structure necessary due to failure to install piping, ducts, sleeves or equipment on schedule, or due to failure to furnish, on schedule, the information required for leaving of openings, is at no additional cost to the Owner.
D. Provide cutting and patching, surface finishing and painting in the existing structure, as required for the installation of work, and furnish lintels and supports as required for openings.
    1. Do not cut structural members without written prior approval of the A/E.
    2. Minimize cutting by using core drills, power saws, or other machines that will provide neat, minimum openings.
    3. Patching shall match adjacent materials and surfaces and be performed by craftsmen skilled in the respective craft.

3.8 SLEEVES

A. Sleeves are required for all piping passing through masonry or concrete partitions (walls, floors ceilings, roofs) and through concrete beams, foundations, and footings.
    1. Position sleeves in formwork prior to placement of concrete.
    2. Provide concrete reinforcing around sleeves.
B. Sleeves for piping passing through non-load bearing or non-fire or smoke rated walls and partitions may be required if included in the design documents by the Engineer.
    1. When required, sleeves shall be galvanized sheet steel with lock seam joints of minimum gauges as follows: pipes 2½" and smaller - 24 gage; 3" to 6" - 22 gage; over 6" - 20 gage.
C. Sleeves for piping passing through load bearing walls, concrete beams, foundations, footings and waterproof floors shall be Schedule 40 galvanized steel pipe or 18 gage galvanized sheet steel.
D. Sleeves for insulated piping shall be of sufficient internal diameter to take pipe and insulation and to allow free movement of pipe due to expansion and contraction.
    1. Provide for continuous insulation wrapping.
    2. Waterproof sleeves shall be of sufficient internal diameter for pipe and waterproofing material.
E. In finished areas where pipes are exposed, terminate sleeves flush with wall, partitions, and ceilings, and shall extend ½" above finished floor level.
    1. Extend sleeves 1" above finished floors in areas likely to entrap water.
    2. Caulk floor sleeves.
F. Flash sleeves passing through waterproofing membrane as required by Division 7.
G. Protect pipe penetrations through fire-rated partitions (walls, floors, or ceilings) in per with FBC.
    1. Protected penetration shall retain the original integrity of the fire rated partition.
    2. Unprotected penetrations through fire-rated partitions are not allowed.
    3. All materials, products, and procedures used to complete the fire stopping assemblies shall be tested, listed, and approved by testing laboratories such as U.L. or Factory Mutual and comply with requirements of ASTM-E119.
    4. Securely fasten sleeves to the partition that are part of the required approved fire stopping.
    5. Close off annular spaces between sleeves and pipes, and between penetrating item and adjacent work with UL listed and approved fire stopping materials and caulk airtight.
    6. Insulation and coverings shall not penetrate the fire-rated partition unless it is part of the approved U.L or Factory Mutual fire-stopping assembly.

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7. Provide close fitting metal collar or escutcheon covers at both sides of penetration.

H. Sleeves for round and rectangular ductwork shall be galvanized sheet steel.
   1. Duct coverings shall not penetrate a wall or floor required to have fire-resistance rating or required to be fireblocked – refer to FBC-M 604.6.

3.9 ESCUTCHEONS

A. Provide chrome-plated escutcheons at each sleeve opening into finished spaces.
B. Escutcheons shall fit around insulation or around pipe when not insulated; outside diameter shall cover sleeve.
C. Where sleeve extends above finished floor, escutcheon shall be high cap type and shall clear sleeve extension.
D. Secure escutcheons or plates to sleeve but not to insulation with setscrews or other approved devices.

3.10 PROTECTION

A. Take special care for the protection of equipment and materials furnished.
   1. Store and completely protect all materials from damage.
   2. Keep materials and equipment clean and dry, free from deterioration by weather elements, painting, plaster, etc., until the project is completed.
   3. Do not install damaged or defective materials.
   4. Touch up any damage from rust, paint, etc., and scratched or marred finishes on equipment to match original finish or completely refinished to restore equipment to original condition.
B. Provide protect of any previously finished area from mars or other damage when an installation or connection of equipment requires work in areas previously finished by other Contractors.
   1. The Contractor shall provide drop cloths, or any other materials necessary to protect floors, walls, furniture, equipment, etc. from soil or damage.
C. Contractor shall arrange with other Contractors for promptly repairing and refinishing any damage to the building or its contents incurred by the installation or testing of the systems installed at no charge to the Owner.
D. Where insulated piping extends to exposed areas, or to weather exposed areas, provide finish or jacket as specified in section 23 07 19.
E. Welding is allowed in the existing buildings as long as the contractor provides for an approved fire watch and other required safety measures.
   1. Contractor's work, and construction means, methods, materials, and equipment used shall not compromise the building fire safety, as well as safety and welfare of coworkers and building occupants.

3.11 HVAC IDENTIFICATION

A. Identification of HVAC systems shall be as specified in Section 23 05 53, HVAC Piping & Equipment Identification.

3.12 WIRING AND ELECTRICAL WORK FOR HVAC EQUIPMENT

A. All electrical work, equipment, and wiring shall comply with NEC.
B. A standard wiring color code shall be established for each electrical and control component of the system and all similar devices shall be wired alike, maintaining the established color code throughout the entire project.
C. The Mechanical Contractor, unless specified otherwise, shall furnish all Division 23 equipment, complete with motors and controls.
   1. The Mechanical Contractor shall set the motors in place.
   2. Some low power single-phase equipment may be furnished with unit mounted disconnects.

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D. Division 16 shall provide power services for motors and equipment furnished by Mechanical Contractor to include safety disconnect switches, (except unit mounted disconnects), motor starters, wiring and final connections.
   1. For special requirements for starters and disconnects in kitchen and exterior locations refer to Division 26.
   2. Provide the entire fire alarm system including interlock wiring required for air handling unit shutdown under Division 28.
E. The Mechanical Contractor shall provide internal wiring, equipment control wiring, interlock wiring (except fire alarm system) for equipment furnished and temperature control wiring.
F. The Mechanical Contractor shall check all electrical service and control connections to ensure proper operation of equipment and systems installed under work in Division 23.
G. Division 26 shall furnish motor starters for motors furnished by Mechanical Contractor, except where other sections specify the equipment supplier furnishes them (e.g. chillers).
H. Mechanical Contractor shall furnish variable frequency drives (VFD) and set the same in place, ready for wiring under Division 26 requirements unless the Controls Contractor as part of the project supplies the VFDs.

3.13 EXCAVATING TRENCHING AND BACKFILLING

A. Provide excavation necessary for water supply piping, underground chilled water piping, etc., and backfill such trenches and excavations after the installation, testing, and approval of work observing OSHA's trench requirements.
   1. Take care in excavating, that walls and footings and adjacent load bearing soils are not disturbed, except where lines must cross under a wall footing.
   2. Where a line must pass under footing, make the crossing by the smallest possible trench to accommodate the pipe.
   3. Keep excavation free from water by pumping if necessary.
B. Trenches for piping and utilities located inside foundation walls and five-foot outside of the wall shall be at less than 16" but no more than 24" wider than the outside diameter of the pipe.
   1. Site conditions shall govern the width of trenches for piping and utilities located more than five-feet outside of building foundation walls, except for sewers.
C. Excavate trenches for sewers so the pipe is laid at the proper alignment and depth and the maximum trench width at the outside top of the pipe is less than 24".
   1. Site conditions govern other trench widths.
D. Shape the trench bottom to support the lower fourth pipe circumference for the full length of the barrel on compacted fill.
   1. Dig bell holes so that no part of the weight of the pipe is supported by the bell, and not larger than necessary for proper jointing.
   2. All piping requiring excavation below the required compacted fill for the structure, excavate at least 6" below pipe invert.
E. Make trenches true to grade by means of substantial and accurately set batter-boards.
F. Immediately after testing and/or inspection, carefully backfill the trench with earth free from clods, brick, etc., to a depth one-half the pipe diameter and then firmly puddle and tamp in such a manner as not to disturb the alignment or joints of the pipe.
   1. Thereafter, puddle and tamp the every vertical foot.
G. Burial depth of gravity drain lines shall have precedence over non-gravity systems.
   1. Offset chilled water and domestic water lines as required to coordinate with gravity lines.
H. The Contractor shall coordinate exact location, depth, and scope of underground piping, electrical conduits, and similar utilities.

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1. Routing shown on drawings is schematic coordinate actual routing with field conditions, grades, and work of other trades, then document in “as-built” drawings.

3.14 CONCRETE WORK

A. Provide concrete bases and housekeeping pads for HVAC equipment unless indicated otherwise.
   1. Concrete work shall be as specified in Division 3, Concrete.
   2. This Contractor shall provide vibration pads and equipment base.
   3. The General Contractor shall provide chiller pads.
B. Provide equipment anchor bolts and coordinate their proper installation and accurate location.

3.15 ANCHORING EQUIPMENT

A. All equipment designed permanent mounting, anchor to its supporting surface in compliance with FBC, 423.14.7.
B. A minimum of two bolts are required per each piece of equipment.
   1. Bolts shall be of sufficient size and rating to prevent equipment from overturning or moving from original mounting position.

3.16 CORROSION

A. Make provisions to prevent corrosion due to contact of metallic pipe and equipment with moisture or dissimilar materials.
B. When joining a pipe with another pipe, valve, fitting, or piece of equipment constructed of dissimilar metal install an insulated joint to prevent formation of galvanic couple.
C. Pipe hangers and supports of dissimilar metal shall be isolated from contact with pipe.
D. Metal pipe and equipment shall be isolated from direct contact with concrete or other corrosive materials and soils.

3.17 PAINTING AND FINISHING

A. Paint all exposed metal surfaces, unless specified otherwise.
   1. HVAC equipment shall have factory finish as specified; any damage to that finish shall be field primed and painted to match existing.
   2. Clean and prime all ferrous metal equipment and supports, not factory finished, with a suitable primer and given two finish coats of exterior enamel.
B. Prime all exposed galvanized metal, including ducts, with galvanized metal primer and paint with enamel paint to match surrounding area.
C. Clean and prime all other unpainted ferrous metal including all pipe sleeves or equipment supports with metal primer suitable to the metal, and finish with two coats, one flat and one enamel.
D. Clean, prime, and paint all equipment and piping, after installing the insulation with one color semi-gloss coat and with one-color enamel paint, as selected by owner.

3.18 TESTS

A. Test all materials, equipment, and systems that require testing by these specifications or by any applicable regulation or code, in the presence of owner or authority having jurisdiction.
   1. Test all items requiring pressure or leakage tests before concealing from view.
   2. Rectify all defects disclosed by tests and the repeat the tests.
      a. Continue process until installation passes all required test.
   3. The Contractor shall provide all labor, materials, and equipment used in tests.
B. Contractors' tests shall be scheduled and documented in accordance with the commissioning requirements.
   1. Refer to Section 01 91 00, Commissioning, for further details.
C. Contract the services of a qualified third party testing agency or manufacturer's representative to perform the specified electrical tests and commissioning required testing.

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1. The testing agency or manufacturer's representative shall provide all test calibrated test equipment.

3.19 COMPLETION OF WORK

A. Prior to acceptance of the installation and final payment of the Contract, the Contractor shall provide and complete the following:

B. CLEANING: as required by Special Conditions applicable to this Division of the work.
   1. At the conclusion of the construction, the site and structure shall be cleaned thoroughly of all debris and unused materials remaining from the mechanical construction.
      a. Clean all areas and temporary storage spaces of all packing boxes, wood frame members and other waste materials used in the mechanical construction.
   2. Clean the entire piping system and equipment internally.
      a. The Contractor shall open all dirt pockets and strainers, completely blowing down as required and clean strainer screens of all accumulated debris.
      b. Clean the strainers in the presence of the Test and Balance firm.
   3. Drain all tanks fixtures and pumps and prove free of sludge and accumulated matter.
   4. Remove all temporary labels, stickers, etc. from all fixtures and equipment.
      a. (Do not remove permanent nameplates, equipment model numbers, ratings, etc.).
   5. Thoroughly clean heating and air conditioning equipment, tanks, pumps, traps, etc., and install new filters or filter media.

C. OPERATION AND MAINTENANCE MANUALS
   1. Refer to Section 01 91 00 – Commissioning for Operations and Maintenance Data requirements.

D. AS-BUILT PRINTS
   1. Requirements and methods of preparing and procedure for submitting project record as-built prints shall be in accordance with Division 1.
   2. Contractor shall keep day-to-day records of all changes, and upon completion of the work, incorporate these changes on the clean copies of the original ACAD drawings.
      a. Provide as-built drawing electronic files in both Autocad and PDF format to the Owner at the date of substantial completion.
   3. The drawings shall show:
      a. All of the equipment and piping (including underground)
      b. Ductwork with dimensions and reference points
      c. All other concealed non-accessible work;
         i) Branching arrangement and valve location for piping systems
         ii) Locations of dampers and heaters in duct systems
         iii) Locations of control system sensors and other control devices
         iv) Work of change orders not shown on contract documents.

E. WARRANTY
   1. The warranty for all mechanical equipment (whether manufacturer's or contractor's warranty) shall comply with Section 01 77 00 in the General Conditions.
   2. All equipment and systems, unless specified otherwise, shall have a manufacturer’s warranty for a period of 5-years from the date of substantial completion.
      a. This warranty shall be against defective materials, design, and workmanship.
   3. The mechanical contractor shall repair or replace any component of the Division 23 work under warranty, which proves to be defective, at no cost to the Owner.
   4. The Contractor upon receipt of notice from the Owner of a failure during the warranty period shall respond the same day and complete warranty service work in a timely manner.

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5. During warranty period, document all responses to warranty calls made by the Contractor by leaving a copy of the mechanics service ticket with the school Principal upon completion of the warranty work, prior to leaving the site.
    a. Without proper documentation, the Owner will not acknowledge repairs are complete.
6. Required optional extended manufacturer or vendor warranties for specific items, their performance, or expected durability will be explicitly included in Division 23 Specifications.
    a. Manufacturer or vendor shall repair or replace any defective component under extended warranty at no cost to the Owner.

3.20 SYSTEM FUNCTIONAL PERFORMANCE TESTING

A. System Functional Performance Testing is part of the Commissioning Process.
B. The Contractor shall perform all Functional Performance Testing and the Commissioning Authority shall witness and document the testing.
C. Refer to Section 01 91 00, Commissioning, for functional performance tests and commissioning requirements.

3.21 DEMONSTRATION AND TRAINING

A. Training of the Owner’s operation and maintenance personnel is required in cooperation with the Owner's Representative.
B. Provide competent, factory-authorized personnel to provide instruction to FS personnel concerning the location, operation, and troubleshooting of the installed systems.
C. Schedule the instruction in coordination with the Owner's Representative after submission and approval of formal training plans.
D. Refer to Section 01 91 00, Commissioning, for further contractor training requirements.

END OF SECTION

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SECTION 23 05 13
MOTOR REQUIREMENTS for HVAC

PART 1 GENERAL

1.1 SECTION INCLUDES
- A. Single-phase electric motors
- B. Three-phase electric motors

1.2 REFERENCES
- A. ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings
- B. ABMA 11 - Load Ratings and Fatigue Life for Roller Bearings
- C. IEEE SA-P112 - Test Procedure for Polyphase Induction Motors and Generators
- D. NEMA MG 1 - Motors and Generators
- E. NFPA 70 - National Electrical Code
- F. 26 28 29 - Motor Controls – Section 26 28 39

1.3 SUBMITTALS
- A. Submit under provisions of Section 01 33 00.
- B. Product Data: Provide wiring diagrams with electrical characteristics and connection requirements.
- C. Test Reports: Indicate test results verifying nominal efficiency and power factor for three-phase motors larger than 5-HP.
- D. Manufacturer's Installation Instructions: Indicate setting, mechanical connections, lubrication, and wiring instructions.

1.4 OPERATION AND MAINTENANCE DATA
- A. Submit under provisions of Section 01 77 00.
- B. Operation Data: Include instructions for safe operating procedures.
- C. Maintenance Data: Include assembly drawings, bearing data including replacement sizes, and lubrication instructions.

1.5 QUALIFICATIONS
- A. Company specializing in manufacture of electric motors and their accessories, with minimum 5-years documented product development, testing, and manufacturing experience.

1.6 REGULATORY REQUIREMENTS
- A. Conform to NFPA 70 - National Electrical Code
- B. Provide certificate of compliance indicating approval of Premium efficiency motors.
- C. Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories, Inc., as suitable for the purpose specified and indicated.

1.7 DELIVERY, STORAGE, AND HANDLING
- A. Deliver, store, protect, and handle products to site under provisions of Section 01 60 00.
- B. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weatherproof covering.

1.8 WARRANTY
- A. All motors shall be provided with a 5-year parts and labor warranty under provisions of Section 01 77 00.

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PART 2 PRODUCTS

2.1 GENERAL CONSTRUCTION AND REQUIREMENTS

A. Motors less than 250-watts, for intermittent service, may use the equipment manufacturers' standard motor.

B. Electrical Service

1. Refer to Section 26 05 19 for required electrical characteristics.
2. Motors ½-HP and smaller: 115 Volts single-phase 60 Hz
3. Motors ¾ to 2-HP: 208 Volts single-phase 60 Hz
4. Motors 3-HP and larger: 480 Volts three-phase 60 Hz

C. Type

1. Motors located in humid conditions or outdoors shall be TEFC type.
2. Motors: Design for continuous operation in a 40°C environment
3. Design for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.
4. Motors with frame sizes 254T and larger: Energy Efficient Type.

D. Explosion-Proof Motors: UL approved and labeled for hazard classification, with over temperature protection.

E. Visible Nameplate: Shall indicate motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, and efficiency.

F. Wiring Terminations

1. Provide terminal lugs to match the branch-circuit conductor quantities, sizes, and materials indicated.
   a. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.
2. For fractional horsepower motors with a direct connection, provide threaded conduit connection in end frame.

G. Motor Starters

1. Provide motor starters with under-voltage, phase loss, phase unbalance and phase reversal relay protection with automatic reset between 3 to 5 minutes after motor shut down.
2. Provide motor starters with overload heaters sized from motor nameplate full load amperage for each phase.
   a. Overload heaters shall be manual reset.
   b. Refer to Sections 262839, "Motor Control", and electrical design.

H. Inverter Rated Motors

1. All motors used in conjunction with variable frequency drives shall be a Premium efficiency and inverter duty rated.

2.2 SINGLE PHASE POWER - SPLIT PHASE MOTORS

A. Starting Torque: Less than 150% of full load torque

B. Starting Current: Up to seven times full load current

C. Breakdown Torque: Approximately 200% of full load torque

D. Drip-proof Enclosure: Class A (50°C temperature rise) insulation, 1.0 Service Factor, pre-lubricated ball bearings.

E. Enclosed Motors: Class A (50° C temperature rise) insulation, 1.0 Service Factor, and pre-lubricated ball bearings.

2.3 SINGLE PHASE POWER - PERMANENT-SPLIT CAPACITOR MOTORS

A. Starting Torque: Exceeding one fourth of full load torque

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B. Starting Current: Up to six times full load current
C. Multiple Speed: Through tapped windings
D. Open Drip-proof or Enclosed Air Over Enclosure: Class A (50°C temperature rise) insulation, minimum 1.0 Service Factor, pre-lubricated sleeve or ball bearings, and automatic reset overload protector.

2.4 SINGLE PHASE POWER - CAPACITOR START MOTORS
A. Starting Torque: Three times full load torque
B. Starting Current: Less than five times full load current
C. Pull-up Torque: Up to 350% of full load torque
D. Breakdown Torque: Approximately 250% of full load torque
E. Motors: Capacitor in series with starting winding, provide capacitor - start /capacitor - run motors with two capacitors in parallel with run capacitor remaining in circuit at operating speeds.
F. Drip-proof Enclosure: Class A (50°C temperature rise) insulation, NEMA Service Factor, and pre-lubricated ball bearings.
G. Enclosed Motors: Class A (50°C temperature rise) insulation, 1.0 Service Factor, and pre-lubricated ball bearings.

2.5 SINGLE PHASE POWER – VARIABLE SPEED MOTORS
A. Brushless DC (BLDC) electronically commutated high efficiency motor.
B. Integrated (built-in) speed controller
C. Single-phase 115 V input
D. Operation range: 20% to 100% of full speed (80% turndown)
E. Motor sizes: ¼, ½, and ¾ HP
F. Control options: 0-10 VDC input wiring, motor mounted dial, or wall mounted dial.
G. Customization options: torque, size, Voltage, current and maximum speed.
H. HVAC Applications: small capacity, variable speed fans and pumps

2.6 THREE PHASE POWER - SQUIRREL CAGE MOTORS
A. Starting Torque: Between one and one-half times full load torque.
B. Starting Current: Six times full load current.
C. Power Output, Locked Rotor Torque, Breakdown, or Pullout Torque: NEMA Design B characteristics.
D. Design, Construction, Testing, and Performance: Conform to NEMA MG 1 for Design B motors.
E. Insulation System: NEMA Class B or better
F. Testing Procedure: In accordance with IEEE 112, load test motors to determine freedom from electrical or mechanical defects and compliance with performance data.
G. Motor Frames: NEMA standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.
H. Thermistor System (Motor Frame Sizes 254T and Larger): Three PTC thermistors imbedded in motor windings and epoxy encapsulated solid state control relay for wiring into motor starter; refer to Section 262839 - Motor Controls.
I. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for re-lubrication, rated for minimum ABMA 9, L-10 life of 20,000 hours.
    1. Calculate bearing load with NEMA minimum V-belt pulley with belt centerline at end of NEMA standard shaft extension.
    2. Stamp bearing sizes on nameplate.
J. Sound Power Levels: To NEMA MG 1

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K. Part Winding Start Above 254T Frame Size: Use part of winding to reduce locked rotor starting current to approximately 60% of full winding locked rotor current while providing approximately 50% of full winding locked rotor torque.
L. Weatherproof Epoxy Sealed Motors: Epoxy seal windings using vacuum and pressure with rotor and starter surfaces protected with epoxy enamel; bearings double shielded with waterproof non-washing grease.
M. Nominal Efficiency: As scheduled at full load and rated voltage when tested in accordance with IEEE 112.
N. Nominal Power Factor: As scheduled at full load and rated voltage when tested in accordance with IEEE 112.

2.7 THREE PHASE POWER – VARIABLE SPEED MOTORS
A. Provide premium efficiency AC inverter duty rated motor suitable for variable frequency drive.
B. Refer to Specification 23 29 23 Variable Frequency Motor Controls.
C. General-purpose motors are not acceptable.

PART 3 EXECUTION

3.1 APPLICATION
A. Single-phase motors for shaft mounted fans: Split phase type.
B. Single-phase motors for shaft mounted fans or blowers: Permanent split capacitor type
C. Single-phase motors for fans, pumps, blowers, and air compressors: Capacitor start type
D. Single-phase motors for fans, blowers, and pumps: Capacitor start, capacitor run type
E. Motors located in exterior locations, wet air streams, air-cooled condensers, direct drive axial fans, dust collection systems: Totally enclosed type (TEFC).
F. Motors located in outdoors: Totally enclosed weatherproof, factory epoxy-sealed type (TEFC).
G. Motors located in draw thru air handling units and cooling towers:
1. Totally enclosed weatherproof, factory epoxy sealed type with special moisture protection package.
2. Fan cooled feature in totally enclosed motors is not required.
3. For additional details refer to Sections 23 70 00 (Air Handling Units) and 23 65 00 (Cooling Towers).

3.2 INSTALLATION
A. Install in accordance with manufacturer's instructions.
B. Install securely on firm foundation.
1. Mount ball bearing motors with shaft in any position.
C. Check line voltage and phase and ensure agreement with nameplate.

3.3 NEMA OPEN MOTOR SERVICE FACTORS SCHEDULE

HP	3600 RPM	1800 RPM	1200 RPM	900 RPM
1/6 - 1/3	1.35	1.35	1.35	1.35
½	1.25	1.25	1.25	1.15
¾	1.25	1.25	1.15	1.15
1	1.25	1.15	1.15	1.15
1½ -150	1.15	1.15	1.15	1.15

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3.4 PERFORMANCE SCHEDULE: THREE- PHASE, ENERGY EFFICIENT, OPEN DRIP-PROOF

HP	RPM (Syn)	NEMA Frame	Minimum Percent Efficiency	Minimum Percent Power Factor
3	1200	213T	86	60
5	1200	215T	87	65
7½	1200	254T	89	73
10	1200	256T	89	74
15	1200	284T	90	77
20	1200	286T	90	78
25	1200	324T	91	74
30	1200	326T	91	78
40	1200	364T	93	77
50	1200	365T	93	79
60	1200	404T	93	82
75	1200	405T	93	80
100	1200	444T	93	80
125	1200	444T	93	84
3	1800	182T	86	86
5	1800	184T	87	87
7½	1800	213T	88	86
10	1800	215T	89	85
15	1800	256T	91	85
20	1800	256T	91	86
25	1800	284T	91	85
30	1800	286T	92	88
40	1800	324T	92	83
50	1800	326T	93	85
60	1800	364T	93	88
75	1800	365T	93	88
100	1800	404T	93	83
125	1800	405T	93	86
150	1800	444T	93	85
200	1800	445T	94	85
3	3600	145T	84	85
5	3600	182T	85	86
7½	3600	184T	86	88
10	3600	213T	87	86
15	3600	215T	89	89
20	3600	254T	90	89
25	3600	256T	90	92
30	3600	284T	91	91
40	3600	286T	92	92
50	3600	324T	93	89
60	3600	326T	93	91
75	3600	324T	93	88
100	3600	365T	92	88

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3.5 PERFORMANCE SCHEDULE: THREE- PHASE, ENERGY EFFICIENT, TOTALLY ENCLOSED, FAN COOLED

HP	RPM (Syn)	NEMA Frame	Minimum Percent Efficiency	Minimum Percent Power Factor
3	1200	213T	85	63
5	1200	215T	86	66
7½	1200	254T	89	68
10	1200	256T	89	75
15	1200	284T	90	72
20	1200	286T	90	76
25	1200	324T	90	71
30	1200	326T	91	79
40	1200	364T	92	78
50	1200	365T	92	81
60	1200	404T	92	83
75	1200	405T	92	80
100	1200	444T	93	83
125	1200	445T	93	85
3	1800	182T	87	83
5	1800	184T	88	83
7½	1800	213T	89	85
10	1800	215T	90	84
15	1800	254T	91	86
20	1800	256T	91	85
25	1800	284T	92	84
30	1800	286T	93	86
40	1800	324T	93	83
50	1800	326T	93	85
60	1800	364T	93	87
75	1800	365T	93	87
100	1800	405T	94	86
125	1800	444T	94	87
150	1800	445T	94	88
200	1800	447T	95	87
3	3600	182T	82	87
5	3600	184T	85	88
7½	3600	213T	86	86
10	3600	215T	86	86
15	3600	254T	88	91
20	3600	256T	89	89
25	3600	284T	90	92
30	3600	286T	91	92
40	3600	324T	91	91
50	3600	326T	90	92
60	3600	326T	91	93
75	3600	364T	91	91
100	3600	365T	92	92

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SECTION 23 05 19
METERS, GAGES and THERMOMETERS for HVAC PIPING

PART 1 GENERAL

1.1 REFERENCES
- A. ASME B40.1 - Pressure Gages and Gauge Attachments
- B. ASTM E1 - Standard Specification for ASTM Liquid in Glass Thermometers
- C. ASTM E77 - Standard Test Method for Inspection and Verification Thermometers
- D. UL 393: Indicating Pressure Gages for Fire and Protection Services
- E. UL 404: Gages, Indicating Pressure for Compressed Gas Service

1.2 SUBMITTALS
- A. Submit under provisions of Section 23 05 00.
- B. Product Data: For each product use in this project, provide catalog data.
- C. Submit sample of plastic, laminated flow chart for venturi flow meter.
- D. Submit sample of metal identification tag for venturi flow meter.

PART 2 PRODUCTS

2.1 LIQUID FLOW METERS
- A. Venturi Flow Meter
  1. 2" diameter and smaller pipe provide bronze construction with threaded ends, larger than 2" diameter; provide steel construction with welded, grooved, or flanged ends as required for installation.
  2. Accessories: Provide nipples, needle valves, push-type quick disconnects, and chained, metal identification tags.
  3. Provide appropriate length nipples to coincide with the thickness of the pipe insulation, to insure cutoff valves and test ports are exposed outside of pipe insulation.
  4. Metal Identification Tags: Identification tag shall define manufacturer, model number, size, design GPM, and design differential pressure.
     a. Design GPM shall be from approved shop drawings for AHUs/cooling coils rather than from design drawings.
  5. Flow Charts: Provide plastic, laminated flow chart (approximately 8.5" x 11").
     a. Hang flow chart from flow venturi with 18-gage, Type 304 stainless steel wire.
  6. Accuracy: +/- 1%
  7. Permanent Head Loss: Not-to-exceed 10% of differential pressure reading.
  8. Portable Meter: Not required
- B. Pitot Tube Flow Meter: Not acceptable.
- C. Orifice Plate Flow Meter: Not acceptable
- D. Circuit Setter: Not acceptable

2.2 PRESSURE GAGES
- A. Gage: Per ASME B40.1, UL 393, and UL 404, a rotary brass movement and brass socket with front re-calibration adjustment, white face with black figures and graduations.
  1. Case: Cast aluminum with phosphor bronze bourbon tube
  2. Size: 4.5" diameter
  3. Accuracy: +/- 1%
  4. Scale: PSIG

2.3 PRESSURE GAGE TAPS
- A. Gage Cock: Brass construction, lever handle, 150 psig
- B. Nipple: Brass construction, minimum length of 4"

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2.4 AIR FILTER PRESSURE GAGES

A. Differential Pressure Gage
   1. Type: Diaphragm actuated, dial type, front zero adjustment for pointer, and adjustable signal flag for maximum allowable air-filter pressure drop.
   2. Housing, provide aluminum with black enamel finish.
   3. Dial 4.5" diameter, white face with black figures and graduations.
   4. Range: 0" WG to 1" WG water with minor divisions of 0.02" WG
   5. Accuracy, +/- 2% of full scale at 70°F
   6. Dwyer Model 2001-AF with ASF option is the base for the performance specifications.
      a. Other products satisfying the specifications are acceptable.

B. Accessories
   1. Adjustable signal flag for visual indication of maximum pressure drop for air filters.
      a. Set signal flag at appropriate level for cost effective change out of filters.
   2. Vent valves for easy zeroing of pointer.
   3. Use right angle static pressure tips and 0.25" diameter aluminum tubing.
   4. Provide surface mounting bracket.

2.5 STEM TYPE THERMOMETERS AND THERMOWELLS

A. Thermometer: ASTM E1; adjustable angle, red or blue fluid, lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device.
   1. Size, 12" scale.
   2. Window, provide clear non-breakable plastic.
   3. Stem: 0.75" NPT brass stem length as noted below
   4. Accuracy shall be per ASTM E77 +/- one scale division.
   5. Scale: Degrees Fahrenheit

B. Provide a well type digital thermometer using a standard 3/4" pipe size long brass insert with a temperature range of 45° to 140° F, industrial rated solar powered. (Attached strap type not acceptable.)

C. Thermowell, use brass construction with or without lagging extensions as noted below.
   1. For thermowells without thermometers or temperature sensors, provide caps and chains.

D. Chilled Water System
   1. Range: 0° to 100°F with 1°F scale divisions
   2. Thermometer Stem Length: 12"
   3. Thermowell: 6" overall length with 2.5" insertion length and 2.5" lagging extension.

E. Condenser Water System
   1. Range: 0° to 120°F with 1°F scale divisions
   2. Thermometer Stem Length: 3.5"
   3. Thermowell: 3.5" overall length with 2.5" insertion length.

F. Domestic Hot Water System
   1. Range: 30° to 240°F with 2°F scale divisions
   2. Thermometer Stem Length: 6"
   3. Thermowell: 6" overall length with 2.5" insertion length and 2.5 lagging extension.

2.6 AIRFLOW MEASURING STATION

A. Airflow Measuring Section with Transmitter
   1. Factory mounted and piped, multiple pilot-tube airflow elements in a 12" deep galvanized steel casing with flanges for connection to the ductwork.
   2. The airflow elements shall be non-corrosive 6063-T5 anodized aluminum.
   3. Position the airflow elements on an equal area basis per ASHRAE guidelines for duct traverses.
   4. The transmitter output shall be either 4-20 MA or 0-10 VDC.

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B. Airflow Straightening Section: Factory mounted, 0.75" opening x 3" depth honeycomb section of aluminum construction.
C. Accuracy: Within 2% throughout the velocity range of 600 FPM to 3000 FPM.
D. Airflow Chart: Attach airflow chart (CFM versus output) to the side of the airflow station.
E. Paragon Controls Model FE-1500-FX is the base for the performance specifications.
    1. Other products satisfying the specifications are acceptable.

PART 3 EXECUTION

3.1 INSTALLATION

A. Do not install instrumentation when areas are under construction, except for required thermowells and pressure gage taps.
B. Install in accordance with manufacturer's instructions.
C. Install thermometers and pressure gage taps to allow field maintenance readings in supply and return of chilled water and condenser water lines of each chiller, cooling tower, air handler unit and where required by Division 23 drawings.
    1. Install meters and gauge so a 5´-10" person can read the meters and gauges while standing on finished floor.
D. For pumps, install pressure gage taps in pump flange taps, pumps shall have flange taps.
E. Install pressure gage taps in the chiller's evaporator manifold taps, chillers shall have manifold taps.
F. Install pressure gage taps in the chiller’s condenser manifold taps, chillers shall have manifold taps.
G. Provide 4" min length brass nipples, allow clearance from insulation with gage cocks isolate gages.
H. For venturi flow meters, provide minimum lengths (or longer lengths) of straight pipe:
    1. Upstream - 5-pipe diameters
    2. Downstream - 2-pipe diameters
I. For installation of thermowells, enlarge pipes smaller than 2.5" diameter.
J. Provide pressure gages with scale ranges selected according to service with largest appropriate scale.
K. Install pressure gages and thermometers so that they are easily readable from normal eye level.
    1. Install vertical to 45 degrees off vertical.
L. Adjust pressure gages and thermometers to final angle, clean windows, lenses, and calibrate to zero.
M. For airflow measuring stations, provide minimum lengths (or longer lengths) of straight ductwork in accordance with the manufacturer's recommendation.
    1. Locate modulating control dampers downstream of the airflow measuring station.
    2. Typical minimum lengths are:
        a. Upstream: 3 duct diameters.
        b. Downstream: 1 duct diameter.

    For rectangular ducts, D equals:
    D = SQRT [(4 x Height x Width) / 3.14]

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SECTION 23 05 29
CURBS, HANGERS and SUPPORTS for HVAC PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES
- A. Pipe and equipment hangers and supports
- B. Equipment bases and supports
- C. Sleeves and seals
- D. Flashing and sealing equipment and pipe stacks

1.2 REFERENCES
- A. ASME B31.1 - Power Piping
- B. ASME B31.2 - Fuel Gas Piping
- C. ASME B31.5 - Refrigeration Piping and Heat Transfer Components
- D. ASME B31.9 – Building Service Piping
- E. ASTM F708 – Standard Practice for Design and Installation of Rigid Pipe Hangers
- F. MSS SP58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation
- G. FBC – Florida Building Code

1.3 SUBMITTALS
- A. Submit under provisions of Section 01 33 00.
- B. Shop Drawings: Indicate system layout with location and detail of trapeze hangers.
- C. Product Data: Provide manufacturers catalog data including load capacity.
- D. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.
- E. Manufacturer Installation Instructions: Indicate special procedures and assembly of components.

1.4 REGULATORY REQUIREMENTS
- A. Conform to applicable code for support of plumbing and hydronic piping.

PART 2 PRODUCTS

2.1 Piping
- A. Hydronic Piping
  1. Conform to ASME B31.9, ASTM F708, and MSS SP58.
  2. Hangers for Pipe Sizes 2 to 1½": Use galvanized steel adjustable swivel split ring.
  3. Hangers for Cold Pipe Sizes 2" and over: Use galvanized steel adjustable clevis.
  4. Hangers for Hot Pipe Sizes 2 to 4": Use carbon steel adjustable clevis.
  5. Hangers for Hot Pipe Sizes 6" and over: Adjustable steel yoke, cast iron roll, double hanger.
  6. Multiple or Trapeze Hangers: Use steel channels with welded spacers and hanger rods.
  7. Multiple or Trapeze Hangers for Hot Pipe Sizes 6" and over: Use steel channels with welded spacers and hanger rods, cast iron roll.
  8. Wall Support for Pipe Sizes to 3": Use cast iron hook.
  9. Wall Support for Pipe Sizes 4" and over: Use welded steel bracket and wrought steel clamp.
  10. Wall Support for Pipe Sizes 6" and over: Use welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.

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11. Vertical Support: Steel riser clamp
12. Floor Support for Cold Pipe: Use galvanized adjustable pipe saddle, lock nut, nipple, floor flange and concrete pier or steel support.
13. Floor Support for Hot Pipe Sizes 4”: Use galvanized adjustable pipe saddle, lock nut, nipple, galvanized floor flange and concrete pier, or galvanized steel support.
14. Floor Support for Hot Pipe Sizes 6” and over: Use adjustable cast iron roll and stand, steel screws, concrete pier or steel support.
15. Copper Pipe Support: Use vinyl coated carbon steel ring, adjustable.
    a. Do not use copper plated or copper clad hangers.

B. Refrigerant Piping
1. Conform to ASME B31.5, ASTM F708, and MSS SP58.
2. Hangers for Pipe Sizes 2 to 1½”: Use galvanized steel adjustable swivel split ring.
3. Multiple or Trapeze Hangers: Use steel channels with welded spacers and hanger rods.
4. Wall Support for Pipe Sizes to 1½”: Use cast iron hook.
5. Vertical Support: Use steel riser clamp.
6. Floor Support: Use galvanized adjustable pipe saddle, lock nut, nipple, floor flange, concrete pier, or steel support.
7. Copper Pipe Support: Use vinyl coated carbon steel ring, adjustable.
    a. Do not use copper plated or copper clad hangers.

2.2 ACCESSORIES
A. Hanger Rods shall be mild steel threaded both ends, threaded one end, or continuous threaded.

2.3 INSERTS
A. Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms, size inserts to suit threaded hanger rods.

2.4 FLASHING
A. Metal flashing: 26-gage stainless steel.
B. Metal Counter-flashing: 22-gage stainless steel.
C. Lead Flashing:
1. Waterproofing: 5-lb/sq ft sheet lead
2. Soundproofing: 1-lb/sq ft sheet lead
D. Flexible Flashing: 47 mil thick butyl sheet; compatible with roofing.
E. Caps: Stainless Steel 22-gage minimum, 16-gage at fire resistant elements

2.5 EQUIPMENT CURBS
A. Factory prefabricated welded aluminum or stainless roof curbs, shell, and base, mitered 3" cant, variable step to match roof profile:
1. Openings less than 50" x 50" use 0.065 aluminum sheets, or 18 gauge stainless steel.
2. Openings 50" x 50" or greater use 0.080 aluminum sheets, or 16 gauge stainless steel.
B. Curb shall be secured to roof joists and decking with watertight flashing and completely sealed with roof membrane.

2.6 SLEEVES
A. For materials, refer to Section 23 05 00, Item 3.7.

PART 3 EXECUTION

3.1 INSTALLATION

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A. Install in accordance with manufacturer's instructions.

3.2 INSERTS

A. Provide inserts for placement in concrete formwork.
B. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4".
D. Where concrete slabs form-finished ceiling, locate inserts to be flush with slab surface.
E. Where inserts are omitted, drill through concrete slab from below, and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

3.3 PIPE HANGERS AND SUPPORTS

A. Support horizontal and vertical piping in accordance with FBC Plumbing.
B. Install hangers to provide minimum 2" space between finished covering and adjacent work.
C. Place pipe hanger within 12" of each turn or elbow, or 8” on center for straight pipe.
D. Use hangers with 1½” minimum vertical adjustment.
E. Support horizontal cast iron pipe adjacent to each hub, with 5' maximum spacing between hangers.
F. Support vertical piping at every floor.
    1. Support vertical cast iron pipe at each floor at hub.
G. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
H. Support riser piping independently of connected horizontal piping.
I. Provide vinyl coated carbon steel hangers and supports.
    1. Do not use copper plated or copper clad hangers.
    2. Avoid contact of dissimilar metals.
J. Design hangers for pipe movement without disengagement of supported pipe.
K. Provide and install galvanized steel hangers and supports.
    1. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not exposed.
    2. When using trapeze hangers are used, provide restraints for each pipe supported.
    3. Provide double nuts to secure rods and supports in place.
    4. When supporting insulated pipe, provide galvanized metal saddles for each hanger to prevent damage to insulation.
    5. Paint all welds with cold galvanized paint to prevent rusting.
    6. All supports and mounting flanges shall be galvanized steel and paint all exterior hangers and supports per section 23 05 00 section 3.17. Color determined by Architect.
    7. All exterior mounting hardware shall be galvanized or stainless steel.

3.4 EQUIPMENT BASES AND SUPPORTS

A. Provide housekeeping pads of concrete, minimum 4" thick and extending 6" beyond supported equipment.
    1. Refer to Section 03 30 00.
B. Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.
C. Construct supports of steel members.
    1. Brace and fasten with flanges bolted to structure.
    2. Raise all floor mounted supports a minimum of 1” AFF and insert grout to prevent to prevent water from puddling under support.

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3. Floor mounted supports shall be provided with removable top bracket that completes the pipe circumference assembly.
4. All wall mounted supports shall be fabricated from galvanized steel with cold galvanized paint covering all welds.

D. Provide rigid anchors for pipes after installing vibration isolation components.

3.5 FLASHING

A. Provide flexible flashing and metal counter-flashing where piping and ductwork penetrate weather or waterproofed walls, floors and roofs.
B. Flash vent and soil pipes projecting 3" minimum above finished roof surface with lead worked one-inch minimum into hub, 8" minimum clear on sides with 24” x 24” sheet size.
   1. For pipes through outside walls, turn flanges back into wall and caulk, metal counter-flash, and seal.
C. Flash floor drains in floors with topping over finished areas with lead; 10" clear on sides with minimum 36" x 36" sheet size.
   1. Fasten flashing to drain clamp device.
D. Seal floor, shower, and mop sink drains watertight to adjacent materials.
E. Provide acoustical lead flashing around ducts and pipes penetrating equipment rooms, installed in accordance with manufacturer's instructions for sound control.
F. Provide curbs for mechanical roof installations 14" minimum high above roof surface.
   1. Flash and counter flash with sheet metal, seal watertight.
   2. Attach counter flashing mechanical equipment and lap base flashing on roof curbs.
   3. Flatten and solder joints.
G. Adjust storm collars tight to pipe with bolts; caulk around top edge.
   1. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

3.6 SLEEVES

A. For construction and execution, refer to Section 23 05 00, item 3.7.

END OF SECTION

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SECTION 23 05 48
HVAC VIBRATION CONTROL

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. The other Contract Documents complement the requirements of this Section.
B. The General Requirements apply to the work of this Section.

1.2 SCOPE

A. Provide vibration isolation supports for all rotating and reciprocating mechanical equipment, piping, and ductwork as required to prevent transmission of vibration to building structure.
B. Various parts of the building shall generally conform to the Design Guidelines for HVAC, Related Background Sound in Rooms as set forth in ASHRAE HVAC Applications Handbook.
C. Mid-point of range of NC criteria curves applies.
D. Contractor shall be responsible for selecting and installing vibration isolators as specified, or indicated or otherwise required to prevent transmission of vibration, which would cause noise levels in excess of those specified in above referenced Design Guidelines.
E. Provide concrete bases as required for equipment.

1.3 QUALITY ASSURANCE

A. A single source manufacturer or supplier shall design and furnish all vibration isolation devices, including auxiliary steel bases and placing forms with steel reinforcing.
    1. The manufacturer or supplier is responsible for adequate coordination of all phases of work.
    2. Equipment base types, vibration isolator types, and minimum deflections shall conform to Selection Guide for Vibration Isolation Table in ASHRAE HVAC Applications.
    3. Concrete material shall be as specified in Section 03 30 00.
B. Air handling units with factory installed spring isolators for blower chassis are acceptable, provided such isolators meet all requirements of this Section, including submittal requirements for vibration isolators, minimum deflections, and requirement for technical supervision and certification letter.
    1. Where internal isolators are used coordinate housekeeping pad height as required to ensure adequate condensate trap depth and positive drainage.
    2. Provide rubber isolation rated pads at MFG defined support locations between air handler and concrete housekeeping pad when internal vibration isolation is acceptable.
C. Vibrator isolation manufacturer responsible for providing such supervision as may be necessary to assure correct installation and adjustment of isolators.
    1. Upon completion of installation and after system is put into operation, manufacturers shall make final inspection and submit his report to the Architect in writing certifying correctness of installation and compliance with approved submittal data.
D. Mason Industries used a basis of design.
    1. Similar and equal equipment and installation complying with this Section by:
        a. Amber Booth
        b. Vibration Eliminator Co
        c. Vibration Mountings and Controls
        d. Kinetics Noise Control acceptable as equal

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1.4 SUBMITTALS

A. In submittal data show type, size dimensions, rated capacity, rated deflection, compressed spring height, solid spring height, identity color coding and labeling details, and location diagrams for each color coding and labeling details, and location diagrams for each isolator proposed and any other information required for Architect to check isolator selections for compliance with these Specifications.
B. All steel bases and concrete inertia bases completely detailed.
C. Submittal documentation, include a clearly outlined procedure for installing and adjusting isolators.

PART 2 PRODUCTS

2.1 EQUIPMENT

A. Unless otherwise noted, mount all mechanical equipment on vibration isolators to prevent transmission of vibration and mechanically transmitted sound to building structure.
   1. Select the vibration isolators to provide uniform weight distribution and to produce reasonable uniform deflection.
   2. Deflections shall be as indicated or specified.
B. All isolators exposed to outdoor weather with galvanized finish of all ferrous parts and bolts and nuts cadmium-plated, or electro-zinc plated.
C. Selection of Vibration Isolators and Mountings shall conform to Notes for Vibration Isolator Selection Guide (Table), in ASHRAE HVAC Applications Handbook.
D. All final electrical connections to vibrating equipment shall be flexible conduit (Greenfield Type).

2.2 PIPING AND DUCTWORK CONNECTED TO VIBRATING EQUIPMENT

A. For piping connected to vibrating equipment (pumps, air compressors, etc) provide flexible hose connectors, to be stainless steel, woven wire braid – S.E. Hose #SECF or approved equal. Three flexible pipe couplings in series may be used in lieu of a stainless steel flexible connection at equipment connections in applicable piping systems. The couplings shall be placed in close proximity to the vibration source and in accordance with the manufacturer's installation instructions for vibration attenuation.
   1. Provide flexible insulation where required; refer to section 23 07 19.
B. For ductwork connected to vibrating equipment (fans, air handler units, etc) provide flexible duct connections – Duro-Dyne, "Metal-Fab" heavy duty Excelon or approved equal.
   1. Provide flexible duct wrap insulation where required; refer to section 23 07 13.

PART 3 EXECUTION

3.1 INSTALLATION

A. Perform the installation and adjustment in accordance with manufacturer's instructions.
B. Vibration isolators shall provide required deflection under imposed loads and shall produce uniform loading and deflection even when equipment weight is not evenly distributed.
   1. Do not use leveling bolts as jacking devices.
C. Provide vibration isolation types and deflections as specified, indicated, or scheduled.
D. Contractor and vibration isolation manufacturer or factory-authorized representative shall perform following tasks in addition to supply and installation of isolation equipment.

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1. Obtain from Architect approved manufacturers name, model number and other necessary identifying data for each item of mechanical equipment to be resiliently mounted.
    a. Coordinate resilient mounting systems with exact equipment furnished concerning physical size, isolator locations, weight, rotating speed, etc.
    b. Direct contact and cooperation between vibration-isolation device fabricator and equipment manufacturer required.
2. Select piping systems isolators for proper coordination with physical arrangement of pipelines and with physical characteristics of building.
3. To assure that vibration isolator installation is in strict accordance with normally accepted practices for critical environments, provide on-the-job supervision as required during installation of resiliently mounted equipment and piping.
4. Replace at no extra cost to Owner, isolators not producing the required deflection, are improperly loaded above or below their correct operating height or which do not produce-required isolation.
5. Cooperation with other Contractors engaged in project so that installation of vibration isolation devices will proceed in manner that is in best interests of Owner.
6. Notify Architect of project conditions affecting vibration-isolation system installation or performance and are found to be different from conditions indicated or specified.
    a. Should vibration-isolation system installation proceed without such notification, remedial Contractor shall accomplish work required to achieve proper isolator performance at no additional cost to Owner.
7. Be alert for possible "short-circuiting" of vibration isolation systems by piping supports, electrical connections, temperature control connections, drain lines, and building construction, etc., and notify involved contractor as to these problems or potential problems.
    a. Where such situations cannot be easily resolved, notify Architect so that preventive or remedial action can take place on timely basis.
    b. Responsible Contractor at no additional cost to Owner shall undertake remedial measures required.

E. Air handling units to be internally isolated under other specification sections.

F. All other equipment including chillers, compressors, pumps, cooling towers, fans, condensing units, packaged units, rooftop equipment, engine driven generators, etc. shall have vibration isolators in conformance with Selection Guide for Vibration Isolation Table in ASHRAE HVAC Applications Handbook.

END OF SECTION

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SECTION 23 05 53
IDENTIFICATION for HVAC PIPING and EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES
- A. Nameplates
- B. Tags
- C. Stencils
- D. Pipe Markers
- E. Pipe Color Coding

1.2 REFERENCES
- A. ASME A13.1 - Scheme for the Identification of Piping Systems

1.3 SUBMITTALS
- A. Submit under provisions of Section 01 33 00.
- B. Submit list of wording, symbols, letter size, and color-coding for mechanical identification.
- C. Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- D. Product Data: Provide manufacturer's catalog literature for each product required.
- E. Manufacturer Installation Instructions: Indicate special procedures and installation.

1.4 PROJECT RECORD DOCUMENTS
- A. Submit under provisions of section 01 77 00.
- B. Record the actual locations of the tagged valves.

PART 2 PRODUCTS

2.1 NAMEPLATES
- A. Label Description: Laminated three-layer plastic with engraved black letters on light contrasting background color.

2.2 TAGS
- A. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color, tag size minimum 1½" diameter.
- B. Metal Tags: Brass with stamped letters; tag size minimum 1½" diameter with smooth edges.
- C. Chart: Provide a typewritten letter size list in anodized aluminum frame.

2.3 STENCILS
- A. Stencils: With clean cut symbols and letters of following size:

OUTSIDE DIAMETER OF INSULATION OR PIPE	LENGTH OF COLOR FIELD	SIZE OF LETTERS
¾" - 1¼"	8"	½"
1½" - 2"	8"	¾"
2½" - 6"	12"	1-1/4"
8" - 10"	24"	2½"
Over 10"	32"	3½"
Ductwork and Equipment	---	2½"

- B. Stencil Paint: As specified in Section 09 91 13 or 09 91 23, semi-gloss enamel, with colors conforming to ASME A13.1.

2.4 PIPE MARKERS
- A. Color: Conform to ASME A13.1.

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B. Plastic Pipe Markers:
   1. Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering.
   2. Minimum information indicating direction of flow arrow and identification of fluid conveyed.
C. Plastic Tape Pipe Markers: Flexible vinyl film tape with pressure sensitive adhesive backing and printed markings.
D. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 6" wide by 4-mil thick, manufactured for direct burial service.

2.5 COLOR STICK-ONS ON CEILING GRID
A. Install self-adhesive color ¾" squares on ceiling grid or on access panels to designate locations of concealed mechanical and HVAC equipment. Color code as follows:
   1. Green - Plumbing water valves
   2. Blue – HVAC equipment
   3. Red – HVAC piping specialties, valves, gauges, etc.
B. Self-adhesive color ¾" diameter dots shall be installed on ceiling grid or on access panels to designate locations of concealed equipment color coded as follows:
   1. Purple – HVAC energy management systems and HVAC control systems.
   2. Colors for other trades - see Section 26 05 53.

2.6 PIPE COLOR CODING
A. Paint all exposed HVAC piping in finished areas the appropriate color in accordance with specification sections 09 91 13 or 09 91-23 Painting, 23 05 00 Mechanical, 22 10 00 Plumbing Piping, 21 00 00 Fire Suppression.
B. The piping colors code is as follows:
   1. Chilled Water Supply Pipe – Light Blue with Flow Arrows
   2. Chilled Water Return Pipe – Dark Blue with Flow Arrows
   3. Glycol Water Supply & Return – Dark Blue with Flow Arrows
   4. Condenser Water Supply Pipe – Light Green with Flow Arrows
   5. Condenser Water Return Pipe – Dark Green with Flow Arrows
   6. Fire Sprinkler Piping – Red
   7. Gas Piping – Yellow
   8. Compressed Air - Orange

PART 3 EXECUTION

3.1 PREPARATION
A. Degrease and clean surfaces to receive adhesive for identification materials.
B. Prepare surfaces in accordance with Section 09 91 13 or 09 91 23 for stencil painting.

3.2 INSTALLATION
A. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive.
   1. Apply with sufficient adhesive to ensure permanent adhesion.
   2. Locate nameplate on unit so that can be clearly identified upon entering mechanical room or roof, minimum size of letters: 1.5”
B. Install tags with corrosion resistant chain.
C. Apply stencil painting in accordance with Section 09 91 13 or 09 91 23.
D. Install plastic pipe markers in accordance with manufacturer's instructions.
E. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.

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F. Provide flow arrows indicating direction of designed chilled water flow within pipe at each valve, and provide pipe identification and chilled water flow direction on each side of wall penetration
G. Install underground-metalized plastic pipe markers 6 to 8" below finished grade, directly above buried pipe.
H. Identify air handling units, fans, pumps, chillers, water heaters, heat transfer equipment, tanks, and water treatment devices with plastic nameplates.
    1. May identify small devices such as in-line pumps with tags.
I. Identify control panels and major control components outside panels with plastic nameplates.
J. Identify thermostats relating to terminal boxes or valves with stick-on laminated paper labels to be located on the inside cover.
    1. Specify AHU number, terminal box number, and EMCS controller address keyed to control schematic.
K. Identify valves in main and branch piping with tags.
L. Identify air terminal units and valves with numbered tags.
M. Tag automatic controls, instruments, and relays, similar to thermostats in item I.
    1. Key to control schematic
N. Identify piping, concealed or exposed, with stenciled painting.
    1. Use tags on piping ¾" diameter and smaller.
    2. Identify service, flow direction, and pressure.
    3. Install in clear view and align with axis of piping.
    4. Locate identification not to exceed 20' on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.
    5. Paint gas-piping yellow for the entire length of the piping above ground including next to regulator.
O. Provide color-coded ceiling stick-on type to locate valves or dampers above T-bar type panel ceilings.
    1. Locate stick-on, on ceiling grid T-bars closest to equipment.
P. Paint all exposed mechanical piping with appropriate color.

END OF SECTION

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SECTION 23 05 83
TESTS – HVAC PIPING SYSTEMS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. The other Contract Documents complement the requirements of this section.
B. The General Requirements apply to the work of this section.

1.2 SCOPE

A. Provide labor, materials, and supervision necessary to perform all piping tests for all systems as follows.
   1. Chilled Water Systems
B. Additional tests as specified in other sections.
   1. Perform this test in addition to those specified in this section.
C. Should a governing body require tests over and above those specified herein, the Contractor shall perform and provide certification for approval by such governing body or agency.
D. Perform additional tests as may be required by utility companies or agencies supplying the particular service such as city water, natural gas, medical gases, etc.
E. Provide certified test reports for all systems.

1.3 EQUIPMENT

A. Contractor shall provide all devices, equipment, gases, etc., necessary conduct required tests.
   1. Do not use devices installed in the work for test purposes.
B. Materials are subject to standard test by manufacturer before shipment.

1.4 GENERAL REQUIREMENTS

A. Make test during installation and after completion.
   1. Tests are at expense of Contractor.
B. Conduct and obtain approval of all piping concealed in building construction, chases, etc., prior to concealment.
   1. Contractor failing to make such tests must assume all costs of removing and replacing defective piping and must pay all costs of cutting and repairing building construction made necessary by this neglect to end of guarantee period.
C. Make tests prior to insulating piping or backfilling of underground work.
D. Make hydrostatic tests with cold water.
   1. The minimum duration shall be four hours.
E. Test in presence of Owner's representative, who may direct Contractor to perform tests in presence of some other appointed witness.
   1. The Engineer, Owner's representative, and/or permitting agency shall witness all Contractor performed test without exception.
   2. Contractor will be responsible for correct testing, observation of results, and corrections necessary.
F. The Contractor shall make provisions for the thorough inspection of the installation and in no case hide any part of construction from the inspector.
G. Do not apply test pressures to a hot valve.
   1. In event, such testing is necessary, install temporary block ahead of valve.
   2. Final test of connection against hot valve shall be by examination of work under service pressure.
H. Disconnect and protected from damage any device connected to the system not designed for

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the test pressure.

I. All parts of system under test must be under constant supervision with authority to bleed off excess pressure that may develop.
   1. No tests shall remain on work unless continuously attended.
   2. Use care so that excess pressure does not develop because of temperature changes.

J. Work shall be completely leak free at any joint, fittings, accessory, or attachment.
   1. If repairs are necessary, re-test work after correction.
   2. Correct defects made manifest by these tests before proceeding with other work.

1.5 CERTIFIED TEST REPORTS

A. For each system tested, provide a certificate testifying that the system was tested as specified and provide the following data:
   1. Identification of system tested referencing specific equipment connected to system.
   2. Date tested
   3. Test pressure and duration of test
   4. Recorded test pressure at end of test
   5. Media used for testing
   6. List necessary repairs made before the system passed the leak test.
   7. Signature of Contractor
   8. Signature of witness
   9. Other data as required by the system specification.

1.6 CHILLED WATER SYSTEM

A. Test the chilled water system hydrostatically at 150% of the maximum system design pressure, but not less than 100 psig.
   1. Refer to FBC-M, Section 1208.
   2. Maintain pressure for not less than four hours with no addition of water.

B. After test, flush piping with clean water, removing debris and sediment.

PART 2 PRODUCTS

2.1 Not Used

PART 3 EXECUTION

3.1 Not Used

END OF SECTION

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SECTION 23 05 93

HVAC TESTING, ADJUSTING AND BALANCING

PART 1 GENERAL

1.1 SCOPE OF SERVICES

A. The District, under separate contract, shall provide an independent TAB Contractor to perform TAB work for HVAC systems.

1. The TAB Contractor shall be the District's representative for all TAB activities.

B. The TAB Contractor shall be a firm registered by the State of Florida to perform Mechanical Engineering, or a firm certified by either the Associated Air Balance Council (AABC) or the National Environmental Balancing Bureau (NEBB).

C. The TAB Contractor shall provide all technically qualified personnel, equipment, instrumentation, and materials on a continuous basis in order to complete TAB services in a timely manner.

D. The scope of services shall include, but not be limited to, the following:

1. Review of project documents to verify the HVAC systems design accommodates the completion of the TAB.
2. Provide pre-TAB inspections of the HVAC systems during construction assuring the systems installation is in conformance with project documents and approved shop drawings.
3. Perform TAB of the HVAC systems in accordance with industry standard (Paragraph 1.2 References) to assure correct air/water flow rates and energy efficient operation.
4. Provide certified TAB report of the HVAC systems in accordance with industry standards (Paragraph 1.2 References) and the District's special requirements.
5. As the District's representative, provide coordination of TAB activities between the Design Mechanical Engineer, Mechanical Contractor, and Energy Management and Control System (EMCS) Contractor.
    a. Initiate conference calls and/or schedule meetings to resolve TAB issues and document solutions to TAB issues.
    b. If resolution is not possible or is timely, schedule a meeting with the appropriate parties and District staff (Project Manager, Mechanical Engineer, and Building Code Services).
6. Unacceptable performance by the TAB Contractor shall result in cancellation of this contract.

1.2 REFERENCES

A. Associated Air Balance Council (AABC) - National Standard for Field Measurement and Instrumentation, Total System Balance, latest edition.

B. National Environmental Balancing Bureau (NEBB) - Procedural Standard for Testing, Balancing, and Adjusting of Environmental Systems, latest edition.

C. American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc., (ASHRAE) - HVAC Systems and Applications Handbook, Testing, Adjusting and Balancing, latest edition.

D. Sheet Metal and Air Conditioning Contractors National Association (SMACNA) - HVAC Systems Testing, Adjusting and Balancing latest edition.

1.3 COMMISSIONING

A. Commissioning of a system or systems specified in this section is part of the construction process.

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B. Documentation and testing of these systems, as well as training of the Owner's operation and maintenance personnel, is required in cooperation with the Owner's Representative and the Commissioning Authority.

C. Project Closeout is dependent on successful completion of all commissioning procedures, documentation, and issue closure.

D. Refer to Section 01 77 00 - Contract Closeout, for substantial completion details.

E. Refer to Section 01 91 00, Commissioning, for detailed commissioning requirements.

PART 2 PROJECT DOCUMENT REVIEW

2.1 The District will provide the TAB Contractor with one copy of the 100% Phase III design documents for review and analysis.

A. Mechanical drawings

B. Division 23 specifications

C. Room-by-room air balance analysis from the HVAC System Design Notebook

2.2 Within 15-calendar days, provide written design review report of deficiencies (errors, omissions, conflicts, etc.) that would preclude TAB in accordance with industry standards and Section 23 05 93, and schedule a meeting with the Program Management, Building Code Services, and the Design Mechanical Engineer to resolve these deficiencies.

A. The report shall address each item in Paragraphs 2.3 through 2.7 by itemizing each area reviewed and the results.

B. The format for the design review report shall be in accordance with Article 1.3.

2.3 Verify that the air distribution systems are completely defined.

A. Turning vanes are located in all mitered elbows greater than 45°.

B. Splitter vanes are located in all smooth radius elbows greater than 45° with r/D ratios less than 1.5.

C. Volume dampers are properly located for correct air distribution and for low system noise.

1. Volume dampers shall be located a minimum of five duct diameters from grilles and diffusers.

2. Do not use opposed blade dampers in grilles and diffusers for balancing.

D. Volume dampers are factory manufactured rather than shop fabricated.

1. For externally insulated ducts, provide 2" high standoffs for the locking quadrants.

E. Air outlets are properly defined:

	PATTERN	CFM	SIZE
Supply Air Grilles	X	X	X
Ceiling Diffusers	X	X	X
Return Air Grilles (plenum)	NAP	X*	X
Return Air Grilles (ducted)	NAP	X**	X
Exhaust Air Grilles	NAP	X	X
Transfer Air Grilles	NAP	X*	X
Door Undercuts	NAP	X*	3/4"
Door Grilles	NAP	X*	X

Outdoor Air Intakes	NAP	X	X

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* CFMs are shown to indicate proper air balance but are not balanced.

** CFMs are not balanced for VAV systems.

NAP Not Applicable

F. For relief air systems and outdoor air systems, the traverse locations have adequate lengths of straight duct for accurate traverses.
   1. Less accurate methods to determine CFMs are not acceptable.

G. The room-by-room air balance analysis results in a properly balanced and positively pressurized building.
   1. During student occupancy, exfiltration air shall equal either 0.10 CFM/SF with a relief air system or up to 0.15 CFM/SF without a relief air system.

H. For VAV systems, the scheduled maximum CFM for each VAV box is equal to the sum of the supply air CFMs for the VAV box.

2.4 Verify that the hydronic systems are completely designed.

A. For each cooling coil, the Venturis are properly located.
   1. Circuit setter valves, piton tube flow meters and automatic flow control valves are not acceptable, and condenser water pumps, the gauge cocks, and pressure gages are properly located using the pump flange taps.

B. For each chiller evaporator and condenser, the Venturis are properly located.
   1. Circuit setter valves, pitot tube flow meters and automatic flow control valves are not acceptable.

C. For chilled water

D. For each chiller, the chilled water and condenser water gauge cocks are properly located using the chiller manifold taps.

E. For each cooling coil, the thermometers are properly located.

F. For each chiller evaporator and condenser, the thermometers are properly located.

G. The scheduled GPMs for the cooling coils are consistent with the equipment schedules for the chilled water pumps and chiller evaporators.

H. The scheduled GPMs for the cooling towers are consistent with the equipment schedules for the condenser water pumps and chiller condensers.

I. The scheduled GPMs for the heating coils are consistent with the equipment schedules for the hot water pumps and boilers.

2.5 Verify that the isolation components for sound and vibration attenuation are properly located.

2.6 Verify that the EMCS and the sequence of operations are compatible with the HVAC system and TAB requirements.

2.7 Verify that other components - not specifically listed above, but necessary for TAB - are properly located.

2.8 Distribute the design review report per the Distribution List in Article 7.1.

2.9 The TAB Contractor is responsible for scheduling the meeting in Article 2.2.

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PART 3 PRE-TAB INSPECTIONS

3.1 Coordinate inspection schedule with the Mechanical Contractor and provide written inspection schedule.

A. Note Substantial Completion and Final Completion milestones on the TAB schedule.

3.2 For each inspection, the TAB Contractor shall sign in and out either at the District's field office or, if the field office does not exist, at the school's administrative office.

3.3 Provide periodic inspections during construction and written pre-TAB punch lists within seven calendar days after each inspection.

A. The frequency of inspections shall be determined by the TAB Contractor to provide adequate inspection coverage but shall not be less than monthly during HVAC system installation.

B. Inspection reports shall define area inspected and shall itemize TAB punch items.

3.4 Inspections shall include, but not be limited to, the following areas.

A. Ductwork Systems (Outdoor, Supply, Return, Exhaust, Relief, etc.): Verify the proper installation of duct fittings, balancing devices, access doors, turning vanes, transitions, flexible connections, etc.

B. Piping Systems (Chilled Water, Condenser Water, Make-up Water, etc.): Verify the proper installation of pipefittings, balancing valves, Venturis, flexible connections, gage cocks, pressure gages, thermometers, etc.

C. HVAC Equipment:

1. Verify that the manufacturer, model number, power supply, motor horsepower, accessories, etc. are per approved shop drawings.
2. When shop drawings of a different manufacturer than scheduled in the project documents are approved, the data per the shop drawings shall be listed in the TAB report as design data.
3. Verify that the motor starter's overload protectors are correct for the motor's rated load amperes.

D. Installation of HVAC Equipment: Verify that the installation is per the project documents and/or approved shop drawings.

E. Hydronic System Commissioning:

1. Monitor the cleaning, flushing, filling, and chemical treatment.
2. Observe water samples being drawn and labeled.
3. Advise the Project Manager, Department of Program Management if the system commissioning is acceptable.
4. Obtain copy of the chemical treatment test report and provide it in the TAB report.

3.5 Distribute the inspection schedule per the Distribution List in Article 7.2.

3.6 Distribute the pre-TAB punch lists per the Distribution List in Article 7.3.

3.7 Obtain a complete set of approved HVAC shop drawings, addenda, architect supplement instructions, change orders, etc. from the Mechanical Contractor (Section 23 08 00).

3.8 The TAB Contractor is responsible for scheduling meetings with the Mechanical Contractor to obtain construction schedules for pre-TAB inspections and to resolve TAB punch items.

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PART 4 TAB WORK

4.1 Coordinate TAB work schedule with the Mechanical Contractor and provide written TAB work schedule. Note Substantial Completion and Final Completion milestones on the TAB schedule.

4.2 The TAB Contractor shall sign in and out at the District's field office or if the field office does not exist, at the school's administrative office each time contractor or representative visits the site.

4.3 Provide written punch lists summarizing non-complying items as soon as they are discovered but at least weekly.

A. Punch lists shall clearly delineate the responsible party (Mechanical Contractor or Design Mechanical Engineer) for each punch item.

4.4 Document punch items, relative to system performance, by providing TAB test reports and plotting measured data on equipment performance curves.

A. See Articles 8.2 through 8.4.

B. These punch items are the responsibility of the Design Mechanical Engineer if the HVAC systems have been installed per the project documents and approved shop drawings.

4.5 The TAB Contractor shall coordinate with the responsible party (Mechanical Contractor or Design Mechanical Engineer) to resolve punch items.

A. Any resolution that modifies the HVAC system design, operational modes or performance levels shall be approved, in writing, by the Mechanical Engineer, Building Code Services.

4.6 After written notification of punch list repairs by the Mechanical Contractor, the TAB Contractor shall provide one re-TAB per item within this contract.

A. Additional TAB fees due to repeat TAB punch items and retesting are the responsibility of the Mechanical Contractor.

B. The TAB Contractor is responsible for clearly documenting any additional fees and providing the documentation to the Project Manager, Department of Program Management.

C. Documentation that is unclear, inaccurate, or untimely is not acceptable.

4.7 Provide personnel on a continuous basis in order to complete the TAB work in a timely manner.

A. Make every effort to complete the TAB work before District occupancy and/or Substantial Completion.

B. After District occupancy, access to occupied areas may be restricted.

4.8 Work schedules shall be modified accordingly and coordinate any work after normal business hours with the Project Manager, Department of Program Management and/or the school's administrative staff.

4.9 On a regular basis, inform the Project Manager, Department of Program Management of the work progress, work schedules, and potential problem areas, which may delay the timely completion of TAB work.

4.10 Distribute the TAB work schedule per the Distribution List in Article 7.2.

4.11 Distribute the TAB punch lists per the Distribution List in Article 7.3.

4.12 The TAB Contractor is responsible for scheduling meetings with appropriate parties to obtain construction schedules for TAB work and to resolve TAB punch items.

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PART 5 TAB REPORT

5.1 Publish the TAB report within 15 calendar days after Substantial Completion; do not delay the report for unresolved punch items.

5.2 Provide data for non-complying systems so that all parties are working with the same information to solve these outstanding punch items.

5.3 Coordinate with the Mechanical Contractor and Design Mechanical Engineer in order to resolve TAB punch items and provide written monthly status report.

A. Provide revised TAB test reports for incorporation into the TAB report within 15-calendar days after outstanding punch items have been resolved.

B. Resolve all punch items and complete the TAB report prior to Final Completion.

5.4 Distribute the TAB report, monthly status reports, and revised TAB test reports per the Distribution List in Article 7.4.

PART 6 VERIFICATION OF MEASUREMENTS

6.1 The District has the option of requesting verification of measurements in the TAB report.

A. Measurement verification shall involve 10% or less of the measurements in the TAB report.

B. The District shall select the measurements the TAB Contractor shall retest and verify in the presence of the District Representative.

6.2 To pass the measurement verification, at least 90% of those measurements shall be within the acceptable tolerance of the DESIGN value.

A. Re-balance any measurements out-of-tolerance to within acceptable tolerances.

6.3 If the measurement verification fails, the TAB Contractor shall rebalance all systems at no cost to the District.

A. Repeat the measurement verification with another set of measurements selected by the District.

6.4 The TAB Contractor shall provide revised TAB test reports for the re-balanced systems within 15-calendar days of measurement verification.

A. Distribute revised TAB test reports according to the Distribution List in Article 7.4.

PART 7 DISTRIBUTION LIST

7.1 Design Review Report:

A. Direct the report to the Mechanical Engineer, Building Code Services.

B. Provide copy of report to the Architect.

C. Provide copy of report to the Design Mechanical Engineer.

D. Provide copy of report to the Commissioning Authority.

7.2 Pre-TAB Inspection Schedule and TAB Work Schedule:

A. Direct the schedules to the Project Manager, Department of Program Management.

B. Provide copy of schedules to the Mechanical Engineer, Building Code Services.

C. Provide copy of schedules to the Architect.

D. Provide copy of schedules to the Design Mechanical Engineer.

E. Provide copies of schedules to the General Contractor.

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F. Provide copy of schedules to the Mechanical Contractor.

G. Provide copy of schedules to the Commissioning Authority.

7.3 Pre-TAB Inspection Punch Lists and TAB Work Punch Lists:

A. Direct punch lists to the Mechanical Contractor.

B. Provide copy of punch lists to the Project Manager, Department of Program Management.

C. Provide copy of punch lists to the Mechanical Engineer, Building Code Services.

D. Provide copy of punch lists to the Architect.

E. Provide copy of punch lists to the Design Mechanical Engineer.

F. Provide copy of punch lists to the General Contractor.

G. Provide copy of punch lists to the Commissioning Authority.

7.4 TAB Report, Monthly Status Reports and Revised TAB Test Reports:

A. Direct the reports to the Project Manager, Department of Program Management.

B. Provide copy of reports to the Mechanical Engineer, Building Code Services.

C. Provide copy of reports to the Director, Department of Facilities Services.

D. Provide copy of reports to the Architect.

E. Provide copy of reports to the Design Mechanical Engineer.

F. Provide copy of reports to the General Contractor.

G. Provide copy of reports to the Mechanical Contractor.

H. Provide copy of punch lists to the Commissioning Authority.

PART 8 TAB REPORT REQUIREMENTS

8.1 Provide reports electronically in PDF format.

A. Include set HVAC floor plans in PDF format with air outlets and equipment identified to correspond with test reports. Number all pages, i.e., Page X of XX.

B. Provide report per the following format:

1. Title Page (8.10.B)
2. Certification Page (8.10.C)
3. Table of Contents
4. Summary of Non-complying Systems (ALL ITEMS)
    a. Itemize all outstanding TAB punch items.
    b. Itemize all out-of-tolerance parameters from each test report. (NO EXCEPTIONS)

C. Instrument Calibration Report (8.10.D)

D. Test reports for each building

E. Test reports for the central cooling/heating plant

F. Test reports for the chemical treatment of the hydronic systems

G. HVAC floor plans

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8.2 Central Station Air Handler Units (AHU)

A. General

1. Air handler unit CFM may be determined either by totaling individual CFMs from supply air grilles or by supply air duct traverse.
   a. If the design CFM (within -5%) cannot be achieved, verify the air handler unit's CFM by supply air duct traverse; do not use return air duct traverse.
   b. When a duct traverse is utilized, provide a Duct Traverse Report (8.10.L) in TAB report, and note traverse locations on reduced set of HVAC floor plans.
2. Adjust fan RPM until either design CFM (-5%/+10%) is obtained or motor is at rated FLA, do not use motor service factor.
3. Plot the TAB data on manufacturer's fan performance curve.
   a. Include fan performance curve in TAB report.
   b. The following information shall be provided:
      i. Plot design point and label data point DESIGN POINT
      ii. Plot measured CFM and RPM, and then label data point OPERATING POINT
      iii. Plot system resistance curve
4. If design CFM (-5%/+10%) cannot be obtained, provide specific recommendations in order to obtain design CFM.
5. Provide measured static pressure data at the following locations:
   a. Filter inlet pressure
   b. Filter delta pressure
   c. Coil (cooling/heating/reheat) delta pressure.
   d. Fan suction pressure
   e. Fan discharge pressure: Determine value from fan performance curve based on CFM and RPM; measured values are not reliable.
6. Provide Air Handler Unit Test Report (8.10.E).
7. Provide Coil Test Report (8.10.F).
   a. Plot actual data on psychrometric chart and include psychrometric chart in TAB report.
   b. The following data shall be provided:
      i. Plot outdoor air DB/WB temperature and label data point (OA).
      ii. Plot return air DB/WB temperature and label data point (RA).
      iii. Plot coil-entering air DB/WB temperature and label data point (CEA).
      iv. Plot coil-leaving air DB/WB temperature and label data point (CLA).
         a) For draw-thru AHUs, the location of coil leaving air temperatures is after the coil but before the fan.
      v. Measured data, when plotted on a psychrometric chart, shall represent consistent HVAC system processes.
         a) Redo any inconsistent measured data.
8. Provide Air Outlet Test Report (8.10.H).
   a. Note any outlet not within ± 10% of design CFM and any outlet with an objectionable noise level.

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b. See Article 8.6.
c. Define area served using both drawing room number and actual room number.

9. For variable air volume systems, provide Variable Air Volume Box Test Report (8.10.P).

B. Provide test reports and data in the following order:

1. Air Handler Unit Test Report (8.10.E)
2. Fan Performance Curve
3. Coil Test Report (8.10.F)
4. Psychrometric Chart
5. Air Outlet Test Report (8.10.H)
6. Variable Air Volume Box Test Report (8.10.P)
7. Duct Traverse Reports (8.10.L): Provide per Article 8.2, A.1.

8.3 Fans (Outdoor, Supply, Exhaust, Relief, Etc.)

A. Provide test reports in the following order:

1. Fan Test Report (8.10.G).
2. Air Outlet Test Report (8.10.H): Provide for fans with multiple supply and/or exhaust grilles.
3. Note any outlet with an objectionable noise level.
4. See Article 8.6.

B. Adjust fan RPM until either design CFM (-5%/+10%) is obtained or motor is at rated FLA.

1. Do not use motor service factor.

C. If design CFM (-5%/+10%) cannot be obtained, provide fan suction and discharge static pressures to determine external static pressure.

D. If design CFM (-5%/+10%) cannot be obtained, provide specific recommendations in order to obtain design CFM.

8.4 Pumps (Primary Chilled Water, Secondary Chilled Water, Condenser Water, Hot Water, etc.)

A. General

1. Determine pump head using pump flange gage taps in order for TAB data to correlate with the pump performance curve.
2. Determine GPM using venturi.
   a. Provide venturi diameter and differential head.
3. Adjust system-balancing valves (coils and pump discharge) until either design GPM (-5%/+10%) is obtained or motor is at rated FLA.
   a. Do not use motor service factor.
4. Plot the TAB data on manufacturer's pump performance curve.
   a. Include performance curve in TAB report.
   b. The following information shall be provided:
      i. Plot valve shut head.
      ii. Plot valve open head and GPM and verify motor will not overload.
      iii. Plot impeller curve

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iv. Plot final operating head and GPM and label data point OPERATING POINT
v. Plot design head and GPM and label data point DESIGN POINT
vi. Plot system-operating curve

5. If design GPM (-5%/+10%) cannot be obtained, provide specific recommendations in order to obtain design GPM.

B. Provide test reports and data in the following order:

1. Pump Test Report (8.10.K).
2. Pump Performance Curve.

8.5 Water Coils:

A. Adjust individual coils to within ± 10% of design GPM, as long as total system water flow is within -5%/+10% of design GPM.

B. Refer to Article 3.3, C.

8.6 Noise: Provide Acoustical Test Report (8.10.X) for those areas that, during TAB work, appear to have an objectionable noise level.

A. Plot octave band acoustical data on NC curves in order to identify problem frequencies and to quantify the level of attenuation required.

B. For student occupied areas, NC levels shall be NC35 or less.

8.7 Venturis: Provide calibration charts (GPM versus differential head loss) in TAB report.

8.8 Balancing Valves and Combination Balancing/Shutoff Valves:

A. All valves used to set GPM shall have adjustable memory stops.

B. Permanently mark the final position of each memory stop.

8.9 Volume Dampers:

A. All dampers used to set CFM shall have locking quadrants.

B. Permanently mark the final position of each locking quadrant.

C. For externally insulated ducts, all volume dampers shall have 2" high standoffs for the locking quadrants.

8.10 Report Forms

A. Each test report shall bear the name of the person recording the data, the date of the recording, and the seal of the supervisor.

1. Test reports shall be computer generated and shall provide all data listed, as well as any required data not listed.

B. Title Page

1. Date
2. Project's name and address
3. Project number (SDPBC)
4. Architect's name and address
5. Design Mechanical Engineer's name and address
6. General Contractor's name and address

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7. Mechanical Contractor's name and address
8. TAB Contractor's name, address, and phone number

C. Certification Page
1. Project's name and address
2. Certification statement
3. TAB Contractor's name
4. TAB Supervisor's name
5. Certification number
6. Date
7. Seal and signature of TAB Supervisor

D. Instrument Calibration Report
1. Instrument
2. Manufacturer
3. Model number
4. Serial number
5. Range
6. Calibration date

E. Central Station Air Handler Unit Test Report
1. Air Handler Unit Data
   a. Mark
   b. Manufacturer, model number and serial Number
   c. Wheel type, forward curve (FC), airfoil (AF), and backward incline (BI)
   d. Wheel diameter (IN)
   e. Fan arrangement: Draw through (DT), blow through (BT)
   f. Fan discharge: Up blast front (UBF), up blast rear (UBR), top horizontal (TH), bottom horizontal (BH)
   g. Number of fan belts, manufacturer, and size
   h. Number of filters, type, and size
   i. Note if the filter pull strip and spacers are installed.
      i. If there are obvious leak paths around the filters, the AHU is not acceptable until the leaks are repaired.
2. Motor Data
   a. Manufacturer
   b. Frame size
   c. Nameplate HP, volts, amps, phase, RPM, and service factor
   d. Starter size and overload element capacity, amps
3. Performance Data (Design and Actual)
   a. Supply air CFM
   b. Outside air CFM

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c. Fan RPM
d. Motor-volts T1-T2, T2-T3, T3-T1
e. Motor FLA T1, T1, T3
f. Fan total static pressure, IN WC
g. Fan suction static pressure, IN WC (Actual)
h. Fan discharge static pressure, IN WC (Actual). Refer to Article 8.2, A.5.e.
i. Filter static pressure loss, IN WC
j. Cooling coil static pressure loss, IN WC
k. Heating coil static pressure loss, IN WC
l. Reheat coil static pressure loss, IN WC
m. AHU casing static pressure loss, IN WC
n. External static pressure loss, IN WC
o. Inlet guide vane position at design CFM (Actual)
p. Variable speed drive output at design CFM (Actual)
q. Note any abnormal vibration.

F. Coil Test Report

1. Coil Data
   a. AHU Mark
   b. Number of rows and fins per foot
   c. Coil CFM
   d. Face area, SF
   e. Face velocity, FPM
2. Air-side Performance Data (Design and Actual)
   a. Outside air CFM
   b. Outside air DB and WB temperatures, °F
   c. Return air CFM.
   d. Return air DB and WB temperatures, °F.
   e. Coil CFM
   f. Coil entering air DB and WB temperatures, °F.
   g. Coil leaving air DB and WB temperatures, °F.
   h. Calculate coil capacity, BTUH (=4.5*CFM*DH)
3. Water-side Performance Data (Design and Actual)
   a. Coil GPM
   b. Coil entering water temperature, °F.
   c. Coil leaving water temperature, °F.
   d. Coil head loss, FT (=2.31*PSID)
   e. Venturi diameter, IN (Actual)
   f. Venturi differential head, IN WC (Actual)
   g. Calculate coil capacity, BTUH (=500*GPM*DT)

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G. Fan (Outdoor, Supply, Exhaust, Relief, etc.) Test Report
   1. Fan Data
      a. Mark
      b. Manufacturer, model number and serial number
      c. Type: Ceiling, inline, roof, wall
      d. Wheel type: Forward curve (FC), airfoil (AF), backward incline (BI)
      e. Wheel diameter, IN
      f. Number of belts, manufacturer, and size
   2. Motor Data
      a. Manufacturer
      b. Frame size
      c. Nameplate HP, volts, amps, phase, RPM, and service factor
      d. Starter size and overload element capacity, amps
   3. Performance Data (Design and Actual)
      a. CFM
      b. Fan RPM
      c. Fan suction static pressure, IN WC (Actual)
      d. Fan discharge static pressure, IN WC (Actual)
      e. Fan total static pressure, IN WC
      f. Motor volts T1-T2, T2-T3, T3-T1
      g. Motor FLA T1, T2, T3
      h. Note any abnormal vibration.

H. Air Outlet Test Report
   1. Outlet Data
      a. Mark
      b. Manufacturer
      c. Drawing and actual room numbers (both room numbers)
      d. Type: Ceiling diffuser (CD), sidewall grille (SWG), exhaust grille (EG), return grille (RG), transfer grille (TG), etc.
      e. Size, IN
   2. Performance Data
      a. Design CFM
      b. Actual CFM
      c. Note all outlets that are not balanced within ±10% of design.
         i. (Actual CFM-Design CFM)/ Design CFM) *100
      d. Note all outlets with an objectionable noise level. See Article 8.6

I. Duct Heater Test Report
   1. Unit Data
      a. Mark
      b. Manufacturer, model number and serial number

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c. Design KW, volts, amps, phase, and number of steps

2. Performance Data (Actual)
   a. Volts T1-T2, T2-T3, T3-T1
   b. Amps T1, T2, T3

J. Unit Ventilator/Fan Coil Unit Test Report
1. Unit Data
   a. Mark
   b. Manufacturer, model number and serial number
   c. Control valve: 2-way or 3-way, 2-position or modulating.
   d. Fan motor nameplate HP, volts, amps, phase, RPM, and service factor
   e. Electric heater KW, volts, amps, phase, and number of steps
2. Performance Data (Design and Actual)
   a. Outside air CFM
   b. Fan motor volts T1-T2, T2-T3, T3-T1
   c. Fan motor FLA T1, T2, T3
   d. Coil GPM
   e. Coil entering water temperature, °F.
   f. Coil leaving water temperature, °F.
   g. Venturi size, IN (Actual)
   h. Venturi differential head, IN WC (Actual)
   i. Heater volts T1-T2, T2-T3, T3-T1
   j. Heater amps T1, T2, T3

K. Pump Test Report
1. Pump Data
   a. Mark
   b. Manufacturer, model number and serial number
   c. Design GPM, head, RPM, and impeller diameter
   d. Required NPSH
   e. Seal type
2. Motor Data
   a. Manufacturer
   b. Frame size
   c. Nameplate HP, volts, amps, phase, RPM, and service factor
   d. Starter size and overload element capacity, amps
3. Performance Data
   a. Valve shut differential head, FT.
   b. Actual impeller diameter, IN
   c. Valve open differential head FT verify motor will not overload.
   d. Valve open GPM
   e. Final suction pressure, PSIG

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f. Final discharge pressure, PSIG
g. Final pump head, FT (=2.31*PSIG)
h. Final pump GPM
i. Motor volts T1-T2, T2-T3, T3-T1
j. Motor amps T1, T2, T3
k. Note any abnormal vibration.

L. Duct Traverse Test Report
1. Duct Data
a. System/Branch
b. Size, IN
c. Area, SF
d. Design airflow, CFM
e. Design velocity, FPM
2. Traverse Data
a. Duct static pressure, IN WC
b. Air temperature, °F
c. Traverse position, IN
d. Traverse velocity pressure, IN WC
e. Traverse velocity, FPM
f. Average duct velocity, FPM
g. Measured airflow, CFM

M. Chiller Test Report
1. Chiller Data
a. Mark
b. Manufacturer, model number and serial number
c. Chiller volts, amps, and phase
d. Starter size and overload element capacity, amps
2. Evaporator Data (Design and Actual)
a. CHW temperature set point, °F.
b. Entering/leaving CHW temperature, °F
c. Entering/leaving CHW pressure, PSIG
d. Differential CHW head, FT (=2.31*PSID)
e. GPM
f. Capacity, TONS (=GPM*DT/24)
g. Note: Test each chiller at full load
3. Compressor Data (Design and Actual)
a. Manufacturer, model number and serial number
b. Volts T1-T2, T2-T3, T3-T1
c. Amps T1-T2, T2-T3, T3-T1

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4. Air Cooled Condenser Data (Design and Actual)
    a. Number of fans
    b. Fan motor HP, volts, amps, and phase
    c. Ambient temperature, °F
5. Water Cooled Condenser Data (Design and Actual)
    a. Entering/leaving CW temperature, °F
    b. Entering/leaving CW pressure, PSIG
    c. Differential CW head, FT (=2.31*PSID)
    d. GPM

N. Cooling Tower Test Report
1. Cooling Tower Data
    a. Mark
    b. Manufacturer, model number and serial number
    c. Fan motor HP, volts, amps, RPM, phase, and service factor
    d. Starter size and overload element capacity, amps
    e. Number of fan belts, manufacturer, and size
2. Performance Data (Design and Actual)
    a. Entering/leaving CW temperature, °F
    b. Design WB temperature, °F
    c. Ambient DB/WB temperatures, °F
    d. GPM
    e. Fan motor volts T1-T2, T2-T3, T3-T1
    f. Fan motor amps T1-T2, T2-T3, T3-T1
    g. Note any abnormal vibration.
3. Temperature Control System Data (Actual)
    a. Single speed fan: Aquastat set point (°F) for fan on/off.
    b. Two speed fan: Aquastat set points (°F) for fan high/low/off.

O. Heat Exchanger Test Report
1. Heat Exchanger Data
    a. Mark
    b. Manufacturer, model number and serial number
    c. Design capacity, BTUH
    d. Primary/secondary fluids
2. Performance Data (Design and Actual)
    a. Primary entering/leaving temperatures, °F.
    b. Primary entering/leaving pressures, PSIG.
    c. Primary differential head, FT (=2.31*PSID)
    d. Primary GPM
    e. Calculate primary capacity, BTUH (=500*GPM*DT)
    f. Secondary entering/leaving temperatures, °F.

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g. Secondary entering/leaving pressures, PSIG.
h. Secondary differential head, FT (=2.31*PSID)
i. Secondary GPM
j. Calculate secondary capacity, BTUH (=500*GPM *DT)

P. Variable Air Volume Box Test Report
1. Box Data
a. Mark
b. Manufacturer, model number and serial number
c. Fan HP, volts, amps, and phase
d. Heater KW, volts, amps, phase, and number of steps
2. Performance Data (Design and Actual)
a. Cooling CFM: Primary maximum/minimum
b. Heating CFM: Primary minimum/secondary/total
c. Heater volts T1-T2, T2-T3, T3-T1
d. Heater amps T1, T2, T3
e. Fan volts T1-T2
f. Fan amps T1

Q. Boiler (Space Heating) Test Report
1. Unit Data
a. Mark
b. Manufacturer, model number and serial number
c. Type
d. Fuel
e. Number of passes
f. Ignition type
g. Burner control
h. Power supply volts, amps, and phase
i. Input/output, MBH
2. Performance Data (Design and Actual)
a. Entering/leaving HW temperatures, °F
b. Entering/leaving HW pressures, PSIG
c. Differential water head, FT (=2.31*PSID)
d. GPM
e. Volts T1-T2, T2-T3, T3-T1
f. Amps T1, T2, T3

R. Make-up Water System Test Report
1. Backflow Preventer
a. Manufacturer and model number
b. Type: Backflow preventer shall be reduced pressure type
c. Size, IN

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d. Install a discharge funnel/air gap.
e. Pipe the discharge to a floor drain (interior location) or to 12" AFG (exterior location)

2. Pressure Regulating Valve
   a. Manufacturer and model number
   b. Set point, PSI, refer to Article 8.10, S.1.c.
   c. Size, IN

3. Pressure Relief Valve
   a. Manufacturer and model number
   b. Set point, PSI.
   c. Size, IN
   d. Pipe the discharge to a floor drain (interior location) or to 12" AFG (exterior location)

S. Expansion Tank Test Report
   1. Full Acceptance Bladder Expansion Tank:
      a. Manufacturer and model number
      b. Acceptance tank volume, GAL
      c. Pre-charged pressure, PSIG
      d. Set point of the pressure-regulating valve shall be equal to the tank pre-charge pressure.
   2. Diaphragm expansion tanks are not acceptable.
   3. Closed compression tanks are not acceptable.

~~T. Surface Heater Test Report~~
~~1. Unit Data~~
~~a. Mark~~
~~b. Manufacturer, model number and serial number~~
~~c. Design KW, volts, amps, and phase~~
~~2. Performance Data (Actual)~~
~~a. Volts T1-T2, T2-T3, T3-T1~~
~~b. Amps T1, T2, T3~~

~~U. Rooftop Unit Test Report~~
~~1. Unit Data~~
~~a. Mark~~
~~b. Manufacturer, model number and serial number~~
~~c. Number of filters, type, and size~~
~~2. Evaporator Fan and Motor Data~~
~~a. Motor nameplate HP, volts, amps, phase, RPM, and service factor~~
~~b. Number of fan belts, manufacturer, and size~~
~~3. Evaporator Fan Data (Design and Actual)~~
~~a. Supply air CFM~~
~~b. Outside air CFM~~
~~c. Fan RPM~~

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~~d. Motor volts T1-T2, T2-T3, T3-T1~~
~~e. Motor amps T1, T2, T3~~
~~f. Fan total static pressure, IN WC~~
~~g. Fan suction static pressure, IN WC (actual)~~
~~h. Fan discharge static pressure, IN WC (actual)~~
~~i. Determine value from fan curve based on CFM and RPM~~
~~ii. Refer to Article 8.2, A.5.e.~~
~~i. External static pressure, IN WC~~
~~j. Note any abnormal vibration.~~

~~4. Evaporator Coil Data (Design and Actual)~~
~~a. Coil CFM~~
~~b. Coil entering air DB/WB temperatures, °F.~~
~~c. Coil leaving air DB/WB temperatures, °F.~~
~~d. Coil capacity, BTUH (=4.5*CFM*DH)~~
~~e. Coil circuiting: row split (intertwined) or face split~~

~~5. Condensing Unit Data (Design and Actual)~~
~~a. Number of compressors/circuits~~
~~b. Ambient temperature, °F~~
~~c. Compressor volts T1-T2, T2-T3, T3-T1~~
~~d. Compressor amps T1, T2, T3~~
~~e. Number of condenser fans (Actual)~~
~~f. Condenser fan HP, volts, amps, phase, RPM (Actual)~~

~~6. Heater Data (Design and Actual)~~
~~a. KW (Design)~~
~~b. Volts T1-T2, T2-T3, T3-T1~~
~~c. Amps T1, T2, T3~~
~~d. Number of steps~~

~~V.~~T. Condensing Unit Test Report

1. Unit Data
   a. Mark
   b. Manufacturer, model number and serial number
   c. Number of compressors/circuits
2. Compressor Data
   a. Ambient temperature, °F
   b. Compressor volts T1-T2, T2-T3, T3-T1
   c. Compressor amps T1, T2, T3
3. Condenser Fan Data
   a. Number of fans
   b. Fan HP, volts, amps, phase, and RPM

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~~W.~~U. Packaged Terminal Air Conditioner Test Report

1. Mark
2. Manufacturer, model number and serial number
3. Nameplate volts, amps, and phase
4. Outside air CFM
5. Nameplate cooling capacity, BTUH
6. Cooling mode volts and amps
7. Nameplate heating capacity, KW
8. Heating mode volts and amps

~~X.~~V. Acoustical Test Report

1. Drawing and actual room numbers (both room numbers).
2. Noise level (dB re 10-12W) by octave band (63 Hz, 125 Hz, 250 Hz, 500 Hz, 1000 Hz, 2000 Hz, 4000 Hz, 8000 Hz), dBA scale.
3. NC. Plot noise levels on NC curve.
4. Note which systems are not within acceptable tolerance (NC35 or less in student occupied areas).

PART 9 DEMONSTRATION AND TRAINING

9.1 Training of the Owner's operation and maintenance personnel is required in cooperation with the Owner's Representative.

A. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems.

B. Schedule the instructions in coordination with the Owner's Representative after submission and approval of formal training plans.

C. Refer to Section 01 91 00, Commissioning, for further contractor training requirements.

9.2 Demonstration and training shall include an overview of the TAB procedures and results.

END OF SECTION

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SECTION 23 07 13

DUCTWORK INSULATION

PART 1 GENERAL

1.1 REFERENCES

A. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate

B. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation

C. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications

D. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation

E. ASTM C921 - Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation

F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials

1.2 SUBMITTALS

A. Submit under provisions of Section 23 05 00.

B. Product Data: For each product used in this project, provide catalog data for insulation, jackets and accessories, and installation instructions.

C. Samples: Not required

1.3 QUALITY ASSURANCE

A. Materials: Flame spread/smoke developed rating of 25/50 or less in accordance with ASTM E84.

B. Applicator: A company specializing in performing the work of this section with minimum 3 years of experience.

1.4 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to site in original factory packaging, labeled with manufacturer's identification, including density and thickness.

B. Store insulation in original wrapping and protect from weather and construction traffic.

C. Protect insulation against dirt, water, chemical and mechanical damage.

PART 2 PRODUCTS

2.1 FLEXIBLE FIBER GLASS INSULATION

A. Provide flexible, noncombustible, minimum R-6 (per plans) blanket insulation made from highly resilient, inorganic glass fibers bonded by a thermosetting resin.

1. Density shall be 1 lb/cu ft. K-value shall be 0.28 at 75°F.
2. ASTM C553

B. Provide factory applied, foil-scrim-kraft vapor barrier with 2" wide stapling flange.

1. ASTM C921

C. Vapor Barrier Tape: Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive adhesive.

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2.2 RIGID FIBER GLASS INSULATION

A. Provide semi-rigid, noncombustible, board insulation made from highly resilient, inorganic glass fibers bonded by a thermosetting resin.

1. Density shall be 6-lb/cu ft.
2. K-value shall be 0.22 at 75°F, ASTM C612.

B. Provide factory applied, foil-scrim-kraft vapor barrier. ASTM C921

C. Vapor Barrier Tape: Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive adhesive.

2.3 CELLULAR GLASS INSULATION

A. Provide molded, impermeable, noncombustible, cellular glass equipment insulation.

1. K-value shall be 0.35 at 75°F, ASTM C552.

B. Provide open mesh, synthetic membrane to reinforce mastic finishes.

1. Thread count shall be 6 strands by 6 strands per square inch.
    a. Thickness shall be 27 mils.

C. Provide 18-ga, Type 304 stainless steel tie wire with twisted ends on maximum 12" centers.

D. Provide flexible, acrylic latex coating for use with cellular glass insulation to provide a vapor barrier finish.

2.4 ALUMINUM JACKET

A. Provide 20-mil thick stucco embossed pattern finish, Type 1100 aluminum jacket per ASTM B209

B. Provide 0.5" wide, 20-mil thick, Type 3003 aluminum bands on maximum 24" centers.

2.5 FIBER GLASS DUCT LINER

A. Duct liner in contact with the air stream is NOT acceptable.

PART 3 EXECUTION

3.1 EXAMINATION

A. Before applying insulation, verify the inspection, testing and approval of ductwork is complete.

B. Before applying insulation, verify that surfaces are clean (with foreign material removed) and dry.

C. Before applying insulation, verify the installation of 2" high quadrant standoffs for volume dampers.

D. Before applying insulation, verify the installation of 2" high brackets for motorized dampers.

3.2 INSTALLATION

A. Install materials in accordance with manufacturer's instructions.

B. Ductwork and equipment insulation or covering shall not penetrate fire-rated assembly unless the specific material has been tested and approved as part of the fire-rated assembly, (FBC)

1. Where not prohibited by code continue insulation through non-rated partitions, sleeves, hangers, and other penetrations.

C. Flexible Fiber Glass Insulation

1. Wrap insulation around ductwork with facing to the outside so that the 2" flap completely overlaps the facing and the insulation at the other end of stretch out.

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2. Place insulation snugly butted ductwork and other insulation.
3. Staple seams with outward clinching staples on maximum 6" centers.
    a. Seal seams with vapor barrier tape or two coats of vapor barrier mastic reinforced with 4" wide, open weave glass fabric.
4. For ductwork 24" wide or greater, secure the insulation on the underside of the ductwork with mechanical fasteners and speed clips on maximum 18" centers.
    a. Cut-off the protruding ends of the fasteners flush after installing the speed clips and seal with vapor barrier tape or mastic.
5. Repair facing damage with vapor barrier tape or mastic.
6. Insulate entire system including fittings, joints, flanges, etc.

D. Rigid Fiber Glass Insulation
1. Install insulation around ductwork with facing to the outside with joints firmly butted.
2. Secure insulation with mechanical fasteners and speed clips located a maximum of 3" from each edge and spaced on a maximum of 12" centers.
    a. Cut-off the protruding ends of the fasteners flush after installing the speed clips and seal with vapor barrier tape or mastic.
3. Overlap vapor barriers a minimum of 2" and seal with vapor barrier tape or mastic.
4. Repair facing damage with vapor barrier tape or mastic.
5. Insulate entire system including fittings, joints, flanges, etc.

E. Cellular Glass Insulation
1. Install insulation to ductwork with all joints tightly fitted and buttered with joint sealer.
    a. Eliminate voids by refitting or replacing insulation.
    b. Do NOT fill voids with joint sealer.
2. Apply insulation as close as possible to ductwork by grooving, scoring, and beveling insulation, if necessary.
    a. Secure insulation with studs, pins, clips, adhesive, wires, or bands.
3. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface.
    a. Use vapor barrier cement.
4. Provide vapor barrier mastic, reinforcing membrane and aluminum jacket.
    a. For horizontal ductwork, locate aluminum jacket seams on bottom of ductwork.
    b. Caulk all seams.
5. Insulate entire system including fittings, joints, flanges, etc.

3.3 SCHEDULE

A. Supply Air Ductwork
1. For single wall sheet metal ductwork in concealed locations, provide 2" thick, 1.0 lb/cu ft, flexible fiberglass insulation.
2. For single wall sheet metal ductwork in exposed areas, provide 1.5" thick, 6.0 lb/cu ft, rigid fiberglass insulation.
    a. This includes mechanical equipment rooms.

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3. Double wall pre-insulated ductwork does not require additional insulation.

B. Return Air Ductwork

1. For single wall sheet metal ductwork located within the conditioned thermal envelope of the building, insulation is NOT required, unless indicated otherwise in the design documents.
2. For single wall sheet metal ductwork located outside of the conditioned thermal envelope of the building, provide insulation the same as for Supply Air Ductwork.

C. Exhaust Air Ductwork: Insulation is NOT required.

D. Outdoor Air Ductwork

~~1. For non-conditioned outdoor air, insulation is usually NOT required see plans.~~

~~a. Engineer may require exterior duct insulation to eliminate sweating inside the non-conditioned outdoor air duct.~~

~~2.~~1. For ~~conditioned~~ outdoor air, provide minimum R-6 (per plans) insulation the same as for supply air ductwork.

~~a. Conditioned outdoor air is defined as outdoor air that has been dehumidified (cooled) or dehumidified (cooled) and reheated.~~

E. Ceiling Diffusers: For lay-in type border, insulate the back of the ceiling diffuser with 2" thick, 1.0 lb/cu ft, flexible fiberglass insulation.

1. Seal the insulation to the perimeter of the extended panel (NOT to T-bar grid) with vapor barrier tape.
2. Seal the insulation to the flexible duct with vapor barrier mastic.

F. Stand-offs for Volume Dampers and Brackets for Motorized Dampers:

1. For insulated ducts, insulate the space between the duct and standoff or bracket with 2" thick, 1.0 lb/cu ft, non-faced, flexible fiberglass insulation.
2. Insulate up to the standoff or bracket, and seal with vapor barrier mastic.

G. Fire Dampers: Insulate the fire damper sleeve with the same type and thickness of insulation as the adjacent ductwork.

H. To prevent condensation on the partition, insulate a 12" wide area around the fire damper sleeve on both sides of the partition.

1. Insulate the partition with 1.5" thick, 6.0-lb/cu ft, rigid fiberglass insulation.
2. Seal the partition insulation to the partition with vapor barrier tape.
3. Seal the partition insulation to the ductwork insulation with vapor barrier tape and mastic.
4. Partition insulation shall be above the ceiling.

I. Flexible Connections: Insulate with 2" thick, 1.0 lb/cu ft, flexible fiberglass insulation.

1. Seal with vapor barrier tape and mastic.

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SECTION 23 07 16
HVAC EQUIPMENT INSULATION

PART 1 GENERAL

1.1 REFERENCES

A. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
B. ASTM C534 – Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
C. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation
D. ASTM C1534 – Standard Specification for Flexible Polymeric Sheet Insulation Used as a Thermal and Sound Absorbing Liner for Duct Systems
E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials

1.2 SUBMITTALS

A. Submit under provisions of Section 23 05 00.
B. Product Data: For each product used in this project, provide catalog data for insulation, jackets and accessories, and installation instructions.
C. Samples: Not required

1.3 QUALITY ASSURANCE

A. Materials: Flame spread/smoke developed rating of 25/50 or less in per ASTM E84.
B. Applicator: A company specializing in performing the work of this section with minimum 3-years experience.

1.4 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
B. Store insulation in original wrapping, and protect from weather and construction traffic.
C. Protect insulation against dirt, water, chemical, and mechanical damage.

PART 2 PRODUCTS

2.1 CELLULAR GLASS INSULATION

A. Provide molded, impermeable, noncombustible, cellular glass equipment insulation, with a K-value of 0.35 at 75°F. ASTM C552
    1. For interior applications, provide vapor barrier mastic and reinforcing membrane or 5 ply self-adhesive vapor barrier mold inhibiting jacket (0.0000 perms)
    2. For exterior applications, provide vapor barrier mastic, reinforcing membrane and aluminum jacket or : eliminate the mastic and aluminum jacket and use one product 5 ply self-adhesive vapor barrier mold inhibiting jacket (0.0000 perms), UV stable; no additional mechanical attachments needed.
B. Provide open mesh, synthetic membrane to reinforce mastic finishes, with a thread count of 6 strands by 6 strands per square inch and a thickness of 27 mils.
C. Provide 18-ga, Type 304 stainless steel tie wire with twisted ends on maximum 12" centers.
D. Provide flexible, acrylic latex coating for use with cellular glass insulation to provide a vapor barrier finish.

2.2 ALUMINUM JACKET

A. Provide 20-mil thick, stucco embossed pattern finish, Type 1100 aluminum jacket, and on horizontal equipment, locate seams on bottom. ASTM B209
B. Provide 0.5" wide, 20-mil thick, Type 3003 aluminum bands on maximum 24" centers.

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2.3 5 PLY SELF-ADHESIVE VAPOR BARRIER AND WEATHER BARRIER JACKET
- A. For pipes, provide Self-Adhesive high performance Vapor Barrier and Weather Barrier Jacket 6mils thick with a perm rating of 0.0000 and is UV stable– finishes include; stucco embossed white, embossed black and smooth silver, with 10-year warranty.
- B. High performance acrylic adhesive capable of installation with no further mechanical attachments

2.4 AMRAFLEX/ARMACELL – ELASTOMERIC THERMAL INSULATION
- A. Fiber free, closed cell and low VOC
- B. Provide built-in vapor barrier
- C. 2” thickness with R-Value of R-8
- D. Apply sheet insulation to unit with manufacturer’s recommended adhesive glue all joints.

PART 3 EXECUTION

3.1 EXAMINATION
- A. Before applying insulation, verify that equipment inspection, testing and approval are complete.
- B. Before applying insulation, verify that surfaces are clean (all foreign material removed) and dry.

3.2 INSTALLATION
- A. Install materials in accordance with manufacturer's instructions.
- B. Do not insulate factory-insulated equipment.
- C. On exposed equipment, locate insulation seams in least visible locations.
- D. Apply insulation as close as possible to equipment by grooving, scoring, and beveling insulation as necessary, then secure to equipment with studs, pins, clips, adhesive, wires, or bands.
- E. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor barrier cement.
- F. Finish insulation at support, protrusions, and interruptions.
- G. Do NOT insulate over nameplate or ASME stamps, bevel and seal insulation around such.
- H. Install insulation for equipment requiring access for maintenance, repair, or cleaning, in such a manner that allows easily removal and replacement without damage.
- I. Chilled Water Pumps: Provide 2" thick, cellular glass equipment insulation.
  1. Install block insulation around pump assembly in such a fashion that it can be removed without damage to each half and secure with stainless steel bands
- J. Chilled Water Air Separators: Provide 2" thick, cellular glass equipment insulation.
- K. Chilled Water Expansion Tanks: Provide 2" thick, cellular glass equipment insulation.
- L. Chilled Water Chemical Treatment Shot Feeder: Provide 2" thick, cellular glass equipment insulation.
- M. Chilled Water Strainers at each air handler: Provide 2” thick cellular glass around assembly in such a fashion that it can be removed without damage to each half and secure with stainless steel bands

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SECTION 23 07 19
HVAC PIPING INSULATION

PART 1 GENERAL

1.1 REFERENCES

A. ASTM A53/A53M – Standard Specification for Pipe, Steel, Black and Hot Dipped, Zinc Coated Welded and Seamless
B. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
C. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
D. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation
E. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation
F. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
G. ASTM C921 - Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation
H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials

1.2 SUBMITTALS

A. Submit under provisions of Section 23 05 00.
B. Product Data: For each product used in this project, provide catalog data for insulation, jackets and accessories, and installation instructions.
C. Samples: Not required

1.3 QUALITY ASSURANCE

A. Materials: Flame spread/smoke developed rating of 25/50 or less in accordance with ASTM E84.
B. Applicator: A company specializing in performing the work of this section with minimum 3-years of experience.

1.4 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
B. Store insulation in original wrapping, and protect from weather and construction traffic.
C. Protect insulation against dirt, water, chemical and mechanical damage.

PART 2 PRODUCTS

2.1 RIGID FIBER GLASS INSULATION

A. Provide molded, heavy density, noncombustible, one-piece pipe insulation made from inorganic glass fibers bonded with a thermosetting resin and K-value of 0.28 at 75°F per ASTM C547.
B. Provide factory installed all service jacket of white kraft paper bonded to aluminum foil and reinforced with glass fibers and provide self-sealing lap for longitudinal seam and butt strips for circumferential joints per ASTM C921.
C. Provide 18-ga, Type 304 stainless steel tie wire with twisted ends on 24" centers but not less than two tie wires per insulation section.
D. Fittings and valves, provide one-piece, molded, 20-mil thick, PVC covers with fiberglass inserts.
    1. Use pressure sensitive, color matching vinyl tape to seal PVC fitting covers to jacket of insulation per ASTM C921

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2.2 FLEXIBLE FIBER GLASS INSULATION

A. Provide flexible, noncombustible, blanket insulation made from highly resilient, inorganic glass fibers bonded by a thermosetting resin.
   1. Density shall be 1.0 lb/cu ft K-value shall be 0.28 at 75°F per ASTM C553
B. Provide factory applied, foil-scrim-kraft vapor barrier with 2" wide stapling flange.
   1. Secure seams with outward clinching staples on 6" centers.
   2. Seal seams with two coats of vapor barrier mastic reinforced with 4" wide, open weave glass fabric per ASTM C921

2.3 CELLULAR GLASS INSULATION

A. Provide molded, impermeable, noncombustible, cellular glass pipe insulation, with K-value of 0.30 at 75°F per ASTM C552.
B. Interior Applications in Concealed Locations
   1. Pipe: All service jacket with self-sealing lap.
   2. Pipe: 5 ply self-adhesive vapor barrier mold inhibiting jacket (0.0000 perms)
   3. Fittings: Vapor barrier mastic and reinforcing membrane.
C. Interior Applications in Exposed Locations
   1. Pipe: Vapor barrier mastic and reinforcing membrane.
   2. Pipe: 5-ply self-adhesive vapor barrier mold inhibiting jacket (0.0000 perms) fittings either pre-formed aluminum or PVC.
   3. Fittings: Same as pipe
D. Exterior Applications
   1. Pipe: Vapor barrier mastic, reinforcing membrane and aluminum jacket.
   2. Pipe: 5-ply self-adhesive vapor barrier mold inhibiting jacket (0.0000 perms), UV stable; fittings either pre-formed aluminum or PVC.
   3. Fittings: Same as pipe
E. Buried Applications
   1. Pipe: Prefabricated material, 120 mil thick, consisting of bituminous resin reinforced with a woven glass fiber, an integral aluminum foil layer and a protective plastic film coating.
   2. 5-ply or 13-ply high performance protective jacket – back fill around the pipe 12" in diameter.
   3. Fittings: Same as pipe
F. Provide open mesh, synthetic membrane to reinforce mastic finishes, with thread count shall be 6 by 6 strands per square inch 27 mils thick.
G. Provide 18-ga, Type 304 stainless steel tie wire with twisted ends on maximum 12" centers but not less than two tie wires per insulation section.
H. Provide flexible, acrylic latex coating for use with cellular glass insulation to provide a vapor barrier finish.

2.4 CELLULAR FOAM INSULATION

A. Provide flexible, closed-cell, slit tubing form, elastomeric pipe insulation.
   1. For large diameter pipe, provide sheet form.
   2. K-value of 0.30 at 75°F
   3. Use contact adhesive to seal longitudinal seams and circumferential joints per ASTM C534/C534M.
B. Fittings and valves, fabricate insulation from mitered-cut tubular form using contact adhesive to seal joints.

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C. If necessary, provide two layers of insulation to obtain specified thickness, staggering the longitudinal and circumferential joints.

2.5 ALUMINUM JACKET

A. For pipes, provide 16- mil thick stucco embossed pattern finish, Type 1100 aluminum jacket, ASTM B209. For horizontal pipe, locate longitudinal lap on bottom.
B. Fittings provide 24-mil thick die shaped smooth finish, Type 1100 aluminum jacket, ASTM B209.
C. Provide 0.5" wide, 20-mil thick, Type 3003 aluminum bands on maximum 24" centers but not less than 2-bands per jacket section.

2.5 5-Ply Self-Adhesive Vapor Barrier and Weather Barrier Jacket.

A. Pipes; provide Self-Adhesive high performance Vapor Barrier and Weather Barrier Jacket 6-mil thick with a perm rating of 0.0000 and UV stable-finishes include, stucco embossed, white, white, embossed, black, and smooth silver, 10-year warranty.
B. Fitting, provide 24-mil thick die shaped smooth finish silver, may use PVC fitting if matching white.
C. High performance acrylic adhesive capable of installation with no further mechanical attachments

2.6 SADDLES, SHIELDS AND INSERTS

A. At all pipe hangers or pipe supports, provide 12" long 180°-arc galvanized sheet metal shields matching the insulation outside dimension.
B. For pipes larger than 2" diameter, provide 12" long 180°-arc cellular glass insulation inserts.

PART 3 EXECUTION

3.1 EXAMINATION

A. Before applying insulation, verify that piping is inspected, tested, and approved.
B. Before applying insulation, verify that surfaces are clean (foreign material removed) and dry.
C. Before applying insulation, verify the installation of the brass thermo wells with 2.5" lagging extensions.
D. Before applying insulation, verify the installation of the 4" long brass nipples for gage cocks.

3.2 INSTALLATION

A. Install materials in accordance with manufacturer's instructions.
B. Exposed insulation, provide jacket or finish, and locate longitudinal seams in least visible locations.
    1. Where insulated piping extends to weather exposed areas, provide specified aluminum sheet metal jacket.
C. Piping, ductwork and equipment insulation or covering shall not penetrate fire-rated assembly unless the specific material has been tested an approved as part of the fire-rated assembly. (FBC,)
D. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe.
E. For above grade applications, maintain 0.5" air space on all sides of the insulation.
F. Finish insulation at supports, protrusions, and interruptions.
G. Chilled Water Black Steel Pipe, Schedule 40 ASTM A53/A53M Grade B
    1. Provide cellular glass insulation with vapor barrier jacket for pipe, fittings, valves, strainers, unions, flanges, etc. No Armaflex permitted.
    2. Apply insulation with all joints tightly fitted and buttered with joint sealer.
        a. Eliminate voids by refitting or replacing insulation.
        b. Do NOT fill voids with joint sealer.
    3. Interior Applications:
        a. Pipes 3" diameter and smaller, provide 1.5" thick insulation.
        b. Pipes larger than 3" diameter provide 2" thick insulation.

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4. Exterior and Buried Applications: All pipe sizes provide 2" thick insulation.
5. Expansion joints:
   a. Flexible connections and mechanical couplings for grooved pipe provide two layers of 1" thick cellular foam insulation.
   b. The longitudinal seam for each layer shall be staggered 180°.
   c. The cellular foam insulation shall overlap the cellular glass insulation a minimum of 3".
6. Provide 1½" cellular glass insulation with vapor barrier jacket for pipe to the expansion tank.
7. Provide 1½"cellular glass insulation with vapor barrier jacket for the pipe to the chilled water make-up system and chilled water chemical treatment system for a minimum length of 6' from the chilled water pipe.

H. Chilled water pre-insulated steel pipe, schedule 40.
1. Carrier pipe shall be black steel schedule 40 ASTM A53/A53M Grade B, surrounded with polyurethane closed cell insulation enclosed in PVC outer jacket.
2. Insulate all joints per manufacturer's requirements, after completing the welding and passing the hydrostatic testing.
3. Use coupling insulation kits of field mixed urethane components poured into a PVC mold sealed to form a watertight seal.
4. Use fitting insulation kits of field mixed urethane components poured into a PVC molded fitting cover, then tape to form a watertight seal.

I. Refrigerant Pipe (Interior and Above Grade Applications)
1. For suction lines, provide 1" thick, cellular foam insulation.
2. For liquid lines, insulation is not required.
3. For hot gas lines, provide ¾" thick, cellular foam insulation.
4. Jacket is not required.

J. Refrigerant Pipe (Exterior Applications)
1. For suction lines, provide 1" thick, cellular foam insulation.
2. For liquid lines, insulation is not required.
3. For hot gas lines, provide ¾" thick, cellular foam insulation.
4. For pipe and fittings insulation, provide 2-coats of UV protection paint or 5-ply Self Adhesive laminate UV stable offers 10-year warranty.
5. Foe vertical wall installations provide galvanized or stainless steel chase cover.

K. Refrigerant Pipe (Buried Applications)
1. For suction lines, provide 1" thick, cellular foam insulation.
2. For liquid lines, insulation is not required.
3. For hot gas lines, provide ¾" thick, cellular foam insulation.
4. Route pipe within schedule 40 PVC sleeve with ends sealed watertight.

END OF SECTION

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SECTION 23 08 00
COMMISSIONING of HVAC SYSTEMS

PART 1 GENERAL

1.1 The District, under separate contract, shall provide an independent Testing, Adjusting, and Balancing (TAB) Contractor to perform TAB work for the HVAC systems.

1.2 The TAB Contractor shall be the District's representative for all TAB activities.

1.3 The Mechanical Contractor shall assist the TAB Contractor in performing his work as noted in PART 3 - EXECUTION and in Section 23 05 93 - TAB of HVAC Systems.

1.4 COMMISSIONING

A. Commissioning of a system or systems specified in this section is part of the construction process.

B. Documentation and testing of these systems, as well as training of the Owner's operation and maintenance personnel, is required in cooperation with the Owner's Representative and the Commissioning Provider.

C. Project Closeout is dependent on successful completion of all commissioning procedures, documentation, and issue closure.

D. Refer to Section 01 77 00 - Contract Closeout, for substantial completion details.

E. Refer to Section 01 91 00, Commissioning, for detailed commissioning requirements.

PART 2 PRODUCTS

2.1 None required

PART 3 EXECUTION

3.1 The Mechanical Contractor shall furnish to the TAB Contractor a complete set of architect supplement instructions, addenda, approved HVAC shop drawings, equipment performance sheets, change orders, etc. as requested by the TAB Contractor.

A. The District shall furnish to the TAB Contractor, a complete set of mechanical plans and Division 23 specifications.

3.2 The Mechanical Contractor shall coordinate with the TAB Contractor to establish written schedules for pre-TAB inspections and for TAB work.

A. Note Substantial Completion and Final Completion milestones on the HVAC/TAB schedules.

B. Complete the schedule TAB work prior to Substantial Completion.

C. HVAC/TAB schedule shall be consistent with and shown on the project's Critical Path Management schedule.

D. Any change in construction schedules that affect the TAB work shall be coordinated with the TAB Contractor.

3.3 The Mechanical Contractor shall notify the Commissioning Provider and TAB Contractor of hydronic system commissioning so that the Commissioning Provider and/or TAB Contractor can monitor the cleaning, flushing, filling, and chemical treatment, and observe water samples being drawn and tested.

A. Provide chemical treatment test report to the Commissioning Provider and TAB Contractor within 10 calendar days of completed tests.

3.4 The TAB work shall not commence until the Commissioning Provider and TAB Contractor have received written notice from the Mechanical Contractor that all HVAC systems are 100% complete and are operational.

A. Phase the TAB work for large projects, on a building-by-building basis.

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

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

3.7 As discovered or at least weekly, the TAB Contractor shall provide the Mechanical Contractor TAB punch lists of non- complying HVAC work.

A. The Mechanical Contractor shall replace or repair non-complying work within two workdays of receipt of written punch list and shall provide written notification of repairs to the TAB Contractor.
B. The TAB Contractor provides one re-TAB per item within his contract with the District.
C. Additional TAB fees due to repeat TAB punch items are the responsibility of the Mechanical Contractor and a Change Order reducing the Contract Amount shall reflect this.

3.8 If the TAB Contractor is prevented from completing his work in a timely and continuous manner (according to the established HVAC/TAB schedule) due to non-operable and/or incomplete HVAC systems, all additional fees for TAB work shall be the responsibility of the Mechanical Contractor and shall be affected by Change Order reducing the Contract Amount.

3.9 The District shall not release the Mechanical Contractor's 10% retainage until notified, in writing, by the TAB Contractor that all HVAC systems have been successfully Tested and Balanced in accordance with Contract Documents and Section 23 05 93.

3.10 The Mechanical Contractor shall verify the following items to ensure proper start-up and preliminary adjustments of air distribution systems.

A. Verify the air grilles (supply, return, exhaust, etc.) installation and connection to the duct system.
B. Verify that duct systems are clean of debris.
C. Verify that ducts attached with flexible connectors align (longitudinal) within ± 0.25", have a uniform gap within ± 0.25", and have a nominal gap width of 2.0".
    1. Flexible duct connectors shall not leak.
D. Verify that filters are clean, and the filter pull strips and spacers installed.
    1. Filter module shall NOT allow leaks around the filters.
E. Verify that balancing dampers are operational and fully opened.
    1. For externally insulated ductwork, verify the installation of 2" high standoff brackets for the locking quadrants.
F. Verify that fire and/or smoke dampers are fully open.
G. Verify proper fan rotation.
H. Verify proper belt drive alignment.
I. Verify capacity of fan motor overload elements (1.25*FLA).

3.11 The Mechanical Contractor shall verify the following items to ensure proper start-up and preliminary adjustments of hydronic systems.

A. Verify that the hydronic systems properly flushed, filled, purged, and chemically treated.
B. Verify that the strainer baskets/screens are clean.
C. Verify that pump/motor shaft has correct alignment.
D. Verify proper pump rotation.
E. Verify that all balancing valves are fully open and equipped with adjustable memory stops.
F. Verify that gauge cocks, pressure gages, and thermometers properly installed at coils, pumps, chillers, heat exchangers, etc.
    1. Extensions to allow for pipe insulation are required.

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2. Gage cocks and pressure gages at pumps shall utilize pump flange taps in order for head measurements to correlate with the pump performance map.
3. Gage cocks at chillers shall utilize evaporator and condenser manifold gage taps in order for head measurements to correlate with the manufacturer's data.

G. Verify capacity of pump motor overload elements (1.25*FLA).
H. Verify that all Venturis properly installed with the minimum upstream and downstream straight pipe lengths.

3.12 The Mechanical Contractor shall verify the following items to ensure the proper start-up and preliminary adjustments of variable air volume (VAV) systems.

A. Verify that the inlet duct to the VAV box is straight for a minimum of three inlet duct diameters.
   1. Flexible duct at the box inlet is NOT acceptable.
B. Verify that the service access to the heater control panel is a minimum of 42".
C. Verify that the static pressure probe is located in the main supply air duct between the last and next-to-last takeoff to the VAV boxes or is located per the drawings.
   1. Mark the location of the probe and notify the TAB Contractor of same.
D. Verify that the actuator of the inlet guide vanes is easily accessible; if not, relocate actuator.
E. Verify that VAV boxes with bottom access are NOT located over light fixtures and that access panels are equipped with quarter-turn quick-release fasteners.

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SECTION 23 09 00
ENERGY MANAGEMENT AND CONTROL SYSTEM

PART 1 GENERAL

1.1 SCOPE

A. Provide a complete and operational Energy Management and Control System (EMCS) that incorporates Direct Digital Control (DDC) for energy management, automatic temperature control, and equipment monitoring.

B. EMCS shall be Automated Logic's WebCTRL Building Control System.

1. Automated Logic's local dealer is Wisch & Jackson Company of Florida, Inc.
2. Wisch & Jackson shall furnish all control devices, under a direct purchase agreement between Automated Logic and the District, to the EMCS Contractor for installation.

C. EMCS Contractor shall receive control devices from Wisch & Jackson and shall provide all labor and materials required to install a complete and operational EMCS unless explicitly excluded in the Contract Documents.

1.2 AUTHORIZED EMCS CONTRACTORS

A. Automated Logic shall train and approve three or more EMCS Contractors to install the EMCS.

B. Call Wisch & Jackson at (561) 747-0484 for the current list of authorized EMCS Contractors.

C. List the name of the authorized EMCS Contractor in Section 26 10 00, and List of Major Subcontractors.

1.3 COORDINATION

A. Mechanical Contractor and EMCS Contractor shall coordinate with Wisch & Jackson to establish written construction schedules for HVAC and EMCS work.

1. Construction schedule shall include adequate time to commission and calibrate the EMCS prior to Substantial Completion.
2. Any change in construction schedules that affect the EMCS work shall be coordinated with Wisch & Jackson.
3. Mechanical Contractor's 10% retainage shall not be released until the EMCS is commissioned and operating properly.

B. Mechanical Contractor shall furnish to Wisch & Jackson copies of mechanical submittals, architect supplemental instructions (ASI), requests for information (RFI), change orders, and critical project management (CPM) schedules.

1. Any change in construction schedules or equipment that affects the installation of the EMCS shall be coordinated with Wisch & Jackson and the EMCS Contractor.

C. For stadium elevators and elevators that open to the exterior of a building, provide a float switch in the elevator pit connected to the EMCS to send an alarm signal to the EMCS monitoring station when the water level in the pit reaches above the steel grate of the dry sump. General contractor shall coordinate the installation of the raceway system for the float switch. General contractor shall coordinate with the elevator inspector.

D. As the School District's representative, Wisch & Jackson shall provide supervision of the EMCS installation.

1. Wisch & Jackson shall initiate conference calls and/or schedule meetings to resolve EMCS issues in a timely manner and shall provide written documentation of solutions to the District.

E. As the School District's representative, Wisch & Jackson shall coordinate EMCS design changes with the Engineer-of-Record and the School District Mechanical Engineer.

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1. Wisch & Jackson shall initiate conference calls and/or schedule meetings to resolve EMCS issues in a timely manner and shall provide written documentation of solutions to the District.

F. EMCS Contractor shall review Divisions 25 - 28 drawings and specifications in order to provide all labor and materials required to install a complete and operational EMCS.

G. Wisch & Jackson shall coordinate EMCS Sequences of Operations and any changes with the Commissioning Authority.

1.4 SUBMITTALS

A. Wisch & Jackson shall submit shop drawings in accordance with Section 23 05 00 and shall be assigned to the Mechanical Contractor for the submittal process and review.

B. Submit the shop drawings in a timely manner and include manufacturer's specifications and engineering data for all parts, devices, and accessories used in the EMCS.

C. Shop drawings shall include material schedules, sequence of operations, equipment interlocks, point-to-point wiring diagrams, system configuration with peripheral devices, power supplies, etc.

1.5 QUALITY ASSURANCE

A. Only competent mechanics, approved by Automated Logic, with full responsibility for proper electrical operation of the EMCS shall install the EMCS.

1. In all cases, the installed system shall be in strict compliance with the Contract Documents.

B. Wisch & Jackson shall have an in-place support facility with technical staff, and all necessary test and diagnostic equipment required for basic electrical troubleshooting.

C. The complete EMCS installation shall be in strict accordance to the national and local electrical codes, and Divisions 25 - 28 of these specifications.

1. All control devices designed for or used in line voltage applications shall be UL Listed.

D. Wisch & Jackson shall provide a warranty on all supplied equipment and a labor warranty for equipment replacement.

1. EMCS Contractor shall provide an installation warranty for workmanship.
2. All warranties shall be for one year from the date of Substantial Completion or acceptance by the District whichever is later.
3. These warranties exclude any misuse or damage caused by others.

1.6 COMMISSIONING

A. Commissioning of a system or systems specified in this section is part of the construction process.

B. Documentation and testing of these systems, as well as training of the Owner’s operation and maintenance personnel, is required in cooperation with the Owner's Representative and the Commissioning Authority.

C. Project Closeout is dependent on successful completion of all commissioning procedures, documentation, and issue closure.

D. Refer to Section 01 77 00 - Contract Closeout, for substantial completion details.

E. Refer to Section 01 91 00, Commissioning, for detailed commissioning requirements.

PART 2 PRODUCTS

2.1 CONTROL WIRING

A. All conductors shall be #18AWG unshielded stranded wire meeting all building codes and regulations for fire ratings.

1. All conductors for analog points (inputs and outputs) and communications shall be as per manufacturer specifications.

B. Label and land all wiring on termination strips.

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1. Properly support all wiring and conduit and run in a neat and skillful manner.
2. All wiring and conduit exposed and in equipment, rooms shall run parallel to or at right angles to the building structure.
3. All piping and wiring within enclosures shall be neatly bundled and anchored to prevent obstruction to devices and terminals.

C. Do not pull bond or ground in conduit with sensor or communication wiring.

2.2 EQUIPMENT

A. All 24-VAC power for valve actuators, damper actuators, and sensors shall be from dedicated 120/24VAC transformers.

B. Provide surge protection for exterior EMCS points, and for communication or EMCS points that travel between equipment rooms.

C. EMCS Contractor shall be responsible for all electrical installation required for a fully functional EMCS and not shown on the Divisions 25 - 28 plans or required by the Divisions 25 - 28.

1. All wiring shall be in accordance to all local and national codes.
2. Install all line voltage wiring in conduit in accordance with the Divisions 25 - 28.
3. Install all control voltage wiring in conduit.

PART 3 EXECUTION

3.1 Design, install, and commission the EMCS in a fully implemental and operational manner.

A. In the work description below, the word, “provide” shall mean to furnish and install.

3.2 Wisch & Jackson shall furnish all control devices (DDC controllers, sensors, actuators, control valves, relays, current transformers, control panels, and other control devices specified on the drawings) to the appropriate Contractor (Mechanical, EMCS or Electrical) for installation.

A. Upon receipt of the control devices, the Contractor is responsible for the control devices until the District accepts the EMCS.

3.3 EMCS Contractor shall receive control devices from Wisch & Jackson and shall provide all control conduit and wiring, mounting of control devices and any other items required to install a complete and operational EMCS unless explicitly excluded in the Contract Documents.

3.4 Wish & Jackson shall provide control dampers that have a 0.5" diameter external shaft for a direct mount actuator.

A. Wisch & Jackson shall furnish control damper actuators and the EMCS Contractor shall install it.

B. EMCS Contractor shall provide control conduit and wiring.

3.5 Mechanical Contractor shall provide smoke and/or fire/smoke dampers with factory mounted actuators with end switches.

A. The fire alarm system shall activate the smoke dampers.

3.6 Wisch & Jackson shall furnish control valves with actuators and the Mechanical Contractor shall install same. EMCS Contractor shall provide control conduit and wiring.

3.7 Wisch & Jackson shall furnish temperature sensors and thermowells.

A. Mechanical Contractor shall install thermowells.

B. EMCS Contractor shall install temperature sensors, and shall provide control conduit and wiring.

3.8 Mechanical Contractor shall install duct static pressure taps and hydronic pressure taps with gauge cocks.

A. Wisch & Jackson shall furnish pressure sensors and the EMCS Contractor shall mount them.

B. EMCS Contractor shall provide control conduit and wiring.

3.9 Mechanical Contractor shall provide access doors to access sensors and/or DDC devices, installed in ductwork.

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3.10 Mechanical Contractor shall provide VAV boxes.
- A. Wisch & Jackson shall furnish control devices to VAV Box Supplier for factory mounting of it prior to VAV box delivery to the site.
- B. EMCS Contractor shall provide control conduit and wiring from the air-handling unit EMCS Cabinet to each VAV box for that air-handling unit.

3.11 Wisch & Jackson shall furnish EMCS Cabinets.
- A. Electrical Contractor shall install EMCS Cabinets and shall provide dedicated 120VAC circuit adjacent to each EMCS Cabinet.
- B. Connect power for EMCS panel to the optional standby power of the generator.
- C. EMCS Contractor shall provide 120vac switch and outlet inside EMCS Cabinet.
- D. EMCS Contractor shall extend the same 120vac circuit to power the control transformers for the actuators.

3.12 Wisch & Jackson shall furnish Variable Frequency Drives (VFD) to the Electrical Contractor.
- A. Electrical Contractor shall install the VFDs and provide power wiring.
- B. EMCS Contractor shall provide control conduit and wiring.

3.13 Wisch & Jackson shall furnish Airflow Measuring Stations.
- A. EMCS Contractor shall provide control conduit and wiring.

3.14 EMCS Contractor shall provide control conduit and wiring from the specified EMCS panels to the gas water heaters for the kitchen and/or gymnasium, as specified by the Engineer.

3.15 Electrical Contractor shall provide conduit with pull string and Class 1 earth grounding for the Network Conduit as shown by the Electrical Riser Diagrams and/or as specified below.
- A. Connection of each EMCS Cabinet within the same building and between buildings.
- B. Connection from the specified EMCS Cabinet to the main switchgear.
- C. Connection from the Gateway Communication EMCS Cabinet to the specified Phone Closet.
- D. Connection from the specified EMCS Cabinet to the nearest Fire Alarm Relay that has a spare set of contacts for fire alarm status.
  1. Fire Alarm Contractor provides fire alarm wiring.
  2. Otherwise, there shall be no interface between the EMCS and the Fire Alarm System.
- E. For the air-cooled chillers and chilled water-pumps, located in the chiller enclosure, connections from the chiller EMCS Cabinet, located within the building, and to the EMCS junction box in the chiller enclosure.
- F. For split systems, controlled by EMCS, provide connection from EMCS Cabinet to the condensing unit control panel.
- G. For rooftop units, provide connection from the rooftop unit EMCS Cabinet (located within the building) to the rooftop-unit control panel.
- H. For split systems controlled by an electric thermostat or remote controller, connection from the indoor AHU control panel to the condensing unit control panel.
- I. EMCS Contractor provides control wiring.
  1. School District Telephone Staff provides telephone wiring.

3.16 Electrical Contractor shall furnish Duct Smoke Detectors and the Mechanical Contractor shall install.
- A. Electrical Contractor shall provide all conduit and wiring from the Duct Smoke Detectors to the Fire Alarm System and from the Fire Alarm System to the Fan Starters.
- B. Except for fire alarm status, there shall be no interface between the EMCS and the Fire Alarm System.

3.17 Electrical Contractor shall provide all 120VAC and above power wiring.

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A. This work includes fans and/or other equipment that are manually controlled by toggle switches, push buttons and/or light switches which interrupt line voltage power and that are automatically controlled by line voltage thermostats.
B. Electrical Contractor shall install fan speed controllers.

3.18 Where a relay or contactor controlled by the EMCS controls multiple pieces of equipment and/or lighting circuits, provide:
A. Electrical Contractor shall provide the relay or contactor and the power wiring to the coil.
B. Electrical Contractor shall coordinate locations and voltages of the relays or contactors with the EMCS Contractor.
C. EMCS Contractor provides the control conduit and wiring.

3.19 For VAV boxes without electric heaters, Electric Contractor shall provide power wiring to and with a disconnect switch at each VAV box.

3.20 Wisch & Jackson shall program and calibrate the EMCS in coordination with the Test and Balance Contractor.

3.21 At least 15 days prior to Functional Performance Testing, Wisch & Jackson shall electronically provide continuous 72-hour Trends to the Commissioning Authority and School District Mechanical Engineer.
A. Trends shall consist of all chilled water temperatures, cooling coil leaving air temperatures, space temperatures, space relative humidity, fan status, and other points controlled by PID strategies.
B. Group all of the Trends together by AHU zone.

3.22 Within one month after Substantial Completion, Wisch & Jackson shall provide one set of preliminary as-built drawings and O&M manuals, and training to the EMCS Section of the School District of Palm Beach County Department of Maintenance and Plant Operations, M&PO.
A. See Section 01 91 00 – Commissioning for additional requirements.

3.23 Within one month after acceptance of EMS System by the District project manager, Wisch & Jackson shall provide hard and electronic copies of final as-built drawings and O&M manuals.
A. See Section 01 91 00 – Commissioning for additional requirements.
B. The sets shall be distributed as follows:
1. One electronic file in PDF format to the Commission Agent
2. One electronic file in PDF format to Building Codes Services
3. One electronic file in PDF format to Utilities Manager

3.24 Within one month after completion of test and balance, Wisch & Jackson shall reconcile the actual project cost and the original purchase order amount.

3.25 FUNCTIONAL PERFORMANCE TESTING
A. System Functional Performance Testing is part of the Commissioning Process.
1. The Contractor shall perform the Functional Performance Testing and the Commissioning Authority shall witness and document the test.
2. Refer to Section 01 91 00, Commissioning, for functional performance tests and commissioning requirements.
B. Systems Readiness Checklists shall be completed and submitted for each piece of equipment included in this section.
C. Perform the functional performance testing of HVAC pumps as part of the Chilled Water System Functional Performance testing.

3.26 DEMONSTRATION AND TRAINING
A. Training of the Owner’s operation and maintenance personnel is required in cooperation with the Owner's Representative.

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1. Provide competent, factory-authorized personnel to provide instruction to District personnel concerning the location, operation, and troubleshooting of the installed systems.
2. Schedule the instruction in coordination with the Owner's Representative after submission and approval of formal training plans.
3. Refer to Section 01 91 00, Commissioning, for further contractor training requirements.

B. Provide demonstration and training for all equipment covered by this section and installed in this project.
   1. Demonstration and Training shall specifically address Sequences of Operation and setpoints for this specific project.

END OF SECTION

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SECTION 23 21 13
HYDRONIC PIPING

PART 1 GENERAL

1.1 REFERENCES

A. ASME BPVC Section IX - Welding and Brazing Qualifications
B. ASME B16.3 - Malleable Iron Threaded Fittings Classes 150 and 300
C. ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings DWV
D. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings DWV
E. ASME B31.9 - Building Services Piping
F. AWS D1.1/D1.1M - Structural Welding Code-Steel
G. AWWA C105 - Polyethylene Encasement for Ductile Iron Piping Systems
H. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot Dipped, Zinc Coated, Welded and Seamless
I. ASTM A234/A234M - Standard Specification for Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
J. ASTM B32 - Standard Specification for Solder Metal
K. ASTM B88 - Standard Specification for Seamless Copper Water Tube
L. ASTM D1785 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
M. ASTM D2466 -Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Type Fittings, Schedule 40
N. ASTM D2467 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Type Fittings, Schedule 80
O. ASTM D2855 - Standard Practice for Making Solvent Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
P. ASTM F1476 - Standard for Performance of Gasketed Mechanical Couplings in Piping Applications.
Q. ASTM F2389 – Standard Specification for Pressure-rated Polypropylene (PP) Piping Systems.

1.2 SUBMITTALS

A. Submit under provisions of Section 23 05 00.
B. Product Data: For each product used in this project, provide catalog data for pipe materials, pipefittings, valves, and accessories.
C. Mechanical Equipment Rooms (AHU)
    1. Provide ⅜" scale piping drawings with ductwork shown.
D. Air Cooled Chillers and CHW Pumps: Provide ¼" scale piping drawings.
E. Water Cooled Chillers, CHW and CW Pumps, and Cooling Towers: Provide ¼" scale piping drawings.
F. Provide welders certification of compliance with ASME BPVC Section IX and AWS D1.1.

1.3 QUALITY ASSURANCE

A. Valves: Manufacturer's name and pressure rating marked on valve body
B. Welding Materials and Procedures: Conform to ASME BPVC Section IX
C. Welders Certification in accordance with ASME BPVC Section IX and AWS D1.1
D. Regulatory Requirements: Conform to ASME B31.9
E. All grooved couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.
F. All castings used for couplings housings, fittings, or valve and specialty bodies shall be date stamped for quality assurance and traceability.

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1.4 DELIVERY, STORAGE, AND HANDLING
- A. Deliver valves to site in original factory packaging, labeled with manufacturer's identification.
- B. Store valves, fittings, couplings, etc in original factory packaging, and protect from weather and construction traffic.
- C. Deliver all piping, valves, and fittings to the site clean and without any debris or other foreign material in the pipe, valve, or fitting and with the open ends covered to protect from collection of dust and dirt during transportation and storage on site.
  1. Remove the protective cover during installation but recover all openings at the completion of the phase of work on the system and at the end of the day.

PART 2 PRODUCTS

2.1 HEATING WATER AND GLYCOL PIPING, BURIED
- A. Steel Pipe: ASTM A53/A53M Schedule 40 black (ERW)
  1. Fittings: ASTM A234/A234M forged steel welding type.
  2. Joints: AWS D1.1 welded.
- B. Factory Pre-insulated Steel Pipe
  1. Carrier: ASTM A53/A53M Schedule 40 black (ERW).
  2. Fittings: ASTM A234/A234M forged steel welding type.
  3. Joints: AWS D1.1, weld, insulate, and seal per manufacturer's recommendations.
  4. Casing
     a. PVC Type 1 Grade 1 ASTM D1785.
     b. Minimum thickness shall be as follows: 0.070" for 3" pipe and smaller; 0.080" for 4" and 5" pipe; 0.100" for 6" pipe, 0.120" for 8" pipe, 0.140" for 10" pipe; 0.160" for 12" pipe; 0.180" for 14" pipe.
  5. Insulation
     a. Factory foamed in-place closed-cell polyurethane foam completely filling the annulus between the steel pipe and casing.
     b. Minimum thickness shall be 2".
     c. For insulation ends, provide factory applied, vapor barrier mastic end seals.
  6. Performance specification based on Pre-insulated Piping Systems, INSUL-TEK 250 Steel.
     a. Other pre-insulated piping systems satisfying the specifications are acceptable.

2.2 HEATING WATER AND GLYCOL PIPING, ABOVE GROUND
- A. Steel Pipe: ASTM A53/A53M Schedule 40 black (ERW).
  1. Fittings: ASTM B16.3, malleable iron or ASTM A234/A234M, forged steel welding type fittings.
     a. ASTM A536 ductile iron or factory-fabricated from ASTM A53 steel pipe, grooved ends. Basis of Design: Victaulic Company.
     b. Installation-Ready™ fittings for Schedule 40 plain end carbon steel piping in HVAC and mechanical applications sizes NPS ½" thru 2" (DN15 thru DN50). System rated for a working pressure of 300 psi (2065 kPa), consisting of a ductile iron housing conforming to ASTM A536, Grade 65-45-12, with Installation-Ready™ ends**,** gasket liner, zinc-electroplated steel bolts and nuts as per ASTM A449, and 300 series stainless steel retainer. Basis of Design: Victaulic QuickVic™ SD.
  2. Joints: Screwed for pipe 2" and under; AWS D1.1 welded or grooved joints for pipe over 2".
- B. Copper Tubing: ASTM B88, Type L, hard drawn.
  1. Fittings: ASME B16.23 cast brass of ASME B16.29 solder wrought copper.

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2. Joints: ASTM B32 solder Grade 95TA.

2.3 CHILLED WATER PIPING, BURIED

A. Steel Pipe: ASTM A53/A53M Schedule 40 black (ERW) factory pre-insulated. Performance based on INSUL-TEK 250 Steel Pre-insulated Piping System.
   1. Fittings: ASTM A234/A234M forged steel welding type, long radius.
   2. Joints: AWS D1.1 welded.
   3. Insulation Casing: PVC Type 1 Grade 1 ASTM D1785 minimum thickness shall be as follows; 0.070” for 3” pipe and smaller; 0.080” for 4” and 5” pipe; 0.100" for 6" pipe, 0.120" for 8" pipe, 0.140" for 10" pipe; 0.160" for 12" pipe; 0.180" for 14" pipe.
   4. Insulation: Factory foamed in-place minimum 2” thick closed-cell polyurethane foam annulus with vapor barrier mastic end seals.

B. Polypropylene Pipe: ASTM F2389 Schedule 40, extruded copolymer, factory pre-insulated. Pipe and fittings shall be virgin PP-R resin with no reworked or recycled materials in the manufacturing process.
   1. Fittings: ASTM F2389 socket fusion, butt fusion.
   2. Joints: Polypropylene fusion welded.
   3. Insulation Casing: Polypropylene or PVC Type 1 Grade 1 ASTM D1785 minimum thickness shall be as follows; 0.070” for 3” pipe and smaller; 0.080” for 4” and 5” pipe; 0.100" for 6" pipe, 0.120" for 8" pipe, 0.140" for 10" pipe; 0.160" for 12" pipe; 0.180" for 14" pipe.
   4. Insulation: Factory foamed in-place minimum 2” thick closed-cell polyurethane foam annulus with vapor barrier mastic end seals.

2.4 CHILLED WATER PIPING, ABOVE GRADE

A. Steel Pipe: ASTM A53/A53M Schedule 40 black (ERW).
   1. Fittings: ASTM B16.3, malleable iron or ASTM A234/A234M, forged steel welding type.
      a. ASTM A536 ductile iron or factory-fabricated from ASTM A53 steel pipe, grooved ends. Basis of Design: Victaulic Company.
      b. Installation-Ready™ fittings for Schedule 40 plain end carbon steel piping in HVAC and mechanical applications sizes NPS ½” thru 2” (DN15 thru DN50). System rated for a working pressure of 300 psi (2065 kPa), consisting of a ductile iron housing conforming to ASTM A536, Grade 65-45-12, with Installation-Ready™ ends**,** gasket liner, zinc-electroplated steel bolts and nuts as per ASTM A449, and 300 series stainless steel retainer. Basis of Design: Victaulic QuickVic™ SD.
   2. Joints: Screwed for pipe 2" and under; AWS D1.1 welded or grooved joints for pipe over 2".

B. Copper Tubing: ASTM B88, Type L, hard drawn, allowed only for run-outs to individual air handling units, when size of 2” and smaller, and not exceeding 20 ft in length.
   1. Fittings: ASME B16.23 cast brass or ASME B16.29 brazed wrought copper, long radius.
   2. Joints: ASTM B32 brazed Grade 95TA.

2.5 COOLING TOWER, CONDENSER WATER PIPING, BURIED

A. Polypropylene Pipe: ASTM F2389 Schedule 40, extruded copolymer. Pipe and fittings shall be virgin PP-R resin with no reworked or recycled materials in the manufacturing process.
   1. Fittings: ASTM F2389 socket fusion, butt fusion.
   2. Joints: Polypropylene fusion welded.

2.6 COOLING TOWER, CONDENSER WATER PIPING, ABOVE GROUND

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A. Polypropylene Pipe: ASTM F2389 Schedule 40, extruded copolymer. Pipe and fittings shall be virgin PP-R resin with no reworked or recycled materials in the manufacturing process.
   1. Fittings: ASTM F2389 socket fusion, butt fusion.
   2. Joints: Polypropylene fusion welded.
B. PVC Schedule 80 with glued joints and flanged connections to equipment as defined in ASTM-D1785 is acceptable provided operating pressures are well within manufacturer's design parameters.

2.7 EQUIPMENT DRAINS AND OVERFLOWS
A. Copper Tubing: ASTM B88 Type M hard drawn.
B. Fittings: ASME B16.23 cast brass, or ASME B16.29 solder wrought copper.
C. Joints: ASTM B32 solder Grade 95TA.
D. PVC Pipe
   1. ASTM D1785 Schedule 40
   2. Use only for cooling towers.
E. Fittings: ASTM D2466 PVC
F. Joints: ASTM D2855 solvent weld

2.8 FLANGES, UNIONS, AND COUPLINGS
A. Pipe 2" and Smaller: Use 150 psig malleable iron unions for threaded ferrous piping and bronze unions for copper pipe soldered joints.
B. Pipe Over 2":
   1. 150 psig forged steel slip-on flanges for ferrous piping; bronze flanges for copper piping.
   2. Grooved Joint Couplings: Two ductile iron housing segments conforming to ASTM A536, Grade 65-45-12; pressure responsive elastomer gasket, and ASTM A449 compliant bolts and nuts. Couplings shall conform to ASTM F1476: Standard for Performance of Gasketed Mechanical Couplings in Piping Applications.
      a. Rigid Type: 12" and smaller Housings cast with offsetting, angle-pattern, bolt pads to verify proper installation upon visual confirmation of bolt pad contact with no torque requirement and to provide system rigidity and support and hanging in accordance with ANSI B31.1 and B31.9. Installation-Ready for complete installation without field disassembly, complete with grade EHP center-leg gasket with pipe stop to ensure proper groove engagement, alignment, and pipe insertion depth, suitable for water service to 250 deg F. Basis of Design: Victaulic Style 107N.
      b. Flexible Type: For use in locations where vibration attenuation and stress relief are required: Basis of Design: Victaulic Installation-Ready Style 177 or Style 77.
      c. AGS two-segment couplings for pipe sizes 14" and larger, with wide-width FlushSeal® gasket and lead-in chamfer on housing key. Basis of Design: Victaulic Style W07 (rigid) and Style W77 (flexible).

2.9 GATE VALVES
A. Pipe 2" and Smaller: Class 150 with bronze body, bronze trim, rising stem, hand wheel, inside screw, solid disc, threaded ends.

2.10 BALL VALVES
A. Pipe 2" and Smaller: 600 psig with brass body, brass trim, one piece body, Teflon seats and seals, lever handle with adjustable memory stop, threaded ends.
B. For insulated lines, provide extended neck so that lever handle clears the pipe insulation.

2.11 PLUG COCKS

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A. Pipe 2" and Smaller: Bronze body, bronze tapered plug, non-lubricated, Teflon packing, threaded ends, set screw, one wrench operator.
B. Pipe over 2": Cast iron body and plug, pressure lubricated, Teflon packing, flanged ends, set screw, one wrench operator.

2.12 BUTTERFLY VALVES

A. Pipe Over 2": Class 150, ductile iron body, 316 stainless steel disc and stem, EPT replaceable seat, lug ends, extended neck, infinite position lever handle with memory stops.
B. For 8" and over, provide hand wheel and gear drive.
C. For equipment isolation service, provide tapped lug ends.

2.13 SPRING LOADED CHECK VALVES

A. Class-150 iron body bronze trim, stainless steel spring, renewable composition disc, screwed, lug, and flanged ends.

2.14 RELIEF VALVES

A. Bronze body, Teflon seat, stainless steel stem, and springs, automatic, direct pressure actuated capacities ASME certified and labeled.

PART 3 EXECUTION

3.1 PREPARATION

A Ream pipe and tube ends to remove burrs, and bevel plain end ferrous pipe.
B Remove scale and dirt on inside and outside before assembly
C Prepare piping connections to equipment with flanges, or unions.
1 Locations of flanges, unions, shall allow the easy removal of coils from air handling units, tube bundles from chillers, impellers from pumps, etc.
2 The Mechanical Contractor shall correct poor piping layouts at no cost to the District and with no time extension for the mechanical contractor.
D After completion, fill, clean, and treat systems. Refer to Section 23 23 00.

3.2 INSTALLATION

A Route piping in an orderly manner, plumb and parallel to building structure, and maintain gradient.
B Do not locate chilled water piping directly over electrical panels or any other electrical junction box.
C Install piping to conserve building space, and not to interfere with the use of space and other work.
D Group piping whenever practical at common elevations
E Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
F Provide clearance for installation of insulation, and access to valves, specialties, and fittings.
G Provide access at valves and fittings that are not exposed.
1 Coordinate size and location of access doors with Section 08 31 99.
2 Locate valves and metering devices in easily accessible locations with adequate clearance to service devices.
H Slope piping and arrange systems to drain at low points.
1 Use eccentric reducers to maintain top of pipe level.
I Where pipe support members are welded to structural framing, scrape, brush clean, and apply one coat of zinc rich primer to welding area.
J Prepare pipe, fittings, supports, and accessories for finish painting, refer to Section 09 91 13 & 09 91 26.

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K Install valves with stems upright or horizontal, not inverted.
1 Valve handles and stems exposed to the weather shall be painted to prevent rusting.
L Underground pipes shall be buried a minimum depth of 36" from grade to the outer surface of insulation.
1 Install a plastic marking tape directly above the buried pipe along its entire run at a depth of 12" below grade.
2 Refer to Section 23 05 53.
M Joints shall not be insulated, concealed, or buried until after inspection, hydrostatic testing, and written acceptance of the piping system.
N Grooved joints shall be installed in accordance with the manufacturer's latest published instructions. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service. Gaskets shall be molded and produced by the grooved coupling manufacturer. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove. Grooved coupling manufacturer's factory trained field representative shall provide on-site training for contractor's field personnel in the proper use of grooving tools, application of groove, and installation of grooved piping products. Factory trained representative shall periodically visit the jobsite to ensure best practices in grooved product installation are being followed. Contractor shall remove and replace any improperly installed products.
O Installation of hydronic piping and specialties shall not obstruct service access and chiller component removal.
P Seal all open pipe end at the end of each day to prevent intrusion of foreign materials into the pipes.
Q On projects modifying existing chilled water system, remove the old inactive piping to the main chilled water source and cap.
1 If the Engineer reuses existing chilled water piping, the Engineer and Owner shall examine the old insulation material for reuse.
2 If found deteriorated the old insulation shall be removed and the new insulation (meeting specification requirements of the current project) shall be installed.

3.3 APPLICATION
A Install unions downstream of screwed valves and at non-flanged equipment connections. Unions or flanges for servicing and disconnect are not required in installations using grooved joint couplings.
B
C Install brass male adapters on each side of valves in copper-piped systems.
1 Sweat solders adapters to pipe.
D For balancing and shutoff service, provide adjustable memory stops for ball valves (2" and smaller) and butterfly valves (over 2").
E For equipment isolation service, provide ball valves (2" and smaller) and tapped lug butterfly valves (over 2").
F For insulated pipe, provide valves with extended necks or neck extensions of adequate length for the handles to clear the insulation without notching the insulation.
G Provide ¾" gate drain valves at main shut-off valves, low points of piping, bases of vertical risers, and at equipment.
1 Pipe discharge to the nearest drain
H Use dielectric fittings or couplings for dissimilar metals.
I Use pipe dope or Teflon tape for screwed pipe connections.

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J For pipe specialties such as thermometers, gauges, etc. use welded thread-o-lets, do not tap pipe to make threads for these devices.

K For flushing procedures, refer to Section 23 25 00.

L For pressure testing, refer to Section 23 05 93.

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SECTION 23 21 16
HYDRONIC SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES
- A. Expansion tanks
- B. Air vents
- C. Air separators
- D. Strainers
- E. Pump suction fittings
- F. Combination fittings
- G. Relief valves
- H. Air eliminator
- I. Flexible Pipe Connectors
- J. Pipe Wells
- K. Vibration Isolation
- L. Backflow preventers

1.2 REFERENCES
- A. ASME - Boiler and Pressure Vessel Code

1.3 REGULATORY REQUIREMENTS
- A. Conform to ASME Boiler and Pressure Vessel Code for manufacture of tanks.

1.4 QUALITY ASSURANCE
- A. Manufacturer: For each product specified, provide components by same manufacturer throughout.

1.5 SUBMITTALS
- A. Submit shop drawings and product data under provisions of Section 01 33 00.
- B. Submit shop drawings and product data for manufactured products and assemblies required for this project.
- C. Include component sizes, rough-in requirements, clearances, service sizes, and finishes.
  1. Include product description, model, and dimensions.
- D. Submit inspection certificates for pressure vessels.
- E. Submit manufacturer's installation instructions under provisions of Section 01 33 00.

1.6 OPERATION AND MAINTENANCE DATA
- A. Submit operation and maintenance data under provisions of Section 01 77 00.
- B. Include installation instruction, assembly views, lubrication instructions, and replacement parts list.

1.7 DELIVERY, STORAGE, AND HANDLING
- A. Deliver products to site under provisions of Section 01 60 00.
- B. Store and protect products under provisions of Section 01 60 00.

PART 2 PRODUCTS

2.1 EXPANSION TANKS
- A. Construction: Full acceptance bladder expansion tank; closed, welded steel, tested and stamped in accordance with ASME Boiler and Pressure Vessels Code; 125 psi working pressure rating; cleaned, prime coated, and supplied with steel support saddles or legs to elevate the tank, with tapings for installation of accessories.

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B. Quick Connect Air Inlet: Provide for automotive tire Schrader valve type, manual air vent, tank drain, and pressure relief valve.
C. Chilled Water System: Set the expansion tank pressure-relief valve at 75-psi maximum and pressure reducing valve at 15 psi.

2.2 AIR ELIMINATOR/VENTS

A. Manual Type Air Vent: Provide 3/8" or ½" threaded brass nipple extending up from highest point in chilled water piping within mechanical room , chiller plant topped with ball valve . When supply and return piping are the same elevation, provide air purge vent in each pipe.
B. Automatic Float Type Air Eliminator: Non-ferrous brass or semi-steel body, copper float, stainless steel float, stainless steel valve and valve seat; suitable for system operating temperature and pressure; with isolating valve.
C. High Volume Automatic Air Eliminator with a cast iron body and bonnet, Model No. 90 AC, CS manufactured by Wright-Austin or Equal. Place discharge pipe within 4" of grade floor.

2.3 AIR SEPARATORS

A. Air Separators: Steel, tested and stamped in accordance with ASME Boiler and Pressure Vessels Code, for 125 psig operating pressure, with inlet and outlet flanged connections tangential to the vessel shell.
B. Provide vessel top with two threaded ports and one lifting lug.
C. Provide a bottom-threaded blow down port connection with horizontal pipe extension, ball valve, and threaded cap for routine cleaning.
D. Provide a high volume air eliminator for one of the top ports.
E. Provide tank insulation after vessel is fully painted with two coats of enamel paint.

2.4 STRAINERS

A. Air Handler - Size 2" and under: Y pattern screwed brass or iron body for 175 psig working pressure, with ⅛" stainless steel perforated screen equal to 2½ times pipe area minimum.
B. Air Handler - Size 2½" to 4": Y pattern flanged or grooved ductile iron body for 300 psig maximum working pressure, with ⅛" or 1/16" stainless steel perforated screen equal to 2½ times pipe area minimum.
C. Chiller Plant - Size 5" and Larger:
    1. Basket pattern flanged iron body for 175 psig working pressure, with ⅛" stainless steel perforated screen equal to 2½ times pipe diameter area.
    2. Fanged and grooved coupling ductile iron body for 300 psig maximum working pressure, T or Y pattern with ⅛" or 1/16" stainless steel perforated screen equal to 2½ times pipe diameter area.
D. Provide one strainer for each air handler, fan coil unit, or chilled water pump unless two or more pumps have common suction connection from one strainer.

2.5 PUMP SUCTION FITTINGS

A. Fitting: Angle pattern, cast-iron or ductile body, threaded for 2" and smaller, flanged or grooved for 2½" and larger, rated for 300 psig maximum working pressure, with inlet vanes, cylinder strainer with 3/16" diameter openings, disposable stainless steel fine mesh strainer to fit over cylinder strainer, and permanent magnet located in flow stream and removable for cleaning.
B. Pump Suction Diffuser: Provide inlet suction diffuser (without strainer) for each pump that has short radius inlet piping in a chilled water or glycol water system.
C. Accessories: Provide base support boss or adjustable foot support, blow down tapping in bottom, gage tapping in side.

2.6 FACTORY ASSEMBLED EQUIPMENT DROPS AND HEADERS

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A. Factory-fabricated grooved end header [manifold] all-in-one assembly for fluid distribution. Header shall consist of an ASTM A53, Grade B, standard weight pipe spool with required outlet connections. Grooved ends roll grooved to Victaulic [OGS] [AGS] dimensions, with enamel coating or galvanized to project requirements. Basis of Design: Victaulic Vic-Header.

B. Factory Assembled Grooved End Vibration Pump Drops: 3" through 12" (DN80 though DN300). Orange enamel coated installation-ready assembly with flexible couplings to accommodate vibration attenuation and stress relief. Rated for working pressure to 300-psig (2068-kPa).

1. Discharge Drop: Class 150 flange for pump connection, [base elbow for horizontal pump connection] [straight line with concentric reducer for vertical pump connections], tri-service valve assembly consisting of a spring-actuated check [Venturi-Check] valve and butterfly valve with offset stem for 360-degree circumferential seating, and pipe spool with thermometer and pressure ports. Basis of Design: Victaulic Series 380.

2. Suction Drop: Suction diffuser with stainless steel basket and diffuser and Class 150 flange for pump connection, butterfly valve with offset stem for 360-degree circumferential seating, and pipe spool with thermometer and/or pressure ports. Basis of Design: Victaulic Series 381.

3. Suction Drop: 90-degree base elbow with Class 150 flange for pump connection, Wye pattern strainer with stainless steel perforated metal basket, butterfly valve with offset stem for 360-degree circumferential seating, and pipe spool(s) with thermometer and/or pressure ports. Basis of Design: Victaulic Series 382.

C. Manufactured grooved end vibration isolation drop for air handling unit coil supply and return connections in sizes 2" through 6" (DN50 though DN150) to accommodate isolation, straining, balancing, and drainage. Orange enamel coated drop, consisting of ASTM A53 carbon steel pipe spool(s), Victaulic #20 (straight) and #25 (reducing) tees or Style 920/920N Mechanical-T fittings, with base end cap with drain outlet and DZR brass drain valve. Supply connections include a Vic-300 MasterSeal butterfly valve and Style 732 Y-pattern strainer with PT ports, and the return connection includes a Series 787 or 789 circuit balancing valve. Installation-ready, with flexible couplings to accommodate vibration attenuation and stress relief, rated for working pressure to 300-psig (2068-kPa). Basis of Design: Victaulic Series 385

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2.7 FLOW INDICATORS
- A. Brass construction, threaded for insertion into piping system, packless, with paddle with removable segments, vapor proof electrical compartment with switches.
- B. Provide pressure differential flow switch with tubing connected to the inlet and outlet of piping to the chiller, cooling tower, etc for verification of water flow prior to start up.

2.8 FLOW VENTURI
- A. Provide welded or threaded flow venturi with two quick disconnect measuring ports and an inline cutoff valve for each port.
- B. Insure measuring tube ports are extended the proper length to the pipe insulation thickness.
- C. Provide tag for each venturi indicating pipe size, type, and other pertinent information.
- D. Measuring ports shall be color-coded red and green, indicating flow direction.

2.9 RELIEF VALVES
- A. Provide relief valve with bronze body, teflon seat, stainless steel stem, and springs, automatic, direct pressure actuated capacities ASME certified and labeled.
- B. Combination pressure relief and pressure reducing valve shall be provided for chiller make-up water system.
  1. Both valves shall be adjustable for designated operating pressures and preferably from the same manufacture

2.10 GLYCOL SYSTEM
- A. Expansion Tank: Provide expansion tank and vent fitting with automatic air eliminator.
- B. Air Separator Tank same as section 2.3, provide tank with two threaded ports in top of vessel.
  1. One port dedicated for the air eliminator and the other plugged or connected to expansion tank. (See Engineered Schematic Drawings).
- C. Glycol Injector Pump System
  1. Provide storage tank, pump, and controls to monitor glycol levels in main system with the ability to add chemical and restore main system make-up volume as necessary.
  2. Glycol Solution: Inhibited ethylene or propylene glycol and water (food safe) solution mixed in a ratio suitable for design operating temperatures specified on the design drawings.
  3. Either glycol type used shall contain anti-corrosion and anti-fouling additives to prevent damage to piping and components.

2.11 CHILLED WATER PIPE WELLS
- A. All chilled water pipe wells shall be ¾" weld-o-let type welded to the steel piping.

2.12 VIBRATION ISOLATION
- A. Provide flexible pipe connectors at chilled water pumps and chillers for vibration isolation.
- B. Flexible pipe connectors shall have annular corrugated seamless hose body with flanged carbon steel fittings and stainless steel braid.
- C. Three grooved joint flexible pipe couplings may be used in lieu of stainless steel flexible connectors at equipment connections in applicable piping systems. Couplings shall be placed in close proximity to the vibration source in accordance with manufacturer's installation instructions for vibration attenuation.

2.13 BACKFLOW PREVENTERS
- A. Spring loaded check valves, Class 150, iron body, bronze trim, stainless steel spring, renewable composition disk, screwed, lug or flanged.
  1. Provide backflow preventer for potable make-up water that connects to the chilled water system as required by code.
  2. Provide piping from backflow preventer's discharge to nearest floor drain.

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PART 3 EXECUTION

3.1 INSTALLATION AND APPLICATION

A. Install specialties in accordance with manufacturer's instructions to permit intended performance.
B. Support tanks inside building from building structure per manufacturer's instructions; coordinate with structural engineer and paint support assembly.
C. Where large air quantities can accumulate, provide enlarged air collection standpipes with air eliminators.
D. Provide manual air vents in chilled water piping at system high points and as indicated for each air handler and various piping in the chiller plant.
E. For automatic air vents in ceiling spaces or other concealed locations, provide vent tubing to nearest drain.
F. Provide air separator on suction side of system circulation pump and connect to expansion tank.
G. Provide valve drain and hose connection on strainer blow down connection.
H. Provide pump suction fitting on suction side of base mounted centrifugal pumps.
    1. Remove temporary strainers after cleaning the systems.
I. Support pump fittings with floor mounted pipe and flange supports or ceiling mounted supports.
J. Provide relief valves on pressure tanks, low-pressure side of reducing valves, heat exchangers, and expansion tanks.
K. Pipe the relief valve outlet to nearest floor drain.
    1. Pipe the backflow preventer to the nearest floor drain.
L. Where one line vents several relief valves, make cross sectional area equal to sum of individual vent areas.
    1. Pipe the make up water to suction side of pump.
    2. Automatic Cold Water Fill Assembly: Pressure reducing valve, reduced pressure double check back flow preventer, test cocks, strainer, vacuum breaker, and valve by-pass.
M. Install high volume air eliminator on top of air separator.
N. Installation of hydronic piping and specialties shall not obstruct service access and chiller component removal.
O. Paint all exposed component steel surfaces and handles with two coats of oil based enamel paint.
P. Provide auxiliary full line size on connection ports in chilled water system for emergency chiller.
    1. Ports connections shall be located on high and low side of chilled water pumps to allow temporary chiller to operate utilizing the existing pumps.
    2. Ports shall consist of flanged, gear- operated valves with bolted blank-off flanges.
    3. Insulate auxiliary port piping and valves making end cap removable.
    4. Include the same in design documents.

3.2 DEMONSTRATION AND TRAINING

A. Training of the Owner’s operation and maintenance personnel is required in cooperation with the Owner's Representative.
    1. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems.
    2. Schedule the instruction in coordination with the Owner's Representative after submission and approval of formal training plans.
    3. Refer to Section 01 91 00, Commissioning, for further contractor training requirements.

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SECTION 23 21 23
HYDRONIC PUMPS

PART 1 GENERAL

1.1 SECTION INCLUDES
- A. In-line circulators
- B. Vertical in-line pumps
- C. Base mounted pumps
- D. Side-stream filters
- E. Suction diffuser

1.2 REFERENCES
- A. UL 778 - Motor Operated Water Pumps

1.3 QUALITY ASSURANCE
- A. Manufacturer: Company specializing in manufacture, assembly, and field performance of pumps with minimum five years of experience.
- B. Alignment: A qualified millwright shall align the base mounted pumps and certify the alignment.

1.4 SUBMITTALS
- A. Submit product data under provisions of Section 01 33 00.
- B. Submit certified pump curves showing performance and efficiency characteristics with selected pump operating point plotted.
  1. Include NPSH curve when applicable.
- C. Submit manufacturer's installation instructions under provisions of Section 01 33 00.

1.5 OPERATION AND MAINTENANCE DATA
- A. Submit operation and maintenance data under provisions of Section 01 77 00.
- B. Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

1.6 DELIVERY, STORAGE, AND HANDLING
- A. Deliver products to site under provisions of Section 01 60 00.
- B. Store and protect products under provisions of Section 01 60 00.

1.7 WARRANTIES
- A. Provide a 5-year warranty on all motors, see section 23 05 13.

1.8 COMMISSIONING
- A. Commissioning of a system or systems specified in this section is part of the construction process.
  1. Documentation and testing of these systems, as well as training of the Owner’s operation and maintenance personnel, is required in cooperation with the Owner's Representative and the Commissioning Authority.
  2. Project Closeout is dependent on successful completion of all commissioning procedures, documentation, and issue closure.
  3. Refer to Section 01 77 00 - Contract Closeout, for substantial completion details.
  4. Refer to Section 01 91 00 - Commissioning, for detailed commissioning requirements

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS
- A. Crane Deming
- B. Bell & Gosset
- C. Peerless

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D. Aurora
E. TACO
F. S.A. Armstrong

2.2 GENERAL CONSTRUCTION REQUIREMENTS
A. Balance: Rotating parts statically and dynamically
B. Construction: Designed and built to permit servicing without breaking piping or motor connections.
C. Pump Motors: Operate at 1800 maximum rpm (Refer to Section 23 05 13)
D. Pump Connections: Flanged.
E. Chilled water and condenser water pumps shall be base mounted end suction type.
F. All pumps operated by a variable frequency drives shall have electric motors that are inverter duty rated, see section 23 05 13.

2.3 IN-LINE CIRCULATORS FRACTIONAL HORSEPOWER
A. Type: Horizontal shaft, single stage, direct connected, with resiliently mounted motor for in-line mounting, oil lubricated, for 125 psig maximum working pressure.
B. Casing: Cast iron
C. Impeller: Cadmium plated steel, Brass or Bronze, keyed to shaft.
D. Bearings: Two sets, oil lubricated bronze sleeves.
E. Shaft: Stainless steel with copper or stainless steel sleeve integral thrust collar.
F. Seal: Carbon rotating against a stationary ceramic seat, viton fitted 225°F maximum continuous operating temperature.
G. Drive: Flexible coupling.

2.4 VERTICAL IN-LINE PUMPS
A. Type: Vertical shaft, single stage, close coupled, radially or horizontally split casing, for in-line mounting, for 175 psig maximum working pressure.
B. Casing: Cast iron or cast steel, with suction and discharge gage port, casing wear ring, seal flush connection, drain plug, flanged suction and discharge.
C. Impeller: Bronze, fully enclosed, keyed directly to motor shaft or extension.
D. Shaft: Stainless steel
E. Seal: Carbon rotating against a stationary ceramic seat, viton fitted 225°F maximum continuous operating temperature.

2.5 BASE MOUNTED PUMPS
A. Type: End suction, horizontal shaft, single stage, long coupling drive; 175 psig maximum working pressure, end suction, back pullout.
B. Casing: Cast iron, with suction and discharge gage ports, seal flush connection, drain plug, flanged suction and discharge.
1. The casing drain is not to be used as a port.
C. Impeller: Bronze or stainless steel, fully enclosed keyed to shaft.
D. Bearings: Grease lubricated roller or ball bearings.
E. Shaft: Shall be stainless steel with a copper, bronze, or stainless steel shaft sleeve.
F. Seal: Carbon rotating against a stationary ceramic seat, viton fitted 225°F maximum continuous operating temperature.
G. Drive: Flexible coupling with coupling guard, woods type.
H. Base plate: Shall be cast iron or fabricated steel with integral drain rim.

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I. Provide manufacturer's Model and Serial identification plate specifying GPM and impeller diameter firmly secured to pump assembly.
J. Pump motors shall be TEFC Premium Efficiency inverter duty rated and suited for the environment in which they are installed.
K. Pump motor RPM shall be 1800 or less.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install pumps in accordance with manufacturer's instructions.
B. Provide access space around pumps for service.
   1. Provide no less than minimum as recommended by manufacturer.
C. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 5% of midpoint of published maximum efficiency curve.
D. Decrease from line size with long radius reducing elbows or reducers.
   1. Support piping adjacent to pump so that pump flex-connector and casings do not carry any weight.
   2. For close coupled or base mounted pumps, provide supports under elbows on pump suction and discharge line sizes 4" and over.
   3. Refer to Section 23 05 48, Vibration Isolation.
E. Provide line sized shut-off valve and suction diffuser on pump suction, and line sized shut-off valve on pump discharge.
F. Provide air cock and drain connection on horizontal pump casings.
G. Provide drains for bases and seals, piped to and discharging into floor drains.
H. Lubricate pumps before start-up.
I. Install base mounted pumps on rigid concrete base or on concrete inertia base (refer to plans), with anchor bolts, set and level, and grout in place.
J. Qualified millwright shall check, align, and certify base mounted pumps prior to start-up.
K. If pump does not meet designed performance within 5% then upgrade pump at no cost to Owner.
L. All base mounted pumps shall have vibration isolation provided at both pipe connections.
M. Install all base mounted pumps with motors facing the center of the room or compound.
N. Pump and motor metal support frame shall be cleaned, primed, and finish painted in accordance with Sections 09 91 13 or 09 91 26).
O. Pumps circulating cold water shall be insulated in such a fashion that the insulation can be removed for servicing and re-assembled without damaging the integrity of the insulation assembly.
P. For larger pumps, provide operating pressure gauge connected to suction and discharge pump ports with isolation valves and pressure bleed. (Refer to piping detail in plans)

3.2 FUNCTIONAL PERFORMANCE TESTING

A. System Functional Performance Testing is part of the Commissioning Process.
   1. The Contractor shall perform the Functional Performance Testing s and the Commissioning Authority shall witness and document the test.
   2. Refer to Section 01 91 00, Commissioning, for functional performance tests and commissioning requirements.
B. Systems Readiness Checklists shall be completed and submitted for each piece of equipment included in this section.

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C. Include the functional performance testing of HVAC pumps as part of the Chilled Water System Functional Performance testing.

3.3 DEMONSTRATION AND TRAINING

A. Training of the Owner’s operation and maintenance personnel is required in cooperation with the Owner's Representative.
   1. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems.
   2. Schedule the instruction in coordination with the Owner's Representative after submission and approval of formal training plans.
   3. Refer to Section 01 91 00, Commissioning, for further contractor training requirements

B. Provide demonstration and training for all types of HVAC Pumps installed in this project.

END OF SECTION

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SECTION 23 23 00
REFRIGERATION PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES
- A. Piping
- B. Refrigerant
- C. Moisture and liquid indicators
- D. Valves
- E. Filter-dryers
- F. Brazing Materials

1.2 REFERENCES
- A. ARI 710 - Liquid Line Dryers
- B. ASHRAE 15 - Safety Standard for Refrigeration Systems
- C. ASHRAE 34 - Designation and Classification of Refrigerants
- D. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
- E. ASME B16.26 - Cast Copper Alloy Fittings For Flared Copper Tubes
- F. ASME B31.5 - Refrigeration Piping and Heat Transfer Components
- G. ASME B31.9 - Building Services Piping
- H. ASTM B32 – Standard Specification for Solder Metal
- I. AWS A5.8/A5.8M Specification for Filler Metals for Brazing and Braze Welding
- J. AWS D1.1/D1.1M - Structural Welding Code, Steel
- K. UL 429 - Electrically Operated Valves
- L. ARI 760 - Solenoid Valves for Use With Volatile Refrigerants
- M. ASTM B280 – Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service
- N. MIL V 23450C - Valves, Expansion, Thermostatic, Refrigerant 12 and 22

1.3 SUBMITTALS
- A. Submit shop drawings under provisions of Division 1.
- B. Submit shop drawings indicating schematic layout of system, including equipment, critical dimensions, and sizes.
- C. Submit product data under provisions of Division 1.
- D. Submit product data indicating general assembly of specialties, including manufacturer's catalogue information.
- E. Submit manufacturer's installation instructions under provisions of Division 1.
- F. Submit design data as a submittal under provisions of Division 1.
- G. Submit data indicating pipe sizing.
- H. Submit test reports under provisions of Division 1.
- I. Submit Test reports indicating results of leak test, acid test.

1.4 PROJECT RECORD DOCUMENTS
- A. Submit documents under provisions of Division 1.
- B. Accurately record the exact locations of equipment and refrigeration accessories on record drawings.

1.5 REGULATORY REQUIREMENTS
- A. Conform to ASME B31.9.

1.6 DELIVERY, STORAGE, AND HANDLING
- A. Deliver products to site under provisions of Division 1.
- B. Deliver and store piping and specialties in shipping containers with labeling in place.
- C. Store and protect products under provisions of Division 1.

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D. Protect piping and specialties from entry of contaminating material by leaving end caps and plugs in place until installation.

PART 2 PRODUCTS

2.1 PIPING

A. Copper Tubing:
   1. Per ASTM B280, type ACR dehydrated hard drawn copper for exposed/accessible lines.
   2. Type ACR soft drawn (annealed) dehydrated rated up to 700 psi, inaccessible piping and for piping below slabs, and grade shall be installed without joints.
   3. Fittings: ASME B16.22 long radius 90-degree elbow, couplings, and Tees shall be fabricated from wrought copper with manufacture stamp on each fitting.

B. Brazing Compound shall be a minimum of 15% silver with melting point greater than 1000° F.

C. See section 23 05 00 part 2.1 F on additional material requirements.

2.2 REFRIGERANT

A. Refrigerant R-134A Tetrafluoroethane

B. Refrigerant R-410A Pentafluoroethane

2.3 MOISTURE AND LIQUID INDICATORS

A. Indicators: Single port type, UL listed, with copper or brass body, flared or solder ends, sight glass, color coded paper moisture indicator and plastic cap; for maximum working pressure of 700 psi and maximum temperature of 200°F.

B. Sight Glass Moisture Indicator is determined by the type of refrigerant contained within the refrigeration system.

2.4 VALVES

A. Packed Angle Valves: Forged brass or nickel plated forged steel, forged brass seal caps with copper gasket, rising stem and seat with back seating, molded stem packing, solder or flared ends; for maximum working pressure of 500 psi and maximum temperature of 300°F.
   1. Compatible with all CFC, HCFC, and HFC refrigerants and oils.

B. Packed Ball Valves: Two piece forged brass Body with teflon ball seals and copper tube extensions, brass bonnet and seal cap, chrome plated ball, stem with neoprene ring stem seals; for maximum working pressure of 500 psi and maximum temperature of 300°F.
   1. Compatible with all CFC, HCFC, and HFC refrigerants and oils.

2.5 FILTER-DRIERS

A. Replaceable Cartridge Type: ARI 710, UL listed, brass shell and bronze cap, brass shell and molded desiccant filter core for maximum working pressure of 500 psi.
   1. Size determined by tonnage of system.
   2. Shell & Core type drier can be used on liquid and suction lines.
   3. Shell & Core type drier shall be used in liquid lines of refrigeration systems 7 tons and larger.
   4. Shell & Core dryer shall be provided with bypass piping and valves to isolate dryer for core replacement and include a Schrader valve port for dryer evacuation.

B. Provide a liquid line filter drier in all new units/systems 5 tons or less unless drier is provided by the Manufacturer of the unit or system.

2.6 EXPANSION VALVES

A. Provide thermostatic expansion valve on all cooling systems 7 tons and larger.

2.7 PRESSURE SWITCHES

A. Provide a high and low-pressure switch for each new refrigeration system or unit 1 ½ ton and larger.

B. Switch to disable the compressor when activated.

PART 3 EXECUTION

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3.1 PREPARATION

A. Ream pipe and tube ends removing burrs.
B. Clean copper or brass fitting to original luster and remove any scale and dirt from the inside and outside of the pipe before assembly before installation.

3.2 INSTALLATION

A. Install refrigeration specialties in accordance with manufacturer's instructions.
B. Route piping in orderly manner, with plumbing parallel to building structure, and maintain gradient.
C. Install piping to conserve building space and not interfere with use of space.
D. Group piping whenever practical at common elevations and locations, and slope piping one percent in direction of oil return.
E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
    1. Nitrogen purge lines during brazing.
F. Provide clearance for installation of insulation and access to valves and fittings.
G. Provide access to concealed valves and fittings.
H. Insulate and support piping; refer to Section 23 07 19 and 23 05 29.
I. Locate expansion valve sensing bulb immediately downstream of evaporator on suction line as per manufacturer’s instructions.
J. Provide external equalizer piping on expansion valves with refrigerant distributor connected to evaporator.
K. Test refrigerant system for leaks by evacuation and maintain pressures for min. of 24 hours, then pressurize system and test joints and connections with soap.
    1. Charge system with refrigerant per Manufacturer’s instructions relative to ambient conditions.
    2. If system was commissioned in cooler weather, installing contractor shall return upon warmer conditions to verify proper charge.
    3. Insure system is labeled indicating type of refrigerant installed. Locate label at condensing unit.

3.3 APPLICATION

A. Provide line size liquid indicators in main liquid line leaving condenser.
    1. Install moisture indicator so it is viewable from service area.
B. Provide replaceable cartridge filter-dryers, with three-valve bypass assembly, one for each refrigeration circuit.
C. Provide an isolation valve in the high and low refrigerant piping located next to condensing unit.
D. Provide charging service ports in high and low refrigerant piping located next to condensing unit. (Schrader Type).

3.4 FIELD QUALITY CONTROL

A. Perform field-testing under provisions of Division 1.
B. Test refrigeration system in accordance with ASME B31.5.
C. Pressure test the system with small amount of refrigerant and dry nitrogen at 200-psi.
    1. Using a halide torch or an electronic leak detector, check for leaks in the system.
    2. Perform final test at 30" vacuum for a 24-hour period with no deviation.
    3. Provide notification a minimum of 48-hours prior to test and submit written report to A/E verifying test results.

END OF SECTION

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SECTION 23 25 00
HVAC WATER TREATMENT

PART 1 GENERAL

1.1 REFERENCE

A. The provisions of Part 1 - General Documents and Division 1 - General Requirements apply to this section.

1.2 SECTION INCLUDES

A. Furnish and install as indicated by drawings a complete chemical treatment system as specified herein.
   1. This system to include a pot feeder system, and other components as required for a complete system.

B. The mechanical contractor under the supervision of the water treatment specialist shall install the treatment system.

C. Provide chemicals for initial charging of system.

D. Initial cleanout prior to water treatment:
   1. Fill and thoroughly flush out the system with Mitco 7100 (or equal) at the rate of 5 to 10 gallons per 100 gallons of system volume.
   2. Maintain a concentration of 1,000 ppm of PO4 during the clean up period.
   3. Drain and flush system until all compounds are removed.
   4. Clean strainer baskets.

E. Upon completion of any additions or modifications to a hydronic system Contractor shall complete cleaning, and flushing of the system, and basket strainers cleaning or replacement as specified in this section.
   1. Contractor shall refill the hydronic system and replenish chemical treatment agents to the specified strengths and concentrations.

PART 2 PRODUCTS

2.1 MATERIALS

A. System Cleaner:
   1. Provide liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products; sodium tripoly phosphate and sodium molybdate.
   2. Algaecide; chlorine release agents such as sodium hypochlorite or calcium hypochlorite, or microbiocides such as quartermary ammonia compounds, tributyl tin oxide, methylene bis (thiocyanate), or isothiazolones.

B. Closed System Treatment (Water):
   1. Provide sequestering agent to reduce deposits and adjust PH, polyphosphate.
   2. Corrosion inhibitors; liquid boron-nitrite, sodium nitrite and borax, sodium totyltriazole, low molecular weight polymers, phosphonates, sodium molybdate, or sulphites.
   3. Provide conductivity enhancer’s phosphates or phosphonates.

C. Condenser Water System Treatment (Cooling Towers):
   1. Provide sequestering agent to inhibit scaling, phosphonates, sodium polyphosphates, lignin derivatives, synthetic polymer polyelectrolytes, or organite phosphates.
   2. Provide acid to reduce alkalinity and pH, sulphuric acid.
   3. Corrosion inhibitor; zinc-phosphate, phosphonate-phosphate, phosphonate-molybdate and phosphonate-silicate, sodium tolytriazole, or low molecular weight polymers.

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4. Algaecide; chlorine release agents such as sodium hypochlorite or calcium hypochlorite, or microbiocides such as quaternary ammonia compounds, tributyl tin oxide, methylene bis (thiocyanate), or isothiazolones.

D. Open System Treatment (Humidifiers, Air Washers, Evaporative Condensers, Small Cooling Towers):
1. Sequestering agent to inhibit scaling and corrosion inhibitor
2. Algaecide

2.2 EQUIPMENT

A. Bypass (Pot) Feeder: 5.0-gal quick opening cap for working pressure of 175 psig.
B. Drip Feeder: Plastic reservoir with coil of capillary tubing with probe, weight, charging syringe, and clip.
C. Solution Metering Pump: Positive displacement, diaphragm pump with adjustable flow rate, thermoplastic construction, continuous-duty fully enclosed electric motor and drive, and built-in relief valve.
D. Liquid Level Switch: Polypropylene housing with integrally mounted PVC air trap, receptacles for connection to metering pump, and low-level alarm.
E. Conductivity Controller: Packaged monitor controller with solid-state circuiting, five percent accuracy, linear dial adjustment, built-in calibration switch, on-off switch and light, control function light, output to control circuit.
F. Water Meter: Displacement type cold-water meter with sealed, tamperproof magnetic drive, impulse contact register, single pole, double throw dry contact switch.
G. Solenoid Valves: Forged brass body globe pattern, normally open or closed as required, watertight solenoid enclosure, and continuous duty coil.
H. Timers: Electronic timers, infinitely adjustable over full range, 150 second, and five-minute range, mounted together in cabinet with hands-off-automatic switches and status lights.

2.3 TEST EQUIPMENT

A. Provide white enamel test cabinet with local and fluorescent light, capable of accommodating 4 – 10 ml zeroing titrating burettes and associated reagents.
B. Provide the following test kits:
1. Alkalinity titration test kit
2. Chloride titration test kit
3. Sulphite titration test kit
4. Total hardness titration test kit
5. Low phosphate test kit
6. Conductivity bridge, range 0 – 10,000 microhms
7. Creosol red pH slide complete with reagent
8. Portable electronic conductivity meter
9. High nitrite test kit

PART 3 EXECUTION

3.1 PREPARATION

A. Systems shall be operational, filled, started, and vented prior to cleaning.
1. Use water meter to record capacity in each system.
B. Place terminal control valves in open position during cleaning.

3.2 CLEANING SEQUENCE

A. Add cleaner to closed systems at concentration as recommended by manufacturer.

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B. Hot Water Heating Systems:
   1. Apply heat while circulating, slowly raising temperature to 160°F and maintain for 12 hours minimum.
   2. Remove heat and circulate to 100°F or less; drain systems as quickly as possible and refill with clean water.
   3. Circulate for 6 hours at design temperatures, then drain.
   4. Refill with clean water and repeat until all system cleaner is removed.

C. Chilled Water System:
   1. Circulate for 48 hours, and then drain systems as quickly as possible.
   2. Refill with clean water, circulate for 24 hours, then drain.
   3. Refill with clean water and repeat until all system cleaner is removed.

D. Use neutralizer agents on recommendation of system cleaner supplier and approval of Architect/Engineer.

E. Flush open systems with clean water for one-hour minimum.
   1. Drain completely and refill.

F. Remove, clean and replace strainer screens.

G. Inspect, remove sludge, and flush low points with clean water after cleaning process is completed.
   1. Include disassembly of components as required.

H. Meet cleaning requirements of other building phases prior to tie-in of existing operating system.
   1. Flush each section before connecting to main system.
   2. Remove all sand and debris and verify with District Representative prior to tie-in.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.

3.4 CLOSED SYSTEM TREATMENT

A. Provide one bypass feeder on each system.
   1. Install isolating and drain valves and necessary piping.
   2. Install around globe valve downstream of circulating pumps unless indicated otherwise.

B. Introduce closed system treatment through bypass feeder when required or indicated by test.

C. Provide ¾-inch water coupon rack around circulating pumps with space for four test specimens.

D. Insulate all water treatment connections to chilled water piping.

E. Maintain water treatment throughout all phases of construction.
   1. Test concentration of chemical after each tie-in and restore as necessary to proper levels.

3.5 CONDENSER WATER SYSTEM (COOLING TOWERS)

A. Provide automatic condenser water control-systems for inhibitor feed, blowdown and biocide feeds.
   1. Inhibitor application shall be meter activated, blow down shall be conductivity activated, and biocide shall be meter fed with blow down locked out to ensure biocide retention time.

B. Control system shall incorporate solid-state integrated circuits and digital LED displays, in NEMA-12 steel enclosures.
   1. Provide gasketed and lockable door.

C. Base dissolved solids and control on conductivity and include:
   1. LED digital readout display

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2. Temperature compensated sensor probe adaptable to sample stream manifold.
3. High, low, normal conductance indicator lights (LED).
4. High or low conductance alarm light (flash or steady switch), trip points field adjustable.
   a. Flash or steady switch shall have silence position.
5. Illuminated legend shall indicate “ALARM” whenever alarm condition exists.
6. Hand-off-automatic switch for solenoid bleed valve.
7. Illuminated legend shall indicate, “BLEED” when valve is operated.
8. Adjustable hysteresis or deadband (internal)

D. Base inhibitor feed control on makeup volume and include:
1. Solid-state counter (1-15 field selectable).
2. Solid-state timer (adjustable ¼ to 5 minutes)
3. Test switch
4. Hand-off-automatic switch for chemical pump
5. Illuminated legend shall indicate, “FEED” when pump is activated.
6. Solid-state lockout timer (adjustable ¼ to 3 hours) and indicator light, with lockout timer that deactivates the pump and activate alarm circuits.
7. Provide panel totalizer (amount of makeup) electro-mechanical type.

E. Biocide programmer to include:
1. Provide a 24-hour timer with 14-day skip feature to permit manual activation at any hour of the day.
2. Precision solid-state bleed lockout timer (0-9 hours) and biocide pump timer (0-2¼ hours), clock controlled.
3. Provide with a solid-state alternator to enable the use of two different formulations.
4. Provide with a digital display of the time of day (24 hours).
5. LED display of day of week (14 days)
6. Fast and slow cook set controls (internal)
7. Battery backup for clock and quartz timekeeping accuracy
8. Hand-off-automatic switches for biocide pumps.
9. Illuminated legend shall indicate “BIOCIDE A” or “BIOCIDE B” when pump is activated.

F. Provide water meter on system makeup, wired to control system.

G. Provide solution pumps to feed sequestering agent and corrosion inhibitor from solution tank into condenser water supply to tower. Provide agitator as required.

H. Provide conductivity controller to sample condenser water and operate 2" solenoid bleed valve and piping to blowdown controller sampler wired to pen when condensing water pump is operating.

I. Introduce algaecide to tower by continuous feed with solution pump or solenoid valve on tank (chlorine).

J. Provide liquid level switch in each solution tank to deactivate solution pump and agitator, and sound local alarm bell.

K. Provide ¾" water coupon rack around circulating pumps with space for 8 test specimens.

3.6 WATER TREATMENT REPORT

A. Provide copies to:
1. Director of Facility Services or representative
2. School District’s Test and Balance Contractor
3. The Commissioning agent

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3.7 DEMONSTRATION AND TRAINING

A. Training of the Owner’s operation and maintenance personnel is required in cooperation with the Owner's Representative.
B. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems.
C. Schedule the instruction in coordination with the Owner's Representative after submission and approval of formal training plans.
D. Refer to Section 01 91 00, Commissioning, for further contractor training requirements.

END OF SECTION

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SECTION 23 29 23
VARIABLE FREQUENCY MOTOR CONTROLS

PART 1 GENERAL

1.1 RELATED WORK
- A. Specified Elsewhere
- B. Drawings and general provisions of Contract, including, but not limited to, General, Special and Supplementary Conditions and other Division-1 Sections, apply to the work of this Section.
  1. Division 23 - applicable sections
  2. Divisions 25, 26, 27, & 28 - applicable sections

1.2 DIVISION 1 REQUIREMENTS
- A. Shop Drawing: All motor starters and enclosures
- B. Product Data: All components

1.3 WARRANTY
- A. Provide 5-year coverage on parts and labor.

1.4 COMMISSIONING
- A. Commissioning of a system or systems specified in this section is part of the construction process.
- B. Documentation and testing of these systems, as well as training of the Owner's operation and maintenance personnel, is required in cooperation with the Owner's Representative and the Commissioning Authority.
- C. Project Closeout is dependent on successful completion of all commissioning procedures, documentation, and issue closure.
- D. Refer to Section 01 77 00 - Contract Closeout, for substantial completion details.
- E. Refer to Section 01 91 00 - Commissioning, for detailed commissioning requirements.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS
- A. Magnetek
- B. Emerson
- C. ABB
- D. Toshiba
- E. Siemens
- F. Cutler Hammer
- G. Vacon
- H. Square-D
- I. Trane (DanFoss)

2.2 MATERIALS
- A. Provide an adjustable frequency drive unit as a complete UL listed assembly and rated for continuous duty at maximum service factor and full load horsepower as indicated on the drawings.
  1. All adjustable frequency drives supplied, per job or project, shall be of the same manufacturer and model unless different horsepower requires different model.
- B. Unit shall operate in condition of 0% to 95% non-condensing humidity and 0° to 40°C ambient temperatures.
- C. House the adjustable frequency drive in a NEMA 1 enclosure with the manufacturer's standard paint system finish. (NEMA 3R, NEMA 12, NEMA 4, & NEMA 4X enclosures shall be available as an option from the same manufacturer).
  1. All power and control electronics shall be of modular construction for ease of maintenance

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and replacement.

D. Power input to the unit shall be as 480 VAC (± 10%), 3-phase.
   1. The Unit shall have an integral high-interrupting (65,000 ACC) minimum circuit breaker disconnects sized in accordance with line current input to the drive.
   2. Door interlock shall disconnect the unit from line power upon opening.
   3. Provide input line reactors with a minimum 5% impedance to protect the AFD, minimize line interference, voltage transients, and short circuit currents. Internal DC link reactors/chokes alone are not acceptable.
   4. Efficiency of the unit shall be 95% minimum at rated load and speed.
   5. Unit power factor shall not be less than 95% lagging throughout the speed range.

E. Provide the inverter unit with a 3-conductor type manual by-pass control, allowing the motor to continue operating at nominal speed when removing VF drive components for service.
   1. The inverter shall utilize the two-step (AC to DC, DC to AC) pulse width modulated type with capacitor bank filtered output or voltage vector control (VVC) technology.
   2. The RFI/EMI filters shall be factory installed Class A devices per FCC Regulations, Part 15, and Subpart J.
   3. Surge arrestors with capabilities to reduce RFI are not acceptable.
   4. Power electronics components:
      a. Do not run in parallel.
      b. Rate them to withstand maximum short circuit conditions without damage.
   5. Unit shall be capable of catching a motor spinning in the forward or reverse direction upon starting.
   6. Unit shall be able to perform a Motor Stator resistance measurement each time the drive is enabled and run
   7. Provide a separate grounding connection for the inverter output.
   8. Unit input shall include a non-reversing NEMA rated contactor to fully isolate the drive input power from the system without the need to use the main disconnect.
   9. Unit output shall include full voltage, non-reversing NEMA rated output motor starter to provide a positive disconnection means, inverter power disconnect and NEMA rated full voltage non-reversing bypass starter mechanically and electrically interlocked to allow connection to the line voltage source and its safety ground in event of invertor failure.
   10. Bypass contactor shall be isolated from inverter output by mechanical and electrical interlocking.
   11. Inverter output shall be constant volts per Hertz as follows:
      a.

Volts	0 to 460 VAC, 3-phase, 3 wire plus ground
Frequency	0 to 1500 Hertz
Service Factor	1.15
Overload	110% for 1-minute

   12. Unit fault conditions shall de-energize output and require manual reset by an operator.
      a. Output shall be protected against faults with front panel indication provided for each of the following conditions:
         DC bus under/over voltage
         Short circuit
         Overload
         Phase Loss
         Over/Under frequency
         Over temperature

F. Unit shall include a microprocessor based control system with non-volatile memory.

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1. Control power shall be electrically isolated from the power electronics using a dedicated step-down control power transformer, power supplies, and filters. The secondary voltage output shall be controlled by 3 phase voltage monitor, with built in adjustable time delay relay.
2. Make all electrical interfaces between the unit and other control equipment on dedicated and labeled terminal blocks.
3. All manual operation interfaces and indications shall be front panel mounted.
4. Provide the following readily accessible interface inputs and outputs:
   a. INVERTOR ON-OFF-INVERTOR BYPASS selector switch
   b. MANUAL/AUTO selector switch
   c. RUN/STOP Pushbuttons (Manual Mode)
   d. RESET Pushbuttons
   e. Local speed adjustment potentiometer (Manual Mode)
   f. Remote RUN-STOP input (dry contact closure)
   g. 0 to 10 VDC, Current input 0 to 20mA, 4 to 20mA, 20 to 0mA, 20 to 4mA remote speed reference
   h. External Trip (dry contactor closure)
   i. RUN/STOP/BYPASS pilot lights
   j. (0 to 10 VDC) User programmable analog output
   k. Programmable Dry Output Contact
5. Provide the following readily accessible user adjustments:
   a. Minimum frequency
   b. Maximum frequency
   c. Speed default upon loss of speed reference signal
   d. Acceleration time
   e. Deceleration time
   f. Overload current
   g. Speed input reference signal bias
   h. Speed input reference signal gain
   i. Motor noise reduction via carrier frequency or
   j. Motor control mode Fan/Pump HVAC mode.
   k. PID control

G. The following communication features shall be provided to interface with the existing Energy Management System:
   1. Serial communications interface hardware.
      a. Provide a serial communications interface board that provides RS485 communications capability to computers or programmable controllers.
      b. It shall be able to access all drive set up parameters and all diagnostic information with the proper software program. Software shall be able to trend a minimum of 4 parameters.
   2. Serial communications interface software.
      a. Provide a software program for setting up all drive operating parameters and accessing all diagnostic information for interface to IBM or compatible computers.

H. Units shall be factory pre-tested prior to shipment, operation at full load and speed for 24 hours.

PART 3 EXECUTION

3.1 INSTALLATION

A. Equipment motors to be controlled, shall be suitable for variable frequency drive operation,

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premium efficiency, AC inverter duty rated.

B. Mount the variable frequency drive unit plumb and level, in accordance with manufacturer's recommendation, in locations shown on the drawings.
   1. To minimize the harmonics the distance between the variable frequency drive and the motor shall not exceed 20 ft.
   2. Variable Frequency Drive shall not be mounted directly against wall, provide a minimum of ½" space between drive and wall.

C. The original equipment manufacturers certified and qualified technician shall energize and test the adjustable frequency drive.
   1. This service shall be included in the base bid cost.
   2. The Contracting Officer shall witness and document the testing on test standard forms.
   3. Test adjustable frequency drive in accordance with manufacturer's requirements and include the following operational tests:
      a. Verify proper operation and indications for manual operation including run/stop and full range manual speed control.
      b. Verify bypass across the line operation and indications including manual and automatic run/stop operation.
      c. Verify automatic operations and indications including run/stop and full range speed control.
      d. De-energize unit and verify non-volatile memory and reset.
   4. Final acceptance shall depend upon the satisfactory performance of the motor-control centers and adjustable frequency drive under test.
      a. Do not energize any motor-control center until the Contracting Officer approves recorded test data.
      b. Initial start-up may be prior to acceptance, provide cover protection during construction and external filtration if operated.
      c. Each Variable Frequency Drive shall be labeled to match corresponding unit or motor being controlled.

3.2 MANUFACTURER'S FIELD SERVICES

A. Prepare and start systems under provisions of Section 01 60 00 and 23 08 00.

B. Contractors' startup shall be scheduled and documented in accordance with the commissioning requirements.
   1. Refer to Section 01 91 00, Commissioning, for further details.

3.3 FUNCTIONAL PERFORMANCE TESTING

A. System Functional Performance Testing is part of the Commissioning Process.
   1. The Contractor shall perform the Functional Performance Testing and the Commissioning Authority shall witness and document the test.
   2. Refer to Section 01 91 00, Commissioning, for functional performance tests and commissioning requirements.

B. Systems Readiness Checklists shall be completed and submitted for each piece of equipment included in this section.

C. Include the Functional Performance Testing of HVAC pumps as part of the Chilled Water System Functional Performance testing.

3.4 DEMONSTRATION AND TRAINING

A. Training of the Owner's operation and maintenance personnel is required in cooperation with the Owner's Representative.
   1. Provide competent, factory-authorized personnel for instruction to Facilities personnel concerning the location, operation, and troubleshooting of the installed systems.

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2. Schedule the instruction in coordination with the Owner's Representative after submission and approval of formal training plans.
3. Refer to Section 01 91 00, Commissioning, for further contractor training requirements.

B. Provide training for all equipment covered by this section installed in this project.

END OF SECTION

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SECTION 23 31 00
DUCTWORK

PART 1 GENERAL

1.1 REFERENCES

A. ASHRAE - Handbook, Duct Design
B. ASHRAE - Handbook, Duct Construction
C. ASTM A90/A90M - Standard Test Method for Weight (Mass) of Coating on Iron and Steel Articles with Zinc or Zinc Alloy Coating
D. ASTM A167 - Standard Specification for Stainless and Heat Resisting Chromium Nickel Steel Plate, Sheet, and Strip
E. ASTM A653/A653M – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip
F. ASTM B209 - Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate
G. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems
H. NFPA 90B - Standard for the Installation of Warm Air Heating and Air Conditioning Systems
I. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations
J. SMACNA: HVAC Duct Construction Standards
K. UL 181: Factory - Made Air Ducts and Connectors

1.2 SUBMITTALS

A. Submit under provisions of Section 23 05 00.
B. Provide catalog cuts of materials and fittings, and indicate ductwork construction features such as gages, sizes, welds, and configuration.
C. Mechanical Equipment Rooms (AHU): Provide ⅜" scale drawings for supply air, return air, outdoor air, relief air, etc.
    1. Provide copy to piping contractor in order for him to prepare his piping drawings.
D. Prior to installation, the Contractor shall provide ductwork shop-fabrication drawings to the Engineer for approval.
E. Samples: Not required

1.3 QUALITY ASSURANCE

A. The sheet metal company fabricating the ducts shall specialize in performing the work of this section with minimum three years experience.
B. Single wall duct with Pittsburgh lockseam construction shall be factory made or shop fabricated by the sheet metal company specialized in Pittsburgh lockseam duct fabrication.
    1. No field fabrication allowed.
C. Double wall duct shall be factory made or shop fabricated by the sheet metal company specialized in double wall duct fabrication with minimum three years experience.
    1. No field fabrication allowed.

1.4 DELIVERY, STORAGE AND HANDLING

A. Store ducts and fittings inside weather-tight trailers or weather-tight buildings.
B. Protect ductwork shall from water, dirt, chemical, and mechanical damage.
C. Deliver all ductwork and fittings to the site clean of any foreign materials and provide protective covers on all openings in the duct and fittings.
    1. Remove the protective cover during installation but recover all openings at the completion of the phase of work on the system and the end of the day.

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2. If ductwork is delivered to the site unassembled, once assembled on the site cover the ends if duct is not scheduled for installation within 24 hours of assembly.

1.5 DEFINITIONS

A. Duct Sizes: Inside clear dimensions.
B. Low pressure/low velocity: Is 2"-WG positive or negative static pressure and velocities less than 2,500 fpm.
C. Medium Pressure/High Velocity: Is 6"-WG positive static pressure and velocities greater than 2,500 fpm.
D. High pressure/high velocity: Is 10"-WG positive static pressure and velocities greater than 2,000 fpm.

PART 2 PRODUCTS

2.1 MATERIALS

A. General: Non-combustible or conforming to requirements for Class 1 air duct materials or UL 181.
B. Steel Ducts: ASTM A653/A653Mgalvanized steel sheet, lock-forming quality, zinc coating of 1.25-oz per sq.ft, for each side in conformance with ASTM A90.
   1. When the contract documents require ductwork be painted, provide paintable galvanized steel.
C. Insulated Flexible Ducts: Flexible duct wrapped with flexible glass fiber insulation, enclosed by seamless aluminum pigmented plastic vapor barrier jacket; maximum 0.23 K-value at 75° F and vinyl interior liner supported by helically wound spring steel wire.
D. Stainless Steel Ducts: Per ASTM A167, Type 304.
E. Glass Fiber Reinforced Plastic Ducts.
F. Fasteners: Rivets, bolts, or sheet metal screws.
G. Sealant: Non-hardening, water resistant, fire resistive, compatible with mating materials; liquid used with tape, or heavy mastic with membrane.
H. Hanger Rod: Steel, galvanized; threaded both ends, threaded one end, or continuously threaded.
I. Fiberglass Ductwork is **NOT** acceptable.
J. Steel Duct with Interior Duct Liner is **NOT** acceptable, if the duct liner is exposed to the air stream.
K. Flexible metallic (aluminum) duct (for clothe dryer venting) is not acceptable for any HVAC ductwork application.

2.2 LOW PRESSURE/LOW VELOCITY DUCTWORK

A. Fabricate and support in accordance with SMACNA Low Pressure Duct Construction Standards and ASHRAE handbooks, except as indicated.
   1. Provide sheet metal duct material, gauges, reinforcing, sealing, etc. for 2" WG positive or negative static pressure.
B. Single wall and double wall sheet metal, round and flat oval ducts shall be spiral lockseam, spiral lockseam with standing rib, or longitudinal seam with solid welded construction.
   1. Fittings shall be standing seam or solid welded construction by the same manufacturer as the ductwork.
C. Single wall sheet metal, rectangular ducts, with inside clear dimension in any direction of 13" or lager, shall be Pittsburgh lockseam construction.
   1. Punch-button snap lock longitudinal seam construction is allowed only for low pressure/low velocity ducts with inside clear dimension in any direction of 12" or smaller.
   2. Replace all ductwork not complying with these requirements at no cost to the District and no time extension for the contractor.

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D. Seal all transverse joints, longitudinal seams, snap-lock ducts and duct wall penetrations.
E. May install round sheet metal ducts in place of rectangular ducts in accordance with ASHRAE's table of equivalent duct sizes.
   1. No variation of duct configuration or sizes permitted except by written permission.
F. Construct tees, bends, and elbows with radius of not less than 1.5 times the width of duct on centerline.
   1. If radius or mitered elbows are required and not used, provide turning vanes at all 90 degree elbows in each direction at the tee intersection.
G. Increase duct sizes gradually, not exceeding 15° divergence wherever possible.
   1. Divergence upstream of equipment shall not exceed 30°; convergence downstream shall not exceed 45°.
H. Connect flexible ducts to the spin collars with dampers that insert into the metal ducts with draw bands, tape, and adhesive mastic.

2.3 MEDIUM AND HIGH PRESSURE/HIGH VELOCITY DUCTS
A. Fabricate and support in accordance with SMACNA High Pressure Duct Construction Standards and ASHRAE handbooks, except as indicated.
   1. Provide sheet metal duct material, gages, reinforcing, sealing, etc. for 6" WG positive pressure, except as indicated.
B. Single wall and double wall, round and flat oval ducts shall be spiral lockseam construction.
   1. Fittings shall be solid welded or flanged construction.
   2. Fittings shall be by the same manufacturer as the ductwork.
C. Construct tees, bends, and elbows with radius of not less than 1.5 times the width of duct on centerline, if not possible or if square throat radius or mitered elbows are used, provide airfoil-turning vanes.
   1. Provide turning vanes at all 90-degree elbows and each direction at the tees intersection.
D. Transform duct sizes gradually, not exceeding 15° divergence and 30° convergence.
E. Seal all transverse joints, longitudinal seams, and duct wall accessory penetrations with adhesive mastic.
F. Provide standard 45° lateral wye takeoffs unless 90° conical tees are indicated.

2.4 DOUBLE WALL, ROUND, FLAT OVAL AND RECTANGULAR DUCTWORK
A. Provide double wall ducts and fittings with inner sheet metal liner, 1" thick fiberglass insulation, and outer sheet metal pressure shell.
   1. Fittings shall be by the same manufacturer as the ductwork.
B. Provide 1" thick, fiberglass insulation with a K-value of 0.27 at 75°F.
C. Provide solid or perforated inner sheet metal liner as indicated by the drawings.
D. Use perforated inner liner for sound attenuating ductwork.
   1. In ducts with perforated inner liner, provide 0.002" thick Mylar plastic sleeve between the inner liner and the insulation to separate the porous insulation from the air stream.
E. At electric duct heaters, provide solid inner liners that start 6" upstream and end 6" downstream of electric duct heaters.
F. Where double wall duct connects to single wall duct, provide double wall to single wall insulated end fitting.

2.5 KITCHEN HOOD EXHAUST DUCTWORK
A. Fabricate in accordance with SMACNA Low Pressure Duct Construction Standards and NFPA 96.
B. Fabricate any exposed and concealed ductwork of stainless steel with continuous externally welded joints and seams.

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2.6 DISHWASHER EXHAUST DUCTWORK
- A. Fabricate in accordance with SMACNA Low Pressure Duct Construction Standards.
- B. Fabricate exposed and concealed ductwork of stainless steel with continuous externally welded joints and seams.
- C. Pitch horizontal ducts to drain condensed vapor back to the floor mounted equipment.

2.7 CLOTHES DRYER VENT DUCTS (EXHAUST)
- A. Dryer vent ducts shall be galvanized steel minimum 4” diameter.
  1. Round or enclosed rectangular 14"or less, shall be galvanized steel 30-gauge.
  2. Round or enclosed rectangular more than14", shall be galvanized steel 28-gauge.
  3. Exposed rectangular 14"or less, shall be galvanized steel 28-gauge.
  4. Exposed rectangular more than 14", shall be galvanized steel 26-gauge.
- B. Nonmetallic duct not allowed.
- C. Terminate the duct outside of the building horizontally with manufactured back draft damper assembly and rain hood. Vertical discharge shall have a sheet metal gooseneck curb at the roof deck penetration.
  1. Do not terminate into pedestrian walkway.
  2. Do not terminate the discharge within 10 feet of any condensing units.
- D. Secure all joints and seams with metal tape, do not use screws, and mount in place.

PART 3 EXECUTION

3.1 INSTALLATION
- A. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- B. Provide openings in ductwork where required to accommodate EMCS controllers.
- C. Connect VAV boxes to medium or high pressure/high velocity ducts directly, do not use flexible duct.
- D. Connect ceiling diffusers to low pressure/low velocity ducts with 5' minimum to 10' maximum laying length of flexible duct.
- E. Connect return air grilles to low pressure/low velocity ducts with 5' minimum to 10' maximum laying length of flexible duct.
- F. Provide residue traps in kitchen hood exhaust ducts at base of vertical risers and provide access doors for cleaning.
  1. Provide access doors at each 90^{o} horizontal elbow.
- G. During construction, provide temporary closures of metal or taped polyethylene on open ductwork to prevent dust from entering the ductwork system.
- H. Metal round duct shall be mechanically fastened (screws) a minimum of 3 points at each joint of duct run. Not applicable if continuously welded.
- I. Where indicated, provide double wall ductwork. At the discharge and inlet of central station AHUs, provide the following minimum lengths of double wall ductwork:
  1. Multizone: 0' supply air, 20' return air
  2. Single Zone: 20' supply air, 20' return air
  3. Variable Air Volume: 30' supply air, 20' return air
  4. If branch ducts are necessary in the double wall main duct, provide double wall branch ducts to obtain the minimum lengths of double wall ductwork.
  5. Double wall ducts shall have all joints buttered prior to assembly to prevent insulation from fraying.

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J. Do not install ductwork within the building until the building is weather-tight. All ductwork damaged by weather shall be replaced at no cost to the District and no time extension for the contractor.

3.2 DUCTWORK APPLICATION SCHEDULE

A. Galvanized sheet metal
   1. Supply, Return, Outdoor and Relief
   2. General Exhaust
   3. Kiln Ventilation
   4. Shower and Locker Room exhaust, pitch horizontal ducts to the exhaust intake grilles.

B. Galvanized Sheet Metal or Aluminum
   1. Emergency Generator Ventilation

C. Stainless steel for exposed and concealed ductwork:
   1. Kitchen Hood Exhaust
   2. Dishwasher Exhaust

D. Stainless Steel or glass fiber reinforced plastic:
   1. Chemical Fume Hood Exhaust

3.3 ADJUSTING AND CLEANING:

A. Clean duct systems with high power vacuum machines.

B. Protect equipment that may be harmed by excessive dirt with filters, or bypass during cleaning.

C. Provide adequate access into ductwork for cleaning purposes.

END OF SECTION

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SECTION 23 33 00
AIR DUCT ACCESSORIES

PART 1 GENERAL

1.1 REFERENCES

A. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems
B. SMACNA: HVAC Duct Construction Standards
C. UL 33: Heat Responsive Links for Fire Protection Service
D. UL 555: Fire Dampers
E. UL 555S: Smoke Systems

1.2 SUBMITTALS

A. Submit under provisions of Section 23 05 00
B. Product Data: For each product used in this project, provide catalog data and installation instructions.
C. Samples: Not required

PART 2 PRODUCTS

2.1 BALANCING DAMPERS

A. Provide factory manufactured balancing dampers that meets or exceeds SMACNA standards, and as indicated.
    1. Shop fabricated balancing dampers are NOT acceptable.
B. For rectangular duct heights 10" or less, provide single blade balancing damper with the following features:
    1. Frame: 22-gage galvanized steel, 3" wide.
    2. Blade: 22-gage galvanized steel, maximum ⅛" gap between the blade and frame.
    3. Control Shaft/Hand Quadrant: ⅜" square axle shaft, secured tight to the blade; molded synthetic end bearings; locking hand quadrant.
    4. Standoff Bracket, for externally insulated ducts, uses a 2" high with hand locking quadrant.
    5. Performance specifications are based on Ruskin MD25.
        a. Nailor or other products satisfying the specifications are acceptable.
C. For rectangular duct heights over 10", provide opposed blade balancing damper with the following features:
    1. Frame shall be 16-gage galvanized steel channel with corner braces.
    2. Blade shall be 8" maximum width, 16-gage galvanized steel.
    3. Axles shall be ⅜" hex axle shaft, secured tight to the blade; molded synthetic bearings.
    4. Control Shaft/Hand Quadrant, provide a ⅜" square control shaft with locking hand quadrant.
    5. Standoff Bracket, for externally insulated ducts uses a 2" high, with hand locking quadrant.
    6. Performance specifications are based on Ruskin MD35.
        a. Other products satisfying the specifications are acceptable.
D. For round ducts, provide single blade balancing damper with the following features:
    1. Frame: 20-gage galvanized steel, 7" long.
    2. Blade: 20-gage galvanized steel, maximum ⅛" gap between the blade and frame.
    3. Control Shaft/Hand Quadrant: ⅜" square axle shaft, secured tight to the blade; molded synthetic end bearings; locking hand quadrant.
    4. Standoff Bracket, for externally insulated ducts, uses a 2" high, with hand locking quadrant.
    5. Performance specifications are based on Ruskin MDRS25.

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a. Other products satisfying the specifications are acceptable.

2.2 CONTROL DAMPERS

A. Except for outdoor air control dampers, provide control dampers with the following features:
1. Frame: 16-gage galvanized steel channel with corner braces.
2. Blade: 6" maximum width, opposed blade, 16-gage galvanized steel.
3. Axles: ⅜" hex axle galvanized steel shaft, secured tight to the blade; non-stick, non-corrosive, molded synthetic bearings.
4. Control Shaft: 6" x ½" diameter galvanized steel control shaft with outboard support bearing.
5. Actuator Bracket: Frame mounted galvanized steel.
6. Seals: None
7. Leakage Rates: Maximum leakage rates shall not exceed the following values when tested at 1"WG pressure differential per AMCA Publication 500.

Damper Width	Leakage Rate
12"	65 CFM/SF
24"	50 CFM/SF
36"	40 CFM/SF
48"	40 CFM/SF

8. Performance specifications are based on Ruskin CD50.
a. Other products satisfying the specifications are acceptable.

B. Provide outdoor air control dampers with the following features:
1. Frame shall be aluminum T-flange type with bolt holes in the corners.
2. Blade shall be 6" maximum width, opposed blade, aluminum airfoil.
3. Axles: ½" hex axle stainless steel shaft, secured tight to the blade; non-stick, non-corrosive, molded synthetic bearings.
4. Control Shaft: 6" x ½" diameter galvanized steel control shaft with outboard support bearing.
5. Actuator Bracket: Conceal in damper frame, galvanized steel.
6. Seals: edge and jam seals.
7. Leakage Rates: Maximum leakage rates shall not exceed the following values when tested at 1" WG pressure differential per AMCA Publication 500.

Damper Width	Leakage Rate
12"	65 CFM/SF
24"	50 CFM/SF
36"	40 CFM/SF
48"	40 CFM/SF

8. Performance specifications are based on Ruskin CD50.
a. Other products satisfying the specifications are acceptable.

2.3 FIRE DAMPERS

A. Fabricate in accordance with NFPA 90A and UL 555, and as indicated.
B. For openings in fire-rated walls and floors, provide curtain type dampers of galvanized steel with interlocking blades.
1. Provide stainless steel closure springs and latches for horizontal installations.
2. Provide 165°F fusible link in accordance with UL 33.
3. Provide type "B" fire dampers with blades configured out of the air stream.
4. Type "A" fire dampers with blades intruding into the air stream, allowable in low velocity ducts with duct depth greater than 13".
5. The Engineer shall determine proper type of fire dampers.

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C. For diffuser and grille openings in fired rated ceilings, floor-ceiling assemblies, and roof-ceiling assemblies, provide ceiling type dampers with UL classified insulation as required.
   1. Provide 165°F fusible link in accordance with UL 33.

2.4 COMBINATION FIRE AND SMOKE DAMPERS

A. Fabricate in accordance with NFPA 90A, UL 555, UL 555S, and as indicated.
B. Provide factory sleeve for each damper.
   1. Install damper operator on exterior of sleeve and link to damper operating shaft.
C. Fabricate with multiple blades with 16 gage galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, stainless steel jamb seals, ⅛" x ½" plated steel concealed linkage, stainless steel closure spring, blade stops, and lock, and ½" diameter actuator shaft.
D. Operators shall be spring return electric type suitable to operate on 120 VAC.
   1. Operators shall be UL listed and labeled, provide end switches to indicate damper position.
   2. To ensure compatibility, coordinate actuator selection with the EMCS contractor.
E. Combination fire/smoke dampers shall have a fail-safe design that enables the dampers to assume desired fail-safe position.
   1. When a smoke detector detects smoke, during testing or if power failure occurs, the damper shall close and remain closed.
   2. When the smoke signal ceases (smoke detector resets), the test is complete or power restored the damper shall automatically reset to open position.
   3. The damper shall automatically reset after the reset of the alarm system from a nuisance alarm.

2.5 SMOKE DAMPERS

A. Fabricate in accordance with NFPA 90A, UL 555, UL 555S, and as indicated.
B. Provide factory sleeve for each damper.
   1. Install damper operator on exterior of sleeve and link to damper operating shaft.
C. Fabricate with multiple blades with 16 gage galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, stainless steel jamb seals, ⅛" x ½" plated steel concealed linkage, stainless steel closure spring, blade stops, and lock, and ½" diameter actuator shaft.
D. Operators shall be spring return electric type suitable to operate on 120 VAC.
   1. Operators shall be UL listed and labeled.
   2. Provide end switches to indicate damper position.
   3. To ensure compatibility, coordinate actuator selection with the EMCS contractor.
E. Combination fire/smoke dampers shall have a fail-safe design that enables the dampers to assume desired fail-safe position.
   1. When a smoke detector detects smoke, during testing or if power failure occurs, the damper shall close and remain closed.
   2. When the smoke signal ceases (smoke detector resets), the test is complete or power restored the damper shall automatically reset to open position.
   3. The damper shall automatically reset after the reset of the alarm system from a nuisance alarm.

2.6 BACKDRAFT DAMPERS

A. Gravity backdraft dampers furnished with fans may be fan manufacturer's standard construction.
B. For gravity relief air systems, provide counterbalanced, multi-blade, parallel action, gravity backdraft dampers with the following features:

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1. Frame shall be 6063T5 extruded aluminum, 0.090" thick wall, mitered corners.
2. Blades shall be 0.025" thick aluminum blade, vinyl edge seals.
3. Bearings shall be Non-stick, non-corrosive, synthetic.
4. Counterbalance shall be adjustable and factory set to open at 0.05"WG differential pressure.
    a. Mechanical contractor shall verified factory setting during installation.
5. Performance specifications are based on Ruskin CBD2.
    a. Other products satisfying the specifications are acceptable.

2.7 AIR TURNING DEVICES

A. Multi-blade device with airfoil blades aligned in the short dimension; steel construction with fixed blades.

B. Where not possible to construct tees, bends, and elbows with radius of not less than 1.5 times the width of the duct on centerline, and where square throat radius or mitered elbows are used, provide airfoil-turning vanes.
    1. Do not provide turning vanes in the kitchen hood exhaust system.

C. Install the turning vanes in accordance with SMACNA construction standards.

2.8 FLEXIBLE DUCT CONNECTIONS

A. Fabricate in accordance with SMACNA Low Pressure Duct Construction Standards, and as indicated.

B. NFPA 90A, UL listed, fire-retardant neoprene coated woven glass fiber fabric, minimum density 36 oz per sq. yd., approximately 3" wide, crimped into metal edging strip.

C. Vinyl sheet a minimum 0.55" thick, 0.87 lbs per sq, ft 10-dB attenuation in 10 to 10,000-Hz range.

2.9 DUCT ACCESS DOORS

A. Fabricate in accordance with SMACNA Low Pressure Duct Construction Standards, and as indicated.
    1. Frame: 22 gage galvanized steel with foam gasket seal.
    2. Door: Removable type with locks and safety chain, 22 gage galvanized steel, single skin for non-insulated ducts, double skin with 1" thick fiberglass insulation for insulated ducts.
    3. Locks: Sash type; one lock for doors 16" and smaller; two locks for doors larger than 16".
    4. Maximum Leakage Rates for double skin door 0.25 CFM/SF single skin door 0.45 CFM/SF.
    5. Performance specifications are based on Ruskin ADC12 and ADC22.
        a. Nailor or other products satisfying the specifications are acceptable.

B. Access doors with sheet metal screw fasteners are not acceptable.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install accessories in accordance with manufacturer's instructions.

B. Provide fire dampers, combination fire and smoke dampers, and smoke dampers at locations indicated, where ducts and outlets pass through fire rated components, and where required by authorities having jurisdiction.
    1. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings, and hinges.

C. Demonstrate resetting of fire dampers to authorities having jurisdiction and District's representative.

D. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.

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E. Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment.
   1. Air handler units with fan modules that are internally isolated do not require flexible connections.
   2. Cover connections to medium and high-pressure fans with vinyl sheet, held in place with metal straps.

F. Provide duct access doors for inspection, cleaning and maintenance service at control dampers, backdraft dampers, fire dampers, combination fire and smoke dampers, smoke dampers, smoke detectors, electric heaters, EMCS sensors and devices, and as indicated.
   1. Access door size shall be at least ¾ the width of the duct.

3.2 DEMONSTRATION AND TRAINING

A. Training of the Owner’s operation and maintenance personnel is required in cooperation with the Owner's Representative.
   1. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems.
   2. Schedule the instruction in coordination with the Owner's Representative after submission and approval of formal training plans.
   3. Refer to Section 01 91 00, Commissioning, for further contractor training requirements

B. Demonstration and training shall be provided for the following equipment covered by this section:
   1. Control Dampers
   2. Fire Dampers
   3. Combination Fire and Smoke Dampers
   4. Smoke Dampers
   5. Backdraft Dampers

END OF SECTION

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SECTION 23 34 23
HVAC POWER VENTILATORS

PART 1 GENERAL

1.1 SECTION INCLUDES
- A. Roof exhausters
- B. Wall exhausters
- C. Cabinet exhaust fans
- D. Ceiling exhaust fans
- E. In-line exhaust or supply fans

1.2 REFERENCES
- A. AMCA 99 - Standards Handbook
- B. AMCA 210 - Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating
- C. AMCA 300 – Reverberant Room Method for Sound Testing of Fans
- D. AMCA 301 - Method of Calculating Fan Sound Ratings from Laboratory Test Data
- E. SMACNA - HVAC Duct Construction Standard

1.3 QUALITY ASSURANCE
- A. Performance Ratings: Conform to AMCA 210 and bear the AMCA Certified Rating Seal
- B. Sound Ratings: tested to AMCA 300 and 301, and bear AMCA Certified Sound Rating Seal
- C. Fabrication: Conform to AMCA 99

1.4 SUBMITTALS
- A. Submit shop drawings and product data under provisions of Section 01 33 00.
- B. Provide product data on wall and roof exhausters, and ceiling and cabinet fans.
- C. Provide fan curves with specified operating point clearly plotted.
- D. Submit sound power levels for both fan inlet and outlet at rated capacity.
- E. Submit manufacturer's installation instructions under provisions of Section 01 33 00.

1.5 COMMISSIONING
- A. Commissioning of a system or systems specified in this section is part of the construction process.
- B. Documentation and testing of these systems, as well as training of the Owner’s operation and maintenance personnel, is required in cooperation with the Owner's Representative and the Commissioning Authority.
- C. Project Closeout is dependent on successful completion of all commissioning procedures, documentation, and issue closure. Refer to Section 01 77 00 - Contract Closeout, for substantial completion details.
- D. Refer to Section 01 91 00, Commissioning, for detailed commissioning requirements

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS
- A. Greenheck
- B. Penn Ventilators
- C. Jenn Aire
- D. Broan
- E. Loren Cook
- F. ACME
- G. Twin City Fans & Blowers

2.2 ROOF EXHAUSTERS

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A. Centrifugal or Axial Fan Unit: V-belt or direct driven, with spun aluminum housing; resilient mounted motor; ½" mesh, 16 gage aluminum bird screen; square base to suit roof curb with continuous curb gaskets; secured with corrosion resistant bolts and screws.
B. Roof Curb: minimum 12" high on any side measured from finished roof, self-flashing with continuously welded seams, built-in cant strip, insulation and curb bottom, interior baffle with acoustic insulation, curb bottom, and factory installed door-nailer strip, see 23 05 29 2.5 for additional information on curbs.
C. Disconnect Switch: Factory wired, non-fusible, in housing for thermal overload protected motor, wall-mounted type.
D. Backdraft Damper: Gravity activated, aluminum multiple blade construction, felt edged with nylon bearings.
E. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts, and keyed; variable and adjustable pitch motor sheave selected to achieve the required rpm with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.

2.3 WALL EXHAUSTERS

A. Centrifugal or Axial Fan Unit: V-belt or direct driven, with spun aluminum housing; resiliently mounted motor; ½" mesh, 16 gage aluminum bird screen secured with stainless steel bolts and screws.
B. Disconnect Switch: Factory wired, non-fusible, in housing for thermal overload protected motor, wall-mounted type.
C. Backdraft Damper: Gravity activated, aluminum multiple blade construction, felt edged with nylon bearings.
D. Sheaves: For V-belt drives, provide cast iron or steel, dynamically balanced, bored to fit, keyed shafts, with self-aligning pre-lubricated ball bearings; variable and adjustable pitch motor sheaves selected to achieve the required RPM with sheaves set at mid-position.

2.4 CABINET AND CEILING EXHAUST FANS

A. Centrifugal Fan Unit: V-belt or direct driven, with galvanized steel housing lined with ½"-inch acoustic insulation, resilient mounted motor, gravity backdraft damper in discharge.
B. Disconnect Switch: Factory wired, non-fusible, in housing for thermal overload protected motor.
C. Grille shall be molded white plastic or aluminum with baked white enamel finish.
D. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts, and keyed; variable and adjustable pitch motor sheaves selected to achieve the required rpm with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.

2.5 IN-LINE EXHAUST OR SUPPLY FANS

A. Fan shall be complete factory assembled unit and shall include housing, centrifugal fan wheel, adjustable V-belt drive, motor, disconnect switch and vibration isolation.
B. Housing shall be heavy gauge, galvanized steel, with square duct mounting collars; 90° intake to discharge configuration is allowed.
C. Wheel shall be centrifugal backward inclined constructed of aluminum, with matched wheel and inlet cones.
D. Motors shall be high efficiency, heavy-duty ball bearing type, mounted out of the air stream.
E. Mount the fan shaft in permanently sealed and lubricated pillow block ball bearings.
F. Each unit shall be equipped with the following accessories:
    1. Self-acting adjustable back-draft damper
    2. Hanging neoprene vibration isolators
    3. Insulated housing and motor cover (only for outdoor ventilation air fans)

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4. Motor cover/belt drive OSHA guard
5. Disconnect device
6. Fans shall be AMCA Certified and for both sound and air performance.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.
B. Secure roof exhausters with lag screws to roof curb.

3.2 SCHEDULE

A. Provide equipment schedule on drawings to include the following data:
Manufacturer
Model
Fan Type
Hood/Housing
Capacity
SP inch WG
Drive
Motor hp
Sound (Sones)
Sound Power
1st Octave
2nd Octave
3rd Octave
4th Octave
5th Octave
6th Octave
7th Octave
8th Octave
Accessories

3.3 FUNCTIONAL PERFORMANCE TESTING

A. System Functional Performance Testing is part of the Commissioning Process.
1. The Contractor shall perform the Functional Performance Testing and the Commissioning Authority shall witness and document the test.
2. Refer to Section 01 91 00, Commissioning, for functional performance tests and commissioning requirements.
B. Systems Readiness Checklists shall be completed and submitted for each piece of equipment included in this section.
C. Perform the functional performance testing of HVAC pumps as part of the Chilled Water System Functional Performance testing.

3.4 DEMONSTRATION AND TRAINING

A. Training of the Owner’s operation and maintenance personnel is required in cooperation with the Owner's Representative.
1. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems.

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2. Schedule the instruction in coordination with the Owner's Representative after submission and approval of formal training plans.
3. Refer to Section 01 91 00, Commissioning, for further contractor training requirements.

B. Provide demonstration and training for the following equipment covered by this section:
1. Roof Exhausters
2. Wall Exhausters
3. Cabinet and Ceiling Exhaust Fans
4. In-Line Exhaust or Supply Fans

END OF SECTION

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SECTION 23 36 16
VARIABLE-AIR-VOLUME UNITS

PART 1 GENERAL

1.1 RELATED DOCUMENTS
- A. The other Contract Documents complement the requirements of this Section.
- B. The General requirements apply to the work of this Section.

1.2 SCOPE
- A. Provide material, equipment, labor, and supervision necessary to install Variable Air Volume Terminal Units as required by the Drawings and this Section.

1.3 STANDARDS
- A. All lining materials shall meet the requirements of NFPA 90A, UL 181 and ASTM C655.
- B. Provide proof of compliance with performance specifications, for air pressure drop and flow and radiated/discharge sound power levels, by manufacturers published certified data derived from tests conforming to ARI 880.
- C. Use electrical components listed by Underwriters Laboratories for their intended use.

1.4 QUALIFICATIONS
- A. Arrangement, capacity, performance, and type as scheduled and/or indicated on the Drawings and specified herein.
- B. Provide certification of equipment in accordance with ARI 880 for air and acoustical performance.
  1. All units shall meet or exceed specified acoustical parameters.

1.5 SUBMITTALS
- A. Submit product information on terminal units including physical dimensions, heaters, air performance, acoustical data, access/maintenance requirements, support locations, wiring diagrams, and similar data.
- B. Provide certified sound performance data for each terminal unit (and silencers, if necessary) at the scheduled operating conditions with 1.5" of inlet static pressure (corrected for silencer pressure drop).
  1. Provide pressure drop data for each terminal unit at the scheduled conditions.

1.6 COMMISSIONING
- A. Commissioning of a system or systems specified in this section is part of the construction process.
- B. Documentation and testing of these systems, as well as training of the Owner’s operation and maintenance personnel, is required in cooperation with the Owner's Representative and the Commissioning Authority.
- C. Project Closeout is dependent on successful completion of all commissioning procedures, documentation, and issue closure.
  1. Refer to Section 01 77 00 - Contract Closeout, for substantial completion details.
- D. Refer to Section 01 91 00, Commissioning, for detailed commissioning requirements.

PART 2 EQUIPMENT

2.1 GENERAL
- A. Acceptable Manufacturers
  1. Variable Air Volume Terminal Units by Trane, Envirotech, Aneomostat, Titus, or Carrier are acceptable.

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B. Use variable air-volume terminal units of size, capacity, and style shown on the drawings.
   1. Use casing constructed of not less than welded 22-gauge galvanized steel.
      a. Leakage rate shall not exceed 4% of the design airflow at 3" water gauge.
   2. The interior surface of the casing shall be acoustically and thermally lined with 1" thick, 1.0 lb/cu ft density glass-fiber insulation (minimum R-value 3.85) with a high density facing covered with a 26-gauge galvanized steel inner liner isolating the fiberglass from the airstream. Cut edges of insulation shall be covered by metal flanges.
      a. Insulation shall be UL listed, and meet NFPA 90A, UL 181 requirements and bacteriological standard ASTM C655.
   3. Provide units with a cylindrical, cast-aluminum airflow control device, or damper assembly with internal or external actuator.
      a. Verify control requirement with Control Subcontractor.
      b. Leak rate shall be 4 percent or less at 3.0' WG.
      c. Provide a pressure independent 16-point airflow sensor (8 points on the high side and 8 points on the low side) and calibration chart on unit. Damper assembly shall maintain airflow to within ± 5% of rated unit airflow with 1.5 diameters of straight duct upstream of the unit.
      d. Flow sensor transducer shall not be integral to the unit.
      e. Flow coefficient calibration data shall be provided for each terminal unit at or near the unit inlet.
      f. Flow sensor pressure transducer shall be pressure tested, with air, prior to field installation.
   4. The Owner's Authorized Control Representative shall provide any VAV-box terminal unit controls consisting of the volume control external (only) actuator and the microprocessor based volume controller.
      a. The control representative will ship control components and a typical wiring diagram to the terminal box manufacturer for factory installation (field installation is not acceptable).
      b. The control representative for each box shall identify the components.
      c. The terminal box manufacturer shall factory mount the components on the terminal box and complete all interconnecting wiring between the controller, actuator, and electrical heater to allow for a single point power connection to the terminal box disconnect.
      d. Provide a fuse-type overprotection device for the control circuit.
      e. The terminal box manufacturer is solely responsible for proper integration of owner furnished control components and the terminal box operation.
   5. Provide factory wired electric heaters as specified in schedule, UL listed resistance open-type element of nickel-chromium.
      a. Provide with airflow switch, disc-type automatic thermal primary safety device, and manual reset thermal secondary device.
      b. Provide with ceramic insulators, interlocking door handle disconnect, and magnetic contractors.
      c. Provide electric heaters listed for use with a circuit breaker protection.
   6. Provide disconnect and transformer for control voltage circuit on VAV boxes without electric heat.

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7. For units with internal actuators, provide a removable access panel in the bottom of each VAV unit for access to the actuator.
   a. Provide fully gasketed access doors not exceeding the specified casing leakage rates.
8. All VAV terminal box units shall meet the following levels of radiated and discharge noise without any credit for environmental adjustment, space effect, sound division, end reflection, or similar elements external to the terminal box.
   a. Noise levels shall be measure at inlet static pressures of 1.5" W.G.
   b. Radiated Noise

i)	Octave Band	2	3	4	5	6	7
ii)	Frequency	63	125	250	500	1000	2000
iii)	dB	76	69	62	57	56	55

   c. Discharge Noise

i)	Octave Band	2	3	4	5	6	7
ii)	Frequency	63	125	250	500	1000	2000
iii)	dB	70	65	61	75	71	66

   d. A maximum variance of +1db is allowed in each octave band and 2db in any octave band.
   e. The Manufacturer may opt to install a pre-manufactured duct type silencer mounted on the box discharge to obtain the listed discharge noise levels.
      i) Provide copy of calculations, including the effect of silencer generated noise levels, indicating the net discharge noise levels and compliance with the above requirements.
      ii) Base the performance for silencers upon independent testing performed in accordance with ASTM E477.
      iii) Add additional pressure drop associated with the silencer to the inlet static pressure requirements in determining discharge and radiated noise levels.
   f. Noise levels listed are for internally lined boxes without foil facing.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.
B. Provide ceiling access doors or locate units above easily removable ceiling components.
   1. Locate bottom of unit not more than 18" above finished ceilings.
   2. Design and installation work shall be coordinated to avoid location of VAV units above the ceiling mounted light fixtures.
   3. Support units individually from structure.
   4. Do not support from adjacent ductwork.
C. Connect to ductwork using rigid duct at inlet and outlet.
   1. Provide a minimum of 5 straight duct diameters upstream of the terminal box inlet and a minimum of 10' of duct downstream of the terminal box prior to the first air device connection.
D. Locate and install units ensuring the minimum service area clearance meets NEC requirements.
   1. Provide 42" of unobstructed clearance in front of control and electric heater panels, spanning the width of the panels (minimum of 30”) and vertically from ceiling grid to 6” above the top of VAV terminals.

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2. Keep building structural components, any piping (including sprinklers), any ductwork, and equipment out of the service clearance area.
3. Advise other trades of encroachment violations and have offending items relocated or with the Engineers approval relocate terminal box to correct nonconforming conditions at no additional cost to the Owner.

3.2 FUNCTIONAL PERFORMANCE TESTING

A. System Functional Performance Testing is part of the Commissioning Process.
   1. The Contractor shall perform the Functional Performance Testing and the Commissioning Authority shall witness and document the test.
   2. Refer to Section 01 91 00, Commissioning, for functional performance tests and commissioning requirements.
B. Systems Readiness Checklists shall be completed and submitted for each piece of equipment included in this section.
C. Perform the functional performance testing of HVAC pumps as part of the Chilled Water System Functional Performance testing.

3.3 DEMONSTRATION AND TRAINING

A. Training of the Owner’s operation and maintenance personnel is required in cooperation with the Owner's Representative.
   1. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems.
   2. Schedule the instruction in coordination with the Owner's Representative after submission and approval of formal training plans.
   3. Refer to Section 01 91 00, Commissioning, for further contractor training requirements
B. Perform demonstration and training for all equipment covered by this section and installed in this project.

END OF SECTION

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SECTION 23 73 13
GRILLES, REGISTERS, DIFFUSERS

PART 1 GENERAL

1.1 RELATED DOCUMENTS
- A. The other Contract Documents complement the requirements of this section.
- B. The General Requirements apply to the work of this section.

1.2 SCOPE
- A. Provide materials, devices, labor, and supervision necessary for the installation of grilles, registers, and diffusers.
- B. Provide grilles, registers, and diffusers as per schedule.

PART 2 PRODUCTS

2.1 APPROVED MANUFACTURERS
- A. Air distribution products by Price Industries, Anemostat, Nailor Industries, Titus, or approved equal.
- B. Louvers shall be Ruskin, Airline Products (Nystrom), Cesco Products, Nailor Industries, or approved equal
- C. Design, specification and schedule based on Titus for diffusers and Ruskin for louvers.

2.2 CEILING DIFFUSERS
- A. Provide ceiling diffusers of type and style with volume control dampers and accessories as scheduled.

2.3 CEILING RETURN AND EXHAUST REGISTERS
- A. Provide ceiling return and exhaust registers, match-ceiling diffusers with opposed blade volume control as scheduled.

2.4 LOUVERS
- A. Louvers shall conform to requirements in section 08 91 19 Fixed Louvers.

PART 3 EXECUTION

3.1 INSTALLATION
- A. In grid-panel type ceilings, acoustical, etc., grilles, registers, and diffusers shall be located in the center of the panel.
- B. Coordinate location of ceiling diffusers and registers with Architect's reflected ceiling plan.

END OF SECTION

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SECTION 23 40 00
HVAC AIR FILTERS

PART 1 GENERAL

1.1 REFERENCES
- A. UL 900: Standard for Air Filter Units
- B. ASHRAE 52: Method of Testing General Ventilation Air Cleaning Devices for Removal Efficiency by Particle Size

1.2 SUBMITTALS
- A. Submit under provisions of Section 23 05 00.
- B. Product Data: For each filter used in this project, provide catalog data for filter media, support grid, enclosing frame, and performance data.
- C. Samples: Not required

1.3 QUALITY ASSURANCE
- A. Filter media shall be UL 900 listed, Class 2.
- B. Provide all filters as product of one manufacturer.

1.4 DELIVERY, STORAGE AND HANDLING
- A. Deliver filters to site in original factory boxes, labeled with manufacturer's identification.
- B. Store filters in original factory boxes, and protect from weather and construction traffic.
- C. Protect filters against dirt, water, chemical and mechanical damage.

PART 2 PRODUCTS

2.1 AIR HANDLING UNITS
- A. Air filters shall be min 4" thick, high efficiency, pleated, disposable type.
- B. Each filter shall consist of non-woven cotton and synthetic fabric media, media support grid, and enclosing-frame.
- C. UL shall classify the filter for flammability as Class 2.
- D. Performance specification is based on Camfil-Farr AP-Thirteen filters.
- E. Filter media shall have a MERV rating of 13 in accordance with ASHRAE 52.
  1. The effective filter media shall be not less than 4.6 sq ft per 1.0 sq ft of filter face area.
  2. The initial resistance shall not exceed 0.08" WG at 250 FPM (0.28"WG at 500 FPM).
  3. The final resistance shall be capable of 0.9" WG.
- F. Media Support Grid shall be welded wire grid with an effective open area not less than 96% to support media.
  1. Bond the grid to the filter media to eliminate the possibility of media oscillation and media pull away.
  2. The grid shall allow total use of the filter media.
- G. Provide an enclosing frame of rigid, heavy-duty, high wet-strength beverage board, with diagonal support members bonded to the air entering and leaving sides of each pleat, to ensure pleat stability.
  1. The inside periphery of the enclosing frame shall be bonded to the filter pack, thus, eliminating the possibility of air bypass.
- H. Provide new clean filter sets and use as follows:
  1. Provide as many filter sets as required during construction.
     a. Do not use low efficiency filters during construction, filters to have minimum MERV rating of 8, check filters on a bi-weekly bases, and replace if dirt is blocking airflow.

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b. The mechanical contractor shall clean the coils prior to Substantial Completion if Architect, Owner or Owner's representative determine the coils require cleaning.

2. Provide one filter set for test and balance work.
   a. The mechanical contractor shall coordinate the installation of new filters prior to test and balance work with the District's test and balance contractor.
3. Provide second filter set as the District's spare set.
   a. Store filter set in closed original factory filter boxes within AHU room and mark the AHU number on the filter boxes.
   b. The mechanical contractor shall NOT use this filter set during construction.
4. On the date of Certificate of Occupancy, all HVAC equipment shall have fresh clean air filters.

I. Provide filter pressure gage for each filter bank.
   1. Refer to Section 23 05 19, Flow Meters, Gages, and Thermometers.

2.2 RETURN AIR GRILLES

A. During construction, before system start-up remove any protective cover from opening and apply temporary filters over the return air grilles to minimize dust from entering the return air system.
   1. Filter shall have a MERV rating of at least 8, check filters on bi-weekly bases, and replace if dirt is blocking airflow.
   2. Provide as many filter sets as required during construction.
   3. The mechanical contractor shall coordinate the removal of the temporary filters prior to test and balance work with the District's test and balance contractor.

2.3 EXHAUST AIR GRILLES

A. During construction, before system start-up remove any protective cover from opening and apply temporary filters over the exhaust air grilles to minimize dust from clogging up the blades on the fan wheels.
   1. Filter shall have a MERV rating of at least 8, check filters on bi-weekly bases, and replace if dirt is blocking airflow.
   2. Provide as many sets of filters as required during construction.
   3. The mechanical contractor shall coordinate the removal of the temporary filters prior to test and balance work with the District's test and balance contractor.

2.4 SUPPLY AIR GRILLES

A. During construction, before system start-up remove any protective cover from opening and apply temporary filters over the supply air grilles to minimize dust from entering the supply duct system.
   1. Filter shall have a MERV rating of at least 8, check filters on bi-weekly bases, and replace if dirt is blocking airflow.
   2. Provide as many sets of filters as required during construction.
   3. The mechanical contractor shall coordinate the removal of the temporary filters prior to test and balance work with the District's test and balance contractor.

PART 3 EXECUTION

3.1 INSTALLATION

A. Air Handling Units: Install air-cleaning devices in accordance with manufacturer's instructions.
B. Air Handling Units: Prevent passage of unfiltered air around filters with felt, rubber, or neoprene gaskets.
C. Do not operate air-handling units or exhaust fans until filters are in place.

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SECTION 23 63 13
AIR COOLED REFRIGERANT CONDENSERS

PART 1 GENERAL

1.1 RELATED DOCUMENTS
- A. The other Contract Documents complement the requirements of this section. The General Requirements apply to the work to this section.

1.2 SCOPE
- A. Provide material, equipment, labor, and supervision necessary to install air-cooled condensing units.
- B. Unit ratings, capacities, and characteristics shall be as scheduled on Mechanical Drawings.

1.3 REFERENCES
- A. AHRI 210/240 – Performance Rating of Unitary Air-Conditioning & Air-Source Heat Pump Equipment
- B. ASHRAE 14 - Measurement of Energy and Demand Savings
- C. ASHRAE 15 - Safety Standard for Refrigeration Systems
- D. ASHRAE 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings
- E. STM B117 – Standard Practice for Operating Salt Spray (Fog) Apparatus
- F. Performance shall be in accordance with the applicable ARI Standards.
- G. Compressor motors, starters, wiring, and control wiring shall all conform to NEMA, UL, NEC, and local utility requirements.

1.4 SECTION INCLUDES
- A. Condensing unit package
- B. Charge of refrigerant and oil
- C. Controls and control connections
- D. Refrigerant piping connections
- E. Motor starters
- F. Electrical power connections

1.5 SUBMITTALS
- A. Submit shop drawings and product data under provisions of Section 01 33 00.
- B. Submit shop drawings indicating components, assembly, dimensions, weights and loadings, required clearances, and location and size of field connections.
- C. Submit shop drawings indicating components, assembly, dimensions, weights and loadings, required clearances, and location and size of field connections.
- D. Include schematic layouts showing condensing units, cooling coils, refrigerant piping, and accessories required for complete system.

1.6 OPERATION AND MAINTENANCE DATA
- A. Submit operation and maintenance data under provisions of Section 01 77 00.
- B. Include start-up instructions, maintenance instructions, parts lists, controls, and accessories.

1.7 DELIVERY, STORAGE, AND HANDLING
- A. Deliver products to site under provisions of Section 01 60 00.
- B. Store and protect products under provisions of Section 01 60 00.
- C. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.
- D. Protect units on site from physical damage.

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1.8 WARRANTY
- A. Provide 5-year extended replacement warranty (parts and labor) on compressor, condenser coils, fans, controls, electrical devices and related system components.

1.9 COMMISSIONING
- A. Commissioning of a system or systems specified in this section is part of the construction process.
- B. Documentation and testing of these systems, as well as training of the Owner's operation and maintenance personnel, is required in cooperation with the Owner's Representative and the Commissioning Authority.
- C. Project Closeout is dependent on successful completion of all commissioning procedures, documentation, and issue closure.
- D. Refer to Section 01 77 00 - Contract Closeout, for substantial completion details.
- E. Refer to Section 01 91 00 - Commissioning, for detailed commissioning requirements

PART 2 PRODUCTS

2.1 MANUFACTURERS
- A. Provide products by one of the following:
  1. Trane
  2. York
  3. Daikin
  4. Engineer and Owner approved equal.

2.2 MANUFACTURED UNITS
- A. Units: Self-contained, packaged, factory assembled and pre-wired units suitable for outdoor use consisting of cabinet, compressors, condensing coil and fans, integral sub-cooling coil, controls, liquid receiver, and screens.
- B. Construction and Ratings in accordance with ARI 210/240
  1. Testing shall be in accordance with ASHRAE 14
- C. Provide energy Efficiency Rating EER of not less than 10.3 or as prescribed by ASHRAE 90A and the FBC: Energy Conservation, whichever is highest.
- D. See Schedule on Drawings for unit capacities, electrical characteristics, and performance criteria.
- E. Provide unit with a holding charge of refrigerant and oil.

2.3 CASING
- A. House components in welded frame with steel panels with weather resistant, baked enamel finish.
- B. Mount starters, disconnects, and controls in weatherproof panel provided with full opening access doors.
- C. Provide removable access doors or panels with piano hinges and quick fasteners.

2.4 CONDENSER COILS
- A. Coils
  1. Aluminum plate fins mechanically bonded to seamless copper tubing.
  2. Provide sub-cooling circuits.
  3. Air test under water to 425 psig, and vacuum dehydrate. Seal with holding charge of refrigerant
- B. All condenser coils shall have corrosion protective coating.
  1. Provide condenser coil coating as specified in design documents.
  2. Approved coil coating materials and methods shall include one of the following:
     a. Blygold PoluA1 XT by Bygold of Florida HVAC Corrosion Protection

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b. Coating process by Eisenheiss
c. Field applied Oxiguard.
d. HVAC Armor by ECM Group of South Florida

C. All coating materials and methods must pass a minimum of 10000 hours of salt spray exposure in a testing performed by an independent laboratory in accordance with ASTM B117.
1. The company providing coating process shall also provide a five-year coil limited warranty.

2.5 FANS AND MOTORS

A. Vertical discharge direct driven propeller type condenser fans with fan guard on discharge.
1. Equip with roller or ball bearings with grease fittings extended to outside of casing.
B. Weatherproof motors suitable for outdoor use, single phase permanent split capacitor or 3-phase, with permanent lubricated ball bearings and built in thermal overload protection.
C. High efficiency motors as indicated.

2.6 COMPRESSORS

A. Construction: Hermetic, scroll and reciprocating type with heat-treated forged steel or cast iron shafts, aluminum alloy connecting rods, automotive type pistons, rings to prevent gas leakage, suction and discharge valves, and sealing surface immersed in oil.
B. Mounting:
1. Statically and dynamically, balance rotating parts and mount on spring rubber-in-shear vibration isolators.
2. Internally isolate hermetic units on springs.
C. Lubrication System: Reversible, positive displacement oil pumps with oil charging valve, oil level sight glass, oil filter, and magnetic plug or strainer.
D. Motor: Constant speed suction gas cooled with electronic sensor and winding over temperature protection, designed for across-the-line starting, furnish with starter.
E. Crankcase Heater:
1. System evaporates refrigerant returning to crankcase during shut down.
2. Energize heater continuously even when compressor is not operating.

2.7 REFRIGERANT CIRCUIT

A. Provide each unit with two speed compressors or dual refrigerant circuit, factory supplied and piped.
B. If dual refrigerant circuits are used, circuit the AHU evaporator coil to provide individual circuits and expansion valves for each compressor, and individual piping runs installed.

2.8 CONTROLS

A. On unit, mount weatherproof steel control panel, NEMA 250, containing power and control wiring, factory wired with single point power connection.
B. For each compressor, provide across-the-line starter with dual pole contactor, minimum 3-minute (or manufacturer standard) anti-cycling time delay compressor overload relay, and control power transformer or terminal for controls power.
1. Provide manual reset current overload protection.
2. For each condenser fan, provide across-the-line starter with starter relay.
C. Provide the following safety controls arranged so that operating any one will shut down machine and require manual reset:
1. High discharge pressure switch (manual reset) for each compressor.
2. Low suction pressure switch (manual reset) for each compressor.
3. Oil Pressure switch (manual reset).
D. The installing contractor shall perform any control field wiring required.

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PART 3 EXECUTION

3.1 INSTALLATION

A. The Contractor shall install equipment in accordance with manufacturer's instructions.
B. Provide for connection to electrical service. (Refer to Division 26)
C. Install units on concrete base as indicated.
D. Provide connection to refrigeration piping system and evaporators.
    1. The Contractor shall provide and install the following for each refrigerant circuit:
        a. Suction and liquid line filter dryer replaceable core type.
        b. A liquid line sight-glass and moisture indicator.
        c. Thermal expansion valve for maximum operating pressure.
        d. Insulated suction line
        e. Suction and liquid line service valves and gage ports.
        f. Charging valves
        g. Refrigerant and oil
E. Refer to Section 23 23 00. Comply with ASHRAE 15

3.2 CONTRACTOR'S FIELD SERVICES

A. Test refrigerant system for leaks including lines connecting the condensing unit with air handling unit.
B. Prepare and start systems.
C. Supply initial charge of refrigerant and oil for each refrigerant circuit.
    1. Replace losses of refrigerant and oil.
D. Inspect and test for refrigerant leaks quarterly during first year of operation.
    1. Repair all leaks and replace losses of refrigerant and oil to meet manufacturer's specifications.

3.3 FUNCTIONAL PERFORMANCE TESTING

A. System Functional Performance Testing is part of the Commissioning Process.
    1. The Contractor shall perform the Functional Performance Testing and the Commissioning Authority shall witness and document the test.
    2. Refer to Section 01 91 00, Commissioning, for functional performance tests and commissioning requirements.
B. Systems Readiness Checklists shall be completed and submitted for each piece of equipment included in this section.
C. Include the functional performance testing of Condensing Units as part of the Air-Cooled Split System Functional Performance testing.

3.4 DEMONSTRATION AND TRAINING

A. Training of the Owner’s operation and maintenance personnel is required in cooperation with the Owner's Representative.
B. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems.
C. Schedule the instruction in coordination with the Owner's Representative after submission and approval of formal training plans.
D. Refer to Section 01 91 00, Commissioning, for further contractor training requirements
E. Provide demonstrations and training for all types of Air-Cooled Split Systems installed in this project.

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END OF SECTION

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SECTION 23 64 16
CENTRIFUGAL WATER CHILLERS

PART 1 GENERAL

1.1 SECTION INCLUDES
- A. Chiller package
- B. Charge of refrigerant and oil
- C. Controls and control connections
- D. Chilled water connections
- E. Condenser water connections
- F. Auxiliary water connections
- G. Starters
- H. Electrical power connections

1.2 REFERENCES
- A. ASHRAE 15 - Safety Code for Mechanical Refrigeration Systems
- B. ASHRAE 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings
- C. ASME BPVC SEC 8 - Boiler and Pressure Vessel Code
- D. UL 1995 - Heating and Cooling Equipment
- E. AHRI 550/590 – Standard for Performance Rating of Water-Chilling and Heat Pump Water-Heating Packages Using the Vapor Compression Cycle

1.3 SUBMITTALS
- A. Submit shop drawings under provisions of Section 01 33 00.
- B. Submit shop drawings indicating components, assembly, dimensions, weights and loadings, required clearances, and location and size of field connections.
  1. Indicate equipment, piping and connections, valves, strainers, and thermostatic valves required for complete system.
- C. Submit product data under provisions of Section 01 33 00.
- D. Submit product data indicating rated capacities, weights, specialties and accessories, electrical requirements and wiring diagrams.
- E. Submit written certification that non-manufacturer furnished components of package meet the manufacturer's requirements.
- F. Submit manufacturer's installation instructions under provisions of Section 01 33 00.
- G. Submit performance data indicating energy input versus cooling load output from 0% to 100% of full load at specified and minimum condenser water temperature.

1.4 OPERATION AND MAINTENANCE DATA
- A. Submit operation data under provisions of Section 01 77 00.
- B. Include start-up instructions, maintenance data, parts lists, controls, and accessories.
  1. Include trouble-shooting guide and installation manual.
  2. Provide expanded breakdown of machine including parts list and number, factory generated service repair manuals and complete as-built wiring diagram of machine and controls.
- C. Submit maintenance data under provisions of Section 01 77 00.

1.5 QUALIFICATIONS
- A. Manufacturer: Company specializing in the manufacture of the products specified in this Section with minimum five years documented experience.

1.6 REGULATORY REQUIREMENTS
- A. Conform to AHRI 550/590 code for testing and rating of centrifugal chillers.

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B. Conform to UL 1955 code for construction of centrifugal chillers.
C. Conform to ASME BPVC SEC 8 for construction and testing of centrifugal chillers.
D. Conform to ASHRAE 15 code for construction and operation of centrifugal chillers.
E. Provide certification of inspection for conforming authority having jurisdiction approval.
F. Mechanical equipment rooms where chiller components containing refrigerants shall meet all requirements of the FBC-M, Chapter 11, including but not limited to design, installation, construction, ventilation, refrigerant detection with alarms, safety equipment, system pressure testing, and refrigerant leak testing.

1.7 DELIVERY, STORAGE, AND HANDLING
A. Deliver products to site under provisions of Section 01 60 00.
B. Store and protect products under provisions of Section 01 60 00.
C. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.
D. Protect units from physical damage.
1. Leave factory-shipping covers in place until installation.

1.8 WARRANTY
A. Provide 10-year warranty under provisions of Section 01 77 00.
B. Warranty coverage is for complete chiller package as manufactured and delivered to site including materials and labor.

1.9 COMMISSIONING
A. Commissioning of a system or systems specified in this section is part of the construction process.
B. Documentation and testing of these systems, as well as training of the Owner’s operation and maintenance personnel, is required in cooperation with the Owner's Representative and the Commissioning Authority.
1. The chiller shall be 4 point performance tested on an AHRI certified factory test loop in accordance with AHRI 550/590. If the chiller manufacturer is not able to test the unit in their facility, the contractor shall coordinate with a qualified AHRI certified third party testing company to perform testing per the specifications.
a. Testing shall be conducted at 100%, 75%, 50% and 25% of design load and at specified entering condenser water temperatures for each condition.
b. A certified test report of all data shall be submitted to the Contracting Officer and the District prior to completion of the project.
C. Project Closeout is dependent on successful completion of all commissioning procedures, documentation, and issue closure.
D. Refer to Section 01 77 00 - Contract Closeout, for substantial completion details.
E. Refer to Section 01 91 00, Commissioning, for detailed commissioning requirements.

1.10 MAINTENANCE SERVICE
A. Furnish service and maintenance of chillers for period of one year from Date of Substantial Completion in accordance with manufacturer's instructions. Maintenance and service to be provided by chiller OEM.
B. Provide factory generated start-up reports to Owner upon commissioning of each chiller, along with manufacturer's recommended periodic service reports.

PART 2 PRODUCTS

2.1 MANUFACTURERS
A. Trane
B. Carrier

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C. York
D. Daikin

2.2 MANUFACTURED UNITS

A. Provide factory assembled and tested, packaged, water cooled, liquid chillers consisting of centrifugal compressors, compressor motor, condenser, evaporator, refrigeration accessories, instrument and control panel including gages and indicating lights, all optional auxiliary components and accessories, and motor starters.
   1. Construction and ratings shall be in accordance with AHRI 550/590.
   2. Chiller shall have the capability to unload to 25% of design tonnage with constant entering water temperature. The chiller loading capabilities shall be demonstrated at the time of the factory performance test. The chiller shall be modified to include hot gas bypass if the minimum load cannot be met.
   3. On loss of power the chiller's compressor must have the capability to restart within 70 seconds, and reach 80% load within 240 seconds.
B. Units shall have Energy Efficiency Rating (EER) not less than prescribed by ASHRAE 90.1.
C. The Engineer shall refer to FPL Commercial/Industrial HVAC Trade Ally Program Standards and select chillers with KW/ton or EER ratings that qualify for incentive rebate payments from FPL, and the Contractor shall supply and install units meeting these minimum requirement.
   1. For cooling loads, exceeding 600 tons of refrigeration and for high schools the engineer shall design the central chiller plant to facilitate stable 1 to 3 hour operation at partial loads ranging from 3.6% to 18% of the total design-cooling load.
   2. The alternatives may include two or three water-cooled centrifugal and/or screw compressor chillers.
   3. For air-cooled chillers refer Section 23 64 10 and for rotary (screw compressor) chillers refer to Section 23 64 26.
D. Design chiller plant to deliver chilled water at temperature not exceeding 44°F.
   1. Use chilled water-fouling factor of not less than 0.00025 for condenser water EWT at 85°F with condenser fouling factor of not less than 0.00025.

2.3 COMPRESSORS

A. Compressor Casing: Cast iron, horizontally or vertically split with machined passages, leak tested with refrigerant trace gas to 45-psig.
   1. Provide sight glass for monitoring compressor rotation and oil level.
B. Impellers: Direct drive multi-stage, in-line design, fully shrouded, statically and dynamically balanced, over speed tested to 20% over operating speed, mounted on heat treated forged or rolled steel shaft, nonferrous, labyrinth seals between stages.
C. Guide Vanes: Modulating radial blade dampers, with externally mounted operator, suitable for capacity reduction to 10% of specified load without hot gas bypass when supplied with design entering water quantity and design temperature of water entering condenser.
D. Bearings: Roller bearings, self-aligning, pressure lubricated.
E. Motor: Shall be a hermetically sealed single speed low slip induction type 3,600-rpm max.
F. Lubrication:
   1. Direct drive, positive displacement oil pump, with oil cooler, pressure regulator, oil filters, thermostatically controlled oil heater, and motor controls ¼ HP minimum motor.
   2. Interlock to start before chiller motor and run after motor shutdown.
   3. Provide sight glass for monitoring oil level.
   4. Provide cut off valves before and after oil filter.

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G. Refrigerant: The unit shall be factory pre-charged and all chillers in the chiller plant shall use the same EPA approved refrigerant.
H. Compressor motor shall be rated 3-phase 480 Volt.

2.4 EVAPORATOR

A. Provide condensers of shell and tube type, seamless or welded steel construction with cast iron or fabricated steel heads, seamless copper tubes or red brass tubes with integral fins, rolled into tube sheets.
   1. Space tube support sheets approximately 2.5'.
   2. Smooth bore tubes, extra thick
B. Design and stamp refrigerant side for working pressure and test refrigerant side at design pressure.
   1. Test and stamp water side for 150 psig working pressure in accordance with ASME BPVC SEC. 8.
C. Provide baffles to ensure even distribution of incoming gas and to concentrate non-condensable gases.
D. Equipment manufacturer shall provide epoxy coating of tube sheets and end bells.
   1. Use one of the following two-pack high solids epoxy phenolic or high molecular weight reactive polymer coating materials:
      a. Heresite CSE 6100,
      b. Jotamastic 80,
      c. Belzona 1321
   2. All above products have common characteristics:
      a. They are manufactured and stored as two components mixed prior to application, component A (base as a powder or paste material) and component B (solvent, curing agent/solidifier or highly reactive polymer)
      b. The product can be applied by spray, brush, or by immersion to obtain the prescribed coverage and the dry film thickness (6 to 15 mills or 150 to 375 microns).
      c. Coating materials solidify and cure within 24 hours from application.
      d. Equipment manufacturer shall include a 10-year warranty for the coating materials to provide high corrosion resistance to Water Treatment chemicals.
         i) See specification 23 25 00, protection against galvanic corrosion and erosion damage of the coated substrate metals.
E. Construction and materials shall conform to ASME BPVC SEC 8.

2.5 CONDENSERS

A. Provide condensers of shell and tube type, seamless or welded steel construction with cast iron or fabricated steel heads, seamless copper tubes or red brass tubes with integral fins, rolled into tube sheets.
   1. Space tube support sheets approximately 2.5'
   2. Smooth bore tubes, extra thick
B. Design and stamp refrigerant side for 45 psig working pressure, test refrigerant side at; design, test and stamp waterside for 150 psig working pressure; in accordance with ASME BPVC SEC. 8.
C. Provide baffles to ensure even distribution of incoming gas and to concentrate non-condensable gases.
D. Equipment manufacturer shall provide epoxy coating of tube sheets and end bells.
   1. Use one of the following two-pack high solids epoxy phenolic or high molecular weight reactive polymer coating materials:

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a. Heresite CSE 6100,
b. Jotamastic 80,
c. Belzona 1321

2. All above products have common characteristics:
   a. They are manufactured and stored as two components to be mixed prior to application. Component A (base as a powder or paste material) and component B (solvent, curing agent/solidifier or highly reactive polymer)
   b. The product can be applied by spray, brush, or by immersion to obtain the prescribed coverage and dry film thickness (6 to 15 mills or 150 to 375 microns).
   c. Coating materials solidify and cure within 24 hours from application.
   d. Equipment manufacturer shall include a 10-year warranty for the coating materials to provide high corrosion resistance to Water Treatment chemicals.
      i) See specification 23 25 00, protection against galvanic corrosion and erosion damage of the coated substrate metals.

E. Construction and materials shall conform to ASME BPVC SEC 8.

2.6 PURGE SYSTEM

A. Provide high efficiency purge system consisting of motor driven compressor, electrically heated oil separator, and baffled drum, for the automatic removal of non-condensable and water vapor.
B. System shall automatically discharge non-condensable.
   1. Provide for manual blow-off of water vapor.
   2. Provide sight glass for monitoring purge condenser drum.

2.7 CONTROLS – Provided by the chiller manufacturer including translator/interface module compatible with Owner's Energy Management Control System (EMCS) hardware and software, see design drawings with controls schematics and sequence of operations for details.

A. On or near chiller, mount steel control panel containing solid state, fully automatic operating, and safety controls.
B. Provide the minimum shown but not limited to safety controls arranged so that operating any one will shut down machine and require manual reset:
   1. High refrigerant (condenser) pressure
   2. Low refrigerant (evaporator) temperature
   3. Low refrigerant (evaporator) pressure
   4. High bearing temperature
   5. Motor winding temperature
   6. Motor overload
   7. Low chilled water temperature
   8. Low oil pressure (differential pressure switch)
C. Provide the following safety controls arranged so that operating any one will shut down machine and automatically reset:
   1. Chilled water flow switch
   2. Condenser water flow switch
   3. Phase protection and delay start
D. Provide the following devices on control panel face of each chiller.
   1. Machine off, auto switch
   2. A machine selector switch allowing load, unload, hold, or automatic operation.
   3. Sequential start pilot light
   4. Operating pilot light

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5. Condenser pressure gage
6. Evaporator pressure gage
7. Oil pressure gage
8. Oil pump pilot light
9. Oil pump switch (manual or automatic)
10. Purge drum pressure gage
11. Purge pump pilot light
12. Purge pump switch (manual-off-auto)
13. Purge oil separator heater pilot light
14. Purge oil separator heater switch
15. Evaporator low temperature cutout pilot light
16. Evaporator low-pressure cutout pilot light
17. Condenser high-pressure cutout pilot light
18. Demand limit switch
19. Motor driven elapsed run time meter
20. Start counter

E. Provide the following operating controls:
1. Solid state, chilled water temperature controller which controls electronic guide vane operator within throttling range setting of 0.8°F and features adjustable load rate. Locate temperature sensor in leaving chilled water.
2. Adjustable thirty minute off timer prevents compressor from short cycling.
3. A demand limit device allowing for manual setting of maximum current infinitely between 40% and 100% of full load amperes.
4. Provide a condenser water-temperature sensor.

F. Provide self-diagnostic digital display module with microprocessor to indicate faults.

2.8 STARTER

A. Provide unit mounted steel NEMA 1 type enclosure, containing Star Delta closed transition starter, factory wired and tested.

B. Design the enclosure for bottom cable entry with front access.
1. Door, interlocked with circuit breaker, shall accommodate padlock.

C. Mount the following devices within enclosure:
1. Disconnect switch on line side with fuses.
2. A high interrupting capacity circuit breaker with ground fault protection.
3. Pilot relays to start and stop compressor on signal from chiller control panel.
4. Electronic overload provides overload protection, protects compressor motor from distribution system irregularities, phase protection with manual or automatic reset, and provides motor current signal to chiller-capacity control module.
5. Control power transformer.
6. Fused control circuits for control circuit, oil pump motor, oil heater, and purge control unit.
7. Contactor interlocks for communication between starter and control panel.
8. Capacitors one per phase, to correct power factor to minimum 95%.
9. Fused disconnect and starter for oil pump.

D. Provide the following devices on starter door:
1. A starter fault-trip indicator and reset control.
2. Overload trip indicator and reset control.
3. Distribution fault trip indicator and reset control.

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4. Ground fault trip indicator and reset control.

E. Provide chiller sequencing panel:
1. For optimizing multiple chiller operation.
2. Chiller manufacturer shall make panel.

2.1 REFRIGANT MONITOR

A. Monitor system shall meet ASHRAE 15
B. Monitor shall have minimum sensitivity of 1ppm
C. Monitor shall have minimum of 4 sensing ports with locations determined by the Engineer.
D. Monitor shall be capable of sensing more than one type of refrigerant during operation.
E. Monitor shall be capable of initiating required alarms.
F. Monitor shall sample continuously.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.
B. Provide for connection to electrical service.
1. Refer to Section 26 05 19.
2. Include for connection of oil pump to separately fused circuit.
C. Provide for connection of electrical wiring between starter and chiller control panel, oil pump, and purge unit, refer to Section 26 05 19.
D. Align chiller on concrete foundations, sole plates, and sub-bases.
1. Level, grout, and bolt in place.
E. Install units in vibration isolation; refer to Section 23 05 48.
F. Provide evaporator connections to chilled water piping.
1. Refer to Section 23 21 13.
2. On inlet, provide thermometer well for temperature controller, thermometer well and thermometer, strainer, 1½" threaded weld-o-let for flow switch, flexible stainless steel corrugated pipe connector, pressure gage, and shut-off valve, ball valve type.
3. On outlet, provide thermometer well and thermometer, corrugated stainless steel flexible pipe connector, pressure gage, and shut-off valve.
G. Furnish and install necessary auxiliary water piping for oil cooling units and purge condensers with strainers and cut-off valves.
H. Insulate Evaporator and any other cold surfaces in accordance with manufacturer's instructions. Minimum 1.5” thick closed cell insulation covering all components subject to sweating. Insulation k value-0.28.
I. Provide condenser connection to condenser water piping.
1. Refer to Section 23 21 13.
2. On inlet, provide thermometer well and temperature limit controller, thermometer well and thermometer, strainer, 1¼" (minimum) weld-o-let and flow switch, flexible pipe connector, pressure gage, and shut-off valve.
3. On outlet, provide thermometer well and thermometer, flexible pipe connector, pressure gage, and shut-off valve.
J. Arrange piping for easy dismantling and clearance to permit tube cleaning and removal.
K. Provide piping from chiller rupture disc to outdoors.
1. Size as recommended by manufacturer, with removable flexible connection at disc.
L. Locate chillers to align with exterior doors for tube pull.

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M. A minimum clearance of 3' must be maintained between chiller and nearest external system component and 6' between any two chillers or manufacturer's commendations whichever is greater.
N. Provide clearance above the top of chiller highest component as recommended by unit's supplier.
O. Provide a trolley I-beam lifting structure built over chillers.
    1. Chiller supplier shall specify the recommended clearances and trolley lifting capacity to allow service and removal of heaviest chiller components.
P. Locate control panels facing each other for dual chillers.
    1. Three or more chiller panels will face same direction.

3.2 MANUFACTURER'S FIELD SERVICES

A. Prepare and start systems under provisions of Section 01 60 00.
B. Provide services of factory-trained representative to leak test, refrigerant pressure test, evacuate, dehydrate, charge, startup, calibrate controls, and instruct Owner on operation and maintenance to Owner's satisfaction.
C. Supply initial charge of refrigerant and oil.
D. Contractors' startup shall be scheduled and documented in accordance with the commissioning requirements.
    1. Refer to Section 01 91 00, Commissioning, for further details.

3.3 OPERATIONAL DATA

A. Start-up and demonstrate system operation and verify specified performance, refer to Sec 23 08 00.
B. Provide equipment schedule on the drawings to include the following data:
    1. Manufacturer
    2. Model Number
    3. Cooling Capacity
    4. Refrigerant
    5. Unit EER
    6. Evaporator
        a. Water Flow
        b. Entering Water Temperature
        c. Leaving Water Temperature
        d. Pressure Drop
        e. Fouling Factor
    7. Condenser
        a. Water Flow
        b. Entering Air Temperature
        c. Leaving Water Temperature
        d. Pressure Drop
        e. Fouling Factor
    8. Heating Recovery Condenser (if applicable)
        a. Water Flow
        b. Entering Water Temperature
        c. Leaving Water Temperature
        d. Pressure Drop
        e. Fouling Factor
    9. Compressor

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a. Maximum Power Input
b. Starter Type

3.4 FUNCTIONAL PERFORMANCE TESTING

A. System Functional Performance Testing is part of the Commissioning Process.
   1. The Contractor shall perform Functional Performance Testing and the Commissioning Authority shall witness and document the test.
   2. Refer to Section 01 91 00, Commissioning, for functional performance tests and commissioning requirements.
B. Systems Readiness Checklists shall be completed and submitted for each piece of equipment included in this section.
C. Include the functional performance testing of HVAC pumps as part of the Chilled Water System Functional Performance testing.

3.5 DEMONSTRATION AND TRAINING

A. Training of the Owner’s operation and maintenance personnel is required in cooperation with the Owner's Representative.
   1. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems.
   2. Schedule the instruction in coordination with the Owner's Representative after submission and approval of formal training plans.
   3. Refer to Section 01 91 00, Commissioning, for further contractor training requirements.
B. Provide demonstration and training for all equipment covered by this section and installed in this project.

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SECTION 23 65 00
COOLING TOWER

PART 1 GENERAL

1.1 SECTION INCLUDES
- A. Mechanical induced draft Cooling Tower
- B. Controls
- C. Ladder and handrails

1.2 REFERENCES
- A. ABMA 9 - Load Rating and Fatigue Life for Ball Bearings
- B. ABMA 11 - Load Rating and Fatigue Life for Roller Bearings
- C. ASME PTC-23 - Atmospheric Water Cooling Equipment
- D. Cooling Tower Institute (CTI) ATC-105 - Acceptance Test Code for Water Cooling Towers
- E. Cooling Tower Institute (CTI) - Certification Standard STD 201
- F. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum)

1.3 SUBMITTALS
- A. Submit shop drawings under provisions of Section 01 33 00.
- B. Submit shop drawings indicating suggested structural concrete supports including dimensions, sizes, and locations for mounting bolt holes using manufacturer's recommendations.
- C. Submit product data under provisions of Section 01 33 00.
- D. Submit product data indicating rated capacities, dimensions, weights and point loadings, accessories, required clearances, electrical requirements and wiring diagrams, and location and size of field connections.
  1. Submit schematic indicating capacity controls.
- E. Certify performance, based on CTI STD 201, and submit performance curve plotting leaving water temperature against entering air wet bulb temperature.
- F. Submit manufacturer's installation instructions under provisions of Section 01 33 00.

1.4 OPERATION AND MAINTENANCE DATA
- A. Submit operation data under provisions of Section 01 77 00.
- B. Include start-up instructions, maintenance data, parts lists, controls, and accessories.
- C. Submit maintenance data under provisions of Section 01 77 00.

1.5 DELIVERY, STORAGE, AND HANDLING
- A. Deliver products to site under provisions of Section 01 60 00.
- B. Factory assemble entire unit.
  1. For shipping, disassemble into as large as practical sub-assemblies so that minimum amount of fieldwork is required for reassembly.
- C. Store and protect products under provisions of Section 01 60 00.
- D. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.

1.6 WARRANTY
- A. Provide 5-year warranty under provisions of Section 01 77 00.
- B. Warranty: Include coverage for cooling tower package, labor, and materials.

1.7 EXTRA MATERIALS
- A. Provide one set of matched fan belts, three spray nozzles for each cell, and water make-up valve-assembly.

1.8 COMMISSIONING
- A. Commissioning of a system or systems specified in this section is part of the construction process.

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B. Documentation and testing of these systems, as well as training of the Owner's operation and maintenance personnel, is required in cooperation with the Owner's Representative and the Commissioning Authority.
C. Project Closeout is dependent on successful completion of all commissioning procedures, documentation, and issue closure.
D. Refer to Section 01 77 00 - Contract Closeout, for substantial completion details.
E. Refer to Section 01 91 00, Commissioning, for detailed commissioning requirements.

PART 2 PRODUCTS

2.1 MANUFACTURERS
A. BAC, stainless steel
B. Tri-Thermal Inc., stainless steel
C. Marley Quadraflow, stainless steel
D. Evapco, stainless steel
E. Berg, stainless steel
F. Tower-Tech Series, anti-corrosion pultruded fiberglass reinforced polyester and stainless steel

2.2 MANUFACTURED UNITS
A. Provide cross-flow type units for outdoor use, factory assembled, sectional, with gravity operated hot deck distribution system, vertical discharge, mechanical induced draft type, with sump, surface sections, drift eliminators, fan, motor, and drive assembly.
B. Provide one cooling tower per chiller having thermal capacity to cool the required flow (GPM) of condenser water from 95°F to 85° F at a design entering air wet-bulb temperature of 80° FWB, certified in accordance with 1.3.E.

2.3 COMPONENTS
A. Framework and Casing: Total Stainless Steel construction
B. Louvers: Stainless Steel material, sight tight spaced to minimize air resistance and splash.
C. Fan: Multi blade, cast aluminum, fixed axial vertical discharge type, with stainless steel shaft, multi-grooved neoprene/polyester belt drive, bearings with ABMA 9 or ABMA 11 L-10 life expectancy of 30,000 hours, with extended copper grease fittings.
D. Motor: Single speed, VFD inverter duty rated, totally enclosed, weatherproof, factory epoxy-sealed type, air over (TEAO) type with special moisture protection, mounted on welded stainless steel frame in fan deck.
    1. Refer to Section 23 05 13.
    2. Cooling tower manufacturer shall provide VFD fan motor drive with manual bypass, all in NEMA type 4X enclosure.
E. Belt Drive, designed for a minimum strength of 150% over the motor nameplate power.
F. Fan Cylinder shall be one-piece welded stainless steel fan assembly.
G. Fan Guard shall be one-piece welded steel rod and wire guard Stainless Steel material.
H. Access, provide large access doors at both ends of tower to eliminators and air plenum.
I. Provide safety railings and ladder from grade to fan deck, aluminum construction.
J. Distribution Basin shall be open, gravity type distribution basin utilizing weirs and plastic metering orifices, with flow control balancing valves at each hot deck inlet.
K. Fill shall be vertical sheets of polyvinyl chloride plastic hung from stainless steel supports.
L. Drift Eliminators shall be two or three-pass polyvinyl chloride plastic, to limit drift loss to 0.7% of total water circulated.

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M. Collection Basin shall be self-cleaning stainless steel with depressed center section, designed to support tower, with cleanout and drain fitting, 8 gage, ¼" stainless steel mesh strainer, bottom outlet or side outlet sump, with separate overflow connection.
N. Overflow shall be stainless steel pipe and fittings.
O. Float Valves shall be brass or bronze make-up valve with plastic or copper float (electronic not acceptable).
P. Hardware shall be stainless steel nuts, bolts, and washers shall.
Q. Finish for Stainless Steel components non-required.
R. Optional Component: If required provide fan cylinder extension (in stainless steel) to elevate fan discharge, prevent moist air recirculation and to mitigate noise.

2.4 ACCESSORIES

A. Temperature Controller shall be located in mechanical room with sensor in conditioned water return to control fans (one per tower).
B. Time Delay Relay shall limit fan motor starts to not more than six per hour (not required if VFD fan drive is used).
C. Provide Capacity Control for stable operation down to 10% of rated cooling at specified wet bulb temperature.
D. Control Panel shall be in NEMA type 4X enclosure and containing:
    1. Unfused disconnect switch
    2. Interlocks and relays
    3. Pilot lights and push buttons
E. Provide water meter for make-up water.
F. Provide backflow preventer for make-up water line.
G. Provide vibration switch, one per each tower.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install one tower per water-cooled chiller.
    1. Do not use dual cell, common sump towers.
    2. Design condenser water piping system so that any tower can be isolated and can serve any chiller.
    3. Install cooling towers in accordance with manufacturer's instructions.
    4. Cooling tower I-beam structural supports shall be aluminum.
B. Provide 8 ft masonry screen walls, louvered walls or corrosion resistant fence around perimeter of tower compound with a minimum clearance of 10' from tower to screen walls or fence.
    1. Elevate tower to maintain maximum positive suction head on condenser water pump.
C. For vibration isolation, refer to Section 23 05 48.
D. Provide a 115 V duplex receptacle in the cooling tower compound.
    1. Connect condenser water piping with flanged connections to tower.
    2. Pitch condenser water supply to tower and condenser water suction away from tower.
    3. Refer to Section 23 21 13.
E. Provide hose bib on make-up water supply in tower.
    1. Connect make-up water piping with brass flanged or union connections to tower.
    2. Refer to Section 23 21 13.
F. Provide full flow-makeup water bypass with valve to fill sump.
    1. Connect bleed to floor drain.

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G. Division 16 wiring for motors in wet locations (Cooling Towers) shall be installed in water tight conduit with both ends sealed and shall be terminated inside the sealed motor terminal boxes with silicone filled wire nuts.
H. Provide concrete pad for the tower compound floor under tower, with rock between tower and fence.
    1. Architect shall specify the rock depth and type.
I. Provide one water treatment system per cooling tower; refer to Section 23 25 00.

3.2 FIELD QUALITY CONTROL

A. Performance of field inspection and testing is per provisions of Section 01 40 00.
B. Test under actual operating conditions in accordance with CTI ATC 105 and verify specified performance.

3.3 MANUFACTURER'S FIELD SERVICES

A. Prepare and start systems under provisions of Section 01 60 00.
B. Inspect tower after installation and submit report prior to start-up, verifying installation is in accordance with specifications and manufacturer's recommendations.
    1. If tower fails to meet field performance, then it shall be up-sized at no cost to Owner.
C. Supervise rigging, hoisting, and installation.
D. Provide startup and instructions to Owners operating personnel and Owner's satisfaction.
E. DO NOT operate the cooling tower until initiation of water treatment system.
F. Contractors' startup shall be scheduled and documented in accordance with the commissioning requirements.
    1. Refer to Section 01 91 00, Commissioning, for further details

3.4 SCHEDULE

A. Provide equipment schedule on the drawings to include the following data:
    1. Manufacturer
    2. Model Number
    3. Cooling Capacity
    4. Water Flow Rate
    5. Entering Water Temperature
    6. Leaving Water Temperature
    7. Entering Air WB Temperature
    8. External Static Pressure
    9. Number of fans, Motors
    10. Motor size, speed, horsepower, volts, phase, and frequency
    11. VFD manufacturer, size, type, and operating range

3.5 FUNCTIONAL PERFORMANCE TESTING

A. System Functional Performance Testing is part of the Commissioning Process.
    1. The Contractor shall perform the Functional Performance Testing and the Commissioning Authority shall witness and document the test.
    2. Refer to Section 01 91 00, Commissioning, for functional performance tests and commissioning requirements.
B. Systems Readiness Checklists shall be completed and submitted for each piece of equipment included in this section.
C. Include the functional performance testing of HVAC pumps as part of the Chilled Water System Functional Performance testing.

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3.6 DEMONSTRATION AND TRAINING

A. Training of the Owner’s operation and maintenance personnel is required in cooperation with the Owner's Representative.
   1. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems.
   2. Schedule the instruction in coordination with the Owner's Representative after submission and approval of formal training plans.
   3. Refer to Section 01 91 00, Commissioning, for further contractor training requirements.

B. Provide demonstration and training for all equipment covered by this section and installed in this project.

END OF SECTION

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SECTION 23 70 00
AIR HANDLING UNITS

PART 1 GENERAL

1.1 RELATED DOCUMENTS
- A. The other Contract Documents complement the requirements of this section.
- B. The General Requirements apply to the work of this section.

1.2 SCOPE
- A. Provide material, equipment, labor, and supervision necessary to install Air Handling Units.

1.3 STANDARDS
- A. Units shall have certified ratings complying with AHRI Standard 430.

1.4 SUBMITTALS
- A. Submittal data shall consist of drawings showing coil dimensions, construction materials, fan performance curves, coil capacity, horsepower, electrical characteristics, and installation instructions.
- B. Fan manufacturers shall furnish for approval for each fan certified sound power ratings with an octave band analysis and the volume-pressure-horsepower characteristic curves from shutoff to free air delivery.

1.5 COMMISSIONING
- A. Commissioning of a system or systems specified in this section is part of the construction process.
- B. Documentation and testing of these systems, as well as training of the Owner's operation and maintenance personnel, is required in cooperation with the Owner's Representative and the Commissioning Authority.
- C. Project Closeout is dependent on successful completion of all commissioning procedures, documentation, and issue closure.
- D. Refer to Section 01 77 00 - Contract Closeout, for substantial completion details.
- E. Refer to Section 01 91 00, Commissioning, for detailed commissioning requirements

1.6 WARRANTIES
- A. Provide 5-year parts and labor warranty to include all motors, fans, bearings, coils, controls, electrical devices and related system components, see section 23 05 13.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS
- A. Air handling units shall be as manufactured by one of the following.
  1. Trane
  2. Carrier
  3. York
  4. Daikin

2.2 GENERAL
- A. Unit shall be factory built and assembled with arrangements as indicated.
- B. Units shall have capacities, ratings, and performance as scheduled.

2.3 CASING
- A. Constructed of a galvanized structural steel framework with 2" insulated double wall roof, wall and floor panels.
  1. Casing shall be constructed of a minimum of 16 gauge, G-90 galvanized steel.
  2. Separate fan, coil, coil access, drain-pan, and a filter sections.

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3. Casings for coil section and all sections downstream from coil section shall be of the dual wall internally insulated with spray injected foam to achieve minimum thermal resistance of R-13 with a solid internal galvanized liner.
4. Unit shall comply with ASHRAE 111 class 6 for casing leakage no more than 1% of design airflow at 1.25 times design static pressure up to +8" w.g. in positive pressure sections and -8" w.g. in negative pressure sections..
5. Casing panel inner liners shall not extend to the exterior of the unit or contact the exterior frame and in all applications must provide a thermal break.
6. Casing shall have lifting lugs or other attachments to facilitate handling.
7. Casing shall have removable panels to provide access to internal components.
8. Coil section shall be removable without disassembly of unit.

B. Casing panels and access doors shall deflect no more than L/240 when subjected to 1.5 times design static pressure up to +8" w.g. in positive pressure sections and -8" w.g. in negative pressure sections.

C. Condensate drain pans shall be stainless steel double wall construction and provided under the complete fan and coil section for horizontal units and under the complete coil section for vertical units, with drain connection on lower end.
1. If coil moisture carry-over is, present drain pan shall extend to the section downstream from the coil.
2. Drain pans shall be insulated with 1" insulation between the two walls and the inner pan shall be coated with an EPR approved antibacterial agent, intercept or equal.
3. Drain pan shall be internally sloped to provide positive drainage of accumulated condensate.

2.4 FANS

A. Centrifugal; Belt or Direct Driven. The air handling unit manufacturer shall provide all fans and shafts constructed in accordance with AMCA with the following features and performance.
1. Construct the fan wheels of galvanized steel.
2. All units shall have externally mounted bearings and motors. Internal bearings, with extended grease lines are permitted.
3. Fan housing shall be die-formed with streamlined inlets and side sheets.
4. Bearings shall be grease lubricated ball bearings selected for an L-10 rating life of not less than 130,000 hours for direct connected service and not less than 42,500 for belt-connected service.
5. Statically and dynamically, balance and factory test the fan unit.
6. Fans shall be internally isolated for vibrations.
7. Fan noise levels shall not exceed the specified performance.

B. Fan Arrays; Direct Driven. The air handing unit manufacturer shall provide multiple, plenum fans constructed per AMCA requirements with the following features and performance.
1. Fans shall be selected to deliver the scheduled airflow quantity, fan/motor speed at a total static pressure that does not exceed 90% of the fan peak performance capability.
2. Factory installed and wired motor overload panel.
   a. Nema type 1 enclosure for indoor units, and NEMA type 4 for outdoor units.
   b. Single or multiple VFD power input for distribution to the fan array motors.
   c. Manual motor protectors, one per fan.
   d. Auxiliary contacts shall be wired in series to terminal blocks for generic trip signaling.
3. Backdraft dampers; for fan isolation tested and rated to AMCA 500.

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a. Produce less than 0.10” w.c. of static pressure drop and/or system effect when the fan is enabled.
b. Rated for maximum back pressure that exceeds the fan array total static pressure with minimal leakage.
c. Extruded aluminum or stainless steel construction.

4. Motors shall incorporate isolated bearings or shaft grounding.
5. Fan/motor assembly shall be dynamically balanced to meet AMCA standard 204-96, category BV-5, to meet or exceed Grade 2.5 residual unbalance.
6. Fan partitions to minimize system effect between fans.

2.5 COILS

A. Furnish coils for cooling media as scheduled.
B. Coils shall be aluminum fin copper tube type.
1. Fins shall have drawn, belled, collars bonded to the tubes by means of mechanical expansion of the tubes.
2. Coils casings shall be galvanized steel.
C. Use refrigerant cooling coils as listed in schedule, and shall be split with two individual circuits.
1. If using independent compressors in lieu of two speed compressors, use a four-circuited coil.
D. Engineer shall specify face split, row split or intertwined coils.

2.6 MOTORS AND DRIVES

A. Motors shall be NEMA Standard, normal torque, 40°C rise, splash proof, of horsepower rating and electrical characteristics as scheduled on drawings.
1. Motors shall be of the high efficiency type.
2. For draw-thru Air Handling Units provide totally enclosed, weatherproof, factory epoxy-sealed type motors., Fan cooled feature in totally enclosed motors is not required.
3. For blow-thru Air Handling Units (motors upstream of cooling coils) provide splash proof motors.
B. Provide drives rated at 1.25 x the motor horsepower rating.
1. Drives shall be adjustable speed for adjustment within plus or minus 10% of specified RPM.
C. Mount the motor on an adjustable, spring isolated mount, suitable for adjusting belt tension and drive alignment.
D. Furnish and install belt guards in accordance with OSHA requirements for all sheaves, exposed shafts, and belts.
E. Motors used with a variable frequency drive shall be high efficiency and inverter duty rated.

2.7 INSULATION

A. Double wall unit casings for coil section and all sections downstream from coil section shall have 2" thick insulation between the shells.
B. Double wall sections shall be factory insulated to prevent sweating at all operating conditions.

2.8 FILTERS

A. Provide manufacturers medium capacity filter section.
B. Filter section shall incorporate full size hinged and gasketed access doors with a minimum of two lever type handles.
C. Filters shall be as specified in Section 23 40 00 and installed prior to use of the unit.

PART 3 EXECUTION

3.1 INSTALLATION

A. The Contractor shall lay out exact unit location based upon coordinated ductwork shop drawings.

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1. Fabricate unit supports as detailed on the drawings.

B. The Contractor shall install units, make piping, and duct connections.

C. Install chilled water or refrigerant piping, thermal expansion valves, sight glasses and similar refrigeration specialties on the same side as the motor access.

D. Extend condensate drain line from the drain pan, through a trap, to a hub drain with a lip 1" above the finished floor.
   1. The condensate drain shall terminate with a 1" air gap above the rim of the open hub drain.
   2. Route the hub drain to a French drain or a storm water system, if connected to a roof storm water system a backwater valve is required.
   3. Contractor shall provide sufficient height between drain pan and condensate drain trap to allow drainage against negative fan pressure.

E. Install fire resistant flexible connectors in ducts at connections to units.
   1. Flexible connectors shall be in accordance with NFPA 90A.

F. Provide flexible pipe connectors at inlet and outlet piping to each air-handling unit.

G. Provide chilled water thermometers and gauges at inlet and outlet piping for each air handler installed.

H. Maintain access to all unit components that require maintenance.
   1. Do not block coil or filter access doors, doors shall open at least 120°.
   2. Provide adequate space for coil and filter pull space.

I. Install all air handlers on housekeeping pad extending minimum 6” beyond the footprint of the unit.

J. Provide vibration isolator pads between the AHU supports and housekeeping pad.
   1. Air handlers without internal spring mounted blowers shall have external spring mounts.

K. When adjustable pulley is set for the required airflow performance, replace it with fixed pulley.

L. Install Division 26 wiring for motors contained inside the Air Handler Units with watertight conduit between motor and unit casing and seal both ends of conduit to prevent moisture intrusion.
   1. Motors with multiple wires, make the electrical connections with mechanical fasteners (multi-cable connector blocks) that have external insulation.

M. Wire the AHU to immediately shut down upon activation of the fire alarm system.

3.2 FUNCTIONAL PERFORMANCE TESTING

A. System Functional Performance Testing is part of the Commissioning Process.
   1. The Contractor shall perform the Functional Performance Testing and the Commissioning Authority shall witness and document the test.
   2. Refer to Section 01 91 00, Commissioning, for functional performance tests and commissioning requirements.

B. Systems Readiness Checklists shall be completed and submitted for each piece of equipment included in this section.

C. Include the functional performance testing of HVAC pumps as part of the Chilled Water System Functional Performance testing.

3.3 DEMONSTRATION AND TRAINING

A. Training of the Owner’s operation and maintenance personnel is required in cooperation with the Owner's Representative.
   1. Provide competent, factory authorized personnel for instructing of operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems.

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2. Schedule the instruction in coordination with the Owner's Representative after submission and approval of formal training plans.
3. Refer to Section 01 91 00, Commissioning, for further contractor training requirements.

B. Provide demonstration and training for all equipment covered by this section and installed in this project.

END OF SECTION

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SECTION 23 81 00
DECENTRALIZED HVAC EQUIPMENT

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. The other Contract Documents complement the requirements of this section. The General requirements apply to the work in this section.

1.2 SUMMARY

A. The Contractor shall provide all necessary labor, materials, equipment, appliances, services and transportation, and perform operations in connection with the construction and installation of the work.
   1. Work to be as herein specified and as denoted on the accompanying drawings.

B. This section of the work includes the providing of the roof curb mounted, weather tight, penthouse type, air conditioning units of the size, capacity, and configuration as denoted, and schedule on the drawings.

C. Ship the units, completely factory assembled, tested, piped, and internally wired, as one piece fully charged with refrigerant and compressor oil.

D. The Contractor shall provide a structurally sound, weather tight, level roof curb with nailer and seal as detailed on the drawings.

1.3 SUBMITTALS

A. Manufacturer shall prepare schedule for approval, listing, and identifying the rooftop unit numbers, noting size, capacity, and other requirements.

1.4 QUALITY ASSURANCE

A. Provide certified data of their handling performance for assurance of rating accuracy.
   1. Coils shall be AHRI certified, Standard 340/360.

B. Unit wiring shall be in accordance with the latest edition of the National Electric Code.

C. Equipment and components other than that specified shall meet and exceed the requirements and quality of the items herein specified and as scheduled on the drawings.

1.5 WARRANTY

A. Provide 5-year parts and labor warranty to include all motors, fans, bearings, coils, controls, electrical devices and related system components, see section 23 05 13.

1.6 COMMISSIONING

B. Commissioning of a system or systems specified in this section is part of the construction process.

C. Documentation and testing of these systems, as well as training of the Owner’s operation and maintenance personnel, is required in cooperation with the Owner's Representative and the Commissioning Authority.

D. Project Closeout is dependent on successful completion of all commissioning procedures, documentation, and issue closure.

E. Refer to Section 01 77 00 - Contract Closeout, for substantial completion details.

F. Refer to Section 01 91 00, Commissioning, for detailed commissioning requirements.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. This specification is based on products as manufactured by Trane, acceptable equivalent products manufactured by:
   1. Carrier
   2. York
   3. Daikin

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2.2 UNIT CASING

A. Exterior surfaces of unit shall be phosphatized, zinc-coated steel (1.25 oz. per square foot minimum), with baked enamel finish.
   1. Provide screws coated with zinc-plus-zinc chromate and with neoprene washers where sealing is required.
B. Hinged access doors shall provide access to control components, filters, outside/return air dampers, evaporator coil, and supply and exhaust fan sections.
   1. Access doors and removable panels shall be double wall construction with 2 lb density insulation sandwiched between galvanized steel panels and complete with neoprene gaskets.
C. Roof assembly shall have modified lock seam joints filled with sealant.
D. Provide drains on each side of the evaporator section.
E. Unit base shall be a one-piece welded assembly with 14-gauge formed, load bearing members, having a formed recess with factory-installed base to roof curb sealing gasket, and shall overhang to facilitate water runoff.
F. Interior surfaces and exterior casing members shall have ½", 1 lb density foil-faced insulation liner.
G. Unit lifting lugs shall accept chains or cables for rigging and shall serve as unit tie-down points.
   1. Tie-down points must not conflict with air openings in down-flow or horizontal discharge units.

2.3 ELECTRICAL CONTROL PANEL

A. Install and test wiring in individual component assemblies, then recheck during final factory run test.
B. Main control panel shall have oil safety controls; supply and exhaust fan overload protectors; fuses for supply, exhaust air, and condenser fans; compressor fuses and dead front panel.
C. Factory wiring shall be complete to load side.
D. Electrical control identification shall be stenciled in control panels and wiring numbered for identification.
E. Provide factory wired 15-amp GFI weatherproof service receptacle.

2.4 REFRIGERATOR SYSTEM

A. Refrigeration
   1. Refrigeration controls shall operate condenser fan and evaporator fan, and shall include compressor contactors, and a 24-volt transformer.
   2. Each circuit of the unit shall have a separate set of refrigeration controls.
   3. Compressor safety controls shall be as outlined in this specification and as required.
B. Compressors
   1. Compressor shall be scroll design installed without suction and discharge valve.
   2. Provide completely enclosed compression chamber, allowing refrigerant liquid to pass through without damage to the compressor.
   3. Each compressor shall include a direct drive, 3600-rpm, suction gas-cooled hermetic motor, centrifugal oil pump, oil-level sight glass, and oil charging valve.
   4. Motors shall have a protective temperature sensor located directly on motor windings.
   5. Compressor safety controls shall include high and low pressure cutouts and reset relay.
   6. Provide a reset relay that protects compressor against cycling by automatically locking out system operation, when interrupted by high-pressure cutout.
   7. Provide a relay requiring manual reset from within the building.
C. Evaporator Coil
   1. Each coil shall be constructed with seamless copper tubing of ½" OD mechanically bonded to heavy-duty aluminum fins and shall be factory pressure and leak tested at 300 psi.

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2. Expansion valves shall be included.

D. Condenser Coil
1. The primary surface shall be a ⅜" OD seamless tube
2. Secondary surface shall be mechanically bonded heavy configured aluminum fins.
3. Sub-cooling circuits shall be an integral part of condenser coils.
4. Coil shall be factory pressure and leak tested at 450 psi and completed dehydrated under vacuum.

E. Condenser Fans and Motors
1. Unit shall have balanced direct-drive fans mounted in full length, bell-mouth orifices.
2. Fan motors shall be permanently lubricated ball bearings and built-in thermal overload protection.
3. Motors shall be line voltage, and shall be equipped with rain shields to eliminate moisture.

F. Low Ambient Operation: Standard refrigeration system shall operate to 35°F ambient.

2.5 AIR HANDLING SYSTEM

A. Indoor air fan unit shall have two, double-inlet, forward-curved, centrifugal-type fans mounted on a common shaft.
1. Statically and dynamically, balance and test the fans at the factory.
2. Supply fan shall test run in the unit as part of unit run test.
3. Mount the fan shaft on two, grease-lubricated ball bearings designed for 200,000 hours average life.

B. Mount the fan motor and fan assembly on common base to eliminate belt slippage at startup and to reduce unit vibration.

C. Drives shall be adjustable, with OSHA guard.
1. If belt drives are used, sheaves shall be cast iron, heavy-duty type.
2. The v-belt shall be static free and sized for 150% of BHP.
3. Motor bases shall be adjustable.

D. All motors shall be high-efficiency type.

2.6 FILTERS

A. Two-inch, high efficiency media filters shall fit in slide-in racks for ease of change-out and provide 35% efficiency by NBS dust spot test.

2.7 OUTSIDE AIR

A. Provide and install standard low leak dampers with 1.5% leakage rate at ½" WG.

B. Damper performance shall meet requirements of AMCA Test Standard 575.

C. Automatically control the outside air damper for the outside quantities stipulated on the drawings.

D. If applicable, for economizer control provide required dampers, and damper actuators.

2.8 ROOF CURB

A. Curb shall mate with rooftop units to provide support and complete weather tight installation when properly installed.
1. Curb shall be constructed of stainless steel with wood nailer strip and supply/return opening with gasket shall be provided.
2. Curb shall ship knocked down for field assembly.
3. Provide curbs approved by National Roofing Contractors Association.

2.9 CENTRAL CONTROL PANEL

A. Panel shall include system operation switches and signal lights for central station control and monitoring.
1. Signal lights shall indicate fan operation, heating malfunction, cooling malfunction, and dirty filters.

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B. Index the rooftop unit "ON" from microprocessor based time controller specified in Section 23 09 00, "CONTROLS AND INSTRUMENTATION."

PART 3 EXECUTION

3.1 INSTALLATION

A. Install per manufacturer and code requirements.
B. The Contractor shall provide and install a structurally sound, weather tight, level roof curb with nailer and seal.
C. The unit manufacturer shall provide spring-type vibration isolation sized to match the specific unit and be suitable for installation by the Contractor.

3.2 CHECK-TEST-START PROCEDURES

A. The Contractor shall provide labor to accomplish the check, test, and start procedure as recommended by unit manufacturer.
B. At time of check-test-start, Contractor shall leak test the factory pre-charged system.
   1. If necessary the Contractor shall evacuate, and charge units in accordance with equipment manufacturer's instructions.
   2. The Contractor shall supply refrigerant.
C. The unit manufacturer shall provide the manufacturer's check, test, and start forms.
   1. Send one copy to the Engineer and one copy to the installation contractor.
D. Contractors' startup shall be scheduled and documented in accordance with the commissioning requirements.
   1. Refer to Section 01 91 00, Commissioning, for further details

3.3 When the work is completed and at a time directed by the Owner or A/E, the Contractor shall carefully adjust parts of the equipment and systems.

A. This includes adjustment of automatic controls and safety devices, proper setting of adjustable devices, dampers and valves, and other necessary operations so the systems are fully operable and automatic in operation.
B. Upon completion of this work, notify the Owner and A/E that system is ready for final tests and inspection.
C. At the time of final inspection, a person of authority shall represent this Contractor.
   1. He shall demonstrate, as directed by the A/E, that his work fully complies with the purpose and intent of the specifications and drawings.
   2. The Contractor shall provide Labor, services, instruments, and tools necessary for demonstrations and tests.
   3. Moving parts of apparatus shall be lubricated and adjusted.
D. The Contractor shall test and adjust each instrument specialty and equipment furnished by him prior to final acceptance.
   1. The Contractor shall demonstrate that subsystems operate as a coordinated and properly functioning integrated system to the approval of the A/E.
E. The Contractor shall furnish labor; provide adjustments, and incidentals necessary to obtain the desired and intended results.

3.4 FUNCTIONAL PERFORMANCE TESTING

A. System Functional Performance Testing is part of the Commissioning Process.
   1. The Contractor shall perform the Functional Performance Testing and the Commissioning Authority witness and document the test.
   2. Refer to Section 01 91 00, Commissioning, for functional performance tests and commissioning requirements.

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B. Systems Readiness Checklists shall be completed and submitted for each piece of equipment included in this section.

3.5 DEMONSTRATION AND TRAINING

A. Training of the Owner’s operation and maintenance personnel is required in cooperation with the Owner's Representative.
   1. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems.
   2. Coordinate the instruction in with the Owner's Representative after submission and approval of formal training plans.
   3. Refer to Section 01 91 00, Commissioning, for further contractor training requirements

B. Provide demonstration and training for all equipment covered by this section and installed in this project.

END OF SECTION

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SECTION 23 82 19
ELECTRIC RESISTANCE DUCT HEATERS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. The other Contract Documents complement the requirements of this section.
B. The General Requirements apply to the work of this section.

1.2 SCOPE

A. Provide material, equipment, labor, and supervision necessary to electric resistance heaters in the duct system as required.

1.3 SUBMITTALS

A. Submittal data shall consist of drawings showing coil dimensions, construction materials, watt density, ratings, and performance including pressure drops on airside.
B. Furnish a separate, complete wiring diagram for each heater.
   1. Diagram shall include recommended supply wire gauges per NEC, and fuse sizes.
   2. Typical wiring diagrams are not acceptable.
   3. Each heater shall be complete with clearly marked power and control terminals.
C. Verify control panel size, door swing and duct size with contractor supplied ductwork shop drawings prior to submittal, and ordering heaters.
   1. Verify electrical characteristics and control requirements prior to order.

PART 2 PRODUCTS

2.1 EQUIPMENT

A. Acceptable Manufacturers
   1. Duct heating coils shall be Brasch, Indeeco, Markel, or Warren.
B. Duct heaters shall be open coil heaters.
   1. Voltage, size, wattage, number of steps and control voltage shall be as scheduled on the drawings.
   2. Furnish three-phase heaters with balanced three-phase steps.
   3. Heaters shall be UL listed for zero clearance and meet all applicable requirements of the NEC.
C. Type: Heaters shall be of the slip-in type for duct mounting.
D. Elements shall be of 80% nickel and 20% chromium; steps arranged to prevent stratification when operating at less than full capacity.
   1. The maximum watts per square inch of wire surface shall be up to 150 HW=50.
E. Coil terminals shall be of stainless steel, terminal insulators and bracket bushings shall be of ceramic and securely positioned.
   1. Terminals shall be machine crimped to coil.
F. Frame shall be of sufficiently heavy gauge galvanized steel to assure structural rigidity and have vertical galvanized steel supports with stiffening ribs and gussets spaced no more than 4" apart, spot welded to the casing.
G. Provide terminal box with solid hinged cover in order to minimize dust infiltration.
   1. Heater terminal box must be totally enclosed, must be without perforated or expanded sheet metal covers and insulated.
H. Provide a recessed terminal box for coils installed in ducts with internal obstruction greater than 1" to assure that heating elements and safety controls are in the air stream.
I. Orientation: Heaters shall be interchangeable for mounting in a horizontal or vertical duct.

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J. Safety Devices:
   1. Furnish a disc type automatic reset thermal cutout for primary over temperature protection.
   2. For secondary protection, a sufficient number of heat limiters in the power lines shall de-energize elements if the primary cutout fails.
   3. All safety devices shall be serviceable through the terminal box without removing the heating coil from the duct.

K. Built-in components shall include disconnecting break magnetic contactors, transformer with primary fusing, pressure-type airflow switch set at .07" WC, all as required by UL, branch circuit fuses per NEC, interlocking disconnect switch and a single terminal block to accept the number, type and size of conductors as required.
   1. Insulate the terminal box.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install systems as required and as recommended by the electric heater supplier.

B. Mount the electric heater in the duct in accordance with the requirements of SMACNA Ducted Electric Heat Guide.

C. The electric heater shall occupy entire cross sectional area of duct.

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SECTION 25 50 00
ENERGY MANAGEMENT AND CONTROL SYSTEM

PART 1 GENERAL

1.1 SCOPE

A. Provide power wiring and Network Conduit for the Energy Management and Control System (EMCS).

1.2 COORDINATION

A. Review Division 23 EMCS contract documents in order to provide all labor, materials, and equipment required to install a complete and operational EMCS.

B. Receive EMCS Panels, and other EMCS components in accordance with contract documents.

1. Upon receipt of EMCS components, Electrical Contractor is responsible for the components until the School District accepts the EMCS.

1.3 COMMISSIONING

A. Commissioning of a system or systems specified in this section is part of the construction process.

B. Documentation and testing of these systems, as well as training of the Owner's operation and maintenance personnel, is required in cooperation with the Owner's Representative and the Commissioning Authority.

C. Project Closeout is dependent on successful completion of all commissioning procedures, documentation, and issue closure.

D. Refer to Section 01 77 00 - Contract Closeout, for substantial completion details.

E. Refer to Section 01 91 00, Commissioning, for detailed commissioning requirements.

F. Refer also to Section 23 09 00 – for commissioning requirements of the EMCS.

PART 2 PRODUCTS

2.1 Provide conduit and wiring in accordance with Division 26 specifications.

2.2 Do not pull bond or ground wires in conduit with sensor or communication wiring.

2.3 EMCS conductors

A. Thermostat Wire – 4 conductor, unshielded, CMP white, AWG 22, Solid, 3 twists/foot nom, Low smoke PVC Plenum rated cable

B. Underground Communication Wire – 2-conductor twisted pair, Shielded, Low Cap AWG 22, 6-twists/foot nom, foam FEP/E-CTFE, Plenum rated cable

C. Above Ground Communication Wire – 2-conductor twisted pair, Shielded, Low Cap AWG 22, 6-twists/foot, foamed halar insulation, low smoke plenum jacket

D. Input/Output Wiring 2 conductor – 2-conductor twisted pair, unshielded, Low Cap AWG 18, 28 pF/ft nom, 3-twists/foot nom, 0.01" PVC insulation

E. Input/Output Wiring 3 conductor – 3-conductor twisted, unshielded, Low Cap AWG 18, 28 pF/ft Nom 3-twists/foot nom, 0.01" PVC insulation

F. Fiber Optic Cable – 4-fiber 62.5/125-um multi-mode cable meeting the TIA-758 standard for water-blocked cables

G. All wires installed underground shall be rated for wet locations.

PART 3 EXECUTION

3.1 Design, install, and commission the EMCS in a turnkey, fully implemented, and operational manner.

A. In the work description below, the word, "provide" shall mean to "furnish and install."

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3.2 Mechanical Contractor shall provide smoke and/or fire/smoke dampers with factory mounted actuators.
   A. Electrical Contractor shall wire and interlock smoke and/or fire/smoke dampers with the Fire Alarm System.
   B. The fire alarm system shall activate the smoke dampers.

3.3 EMCS Contractor shall furnish EMCS Panels via the EMCS Contractor to the Electrical Contractor.
   A. Electrical Contractor shall install EMCS Panels and shall provide dedicated 120vac circuit adjacent to each EMCS Panel.
   B. EMCS Contractor shall provide 120vac switch and outlet inside of EMCS Panel
      1. Connect the power for EMCS panel to the optional standby power of the generator.

3.4 Wisch & Jackson shall furnish Variable speed drives to the Electrical Contractor.
   A. Electrical Contractor shall install Variable Speed Drives and provide power wiring.
   B. EMCS Contractor shall provide control conduit and wiring.

3.5 Electrical Contractor shall provide conduit with pull string and Class 1 earth grounding for the Network Conduit as shown by the Riser Diagrams and as specified below.
   A. The connection of each EMCS Cabinet within the same building and between buildings that are physically separated and require EMCS controls.
   B. Connection from the EMCS cabinet as specified in 23 09 00 to the Electric Meter.
   C. Connection from the Gateway Communications EMCS Cabinet to the data closet as specified in 23 09 00.
   D. For air-cooled chillers and chilled water pumps, located in the chiller enclosure, connection from the chiller EMCS cabinet, located within the building, to each chiller control panel and to each pump starter.
   E. For direct expansion split systems greater than 5 tons, connection from the AHU EMCS cabinet to the condensing unit control panel.
   F. For direct expansion packaged units greater than 5 tons, connection from the packaged unit EMCS cabinet, located within the building, to the packaged unit control panel.
   G. For chilled water penthouse AHU’s, connection from the AHU EMCS cabinet, located within the building, to the penthouse AHU control panel.
   H. EMCS Contractor provides control wiring and School District Telephone Staff provides telephone wiring.
   I. Run one-inch conduit from power metering device(s) at main switchboard(s) to nearest EMCS terminal cabinet(s).
   J. Run one 2" conduit from the irrigation pump controller to the nearest EMCS terminal cabinet.
   K. EMCS conduits from building to building shall be minimum 2”.
   L. EMCS conduit to chiller plant shall be minimum 2”.
   M. Underground EMCS conduits shall be minimum 2”.
   N. For stadium elevators and elevators that open to the exterior of a building, provide a float switch in the elevator pit connected to the EMCS to send an alarm signal to the EMCS monitoring station when the water level in the pit reaches above the steel grate of the dry sump.
      1. General contractor shall coordinate the installation of the raceway system for the float switch.
      2. General contractor shall coordinate with the elevator inspector.
   O. Do not provide temperature sensors in electrical rooms.
   P. Monitor temperature only in dry food storage.

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Q. EMCS is not required to control water heater/pump for kitchen, lockers, and home economic rooms.
R. Lighting amperage status is not required for parking lights.

3.6 Electrical Contractor shall provide all 120-vac power wiring.
A. This work includes fans and/or other equipment that are manually controlled by toggle switches, push buttons and/or light switches which interrupt line voltage power and that are automatically controlled by line voltage thermostats.

3.7 Electrical Contractor shall provide the power wiring and the relay or contactor where a relay or contactor ties to the EMCS, and controls multiple pieces of equipment and/or lighting circuits.
A. EMCS Contractor provides the control conduit and wiring.

END OF SECTION

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SECTION 26 00 00
ELECTRICAL REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Basic Electrical Requirements specifically applicable to, but not limited to Division 25, 26, 27, &28 in addition to Division 1 -General requirements.

1.2 CODES AND FEES

A. Unless specifically noted to the contrary, the Contractor shall furnish all equipment, materials, labor, and install and test in accordance with the FBC.

B. The Contractor shall comply with applicable building and construction codes as stated in Section 01 41 00.

1.3 STANDARDS

A. All materials shall be new, free of defects, and shall be U.L. listed, bear the U.L. label or be labeled or listed with an approved, nationally recognized Electrical Testing Agency.

B. Where no labeling or listing service is available for certain types of equipment submit test data to the Engineer proving that equipment meets or exceeds available standards.

1.4 UTILITY COMPANY FEES, CHARGES, COSTS

A. It is the contractor's responsibility to contact the appropriate Utility Company to determine if any fees, charges, or costs will be due, as required by the Utility Company for temporary power In/Out installations, hook-ups, etc.

1. This fee, charge, or cost and all the usage charges for the temporary power shall be included in this contractor's bid price.

B. The contractor shall pay all costs, charges, or fees due to the contractor’s use of School District owned electrical service.

1.5 QUALITY ASSURANCE

A. A person with a current Palm Beach County Journeyman Electricians Certificate of Competency shall be on site and supervise all electrical work.

1. A copy of the certification shall be available in the General Contractors site office.

B. Coordinate with other trades to provide adequate working clearance about equipment.

C. Materials, where applicable, shall bear the label of an approved testing agency, such as:

1. ETL (Electrical Testing Laboratories)
2. UL (Underwriters Laboratories, Inc.)
3. FM (Factory Mutual)

D. Protect all materials subject to corrosion.

1.6 RELATED WORK

A. Continuity of Service:

1. Do not interrupt or change service or circuits without authorization from the Architect and the Owner. Obtain written authorization before starting work.

B. Demolition:

1. Deliver all equipment removed and turned over to the Owner at a place and time mutually agreed upon location.
2. Maintain all materials turned over to the Owner or reused and installed in the condition equal to that existing before work began.
    a. Repair or replace damaged materials or equipment at no additional cost to the Owner.

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C. Outdoor equipment not secured to wall surface shall be mounted on steel channel or iron supports.

1.7 TEMPORARY WIRING

A. New Construction: Install according to NEC.
B. Remodel:
   1. Coordination of conductors and routing of temporary wiring in or on existing buildings and approved is by the Department of Facility and Construction Management.
   2. Remove temporary wiring upon completion of project.
   3. Install according to NEC.
C. Grounding: Bond the equipment grounding conductors to available electrodes at each building.

1.8 EQUIPMENT

A. Equipment of a similar nature shall be identical and of the same manufacturer.
B. Equipment shall be set level.
   1. Where grouped, mount at the same height, properly align, bolt together in sections, and fastened in place.
   2. Tighten screws, bolts, nuts, lamps, fittings, or other fastening devices.
   3. Install all covers, plates, fittings, and accessories.

PART 2 PRODUCTS

2.1 Not Used

PART 3 EXECUTION

3.1 Not Used

END OF SECTION

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SECTION 26 05 00
ELECTRICAL MATERIALS AND METHODS

PART 1 GENERAL

1.1 SCOPE
- A. The work shall include the furnishings of systems as defined in Section 26 08 00 "Work Included".
- B. Drawings for the work are diagrammatic, intended to convey the Scope of the Work and to indicate the general arrangement and locations of the work.
  1. Because of the scale of the drawings, certain basic items such as conduit fittings, access panels, sleeves, pull, and junction boxes may not be shown.
  2. Where such items are required by Code or by other sections, such items shall be included.

1.2 RELATED DOCUMENTS
- A. The other Contract Documents complement the requirements of this Section.
- B. The General Requirements apply to the work of this Section.

1.3 TEMPORARY POWER
- A. Furnish, install, and maintain temporary power used by all trades during construction.
  1. See Section 16 00 00 for in/out" fees
  2. The entire system shall be grounded and bonded to building steel prior to energizing temporary power, follow NEC for any other conditions.
  3. Payment for monthly power consumption shall be the responsibility of the General Contractor.
  4. Provide overcurrent protection for all circuits.
  5. Use thermal magnetic breakers or cartridges fuses only for overcurrent protection.
  6. All receptacles shall be GFI protected.
- B. The Building Department and Utilities Department Manager shall review and approve any connection to the existing School District owned electrical service on existing facilities.
  1. Contractor is responsible for all cost of temporary power.

1.4 SUPERVISION OF THE WORK
- A. Provide field supervisor for electrical work, who has had a minimum of 4-year previous successful experience on projects of comparable sizes and complexity.
- B. The supervisor shall be providing on the job site supervision at all times during the performance of any work under this Division or if the work under this Division is affected.
- C. Supervisor shall have a valid Palm Beach County Electrical Journeyman Certificate of Competency with a copy on file at the General Contractors site office.
- D. Submit a resume of the Foreman's experience to Engineer before starting work.

1.5 DELIVERY AND STORAGE
- A. Handle, store and protect equipment and materials in accordance with the manufacturer's recommendations and with the requirements of NFPA 70B, Appendix-I, titled "Equipment Storage and Maintenance during Construction".
  1. Replace damaged or defective items with new items.

1.6 ELECTRICAL CONNECTIONS
- A. Tighten all connections to the torque values pert hat device manufacturer's instructions.
- B. If manufacturer does no provide the values, tighten to pound-inch or pound-foot values in UL Standard 486B, a summary is in Section 110-14 of the NEC Handbook.

1.7 ACTIVE SERVICES
- A. Protect all existing active services; water, gas, sewer, electric, when encountered, against damage.

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B. Do not prevent or disturb operation of active services, which are to remain.
C. If contractor encounters active services, which require relocation, make request to authorities with jurisdiction for determination of procedures.
D. Where existing services are to be abandoned, they shall be terminated in conformance with requirements of the utility or Municipality having jurisdiction and Architectural and Electrical Demolition Drawings.
E. The Contractor at his expense shall immediately restore any damaged active services to its original condition, and with properly licensed and trained people.
F. Inform the District Representative immediately of any damage.
G. Contractor shall use lock out/tag out procedures when active services; gas, water, sewer, electric, mechanical, ands life systems have been interrupted.
    1. Tag shall have company name, acting supervisor's contact phone number and date of interruption.
    2. This applies to work in all buildings as well as portable installations and relocatable buildings.

1.8 TESTS

A. System Functional Performance Testing is part of the Commissioning Process.
    1. The Contractor shall perform the Functional Performance Testing and the Commissioning Authority shall witness and document the test.
    2. Refer to Section 01 91 00, Commissioning, for functional performance tests and commissioning requirement.
    3. Approved test results shall be available for the Electrical Inspector at the time of inspection.
B. Prior to beginning work, all electrical equipment and systems shall be operated in the presence of representatives of the Contractor and Representatives of the School District, in order to establish that all systems are in proper working order at the start of the project.
    1. Upon completion of the above test, the Contractor shall submit a detailed listing indicating any items noted which are not in operational condition.
    2. All parties present at the test shall sign the listing.
    3. Commencement of work prior to the above shall constitute acceptance of all systems by the Contractor in as operational system.
    4. The Contractor shall have all electrical systems back in working order at the end of the project.
C. After work is completed, perform a load balance test for each panel board to demonstrate that with full lighting and mechanical load, the balance between phases is within 15%.
    1. Correct any unbalance beyond this limit, maintaining proper phase relation to neutral at all times.
    2. The Contractor shall reproduce as many copies of load-balance report sheet, located at end of this Section, as required and submit to Engineer prior to request for final inspection.
D. Test all grounding electrodes to demonstrate that the ground resistance does not exceed 25 ohms. (See Section 26 05 26 for report requirements.)
E. Perform such test as required by authorities having jurisdiction over the site.
    1. The Engineer of Record shall witness all required tests, unless approved by SDPBC.
    2. The Contractor shall record and submit typewritten results to the Engineer for approval.
F. Provide a copy of the test results approved by the Engineer at the time of the equipment inspection by the Building Department and the Commissioning Agent.

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1.9 DEMONSTRATIONS

A. Training of the Owner’s operation and maintenance personnel is required in cooperation with the Owner's Representative.
B. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems.
C. Schedule the instruction in coordination with the Owner's Representative after submission and approval of formal training plans.
D. Refer to Section 01 91 00, Commissioning, for further contractor training requirements.

1.10 IDENTIFICATION

A. Contractor shall provide identification for wiring systems and equipment in accordance with Section 26 05 33.
B. Power and lighting circuits shall have conductors color banded, per 26 05 13 "Wire and Cable" in each junction and pull box.

1.11 NAMEPLATES

A. The following items shall be equipped with nameplates:
    1. All motor starters, pushbutton stations, control panels, time switches, disconnect switches, Panelboards, contactors or relays in separate enclosures, power receptacles where the nominal voltage between any pair or contacts is greater than 150V, all switches controlling outlets or equipment where the outlets are not located within sight of the controlling switch, high voltage boxes and cabinets.
    2. Special electrical systems shall be identified at terminal cabinets and equipment racks.
B. Power panels and switchgear without doors, shall have circuit breakers and switches identified by engraved plastic tags affixed to cabinet adjacent to device.
C. Nameplates shall adequately describe the function of the particular equipment involved.
    1. Nameplates detailed on the drawings, inscription and size of letters shall be as shown on the approved shop drawings.
    2. Nameplates for panel board and switchboards shall include the panel designation, voltage, and phase of the supply.
    3. For example, "panel PA 120/208V 3-phase 4-wire".
    4. The name of the machine on the nameplates for a particular machine shall be the same as the one used on all motor starters, disconnect and P.B. station nameplates for that machine.
D. Nameplates shall be laminated phenolic plastic, black front and back with white core, with lettering engraved through the outer covering.
    1. Attach with plated self-tapping screws or small brass screws.
    2. Nameplates to identify emergency devices shall be red laminate.
E. Panelboards shall have typewritten circuit directories installed inside the doors under transparent plastic covers that identify components and corresponding room numbers.

1.12 SUBMITTALS

A. Method of preparing and procedure for submitting Shop Drawings and submittal data shall comply with Division 1.
B. Submittal data for electrical equipment shall consist of Shop Drawings and/or catalog cuts showing technical data necessary to evaluate the material or equipment, to include dimensions, wiring diagrams, performance curves, ratings, control sequence, and other descriptive data necessary to describe fully the item proposed and its operating characteristics.

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C. Any submittal data in following electrical sections, peculiar to that section, is in addition to submittal requirements of this section.
D. Where more than one item or option is on a single submittal sheet, clearly indicate which one you are proposing for the project.

1.13 CONCRETE WORK

1. Where cutting sidewalks to route conduit concealed into buildings, this Contractor is responsible for all repair work to return concrete sidewalks to original conditions.
2. Furnish and install reinforced concrete pads for transformers, switchgear, generators, and motor control centers, of size as shown on the drawings or required.
    a. Unless otherwise noted pads shall be 4" high and shall exceed dimensions of equipment being set on them, including future sections, by 4" on all sides, except when equipment is flush against a wall, then the side or sides against the wall shall be flush with the equipment.
    b. Chamfer top edges ½".
    c. Trowel all surfaces smooth.
    d. Reinforce pads with 6" X 6" X 6/6 welded wire fabric.
3. This contractor shall furnish all equipment anchor bolts and shall be responsible for their proper installation and accurate location.

PART 2 PRODUCTS

2.1 Not Used

PART 3 EXECUTION

3.1 Not Used

END OF SECTION

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SECTION 26 05 13
ELECTRICAL WIRE AND CABLE

PART 1 GENERAL

1.1 SECTION INCLUDES
- A. Building wire and cable
- B. Wiring connectors and connections

1.2 REFERENCES
- A. ANSI/NFPA 70 - National Electric Code

1.3 QUALIFICATIONS
- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum 3 years of experience.

1.4 PROJECT CONDITIONS
- A. Verify that field measurements are as shown on Drawings.
- B. Wire and cable routing shown on Drawings is approximate unless dimensioned.
  1. Route wire and cable as required to meet the Project Conditions.
- C. Where wire and cable routing is not on plans, and only the destination only is on the plans, determine exact routing and lengths required.

1.5 COORDINATION
- A. Determine required separation between cable and other work.
- B. Determine cable routing to avoid interference with other work.

PART 2 PRODUCTS

2.1 BUILDING WIRE AND CABLE
- A. Description
  1. Single conductor insulated wire
  2. Thermostat cable
  3. Type MC cable
     a. Interlocked construction
     b. Connectors shall be steel or malleable iron with steel locknuts, do not use push-in or snap-in connectors.
- B. Conductor
  1. Copper: Feeder sizes 100 amps and smaller
  2. Copper: Branch circuits
  3. Copper: Equipment grounding conductors and grounding electrode conductors
  4. Copper or Aluminum: Feeder sizes larger than 100 amps
- C. Insulation Voltage Rating
  1. Single conductor wire - 600 volt
  2. Thermostat cable - 300 volt
  3. Type MC cable – 600 volt
- D. Insulation
  1. Single conductor wire - NFPA 70 Type THHN/THWN
  2. Thermostat cable - Multi-conductor jacketed
  3. Wire and cables shall be listed by a nationally recognized testing lab for the environmental conditions they are installed.
- E. Temporary wiring according to National Electrical Code, open conductors are permitted.

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2.2 WIRING CONNECTORS
- A. Solderless Pressure Connectors
  1. Ilsco
  2. Substitutions: Under provisions of Section 01 60 00
- B. Spring Wire Connectors
  1. Ideal
  2. Scotchloc
  3. Holub
  4. Substitutions: Under provisions of Section 01 60 00
- C. Compression Connectors
  1. Panduit
  2. Burndy
  3. 3M
  4. Substitutions: Under provisions of Section 01 60 00
- D. Insulate Multi Cable Connector Blocks
  1. Polaris products molded for precise fit and supplied with removable access plugs over hex screws.
- E. Do not use insulation piercing or push-in type connectors.
- F. Do not use split-bolt type connectors.
- G. Do not use silicon filled twist on wire connectors in wet locations.

PART 3 EXECUTION

3.1 EXAMINATION
- A. Verify that interior of building has been protected from weather.
- B. Verify that mechanical work likely to damage wire and cable is complete before installation of work under this section.

3.2 PREPARATION
- A. Completely and thoroughly swab raceway before installing wire.

3.3 INSTALLATION
- A. Install products in accordance with manufacturer's instructions.
- B. Use stranded conductors for control circuits.
- C. Use conductor no smaller than 12 AWG for power and lighting circuits.
- D. Use conductor no smaller than 16 AWG to supply a single fixture.
- E. Use conductor no smaller than 14 AWG for control circuits.
- F. Conductors for thermostats:
  1. Low voltage thermostats (0-30 volts) - use thermostat cable with conductors 18 AWG or larger, with a minimum of 5-conductors and a maximum length of 50' or single conductors 14 AWG or larger.
  2. All other thermostats use single conductors 14 AWG or larger.
- G. Pull all conductors into raceway at same time.
- H. Use suitable wire pulling lubricant for building wire 4 AWG and larger.
- I. Protect exposed cable from damage.
- J. Use suitable cable fittings and connectors.
- K. Neatly train the wiring inside boxes, equipment, and panel boards.
- L. Clean conductor surfaces before installing lugs and connectors.

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M. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
N. Use sealed weatherproofing kits for underground splices.
O. Provide 8" of free conductor at outlet, switch, and junction boxes.
    1. Conductors not spliced or terminate at the box, shall require only 6” loop inside each box.
P. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 8 AWG and smaller.
Q. Splices and joints made in conductors #6 AWG and larger shall be with copper compatible sleeves using indent method or "Ilsco" or equal insulated power distribution block.
R. Maximum size wire: 600 MCM.
S. Conductors and cables, regardless of voltage, shall be installed in a complete raceway system, except:
    1. Underground irrigation zone control wires of 24 volts or less.
    2. Temporary wiring
    3. Open wiring as permitted by 27 60 00.
T. Adjust conductor size to compensate for a maximum of 3% voltage drop for branch circuits and maximum of 2% voltage drop for feeders.
U. Use minimum size #10 AWG conductors for all 20 amps, 120-volts branch circuits longer than 200 feet and use minimum size #10 AWG conductors for all 20 amps, 277-volts branch circuits longer than 300 feet.
V. When flexible conduit is used, use stranded wire in the raceway.
W. Type MC cable may only be used as a fixture whip from a single fixture to a junction box - maximum length of 6-feet

3.4 INTERFACE WITH OTHER PRODUCTS

A. Identify wire and cable under provisions of Section 26 05 33.

3.5 FIELD QUALITY CONTROL

A. Perform field inspection and testing under provision of Section 01 45 00 and 26 05 00.
B. Inspect wire and cable for physical damage and proper connection.
    1. Damaged conductors will be replaced at no cost to the District.
C. Tighten all connections to the manufacturer's recommended values.
    1. Engineer shall witness the torque values and submit a written report of the measurements and statement that they are correct to the Owner's representative.
    2. Provide copy of the approved report at time of equipment inspection by the Commissioning Agent.
D. Verify continuity of each branch circuit conductor.
E. Conductors for circuits of 100 amps or larger shall be tested with a megger.
    1. The Engineer of Record or designated representative shall review all megger test results.
    2. The Engineer of Record or designated representative shall witness a minimum of 10 % of the test.
    3. Submit all Engineer approved megger test to the Building Department.
    4. Provide copy of the approved report at time of equipment inspection by the Commissioning Agent.
F. Test all service conductors with a megger.
    1. The Engineer of Record or designated representative shall witness all service conductor meggering.
    2. The Contractor shall record the results and the Engineer of Record shall approve.

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3. The Building Department requires a copy of the approved report before they authorize the utility company to turn on the power.

G. Megger report shall at a minimum include the following for the Commissioning Agent
   1. Test date
   2. Manufacture and model number of test equipment.
   3. Provide documentation of the last re-calibration of test equipment.
   4. Weather conditions including humidity at time of test.
   5. Sign-in sheet of witnesses.
   6. Verification the test voltage was 1000 volts for at least one minute.
   7. The results shall be in numerical value.
   8. Provide circuit description, including circuit id, wire size, and length.
      a. Indicate service conductor in description.
   9. Configuration shall include A-B, A-C, B-C, A-N, B-N, C-N, A-G, B-G, C-G, and N-G, where applicable.
   10. Check the test equipment at the start and end of each test session with the test lead open test and a short test.
      a. Provide copy of the confirmation of passing the open and short tests.

END OF SECTION

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SECTION 26 05 19
EQUIPMENT WIRING SYSTEMS

PART 1 GENERAL

1.1 WORK INCLUDED
- A. Electrical connections to equipment specified under other Sections or furnished by Owner.

1.2 REFERENCES
- A. FS W C-596 - Electrical Power Connector, Plug, Receptacle, and Cable Outlet
- B. NEMA WD 1 - General Requirements for Wiring Devices
- C. NEMA WD 5 - Specific Purpose Wiring Devices

PART 2 PRODUCTS

2.1 CORDS AND CAPS
- A. Straight-blade Attachment Plug: NEMA WD 1
- B. Locking-blade Attachment Plug: NEMA WD 5
- C. Attachment Plug Configuration: Match receptacle configuration at outlet provided for equipment.
- D. Cord Construction: Oil-resistant thermoset insulated Type SO multi-conductor flexible cord with identified equipment grounding conductor, suitable for extra hard usage in damp locations.
- E. Cord Size: Suitable for connected load of equipment and rating of branch circuit over current protection.

PART 3 EXECUTION

3.1 INSPECTION
- A. Verify that equipment is ready for electrical connection, wiring, and energization.

3.2 PREPARATION
- A. Review equipment submittals prior to installation and electrical rough in.
- B. Verify location, size, and type of connections.
- C. Coordinate details of equipment connections with supplier and installer.

3.3 INSTALLATION
- A. Use wire and cable with insulation listed by a nationally recognized testing lab for the installations environmental conditions.
- B. Install pre-finished cord set where connection with attachment plug is indicated or specified, or use attachment plug with suitable strain-relief clamps.
- C. Provide suitable strain-relief clamps for cord connections to outlet boxes and equipment connection boxes.
- D. Make wiring connections in control panel or in wiring compartment of prewired equipment in accordance with manufacturer's instructions.
  1. Provide interconnecting wiring where indicated.
- E. Install disconnect switches, controllers, control stations, and control devices such as limit switches and temperature switches as indicated.
  1. Connect with conduit and wiring as indicated.

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SECTION 26 05 26
GROUNDING and BONDING of ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 WORK INCLUDED
- A. Power system grounding
- B. Communication system grounding
- C. Electrical equipment and raceway grounding and bonding

1.2 SYSTEM DESCRIPTION
- A. Ground the electrical service system neutral at service entrance equipment to metallic water service and to all available grounding electrodes.
- B. Ground each separately-derived system neutral to nearest effectively grounded metallic water pipe or nearest effectively grounded building structural steel member.
- C. Provide communications system-grounding conductor at point of service entrance and connect to nearest effectively grounded metallic water pipe or nearest effectively grounded building structural steel member.
- D. Bond together system neutrals, service equipment enclosures, exposed non-current carrying metal parts of electrical equipment, metal raceway systems, grounding conductor in raceways, receptacle and switch ground connectors, and plumbing systems.

1.3 SUBMITTALS
- A. Submit shop drawings under provisions of Section 01 33 00.
- B. Indicate location of system grounding electrode connections, and routing of grounding electrode conductor.

PART 2 PRODUCTS

2.1 MATERIALS
- A. Ground Rods: Copper-clad steel, ⅝" diameter, minimum length 10'.
- B. Bonding Bushings: Steel lay-in type

PART 3 EXECUTION

3.1 INSTALLATION
- A. Provide a separate, insulated equipment-grounding conductor in feeder, branch circuit, or grounded control circuit conduit(s).
  1. This bonding conductor shall be continuous through raceway system from main switch ground bus to panelboard ground bus and to each outlet, switch, device, box, or equipment using terminal bars, screws, lugs, expressly designed for that purpose.
  2. Do not use raceways and metal enclosures for ground path.
- B. Connect grounding electrode conductors to metal water pipe using a suitable ground clamp.
- C. Supplementary Grounding Electrode:
  1. Use driven ground rod in main service equipment area.
  2. Use effectively grounded metal frame of the building.
  3. Use minimum of 20' bare copper wire embedded in concrete foundation.
- D. Use minimum 6-AWG un-spliced copper conductors for communications service grounding conductor from the grounding collector plate in the nearest electrical room.
- E. Exothermic weld (Cadweld) or approved equal all ground wire to ground rod connections.

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F. Separate buildings or buildings connected by a breezeway shall have main feeder(s) grounding conductor(s) connected to all of the available grounding electrodes of that structure.
G. Ground the equipment grounding conductor for temporary wiring to the available electrodes, metal piping, and metal components of a building when run inside a building.
H. Install a ground rod at all freestanding exterior electric scoreboards and electric signs.

3.2 FIELD QUALITY CONTROL

A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.
B. Measure ground-rod resistance when not connected to electrode conductor, using approved ground testing equipment.
    1. Resistance shall not exceed 25 ohms.
    2. Extend the rod as deep as necessary to meet the minimum resistance.
    3. The Electrical Engineer and Owner shall observe the test.
C. Contractors' tests shall be scheduled and documented in accordance with the commissioning requirements.
    1. Refer to Section 01 91 00, Commissioning, for further details.
D. Contractor shall provide ground rod resistance report to the Commissioning Agent, with the following information:
    1. Date of test
    2. Manufacture and model number of the test equipment
    3. Documentation of the last re-calibration of the test equipment
    4. Weather conditions, including the humidity during the test
    5. Sign-in sheet of witnesses to the test
    6. The results in a numerical value
    7. Location of the rod(s) tested

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SECTION 26 05 29
HANGERS and SUPPORTS for ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 WORK INCLUDED
- A. Conduit and equipment supports
- B. Fastening hardware

1.2 COORDINATION
- A. Coordinate size, shape, and location of concrete pads with Section 03 30 00.

1.3 QUALITY ASSURANCE
- A. The support systems shall be adequate for weight of equipment and conduit including any wiring they carry.

PART 2 PRODUCTS

2.1 MATERIAL
- A. Support Channel: Galvanized steel
- B. Hardware: Corrosion resistant

PART 3 EXECUTION

3.1 INSTALLATION
- A. Fasten hanger rods, conduit clamps, and outlet and junction boxes to building structure using expansion anchors, beam clamps, spring steel clips.
- B. Use toggle bolts or hollow wall fasteners in hollow masonry, plaster, or gypsum board partitions and walls; expansion anchors or preset inserts in solid masonry walls; self-drilling anchors or expansion anchor on concrete surfaces; sheet metal screws in metal studs; and wood screws in wood construction.
- C. Do not fasten supports to piping, ductwork, mechanical equipment, or conduit.
- D. Do not use powder-actuated anchors.
- E. Do not drill structural steel members.
- F. Fabricate supports from structural steel or steel channel, rigidly welded or bolted to present a neat appearance.
  1. Use hexagon head bolts with spring lock washers under all nuts.
- G. Install freestanding electrical equipment on a housekeeping pad, minimum 4" thick, and 4" overhang.
- H. Install surface mounted cabinets and panel boards with minimum of four anchors.
  1. Provide steel channel supports to stand cabinet ¾" off wall.
- I. Bridge studs top and bottom with channels to support flush-mounted cabinets and panel boards in stud walls.

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SECTION 26 05 33
ELECTRICAL SYSTEM RACEWAY and BOXES

PART 1 GENERAL

1.1 SECTION INCLUDES
- A. Metal conduit
- B. Flexible metal conduit
- C. Liquid tight flexible conduit
- D. Electrical metallic tubing
- E. Non-metallic conduit
- F. Fittings and conduit bodies
- G. Outlet boxes
- H. Floor boxes
- I. Pull and junction boxes
- J. Surface Metal Raceways
- K. Aluminum conduit

1.2 REFERENCES
- A. NEMA ANSI C80.1 – Electrical Rigid Steel Conduit
- B. NEMA ANSI C80.3 – Steel Electrical Metallic Tubing
- C. ANSI/NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable
- D. ANSI/NEMA OS 1 - Sheet-steel Outlet Boxes, Device Boxes, Covers, and Box Supports
- E. NFPA 70 - National Electrical Code
- F. NECA "Standard of Installation"
- G. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum)
- H. NEMA RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel conduit and intermediate metal conduit
- I. NEMA TC 3 – Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing

1.3 SUBMITTALS
- A. Submit under provisions of Section 01 33 00.

1.4 PROJECT RECORD DOCUMENTS
- A. Submit under provisions of Section 01 77 00.
- B. Accurately record actual routing of all empty conduits including exterior underground installations and provide written record for the project.
- C. Accurately record actual locations and mounting heights of outlet, pull, and junction boxes.

1.5 DELIVERY, STORAGE, AND HANDLING
- A. Deliver, store, protect, and handle Products to site under provisions of Section 01 60 00.
- B. Accept conduit on site. Inspect for damage.
- C. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.
- D. Protect PVC conduit from sunlight.

1.6 PROJECT CONDITIONS
- A. Verify that field measurements are as shown on Drawings.
- B. Verify routing and termination locations of conduit prior to rough-in.
- C. Conduit routing shown on Drawings is in approximate locations unless dimensioned.
  1. Route as required to complete wiring system.

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D. Verify locations of floor boxes and outlets prior to rough-in.
E. Electrical boxes shown on Drawings are in approximate locations unless dimensioned.
   1. Install at location required for box to serve intended purpose.
   2. The Architect may change the location of a box as much as 6', at no extra cost to the Owner.

PART 2 PRODUCTS

2.1 CONDUIT REQUIREMENTS

A. Minimum Size: ½" unless otherwise specified, ¾" for home runs and feeders.
B. Underground Installations:
   1. Use rigid galvanized steel conduit (RGS), plastic coated conduit, or thick wall nonmetallic conduit.
   2. Minimum Size is ¾" for home runs and feeders.
   3. Install conduits outside building line at a minimum of 30" below finished grade (except for conduits for Electrical Utility Company's cables.)
   4. Terminate PVC conduits with bell ends or connectors and bushings.
   5. Cover underground PVC conduits larger than 2" outside of building footprint with 3" thick by trench width, 2,500 psi Concrete.
   6. In areas with muck, either de-muck the area or support the conduit from structure or slabs as indicated by the engineer.
   7. Seal underground utility conduits.
   8. All conduit 90 degree bends for conduits larger than 2" shall be rigid galvanized steel conduit.
   9. Install conduits from Electrical Utility Company's connection point to the building service entrance equipment at a min depth of 36" and covered with 3" thick by trench width 2,500-psi concrete.
   10. Underground conduit installation using "directional bore" method shall be allowed with conduits installed at 36" below grade:
      a. Directional bore method not allowed for conduits from Electrical Utility Company's connection point to the building service entrance equipment.
      b. Concrete cover for conduits installed using directional bore, at least 42" below grade, is not required.
      c. Identification tape for conduits installed using directional bore is not required.
C. Outdoor and Wet Locations, Above Grade:
   1. Use rigid steel conduit (RGC).
   2. PVC schedule 80 may extend from underground to maximum of 10'-0" above finished grade on vertical conduit runs only.
   3. The maximum length of liquid-tight flexible nonmetallic or metallic conduit is 6'.
   4. Use EMT minimum 6'-0" above grade
D. In Slab Not on Grade:
   1. Use rigid steel conduit, electrical metallic tubing, and thick wall nonmetallic conduit.
   2. Maximum Size Conduit in Slab is ¾".
E. Outdoor damp Locations:
   1. Use rigid steel conduit, electrical metallic tubing.
   2. PVC schedule 80 may extend from underground to maximum of 10'-0" above finished grade on vertical conduit runs only.
F. Dry Locations: Concealed:
   1. Use rigid steel conduit, electrical metallic tubing.

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2. PVC conduit may extend from underground to the first box in interior stud wall, masonry or concrete poured wall.
3. PVC conduit may extend from underground through the slab in tilt wall if it changes to EMT or rigid within 2" above tilt wall.

G. Dry Locations: Exposed:
1. Use rigid steel conduit, electrical metallic tubing.
2. PVC conduit may stub-up under floor-mounted switchgear, floor mounted motor control center, and floor mounted transformer.
3. PVC conduit schedule 80 may extend from underground to maximum of 10’-0” above finished floor on vertical conduit runs only within electrical, communication and mechanical rooms and terminate in approved fittings.
4. PVC conduit may sleeve a grounding electrode conductor or bonding jumper.
5. Installer may use surface metal raceway in remodel or renovation projects only where concealed conduit is not possible or practical.
a. Prior approval required by the Building Department.
b. Use Wiremold 700 series as minimum, or approved equal.

H. Corrosive Areas: PVC externally coated galvanized or thick wall non-metallic conduit.
I. Subject to Physical Damage: PVC externally coated galvanized or rigid steel conduit.
J. Flexible conduit: Minimum ⅜" steel, maximum 6' long for a single fixture from a junction box, for type MC cable, see section 26 05 13.
K. Use steel flexible conduit or liquid tight conduit ½" minimum 6' long maximum, to connect equipment where subject to vibration or frequent changing.

2.2 METAL CONDUIT
A. Rigid Galvanized Steel Conduit: Use material meeting ANSI C80.1.
B. Fittings and Conduit Bodies: Use materials meeting ANSI/NEMA FB 1 material to match conduit and steel fittings.
1. Do not use push-in or snap-in connectors or couplings.

2.3 PVC COATED METAL CONDUIT
A. Description: NEMA RN 1, rigid galvanized steel conduit with external PVC coating, 20-mil thick.
B. Fittings/Conduit Bodies: ANSI/NEMA FB1 steel fittings with external PVC coating to match conduit.
1. Do not use push-in or snap-in connectors or couplings.

2.4 FLEXIBLE METAL CONDUIT
A. Description, interlocked construction
B. Fittings: ANSI/NEMA FB 1, connectors and/or couplings shall be steel or malleable iron.
1. Do not use push-in or snap-in connectors or couplings.

2.5 LIQUID TIGHT FLEXIBLE CONDUIT
A. Description, interlocked construction with PVC jacket
B. Fittings: ANSI/NEMA FB 1, connectors and/or couplings shall be steel or malleable iron.
1. Do not use push-in or snap-in connectors or couplings.
2. Use two-piece fittings.

2.6 ELECTRICAL METALLIC TUBING (EMT)
A. Description: ANSI C80.3 galvanized tubing.
B. Fittings/Conduit Bodies: ANSI/NEMA FB 1 steel compression or setscrew type.
1. Do not use push-in or snap-in connectors or couplings.

2.7 NONMETALLIC CONDUIT
A. Description: NEMA TC 2 Schedule 40 PVC or Schedule 80 PVC.

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1. Do not use ENT.

B. Fittings and Conduit Bodies: NEMA TC 3
1. Do not use push-in or snap-in connectors or couplings.

2.8 OUTLET BOXES
A. Sheet Metal Outlet Boxes: ANSI/NEMA OS 1, galvanized steel, 4" x 4" x 1.5" deep, minimum.
B. Cast Boxes
1. NEMA FB 1 Type FD cast iron.
2. Provide gasketed cover by box manufacturer.
3. Provide threaded hubs.
C. May use PVC single gang boxes on aluminum covered walkway posts where conduit and boxes are covered by aluminum cap on post.

2.9 FLOOR BOXES
A. Floor Boxes: GENERALLY NOT ALLOWED
B. When permitted, in writing from the District:
1. Use cast iron floor boxes or nonmetallic floor boxes for installations in slab on grade; formed steel boxes are acceptable for other installations.
2. In meeting rooms (measuring at least 12’ wide with a floor area of at least 215 square feet), stub up conduit and box with outlet in the location of the conference table leg furthest from the screen / smart board. (NEC 210.65)
3. Do not use floor boxes for feed through wiring except to another floor box.
4. Set floor boxes level.
5. Adjust floor box flush with flinish flooring material.

2.10 PULL AND JUNCTION BOXES
A. Sheet Metal Boxes: NEMA OS 1 galvanized steel.
1. Minimum Size Box is 4" x 4" x 1.5" deep.
B. Surface-Mounted Cast Metal Box, NEMA 250, Type 4; flat-flanged, surface-mounted junction box:
1. Material: Galvanized cast iron
2. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover screws.
C. Fiberglass/Polymer Concrete Hand holes:
1. Use minimum size die-molded fiberglass handholds.
a. Highline Products 111812H series, or approved equal for handholds with conduit sizes 1½" or smaller.
b. Highline Products 132415H series, or approved equal for handholds with conduit sizes 2" or larger.
2. Cover: Bolt down polymer concrete weatherproof cover with ⅜" stainless steel bolts and is traffic rated, color coded for designated system (see section 26 05 53).
D. May use PVC single gang boxes on aluminum covered walkway posts where conduit and boxes are covered by aluminum cap on post.

PART 3 EXECUTION

3.1 INSTALLATION - CONDUIT
A. Install conduit in accordance with NECA "Standard of Installation."
B. Install nonmetallic conduit in accordance with manufacturer's instructions.
C. Arrange supports to prevent misalignment during wiring installation.
D. Support conduit using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.

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E. Support all multiple parallel runs of suspended conduits by steel channel and straps.
F. Fasten conduit supports to building structure and surfaces under provisions of Section 26 05 29.
G. Do not support conduit with perforated pipe straps, and remove any wire used for temporary supports.
H. Steel tie wire may support conduit within interior partitions only.
I. Arrange conduit to maintain a minimum of 6'-6" of headroom and present neat appearance.
J. Route exposed conduit parallel and perpendicular to walls.
    1. Exposed conduit below 10' above floor in student areas, shall have a two-hole strap spaced a maximum of 5' oc.
K. Do not route conduits on floors in areas used for access to any equipment.
L. Route the conduit in and under slab from point-to-point.
M. Use liquid tight flexible metal or liquid tight flexible nonmetallic conduit for connection to all motors 3/4 horsepower or larger.
N. Maintain adequate clearance between conduit and piping.
O. Maintain 12" clearance between conduit and surfaces with temperatures exceeding 104°F.
P. Cut conduit square using saw or pipe cutter; de-burr cut ends.
Q. Bring conduit to shoulder of fittings; fasten securely.
R. Join nonmetallic conduit using cement as recommended by manufacturer.
    1. Wipe nonmetallic conduit dry and clean before joining.
    2. Apply full even coat of cement to entire area inserted in fitting.
    3. Allow joint to cure for 20 minutes, minimum.
S. Use conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations and cast metal boxes.
T. Use conduit bodies to make sharp changes in direction, as around beams.
    1. Use hydraulic one-shot bender to fabricate factory elbows for bends in metal conduit larger than 1½" size.
U. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system.
V. Provide suitable fittings to accommodate expansion and deflection where conduit crosses expansion joints.
W. Provide a 200-lb. test pull string in each empty conduit except sleeves and nipples.
X. Cap spare and unused conduits by approved means.
Y. Ground and bond the conduit under the provisions of Section 26 05 26.
Z. Identify conduit under provisions of Section 26 05 53.
AA. New Construction: Conceal all conduits run in finished areas.
BB. May install exposed conduits on existing block walls.
    1. Exposed conduits in classrooms, offices, corridors or other normally occupied spaces shall be surface raceways.
CC. Do not install conduits on roof surfaces.
DD. Do not use "all-thread" conduit nipples.
EE. Provide two-1" spare conduits from recessed panel boards and 1” spare conduit from surface panel boards into the closest suspended acoustical ceiling outside the room where panel is located.
FF. Do not use disconnect switches, magnetic starters, contactors, control cabinets, and panel boards as raceways.
GG. Flexible metal conduit and liquid tight flexible metal conduit shall not penetrate walls or ceilings.
HH. Complete electrical raceway installation before starting the installation of conductors.
II. Patch around conduits that penetrate wall, ceiling, or floor.

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JJ. Install fire alarm, security, A/C, EMS, ITV, intercom, telephone/data systems, and circuits from different panels in separate raceway systems.
1. Exception: Installer may install wiring for the sound-field enhancement system and the ceiling projector system above the ceiling without raceway.
a. Wiring from the wall junction box to the ceiling space must be in conduit.
b. Sound field enhancement system installation shall meet NEC.

KK. Install conduit to preserve fire resistance rating of partitions and other elements, using materials and methods under the provisions of Section 07 84 00.

LL. Route conduit through roof openings for piping and ductwork or through suitable roof jack with pitch pocket.
1. Coordinate location with roofing installation.

MM. If using an existing raceway for new work, it must meet current codes and DMS requirements, or made to meet the requirements.

NN. All locknuts are to be steel or malleable iron.

OO. Aluminum conduit is allowed only in locations where conduit will have direct contact with aluminum walkway covers and aluminum canopies.

PP. Add pull boxes, as necessary, to eliminate conduit runs from exceeding 400' in length for systems and 750’ in length for power.

QQ. Support conduit in or on aluminum walkways with stainless steel bolts or screws.

RR. Caulk the penetrations of walkway roofs with silicone caulking.

SS. May use surface metal raceway in remodel or renovation projects, only where concealed conduit is not possible:
a. Prior approval required by the Building Department.
b. Use Wiremold 700 series as minimum, or approved equal.

3.2 INSTALLATION - BOXES

A. Install electrical boxes as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections and compliance with regulatory requirements.

B. Install electrical boxes to maintain a 6'-6" headroom and to present neat mechanical appearance.

C. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.

D. Inaccessible Ceiling Areas: Install junction boxes no more than 24" from ceiling access panel or from removable recessed luminary with box opening facing access panel or luminary.

E. Install boxes to preserve fire resistance rating of partitions and other elements, using materials and methods under the provisions of Section 07 84 00.

F. Align adjacent wall-mounted outlet boxes for switches, thermostats, and similar devices with each other.

G. Use flush mounting outlet boxes in finished areas.

H. Do not install flush mounting boxes back-to-back in walls; provide minimum 6" separation.
1. Provide minimum 24" separation in acoustic rated and fire rated walls.

I. Secure flush mounting box to interior wall and partition studs.
1. Accurately position to allow for surface finish thickness.

J. Use stamped steel bridges or steel studs to fasten flush mounting outlet box between studs.

K. Install flush mounting box without damaging wall insulation or reducing its effectiveness.

L. Do not support boxes with wires.

M. Support boxes from building structure or structural member.

N. Use gang box when mounting more than one device together, do not use sectional box.

O. Use gang box with plaster ring for single device outlets.

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P. Use cast outlet box in exterior locations exposed to the weather and wet locations.
Q. Large Pull Boxes: Boxes larger than 100 cubic inches in volume or 12" in any dimension.
   1. Interior Dry Locations: Use hinged enclosure under provisions of Section 26 27 16.
   2. Other Locations: Use surface-mounted cast metal box.
R. Cast boxes at the end of a run shall have one additional conduit into slab for support.
S. Add pull boxes, as necessary, to eliminate conduit runs from exceeding 400' in length for systems and 750’ in length for power.
T. Locate handholds, in grassy areas.
U. Use a maximum of one extension ring on a box.
V. Lay-in type ceiling area: Install junction boxes no more than four feet above the ceiling grid.
W. Use splices in underground locations rated for a wet location.
   1. Hand holes must be set on a minimum of 3” bed of pea-rock.
   2. Label hand holes per 26 05 53.
X. Fire alarm visual alarm signal devices (strobe lights) shall be set at 80” to 96” to the bottom of the devices’ above finished floor.
Y. If using existing boxes for new work, the box must meet current code and DMS requirements, or made to meet the requirements.

3.3 INTERFACE WITH OTHER PRODUCTS

A. Coordinate installation of outlet box for casework furnished under Section 06 41 00.
B. Coordinate locations and sizes of required access doors with Section 08 31 00.
C. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only.
   1. Coordinate masonry cutting to achieve neat opening.
D. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.
E. Position outlet boxes to locate luminaries as shown on reflected ceiling plan.

3.4 ADJUSTING

A. Adjust flush-mounting boxes to make front flush with finished wall material.
   1. Installer may use plastic Add-a-depth rings for recessed boxes if the box is within ½” of the surface.
B. Install knockout closure in unused box opening.

END OF SECTION

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SECTION 26 05 36
CABLE TRAY

PART 1 GENERAL

1.1 SECTION INCLUDES
- A. Metallic Cable Tray
- B. Metal conduit
- C. Flexible metal conduit
- D. Fittings and conduit bodies

1.2 REFERENCES
- A. ANSI C80.1 –Electrical Rigid Steel Conduit
- B. ANSI C80.3 – Steel Electrical Metallic Tubing
- C. ANSI/NEMA FB 1 - Fittings, Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable

1.3 SUBMITTALS
- A. Submit under provisions of Section 01 33 00.

1.4 QUALIFICATIONS
- A. Manufacturer: Company specializing in manufacturing products specified in this Section with a minimum of three (3) years of experience.

1.5 PROJECT RECORD DOCUMENTS
- A. Submit under provisions of Section 01 77 00.
- B. Accurately record actual routing of all cable trays and provide written record for the project.

1.6 DELIVERY, STORAGE, AND HANDLING
- A. Deliver, store, protect, and handle Products to site under provisions of Section 01 60 00.
- B. Accept cable trays on site. Inspect for damage.
- C. Protect cable trays from corrosion and entrance of debris by storing above grade, and provide appropriate covering.

1.7 PROJECT CONDITIONS
- A. Verify that field measurements are as shown on Drawings.
- B. Verify routing and termination locations of cable trays prior to rough-in.

1.8 WORK INCLUDES
- A. Provide all labor, materials, necessary equipment, and services to complete the Conduits, Fittings, and Supports work, as indicated on the drawings, as specified herein or both.

PART 2 PRODUCTS

2.1 CABLE TRAY REQUIREMENTS
- A. Metallic Cable Tray: Conform to NEMA VE 1.
- B. Ladder or Basket – Type Cable Tray:
  1. Description: NEMA VE 1, Class 12A, ladder type center hung tray designated to support 50 pounds per linear foot or as required for cable weight
  2. Material: Aluminum or Steel
  3. Inside Width: As indicated on drawings (24” wide minimum)
  4. Straight Section Rung Spacing: Six inches (6”) on center
  5. Inside Depth: Four inches (4”)
  6. Inside Radius of Fitting: Twelve inches (12”)

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7. Supports: The tray system shall be center hung and shall be supported on 4-foot centers by a single 3/8 inch threaded rod or as required for cable weight.
8. Provide all horizontal and vertical 90-degree elbows, tees, and crosses required by the layout shown on the drawings.
9. All edges of cable trays, fittings, and connectors shall be rounded and smooth to prevent injury to the cable during its installation.
10. Provide manufacturer's standard clamps, hangers, brackets, splice plates, reducer plates, blind ends, barrier strips, connectors, and grounding straps as required.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions and NEMA VE 1.
B. Only cables and conductors for systems operating at 24 volts or less shall be installed in cable tray.
C. Fire alarm system and voice alarm system cables shall not be installed in cable tray.
D. Use expansion connectors where required.
E. Install warning signs at 30 feet centers along cable tray, located to be visible.
F. Support trays in accordance with Section 26 05 29.
   1. Provide supports at each connection point, at the end of each run, and at other points to maintain spacing between supports of 4 feet maximum.
G. Provide firestopping using UL listed assemblies for all penetrations of rated walls.
   1. Use metallic sleeves with grounding type bushing on each end.
H. Coordinate cable tray routing with ducts, piping, and work of other trades.
I. All cables extending to/from cable tray from/to terminal cabinets, wiring gutters, outlets, devices, and other equipment shall be installed in approved conduits or conduit sleeves.
J. Maintain adequate clearance between cable tray and piping.
K. Maintain 12" clearance between cable tray and surfaces with temperatures exceeding 104°F.
L. Ground and bond cable tray per NFPA 70 Article 392.
   1. Provide continuity between tray components.
   2. Use anti-oxidant compound to prepare aluminum contact surfaces before assembly.
   3. Connections to tray may be made using mechanical or exothermic connectors.

3.2 WARNING SIGNS

A. Engraved Nameplates: 3/4 inch high black letters on yellow laminated plastic nameplate, engraved with the following wording shall be installed at locations shown on the engineer's plans:
   1. WARNING: DO NOT USE CABLE TRAY AS WALKWAY, LADDER, OR SUPPORT! USE ONLY AS MECHANICAL SUPPORT FOR CABLES AND TUBING!

END OF SECTION

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SECTION 26 05 53
ELECTRICAL IDENTIFICATION

PART 1 GENERAL

1.1 SESSION INCLUDES
- A. Nameplates
- B. Wire and conduit markers
- C. Box color coding
- D. Lighting and power junction boxes
- E. Panel directories
- F. Conduit

1.2 SUBMITTALS
- A. Submit shop drawings under provisions of Section 01 33 00.
- B. Include schedule for nameplates.

PART 2 PRODUCTS

2.1 MATERIALS
- A. Nameplates: Engraved three-layer laminated plastic, white letters on a colored background.
  1. Background color shall match box color coding schedule, see section 26 05 33 3.4A
- B. Underground-Type Plastic Line Marker:
  1. Manufacturer's standard permanent bright-colored continuous-printed plastic tape intended for direct-burial service not less than 6" wide x 4 mils thick.
  2. Provide tape with printing which most accurately indicates the type of the buried conduit.
- C. Wire and Cable Markers: Provide cloth markers, split sleeve, or tubing type.

PART 3 EXECUTION

3.1 INSTALLATION
- A. Degrease and clean surfaces to receive nameplates.
- B. Install nameplates parallel to equipment lines.
- C. Secure nameplates to equipment fronts using screws, rivets, or adhesive.
  1. Secure nameplate to outside face of recessed panel board doors in finished locations.
- D. Do not use embossed tape for any application.
- E. Provide underground-type plastic line marker above exterior underground conduits.
  1. Bury 6" to 8" below finish grade.
  2. Provide line markers on each side of trench if wider than 16".

3.2 WIRE IDENTIFICATION
- A. Wire Color Coding:
  1. 120/208-volt system, "A" phase - black, "B" phase -red, "C" phase - blue, neutral - white, and ground green.
  2. 277/480-volt system, "A" phase - brown, "B" phase - purple, "C" phase - yellow, neutral - gray, and ground - green.
- B. Maintain A, B, C, phase relation left to right or top to bottom when viewed from front.
  1. Maintain color-coding including switch legs and travelers throughout entire project.
  2. Switch legs and travelers may be marked with tape or wire markers to identify them but must maintain the phase color code.
- C. Conductors' #10 and smaller shall have a continuous outer factory finish, meeting the requirements of 26 05 53-3.2a.

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1. Neutrals and equipment-grounding conductors' #6 or smaller shall have a continuous outer factory finish (NEC 200.6 and 250.119.).

3.3 NAMEPLATE ENGRAVING SCHEDULE (EXAMPLE)

A. Provide nameplates of minimum letter height as scheduled below.
B. Panelboards, Switchboards, and Motor Control Centers: ½" identify equipment designation, and ¼" identify voltage rating.
C. Individual Circuit Breakers, Switches, and Motor Starters, Switchboards, and Motor Control Centers: ⅜" identify circuit and load served, including location.
D. Safety Switches, Enclosed Switches, and Motor Starters: ¼" identify panel load served, and room number if not obvious.
E. Transformers: ⅜" identify equipment designation, ¼" identify primary and secondary voltages.
F. Electrical Cabinets and Enclosures: ⅜" identify equipment designation.
G. System Terminal Cabinets: ⅜" identify equipment designation.
H. Switches Not Within Sight of the Equipment or Light(s) Controlled: ⅛" identify load served.
I. Electrical equipment located above suspended or hard ceilings: ⅛", identify circuit number on grid or hard ceiling.
J. Hand hole and manhole: ¼", labeled on the outside to identify system or panel.

3.4 BOX COLOR CODING SCHEDULE

A. Paint junction box and cover in the following manner:
   1. Emergency power - red
   2. Fire alarm - orange
   3. Optional Standby Power - green
   4. Intercom system - blue
   5. Security system - black
   6. ITV system - brown
   7. Data and Telephone systems - yellow
   8. AC and EMS controls - purple
   9. Video Surveillance system - Gold
   10. Card Access system - Tan
B. In exposed finished painted areas, occupied by students, identify junction box with ½" diameter self-adhesive colored dot (same as in 26 05 53-3.4 A) instead of painting.
C. For junction boxes above suspended ceilings, install ½" diameter self-adhesive colored dot (same as in 26 05 53-3.4 A) on ceiling "T" bar below each junction box to show location.

3.5 LIGHTING AND POWER JUNCTION BOX IDENTIFICATION

A. Permanently identify lighting and power junction box covers with circuit and panel board number on the outside.
B. In exposed finished student occupied areas, place circuit and panel board number on inside of cover.

3.6 PANEL DIRECTORY

A. Each panel directory shall be typewritten, indicate specific and clear area of control, using official school district room numbers, and protected by a plastic covering.
B. Each panel directory shall include the conductor color code.
C. Each panel directory shall indicate the voltage and phase of the feeder, ID of the feeder, and location of the feeder disconnect.

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3.7 Arc Fault Hazard Warning

A. Each switchboard, panel board, industrial control panel, meter socket, and motor control center shall be marked to warn of the potential electric arc flash hazards to comply with NFPA 70E and ANSI Z535.41998.

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SECTION 26 08 00
WORK INCLUDED

PART 1 GENERAL

1.1 DESCRIPTION OF SYSTEMS

A. The work required under this Division shall include all materials, labor, and auxiliaries required to install, start up, and test a complete and properly operating electrical system.

1. The electrical systems required under this Division consists basically of, but is not limited to, the following:
   a. The underground feeders from the utility company and equipment to main switchgear, including all necessary risers, etc.
   b. The main switchboard and distribution panels.
   c. A complete emergency electric generating system and automatic transfer switches (life safety and equipment branch/optional branch) including all peripheral components required for a complete working system.
   d. Complete distribution system for lighting including the necessary feeders, branch circuits, lighting fixtures, control switches, and receptacles.
   e. Complete distribution system for power including feeders, branch circuits, convenience outlets, and connections to motors and other power loads.
   f. A complete electric service ground system and special grounds as required or noted.
   g. Connecting motors and manual control, unless otherwise specified.
   h. Complete exit lighting system.
   i. Complete emergency lighting system.
   j. Complete system of empty raceways, cabinets, and terminal boards for communication systems.
   k. Complete system of electrical distribution including receptacles, non-linear panels, and transformers, grounding for computers.
   l. Complete ITV television system, including all distribution equipment, cables, and master antenna.
   m. Complete intercom and public address system.
   n. Complete system of surge suppression devices.
   o. Complete system of lightning protection system.
   p. Complete fire alarm system.
   q. Complete power distribution system for HVAC equipment including wiring, conduits, and disconnect switches.
   r. Complete system of empty raceways and terminal cabinets for security and intrusion alarm systems, video surveillance system, card access system, and emergency radio communications systems.
   s. Complete system of empty raceways and terminal cabinets and power requirements for EMCS (Energy Management and Control System).
   t. Furnishing and installing all necessary access panels.
   u. Concrete work for pad mounted equipment, or encased raceways.
   v. Painting of special equipment
   w. Temporary power
   x. Coordination and verification of power and Telephone Company service requirement prior to bid.

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i) Bid to include all work required.

y. Contractor shall check site and existing conditions thoroughly before bidding.
   i) Inform the Architect of discrepancies or questions noted.

z. On existing buildings being remodeled or renovated, existing disconnected conductors no longer being used shall be removed and associated existing conduits located above ceilings and within walls shall be removed, existing conduits located underground shall be capped and abandoned.

1.2 COMMISSIONING

A. Commissioning of a system or systems specified in this section is part of the construction process.

B. Documentation and testing of these systems, as well as training of the Owner's operation and maintenance personnel, is required in cooperation with the Owner's Representative and the Commissioning Authority.

C. Project Closeout is dependent on successful completion of all commissioning procedures, documentation, and issue closure.

D. Refer to Section 01 77 00 - Contract Closeout, for substantial completion details.

E. Refer to Section 01 91 00 - Commissioning, for detailed commissioning requirements.

PART 2 PRODUCTS

2.1 Not Used

PART 3 EXECUTION

3.1 Not Used

END OF SECTION

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SECTION 26 09 00
ELECTRICAL INSTRUMENTATION and CONTROL

PART 1 GENERAL

1.1 SECTION INCLUDES
- A. General purpose contactors
- B. Lighting contactors

1.2 REFERENCES
- A. NEMA ICS 6 - Enclosures for Industrial Controls and Systems
- B. NEMA ICS 2 - Controllers, Contactors and Overload Relays Related to 600V
- C. NFPA 70 - National Electrical Code

1.3 SUBMITTALS
- A. Submit under provisions of Section 01 33 00.
- B. Product Data: Include dimensions, size, voltage ratings, and current ratings.

1.4 PROJECT RECORD DOCUMENTS
- A. Submit under provisions of Section 01 77 00.
- B. Accurately record actual locations of each contactor and indicate circuits controlled.

1.5 OPERATION AND MAINTENANCE DATA
- A. Submit under provisions of Section 01 77 00.
- B. Maintenance Data: Include instructions for replacing and maintaining coil and contacts.

1.6 QUALIFICATIONS
- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years experience.

PART 2 PRODUCTS

2.1 MANUFACTURERS - GENERAL PURPOSE CONTACTORS
- A. Square D
- B. General Electric
- C. Allen-Bradley
- D. Cutler Hammer
- E. Siemens/ITE

2.2 GENERAL PURPOSE CONTACTORS
- A. Description: NEMA ICS 2 AC general-purpose magnetic contactor
- B. Coil Voltage: 120 volts, 60 Hertz
- C. Poles: As indicated
- D. Size: As indicated
- E. Enclosure: NEMA ICS 6, Type as required to meet conditions of installation, unless indicated on the Drawings.
- F. Accessories:
  1. Pushbutton: ON/OFF
  2. Selector Switch: ON/OFF
  3. Indicating Light: RED
  4. Auxiliary Contacts: Field convertible

2.3 MANUFACTURERS - LIGHTING CONTACTORS
- A. Square D
- B. General Electric

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C. Allen-Bradley
D. Cutler Hammer
E. Siemens/ITE

2.4 LIGHTING CONTACTORS
A. Description: NEMA ICS 2 magnetic lighting contactor
B. Configuration: Electrically held or mechanically held 3-wire control.
C. Coil Voltage: 120 volts, 60 Hertz
D. Poles: As indicated
E. Contact Rating: Match the branch-circuit over-current protection, take-in consideration the de-rating for continuous loads.
F. Enclosure: NEMA ICS 6, Type as required to meet conditions of installation unless indicated on the Drawings.
G. Accessories:
1. Selector Switch: ON/OFF/AUTOMATIC
2. Indicating Light: RED
3. Auxiliary Contacts: Field convertible

2.5 ACCESSORIES
A. Pushbuttons and Selector Switches: NEMA ICS 2 heavy-duty type
B. Indicating Lights: NEMA ICS 2 transformer type
C. Auxiliary Contacts: NEMA ICS 2 Class A300 or A600

PART 3 EXECUTION

3.1 INSTALLATION
A. Install in accordance with manufacturer's instructions.

END OF SECTION

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SECTION 26 10 00
ELECTRICAL UTILITY SERVICES

PART 1 GENERAL

1.1 SESSION INCLUDES
- A. Arrangement with Utility Company for permanent electric service
- B. Underground service entrance

1.2 SYSTEM DESCRIPTION
- A. System Voltage: 277/480 volts three phase, four-wire, 60 Hertz.
- B. Service Entrance: Main

1.3 QUALITY ASSURANCE
- A. Utility Company: Florida Power and Light or Lake Worth Utilities
- B. Install service entrance in accordance with Utility Company's rules and regulations

1.4 SUBMITTALS
- A. Submit shop drawings and product data under provisions of Section 01 33 00.
- B. Submit Utility Company prepared drawings.

PART 2 PRODUCTS

2.1 METERING EQUIPMENT
- A. Meter; meter base and transformer cabinet.

PART 3 EXECUTION

3.1 INSTALLATION
- A. Arrange with Utility Company to obtain electric service to the Project.
- B. Underground: Install service entrance conduits at a minimum depth of 36" from Utility Company's pad-mounted transformer or Utility Company’s pole mounted transformer to building service entrance equipment.
  1. Utility Company will connect service lateral conductors to service entrance conductors.
- C. Provide concrete pad for transformer.
- D. Install primary conduits (conduits furnished by Utility Company) from project’s property line as determined by Utility Company.
  1. Locate conduits at a minimum depth of 36"; cover conduits with 3" thick by trench width concrete and warning tape.

END OF SECTION

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SECTION 26 22 10
DRY TYPE TRANSFORMERS

PART 1 GENERAL

1.1 SECTION INCLUDES
- A. Two winding transformers
- B. Two-winding transformers rated for nonlinear loads
- C. Shielded Transformers

1.2 REFERENCES
- A. NEMA ST 1 - Specialty Transformers
- B. NEMA ST 20 - Dry Type Transformers for General Applications
- C. NFPA 70 - National Electrical Code

1.3 SUBMITTALS FOR REVIEW
- A. Section 01 33 00 - Submittals Procedures for submittals.
- B. Product Data: Provide outline and support point dimensions of enclosures and accessories, unit weight, voltage, KVA, and impedance ratings and characteristics, tap configurations, insulation system type, and rated temperature rise.
- C. Test Reports: Indicate the loss data efficiency at 25, 50, 75, and 100 % rated load and indicate the sound level.
- D. Submit manufacturer's installation instructions.
  1. Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements.
  2. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

1.4 DELIVERY, STORAGE, AND HANDLING
- A. Section 01 60 00 - Material Equipment and approved equals, transport, handle, store, and protect products.
- B. Store in a clean, dry space
  1. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle in accordance with manufacturer's written instructions.
  1. Life only with lugs provided for that purpose.
  2. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

PART 2 PRODUCTS

2.1 TWO-WINDING TRANSFORMERS
- A. Manufacturers:
  1. Square D
  2. Cutler Hammer
  3. General Electric
  4. Substitutions: Under provisions of Section 01 60 00
- B. NEMA ST 20 factory-assembled air-cooled dry type transformers, shown on the drawings
- C. Primary Voltage: 480 volts, 3 phase
- D. Secondary Voltage: 208/120 volts, 3 phase
- E. Insulation system and average winding temperature rise for rated KVA as follows:
  1. 1-15 KVA: Class 185 with 115°C rise

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2. 16-500 KVA: Class 220 with 80°C rise
3. Transformers shall not depend on mechanical ventilation to maintain required temperatures due to heat rise (transformers with integral fans are not allowed.)

F. Case temperature: Do not exceed 35°C rise above ambient at warmest point at full load.
G. Winding Taps:
1. Transformers less than 15 KVA: Two-5% below rated voltage, full capacity taps on primary winding.
2. Transformers 15 KVA and Larger: NEMA ST 20.
H. Sound Levels: Maximum sound levels are as follows:
1. 1-5 KVA: 40 dB
2. 6-25 KVA: 45 dB
3. 26-150 KVA: 50 dB
4. 151-225 KVA: 55 dB
5. 226-300 KVA: 55 dB
6. 301-500 KVA: 60 dB
I. Basic Impulse Level for 10 kV for transformers shall be less than 300 KVA, 30 kV for transformers 300 KVA and larger.
J. Ground core and coil assembly to enclosure by means of a visible flexible copper-grounding strap.
K. Mounting:
1. 1-15 KVA: Provide unit suitable for wall mounting.
2. 16-75 KVA: Provide unit suitable for wall, floor, or trapeze mounting.
3. Larger than 75 KVA: Suitable for floor or trapeze mounting.
L. Coil Conductor: Continuous windings with terminations brazed or welded.
M. Enclosure: Use a NEMA ST 20 Type 1 or Type 3R ventilated or non-ventilated.
N. Isolate core and coil from enclosure using vibration-absorbing mounts.
O. Nameplate: Include transformer connection data and overload capacity based on rated allowable temperature rise.
P. Transformers shall meet the energy efficiency standards requirements of NEMA Standard TP-1.

2.2 TWO-WINDING TRANSFORMERS RATED FOR NONLINEAR LOADS
A. Manufacturers:
1. Square D
2. Cutler Hammer
3. General Electric
4. Substitutions: Under provisions of Section 01 60 00
B. Description: NEMA ST 20, factory-assembled, air-cooled, dry type transformers, ratings as shown on the drawings, designed to supply a 100% nonlinear load as noted on the drawings.
C. Primary Voltage: 480 volts, 3 phase
D. Secondary Voltage: 208Y/120 volts, 3 phase
E. Core Flux Density: Below saturation at 10% primary over voltage
F. Insulation and temperature rise:
1. Provide a class 220 insulation system with 80°C average winding temperature rise.
2. Transformers shall not depend on mechanical ventilation to maintain required temperatures due to heat rise (transformers with integral fans are not allowed.)
G. Case temperature: Do not exceed 35°C rise above ambient at its warmest point at full load.
H. Winding Taps:

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1. Transformers less than 15 KVA: Two 5% below rated voltage, full capacity taps on primary winding.
2. Transformers 15 KVA and Larger: NEMA ST 20.

I. Sound Levels: NEMA ST 20, Maximum sound levels are as follows:
1. 1-5 KVA: 40 dB
2. 6-25 KVA: 45 dB
3. 26-150 KVA: 50 dB
4. 151-225 KVA: 55 dB
5. 226-300 KVA: 55 dB
6. 301-500 KVA: 60 dB

J. Basic Impulse Level for 10 kV for transformers shall be less than 300 KVA, 30 kV for transformers 300 KVA and larger.

K. Ground core and coil assembly to enclosure by means of a visible flexible copper-grounding strap.

L. Mounting:
1. 1-15 KVA: Suitable for wall mounting
2. 16-75 KVA: Suitable for wall, floor, or trapeze mounting
3. Larger than 75 KVA: Suitable for floor or trapeze mounting

M. Coil Conductor:
1. Continuous windings with terminations brazed or welded.
2. Individually insulate secondary conductors and arrange to minimize hysteresis and eddy current losses at harmonic frequencies.
3. Size the secondary neutral conductor at twice the secondary phase conductor ampacity.

N. Electrostatic Shield: Use copper between primary and secondary windings.

O. Enclosure:
1. Use a NEMA ST 20 Type 1 or Type 3R ventilated or non-ventilated.
2. Provide lifting eyes or brackets.

P. Isolate core and coil from enclosure using vibration-absorbing mounts.

Q. Nameplate: Include transformer connection data and overload capacity based on rated allowable temperature rise.

R. Transformers shall meet the energy efficiency standards requirements of NEMA Standard TP-1.

2.3 SHIELDED TRANSFORMERS

A. Manufacturers:
1. Square D
2. Cutler Hammer
3. General Electric
4. Substitutions: Under provisions of Section 01 60 00

B. Description: Use NEMA ST 20 factory-assembled air-cooled dry type transformers, with ratings as shown on the drawings.

C. Primary Voltage: 480 volts, 3 phase.

D. Secondary Voltage: 208Y/120 volts, 3 phase.

E. Insulation system and average winding temperature rise for rated KVA as follows:
1. 10-15 KVA: Class 185 with 115°C rise
2. 16-500 KVA: Class 220 with 150°C rise
3. Transformers shall not depend on mechanical ventilation to maintain required temperatures due to heat rise (transformers with integral fans are not allowed.)

F. Case temperature: Do not exceed 50°C rise above ambient at warmest point at full load.

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G. Winding Taps:
   1. Transformers less than 15 KVA: Two 5% below rated voltage, full capacity taps on primary winding.
   2. Transformers 15 KVA and Larger: NEMA ST 20.
H. Sound Levels: NEMA ST 20 Maximum sound levels are as follows:
   1. 1-5 KVA: 40 dB.
   2. 6-25 KVA: 45 dB.
   3. 26-150 KVA: 50 dB.
   4. 151-225 KVA: 55 dB.
   5. 226-300 KVA: 55 dB.
   6. 301-500 KVA: 60 dB.
I. Basic Impulse Level for a 10 KV for transformers shall be less than 300 KVA, 30 kV for transformers 300 KVA and larger.
J. Ground core and coil assembly to enclosure with visible flexible cooper grounding strap.
K. Winding Shield: Electrostatic, with separate insulated grounding connection.
L. Mounting:
   1. 1-15 KVA: Suitable for wall mounting
   2. 16-75 KVA: Suitable for wall, floor, or trapeze mounting
   3. Larger than 75 KVA: Suitable for floor or trapeze mounting
M. Coil Conductors: Continuous windings with terminations brazed or welded.
N. Enclosure:
   1. Use a NEMA ST 20 Type 1 or Type 3R ventilated or non-ventilated.
   2. Provide lifting eyes or brackets.
O. Isolate core and coil from enclosure using vibration-absorbing mounts.
P. Nameplate: Include transformer connection data.
Q. Transformers shall meet the energy efficiency standards requirements of NEMA Standard TP-1.

2.4 ALTERNATIVE SYSTEM
A. Transformers combined with integrated power distribution system containing switchboard, panel boards, transformers, transient voltage-surge suppression devices (TVSS), and other electrical equipment will be acceptable.

PART 3 EXECUTION

3.1 INSTALLATION
A. Set transformer plumb and level.
B. Use flexible conduit, under the provisions of Section 26 05 33, 2' minimum length, for connections to transformer case.
   1. Make conduit connections to side panel of enclosure.
C. Mount wall-mounted transformers using integral flanges or accessory brackets furnished by the manufacturer.
D. Mount floor-mounted transformers on vibration isolating pads suitable for isolating the transformer noise from the building structure.
E. Mount trapeze-mounted transformers as indicated.
F. Provide grounding and bonding in accordance with Section 26 05 26.

3.2 FIELD QUALITY CONTROL
A. Check for damage and tight connections prior to energizing transformer.
B. Measure primary and secondary voltages and make appropriate tap adjustments.

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C. Provide disconnecting means, for the primary, adjacent to power transformer.
D. Provide power transformers with a grounding bar attached to the enclosure for all grounding conductors.

END OF SECTION

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SECTION 26 23 10
DISCONNECT SWITCHES

PART 1 GENERAL

1.1 WORK INCLUDED
- A. Disconnect switches
- B. Fuses
- C. Enclosures

1.2 REFERENCES
- A. UL 248-12- Class R Fuses
- B. NEMA KS 1 – Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)

1.3 SUBMITTALS
- A. Submit product data under provisions of Section 01 33 00.
- B. Include outline drawings with dimensions, and equipment ratings for voltage, capacity, horsepower, and short circuit.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS - DISCONNECT SWITCHES
- A. Square D
- B. General Electric
- C. Cutler Hammer
- D. Siemens/ITE

2.2 DISCONNECT SWITCHES
- A. Fusible Switch Assemblies: Provide NEMA KS-1 Type HD quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position.
  1. Handle lockable in OFF position, Fuse Clips
  2. Designed to accommodate only Class R-fuses
  3. Provide with fuse rejection clip
- B. Non-fusible Switch Assemblies:
  1. Provide NEMA KS-1 Type HD quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position.
  2. Handle lockable in OFF position.
- C. Enclosures shall be NEMA KS-1 as indicated on Drawings.
- D. Provide ground bar kit for equipment grounding conductors.
- E. Provide neutral bar kit where neutral(s) are present in disconnect switch.

2.3 ACCEPTABLE MANUFACTURERS - FUSES
- A. Gould Shawmut
- B. Bussmann
- C. Reliance Fuse
- D. Substitutions: Under provisions of Section 01 60 00
- E. Little Fuse

2.4 FUSES
- A. Fuses 600 Amperes and Lower, use Class RK1 or RK5 and keep dual element, current limiting, and time delay one-time fuse, of 250 or 600 volt.

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B. Interrupting Rating shall be minimum 200,000 rms amperes.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install disconnect switches where indicated on Drawings.

B. Install fuses in fusible disconnect switches.

END OF SECTION

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SECTION 26 24 13
SWITCHBOARDS

PART 1 GENERAL

1.1 SECTION INCLUDES
- A. Main and distribution switchboards

1.2 REFERENCES
- A. ANSI C12.1 – Electric Meters Code for Electricity Metering
- B. ANSI C39.1 - Requirements for Electrical Analog Indicating Instruments
- C. ANSI/IEEE STD C57.13 – IEE Standard Requirements for Instrument Transformers
- D. FS W-C -375 - Circuit Breakers, Molded Case, Branch Circuit and Service
- E. UL 489 - Molded Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures (UL 489 replaces NEMA AB 1)
- F. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches
- G. NEMA PB 2 - Dead Front Distribution Switchboards
- H. NEMA PB 2.1 – General Instructions for Proper Handling, Installation, Operation and Maintenance of Dead front Distribution Switchboards Rated 600 Volts or Less

1.3 SUBMITTALS
- A. Submit product data under provisions of Section 01 33 00.
- B. Include front and side views of enclosures with overall dimensions shown; conduit entrance locations and requirements; nameplate legends; size and number of bus bars per phase, neutral, and ground; switchboard instrument details; instructions for handling and installation of switchboard; and electrical characteristics including voltage, frame size and trip ratings, withstand ratings, and time-current curves of all equipment and components.
- C. Submit manufacturer's instructions under provisions of Section 01 33 00.

1.4 OPERATION AND MAINTENANCE DATA
- A. Submit operation and maintenance data under provisions of Section 01 77 00 and Section 01 91 00.

1.5 DELIVERY, STORAGE, AND HANDLING
- A. Deliver products to the site under provisions of Section 01 60 00.
- B. Store and protect products under provisions of Section 01 60 00.
- C. Store in a clean dry space
  1. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- D. Handle in accordance with NEMA PB2.1 and manufacturer's written instructions.
  1. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to switchboard internal components, enclosure, and finish.

1.6 COMMISSIONING
- A. Commissioning of a system or systems specified in this section is part of the construction process.
- B. Documentation and testing of these systems, as well as training of the Owner’s operation and maintenance personnel, is required in cooperation with the Owner's Representative and the Commissioning Authority.
- C. Project Closeout is dependent on successful completion of all commissioning procedures, documentation, and issue closure.
- D. Refer to Section 01 77 00 - Contract Closeout, for substantial completion details.
- E. Refer to Section 01 91 00 - Commissioning, for detailed commissioning requirements

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PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Square D
B. General Electric
C. Cutler Hammer
D. Siemens/ITE

2.2 SWITCHBOARD CONSTRUCTION AND RATINGS

A. Provide factory assembled, dead front, metal enclosed, and self-supporting switchboard assembly conforming to NEMA PB2, and complete from incoming line terminals to load side terminations.
B. Provide and install switchboard electrical ratings and configurations as shown on Drawings.
C. Line and Load Terminations: Accessible from the front only of the switchboard, suitable for the conductor materials used.
D. Main Section Devices: Panel mounted or individually mounted.
    1. Individually or mounted and compartmented.
E. Distribution Section Devices: Panel mounted, individually mounted, or individually mounted and compartmented.
F. Auxiliary Section Devices: Individually mounted or individually mounted and compartmented.
G. Bus Material: Use copper rated at 1000-amp per square inch.
H. Bus Connections: Use a bolted type that is accessible from the front for maintenance.
I. Provide copper ground bus through the length of the switchboard.
J. Enclosure shall be NEMA PB 2 Type 1 - General Purpose or 3R - Rain tight.
    1. Sections shall align at front and rear.
K. Finish: Manufacturer's standard color, enamel over external surfaces and minimum one coat corrosion-resisting paint or plated with cadmium or zinc on internal surfaces.
L. Provide surge protection meeting the requirements of 26 43 00.
M. Pull Box: Same construction as switchboard, size as shown on Drawings.
    1. Top and sides shall be removable.
    2. Insulating, with a fire resistive bottom and separate openings for each circuit to pass into switchboard.
N. Pull Section: Same construction as switchboard, size as shown on Drawings, arrange as shown on Drawings.
O. Future Provisions:
    1. Fully equip spaces for future devices with bussing and bus connections, suitably insulated and braced for short circuit currents.
    2. Continuous current rating as indicated on Drawings.
P. Provide instruments and sensors as per 26 24 13-2.6 on main switchboards of 1000-amps or greater.
Q. Install neutral and ground bus bars in the front of the switchboard for easy access for maintenance.

2.3 SWITCHING AND OVERCURRENT PROTECTIVE DEVICES

A. Fusible Switch Assemblies:
    1. NEMA KS 1, quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle.
    2. Provide interlock to prevent opening front cover with switch in ON position.
    3. Handle lockable in OFF position.

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4. Fuse Clips: Designed to accommodate Class R fuses, type as specified.

B. Fusible Switch Assemblies, 800 Amperes and Larger:
   1. Bolted pressure contact switches.
   2. Fuse Clips: Designed to accommodate Class L fuses.

C. Molded Case Circuit Breakers: UL 489 provides circuit breakers with integral thermal and instantaneous magnetic trip in each pole.

D. Molded Case Circuit Breakers with Current Limiters shall be UL 489; molded case circuit breakers with replaceable current limiting elements, in addition to integral thermal and instantaneous magnetic trip in each pole.

E. Current Limiting Molded Case Circuit Breakers UL 489; provide molded case circuit breakers with integral thermal and instantaneous magnetic trip in each pole, coordinated with automatically resetting current limiting elements in each pole.
   1. Provide for an interrupting rating of 100,000-rms amperes symmetrical let-through current and energy level less than permitted for same size Class RK-5 fuse.

F. Solid-state Molded Case Circuit Breakers: UL 489 with electronic sensing, timing, and tripping circuits for adjustable current settings, ground fault trip, instantaneous trip, and adjustable short time trip.
   1. Provide stationary mounting.
   2. Provide a zero sequence type ground-fault sensor.

2.4 INSTRUMENTS AND SENSORS

A. Provide main switchboard of 1000 amps or greater with a stand alone, microprocessor based, three phase power metering device, with six digit LED display, Ethernet communication card, and BACKNET interface capabilities for the generator to allow remote monitoring of the unit School District Energy Management System and Data NetWork System.
   1. Metering device shall provide metering functions, sag/swell monitoring, trending and forecasting functions, web-enable access directly to the meter, and disturbance monitoring.
   2. Provide a device equal to Square D Power Logic Circuit Monitor Model CM 3350 with Display unit and recessed in the front of the switchboard.
   3. Power Logic Circuit Monitor device shall have all required software and programming to allow monitoring of the electrical power data information via School District Energy Management System and Data NetWork System.

B. Provide a zero sequence type ground-fault sensor.

C. Ground Fault Relay: Adjustable ground fault sensitivity from 200 to 1200 amperes time delay adjustable from 0 to 15 seconds.
   1. Provide monitor panel with lamp to indicate relay operation, TEST and RESET control switches.

2.5 ALTERNATIVE SYSTEM

A. Switchboards combined with integrated power distribution system containing switchboard, panelboards, transformers, transient voltage surge suppression devices (TVSS), and other electrical equipment will be acceptable.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install switchboard in locations shown on Drawings, in accordance with manufacturer's written instructions and NEMA PB 2.1.

B. Tighten accessible bus connections and mechanical fasteners after placing switchboard.

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C. Install fuses in each switch.
D. Coordinate with energy management system's contractor to insure that the Power Logic Circuit Monitor Device is fully operational upon connection to the School District energy management system.
   1. Electrical contractor must furnish and install all required conduits, junction boxes, and power requirements.
E. Install ¾" conduit from the Power Logic Circuit Monitor Device to the School District Data Network System.

3.2 FIELD QUALITY CONTROL
A. Inspect completed installation for physical damage, proper alignment, anchorage, and grounding.
B. Measure the insulation resistance of each bus section, phase to phase and phase to ground for one minute each.
   1. Test voltage shall be 500 volts, and minimum acceptable value for insulation resistance is 2 megohms.
C. Check tightness of accessible bolted bus joints using a calibrated torque wrench.
   1. Tightness shall be in accordance with manufacturer's recommended values.

3.3 ADJUSTING AND CLEANING
A. Adjust all operating mechanisms for free mechanical movement.
B. Touch up scratched or marred surfaces to match original finish.
C. Adjust trip and time delay settings to values as instructed by the Architect/Engineer.

3.4 FUNCTIONAL PERFORMANCE TESTING
A. System Functional Performance Testing is part of the Commissioning Process.
   1. The Contractor shall perform the Functional Performance Testing and the Commissioning Authority shall witness and document the test.
   2. Refer to Section 01 91 00, Commissioning, for functional performance tests and commissioning requirements.
B. Systems Readiness Checklists shall be completed and submitted for each piece of equipment included in this section.
C. Perform the functional performance testing of Switchboards as part of the electrical system Functional Performance testing.

3.5 DEMONSTRATION AND TRAINING
A. Training of the Owner's operation and maintenance personnel is required in cooperation with the Owner's Representative.
   1. Provide competent, factory-authorized personnel to provide instruction to FS personnel concerning the location, operation, and troubleshooting of the installed systems.
   2. Schedule the instruction in coordination with the Owner's Representative after submission and approval of formal training plans.
   3. Refer to Section 01 91 00, Commissioning, for further contractor training requirements
B. Provide demonstration and training for all types of Switchboards installed in this project.

END OF SECTION

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SECTION 26 24 16
PANEL BOARDS

PART 1 GENERAL

1.1 SECTION INCLUDES
- A. Service and distribution panel boards
- B. Lighting and appliance branch circuit panel boards

1.2 REFERENCES
- A. FS W-C -375 - Circuit Breakers, Molded Case, Branch Circuit and Service
- B. FS W-P -115 – Panel, Power Distribution
- C. UL 489 - Molded Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
- D. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches
- E. NEMA PB 1 - Panelboards
- F. NEMA PB 1.1 – General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or less
- G. NEMA PB 2.2 - Application Guide for Ground-Fault Protective (GFP) Devices for Equipment

1.3 SUBMITTALS
- A. Submit shop drawings for equipment and component devices under provisions of Section 01 33 00.
- B. Include outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes.

1.4 COMMISSIONING
- A. Commissioning of a system or systems specified in this section is part of the construction process.
- B. Documentation and testing of these systems, as well as training of the Owner’s operation and maintenance personnel, is required in cooperation with the Owner's Representative and the Commissioning Authority.
- C. Project Closeout is dependent on successful completion of all commissioning procedures, documentation, and issue closure.
- D. Refer to Section 01 77 00 - Contract Closeout, for substantial completion details.
- E. Refer to Section 01 91 00 - Commissioning, for detailed commissioning requirements.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURES - PANELBOARDS
- A. Square D
- B. General Electric
- C. Cutler Hammer
- D. Siemens/ITE

2.2 MAIN AND DISTRIBUTION PANELBOARDS
- A. Panel boards: Use a NEMA PB 1 circuit breaker type fusible switch type.
- B. Enclosure: NEMA PB 1 type as required to meet conditions of installation unless indicated on the Drawings.
- C. Provide flush lock in hinged door(s).
  1. Covers finished in manufacturer's standard enamel color.
- D. Provide panel boards with copper bus, ratings as scheduled on Drawings.
  1. Provide copper ground bus in all panel boards.
- E. Minimum Integrated Short Circuit Rating: 10,000 amperes rms symmetrical for 208 volt panel boards; 14,000 amperes rms symmetrical for 480 volt panel boards, or as shown on Drawings.
- F. Fusible Switch Assemblies:

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1. NEMA KS 1 quick-make quick-break load interrupter enclosed knife switch with externally operable handle.
2. Provide interlock to prevent opening front cover with switch in ON position.
3. Handle lockable in OFF position.
4. Fuse Clips: Designed to accommodate Class R fuses, type as specified.

G. Molded Case Circuit Breakers: Provide UL 489 circuit breakers with integral thermal and instantaneous magnetic trip in each pole.
1. Provide circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.

H. Molded Case Circuit Breakers with Current Limiters: Provide UL 489, circuit breakers with replaceable current limiting elements, in add provide an integral thermal and instantaneous magnetic trip in each pole.

I. Current Limiting Molded Case Circuit Breakers; UL 489; provide circuit breakers with integral thermal and instantaneous magnetic trip in each pole, coordinate with automatically resetting current limiting elements in each pole.
1. Interrupting rating of 100,000 symmetrical amperes, let-through current, and energy level less than permitted for same size Class RK-5 fuse.

J. Breakers to have bolted bus connections

2.3 BRANCH CIRCUIT PANELBOARDS

A. Lighting and Appliance Branch Circuit Panel boards, provide NEMA PB1 circuit breaker type.

B. Enclosure: Use a NEMA PB 1 Type 1 or Type 3R.

C. Provide applicable cabinet front with concealed trim clamps, concealed hinge, and flush lock all keyed alike.
1. Finish in manufacturer's standard enamel.

D. Provide panel boards with copper bus, ratings as scheduled on Drawings.
1. Provide copper ground bus in all panel boards.

E. Minimum Integrated Short Circuit Rating: 10,000 amperes rms symmetrical for 208 volt panel boards; 14,000 amperes rms symmetrical for 480 volt panel boards, or as shown on Drawings.

F. Molded Case Circuit Breakers: UL 489 bolt on type thermal magnetic trip circuit breakers, with common trip handle for all poles.

G. Current Limiting Molded Case Circuit Breakers:
1. UL 489; provide bolt-on type circuit breakers with integral thermal and instantaneous magnetic trip in each pole, coordinated with automatically resetting current limiting elements in each pole.
2. Interrupting rating of 100,000 symmetrical amperes let-through current and energy level less than permitted for same size Class RK-5 fuse.

H. Do not use tandem circuit breakers.

I. Use full width, breakers.

J. Breakers for kitchen equipment shall have permanent padlock breaker locks.

K. Provide a neutral conductor to every panel board.

2.4 ALTERNATIVE SYSTEM

A. Panelboards combined with integrated power distribution system containing switchboard, panelboards, transformers, transient voltage surge-suppression devices (TVSS), and other electrical equipment will be acceptable.

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PART 3 EXECUTION

3.1 INSTALLATION

A. Install panel boards plumb and flush with wall finishes where recessed, in conformance with NEMA PB 2.1.
B. Height: 6' maximum
C. Provide filler plates for unused spaces in panel boards.
D. Provide typed circuit directory for each branch-circuit panel board.
   1. Revise directory to reflect circuiting changes required to balance phase loads.
E. Provide two - 1" spare conduits from recessed and one - 1" spare conduit from surface panel boards into the closest suspended acoustical ceiling outside the room where the panel is located.
F. Install surface-mounted panel boards with minimum of four anchors.
   1. Provide steel channel supports to stand panel boards ¾" off wall.
G. Bridge studs top and bottom with channels to support flush-mounted panel boards in stud walls.

3.2 FIELD QUALITY CONTROL

A. Measure steady state load currents at each panel board feeder.
   1. Should the difference at any panel board between phases exceed 15%, rearrange circuits in the panel board to balance the phase loads within 15%.
   2. Take care to maintain proper phasing for multi-wire branch circuits.
B. Visual and Mechanical Inspection: Inspect for physical damage, proper alignment, anchorage, and grounding.
   1. Check proper installation and tightness of connections for circuit breakers, fusible switches, and fuses.

3.3 FUNCTIONAL PERFORMANCE TESTING

A. System Functional Performance Testing is part of the Commissioning Process.
   1. The Contractor shall perform the Functional Performance Testing and the Commissioning Authority shall witness and document the test.
   2. Refer to Section 01 91 00, Commissioning, for functional performance tests and commissioning requirements.
B. Systems Readiness Checklists shall be completed and submitted for each piece of equipment included in this section.
C. Perform the Functional performance testing of Panelboards as part of the Electrical System Functional Performance testing.

3.4 DEMONSTRATION AND TRAINING

A. Training of the Owner’s operation and maintenance personnel is required in cooperation with the Owner's Representative.
   1. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems.
   2. Schedule the instruction in coordination with the Owner's Representative after submission and approval of formal training plans.
   3. Refer to Section 01 91 00, Commissioning, for further contractor training requirements
B. Provide demonstration and training for all types of panelboards installed in this project.

END OF SECTION

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SECTION 26 27 16
ELECTRICAL CABINETS AND ENCLOSURES

PART 1 GENERAL

1.1 SECTION INCLUDES
- A. Hinged cover enclosures
- B. Cabinets
- C. Terminal blocks and accessories

1.2 REFERENCES
- A. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum)
- B. NEMA ICS 1 - Industrial Control and Systems: General Requirements
- C. NEMA ICS 4 – Application Guideline for Terminal Blocks
- D. NEMA ICS 6 - Enclosures

1.3 SUBMITTALS
- A. Submit product data under provisions of Section 01 33 00.
- B. Shop Drawings for Equipment Panels: Include wiring schematic diagram, wiring diagram, outline drawing and construction diagram as described in NEMA ICS 1.

PART 2 PRODUCTS

2.1 HINGED COVER ENCLOSURES
- A. Construction: Use NEMA 250 steel types as required to meet conditions of installation unless indicated on the Drawings.
- B. Finish: Use manufacturer's standard enamel finish.
- C. Covers: Continuous hinge, held closed by flush latch operable by key.
- D. Panel for Mounting Terminal Blocks or Electrical Components: 14-gage steel, enamel finish.

2.2 CABINETS
- A. Cabinet Boxes: Provide galvanized steel with removable end walls.
  1. Provide ¾" thick plywood backboard (exterior fir, type A/C, 7 ply) painted gray on all sides, for mounting terminal blocks.
- B. Cabinet Fronts: Steel, flush or surface type with screw cover front, concealed hinge and flush lock keyed to match branch circuit panel board; finish in baked enamel.

2.3 TERMINAL BLOCKS AND ACCESSORIES
- A. Terminal Blocks: NEMA ICS 4; UL listed.
- B. Power Terminals: Unit construction type, closed-back type, with tubular pressure screw connectors, rated 600 volts.
- C. Signal and Control Terminals: Modular construction type, channel mounted; tubular pressure screw connectors, rated 300 volts.

2.4 FABRICATION
- A. Shop assemble the enclosures and cabinets housing terminal blocks or electrical components in accordance with NEMA ICS 6.
- B. Provide knockouts on enclosures.
- C. Provide protective pocket inside front cover with schematic diagram, connection diagram, and layout drawing of control wiring and components within enclosure.

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PART 3 EXECUTION

3.1 INSTALLATION

A. Install cabinets and enclosures plumb; anchor securely to wall and structural supports at each corner, minimum.
B. Provide accessory feet for free-standing equipment enclosures.
C. Install trim plumb.

END OF SECTION

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SECTION 26 27 23
INDOOR SERVICE POLES

PART 1 GENERAL

1.1 SECTION INCLUDES
- A. Indoor service poles

1.2 REFERENCES
- A. NFPA 70 - National Electrical Code
- B. NEMA WD 6 – Wiring Devices – Dimensional Specifications

1.3 SUBMITTALS
- A. Submit product data under provisions of Section 01 33 00.
- B. Product Data: Indicate materials, finishes, receptacle and connector configuration, and attachment details.

1.4 QUALIFICATIONS
- A. Manufacturer: Company specializing in manufacturing Products specified in this Section with minimum three years experience.

1.5 PROJECT CONDITIONS
- A. Verify field measurements are as shown on Drawings.
- B. Locations of indoor service poles shown on Drawings are approximate unless dimensioned.
  1. Determine actual furniture arrangement and locate poles as required to accommodate furniture layout.

1.6 COORDINATION
- A. Coordinate work under provisions of Section 01 31 00.
- B. Coordinate work with telephone cable installer.
- C. Coordinate work with data-communications cable installer.

PART 2 PRODUCTS

2.1 MANUFACTURERS
- A. Wiremold
- B. Square "D"
- C. Substitutions: Under provisions of Section 01 60 00

2.2 MATERIALS
- A. Main Body: Steel
- B. Cover Plates: Steel

2.3 COMPONENTS
- A. Convenience Receptacle Configuration: NEMA WD 6; Type 5-20
- B. Foot: Suitable for floor finish as indicated
- C. Provide concealed top clamp to fasten pole to inverted "T" grid ceiling suspension member.

2.4 ACCESSORIES
- A. Provide trim plate for closing ceiling opening.

PART 3 EXECUTION

3.1 EXAMINATION
- A. Verify under provisions of Section 01 31 00.
- B. Verify that installation of ceiling suspension system is complete.
- C. Verify that floor covering installation is complete.

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D. Verify branch circuit wiring installation is complete, tested, in proper location and ready for connection to indoor service poles.
E. Verify telephone raceway installation is complete, in proper location and ready for connection to indoor service poles.
F. Verify data-communication raceway installation is complete, in proper location and ready for connection to indoor service poles.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.
B. Install poles plumb.
C. Fasten to floor with screws, bolts.
D. Make wiring connections to branch circuit outlets using flexible conduit under Provisions of Section 25 05 33.
E. Bond the equipment grounding conductor and body of pole, to branch circuit equipment grounding conductor.
F. Neatly cut openings in ceiling panels and install trim plate.

3.3 INTERFACE WITH OTHER PRODUCTS

A. Interface with installation of telephone cable and connectors.
B. Interface with installation of data communications cable and connectors.

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SECTION 26 27 26
WIRING DEVICES

PART 1 GENERAL

1.1 SECTION INCLUDES
- A. Wall switches
- B. Wall dimmers
- C. Receptacles
- D. Device plates
- E. Floor box service fittings
- F. Poke-through service fittings
- G. Vacancy/Occupancy sensors
- H. Automatic light switches

1.2 REFERENCES
- A. NEMA 5-WD 1 - Wiring Devices
- B. NEMA WD 6 - Wiring Devices – Dimensional Specifications

1.3 SUBMITTALS
- A. Submit under provisions of Section 01 33 00.
- B. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.

1.4 QUALIFICATIONS
- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum 3-years of experience.

1.5 ALLOWANCES
- A. Provide for twenty additional receptacles as directed in field.
  1. Allowance includes purchase, delivery, and installation of box, receptacle cover plate, wire, and 100 feet of conduit for each receptacle.

1.6 WARRANTIES
- A. All devices specified in this section shall be provided with 5-year manufacture' warranty on parts and labor.

PART 2 PRODUCTS

2.1 WALL SWITCHES
- A. Single Pole Switches shall be 20-amps, 120/277 volts, industrial, heavy duty, specification grade, back and side wired, toggle type, and ground screw.
  1. Switches may be single poles, double pole, three-way, four-way, indicator type, locator type, key type, and pilot lighted as shown on the plans.
  2. Switches for normal lighting shall be ivory color and switches for emergency lighting shall be red color.
  3. The Pilot light in pilot light switches shall be lit when the load is on.
- B. Manufacturers
  1. Hubbell
  2. Leviton
  3. Pass & Seymour
  4. Substitutions: Under provisions of Section 01 60 00
- C. Time Delay Light/Fan Switch
  1. Penn Ventilator Model Airminder AM-12

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2. Substitutions: Under provisions of Section 01 60 00

2.2 WALL DIMMERS

A. Manufacturers
1. Lutron
2. Eaton
3. Copper
4. Wattstopper
5. Leviton
6. Substitutions: Under provisions of Section 01 60 00

B. Description: UL Listed, low voltage dimmers for LED lights, type as indicated on Drawings or Schedule.

C. Device Body: Ivory plastic with five (5) buttons (All ON, Half ON, Raise, Lower, All Off)

D. Voltage: 24 volts supplied by room controller

E. Power Rating: Match load shown on Drawings.

2.3 RECEPTACLES

A. Receptacles shall be 20 amps, 125 volts grounding type, industrial, specification grade, back and side wired, and with ground screw.
1. Receptacles shall be single, duplex, quaderplex, tamper resistant, GFCI, combination tamper resistant/GFCI, and surge protected as shown on the plans.

B. General convenience receptacles shall be ivory color, receptacles supplied by branch circuits via emergency generator backed panels shall be red color, receptacles for communication systems equipment (computers) shall be gray color, and receptacles controlled automatically shall be green in color.

C. Heavy-duty special receptacle outlets for dryers, kiln, and ranges as specified on the plans.

D. Surge protected receptacles shall be UL 1449 listed (second edition), shall have metal minimum of four metal oxide varistors protecting phase-neutral, phase-ground, and neutral-ground.
1. These receptacles shall have power-on indicator light and damage alert light or sound features.

E. Manufacturers
1. Hubbell
2. Leviton
3. Pass & Seymour
4. Substitutions: Under provisions of Section 01 60 00

2.4 WALL PLATES

A. Decorative Cover Plate: Stainless steel type 302 satin finished, non-magnetic.

B. Weatherproof Cover Plate: Cast type, UL listed for wet and damp locations.
1. Sierra
2. Hubbell
3. Leviton
4. Pass & Seymour
5. Substitutions: Under provisions of Section 01 60 00

2.5 POKE-THROUGH FITTINGS

A. Manufacturers
1. Hubbell
2. Steel City
3. Leviton
4. Pass & Seymour
5. Substitutions: Under provisions of Section 01 60 00

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B. Description: Assembly comprising service fitting, poke-through component, firestops and smoke barriers, and junction box for conduit termination.
C. Fire Rating: Code requirement
D. Service Fitting
   1. Type: Pedestal or Flush
   2. Housing: Satin aluminum
   3. Device Plate: Stainless steel
   4. Substitutions: Under provisions of Section 01 60 00

2.6 TIME CLOCKS
A. Manufacturers
   1. Intermatic
   2. Paragon
   3. Tork
   4. Substitutions: Under provisions of Section 01 60 00
B. Enclosure: NEMA ICS 2 Type as required to meet conditions of installation unless indicated on the Drawings.
C. Time clocks to be a 7-day 24-hour day clock skipping with minimum 12-hour carryover.

2.7 PHOTOCELL SWITCH
A. Manufacturers
   1. Intermatic
   2. Paragon
   3. Tork
   4. Substitutions: Under provisions of Section 01 60 00

2.8 VACANCY/OCCUPANCY SENSORS (SENSORS)
A. Vacancy/Occupancy Sensors (referred to as Sensors) shall be Dual Technology, Ultrasonic, and Passive Infrared.
B. Sensors shall be UL, ceiling mounted, Class 2 devices, 24 volts DC, and 360 degrees, with LED indicators.
C. Sensors' power packs shall be UL listed, mounted above ceiling and directly above the Sensors.
D. Provide power packs rated at 20 amps, 125/277 volts on the primary side and 24 volts DC on the secondary side with self-contained transformer and relay.
E. Connections from Sensors to the power packs shall be Class 2 wiring at 24 volts DC.
F. Power packs shall be capable of controlling multi Sensors and connections to multi light switches (dual-level switching).
G. Sensors shall have an auxiliary contact/relay for control of HVAC system.
H. Sensors shall have adjustable time delay with settings at 5, 10, and 20 minutes.
   1. Initial factory settings shall be at 20 minutes.
I. Each Sensor shall cover minimum area of 1000 square feet.
   1. Spaces larger than 1000 square feet shall have multiple numbers of occupancy sensors.
J. Occupancy Sensors shall have adjustable sensitivity feature.
K. Manufacturer of the Vacancy/Occupancy Sensors shall provide minimum five-year full-unlimited warranty for materials and labor.
L. Sensors shall be fail-safe: upon failure of the Sensors, the lighting in the controlled area shall be capable of being turn ON and OFF by the wall mounted light switches.
M. Vacancy/Occupancy Sensors shall be complete system with Sensors, Power Packs, and interconnected wiring.
N. Manufacturers

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1. Wattstopper, Model DT-300 Series
2. Hubbell, Model ATD2000CRP Series
3. Cooper OMC-DT Series
4. Substitutions: Under provisions of Section 01 60 00

2.9 AUTOMATIC LIGHT SWITCHES

A. Automatic light switches shall be Dual Technology, Ultrasonic, and Passive Infrared.
B. Automatic light switches shall be combination of light switch and occupancy sensor.
C. Automatic light switches shall be UL, wall mounted, ivory color with LED indicators.
D. Automatic light switches shall have choice of “auto-on or manual-on” operation.
E. Automatic light switches rated at 20 amps, 125/277 volts.
F. Automatic light switches must be compatible with all electronic ballasts.
G. Automatic light switches shall have adjustable time delay with settings at 5, 10, and 20 minutes.
   1. Initial factory settings shall be at 20 minutes.
H. Automatic light switches shall have adjustable sensitivity feature.
I. Manufacturer of the Automatic light switches shall provide minimum five-year full-unlimited warranty for materials and labor.
J. Automatic light switches shall be fail-safe: upon failure of the device’s sensors, the light switch shall be fully operational and be able to shut the lights on and off manually.
K. Device shall have vandal-resistant sensor lens.
L. Manufacturers
   1. Watt Stopper, Model DW-100-1 Series
   2. Hubbell, Model AD12277I1 Series
   3. Cooper OSW-DT Series
   4. Substitutions: Under provisions of Section 01 60 00

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify conditions under provisions of Section 01 31 00
B. Verify outlet boxes are installed at proper height.
C. Verify wall openings are neatly cut and completely covered by wall plates.
D. Verify floor boxes are properly adjusted.
E. Verify branch circuit wiring installation is complete, tested, and ready for connection to wiring devices.

3.2 PREPARATION

A. Provide extension ring to bring outlet boxes flush with finished surface.
B. Clean debris from outlet boxes.

3.3 INSTALLATION

A. Install products in accordance with manufacturer's instructions.
B. Install devices plumb and level.
C. Install switches with OFF position down.
D. Install wall dimmers to achieve full rating specified and indicated after de-rating for ganging as instructed by manufacturer.
E. Do not share neutral conductor on load side of dimmers.
F. Connect wiring device grounding terminal to branch circuit equipment grounding conductor.
G. Install decorative plates on switch, receptacle, and blank outlets in finished areas.
H. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.

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I. Provide one GFCI receptacle, minimum, in janitorial closets, adjacent to roof mounted equipment and pad mounted air conditioning equipment.
J. Any receptacle within six (6) feet of a sink shall be a GFCI type.
K. Receptacles on science work islands and adjacent to locker room shower and drying areas shall be GFCI type.
L. When plans or the code specifies GFCI, use only GFCI receptacles.
    1. Do not protect "down stream" receptacles with GFCI receptacles.
    2. Receptacles in one continuous multi-outlet surface raceway may be protected by one GFCI receptacle installed in the multi-outlet surface raceway.
M. Do not install receptacles and/or switches in-group toilets.
    1. Light shall be controlled from the nearest custodial space by a toggle switch with pilot light.
N. Switches in classroom and teachers workrooms for exhaust fans and contactors, shall have a pilot light.
O. Do not use push-in connections on any device.
P. Switches not within sight of what they control shall be a switch with a pilot light.

3.4 INTERFACE WITH OTHER PRODUCTS

A. Coordinate locations of outlet boxes provided under Section 26 27 16 to obtain mounting height specified and indicated on Drawings.
B. Install wall switches between 44"- 46” to center above finished floor.
C. Install convenience receptacles 18”- 20" to center above finished floor.
D. Install convenience receptacles 6" above backsplash of counter.
E. Install dimmers 44"– 46” to center above finished floor.
F. Install telephone jack 18"– 20” to center above finished floor.
G. Install telephone jacks for wall telephone 44"– 46” to center above finished floor.
H. Install outdoor receptacles 60" to center above finished grade.

3.5 FIELD QUALITY CONTROL

A. Inspect each wiring device for defects.
B. Operate each wall switch with circuit energized and verify proper operation.
C. Verify that each receptacle device is energized.
D. Test each receptacle device for proper polarity.
E. Test each GFCI receptacle device for proper operation.

3.6 ADJUSTING

A. Adjust devices and wall plates to be flush and level.

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SECTION 26 28 13
FUSES (600 VOLT AND BELOW)

PART 1 GENERAL

1.1 FURNISH AND INSTALL FUSES OF THE TYPES AND SIZES AS INDICATED ON THE DRAWINGS AND/OR AS SPECIFIED HEREIN.
- A. All fuses furnished and installed under this specification shall be as specified; shall be new, unused fuses; shall be delivered to the job site in manufacturer's original boxes or cartons whether furnished by the Contractor or by the manufacturer of equipment.
- B. All fuses shall have a minimum interrupting rating of 200,000 amperes.
- C. Should utilization, conversion, or distribution equipment provided under any division of these specifications require fuse classes offering a higher degree of protection or different ampere ratings than fuses specified, such fuse classes and ampere ratings may be used.

1.2 EVENLY TORQUE ALL MOUNTING BOLTS OR NUTS TO ASTM RECOMMENDATIONS FOR TYPE AND DIAMETER OF MOUNTING BOLTS OR STUDS PROVIDED.
- A. The inside of each fuse enclosure shall contain a durable, readily visible label, which shall clearly indicate the correct type and size of replacement fuse.
- B. Label shall not cover or interfere with equipment manufacturer's instructions.

1.3 FUSES SHALL BE MADE BY ONE OF THE FOLLOWING MANUFACTURERS:
- A. Reliance Fuses
- B. Gould Shawmut
- C. Littlefuse
- D. Bussmann
- E. Substitutions:
  1. Should the Contractor propose to provide fuses other than those specified, at least six weeks prior to the installation of the fuses, he shall furnish the Engineer complete technical data sufficient for the Engineer to determine whether system function will be adversely affected, whether proposed fuses meet this specification and whether they are equal in quality.
  2. Proposal for substitution shall state the dollar cost savings to the Owner and reason for proposed substitution.

1.4 TO ASSURE SELECTIVE COORDINATION OF PROTECTIVE DEVICES, ALL FUSES SHALL BE OF THE SAME MANUFACTURER.

PART 2 PRODUCTS

2.1 FUSES FOR SERVICE, SWITCHBOARD MAINS, FEEDERS, AND BRANCH CIRCUITS
- A. 0 to 600 amperes: Fuses 0 to 600 amperes shall be UL listed RK1 dual-element, time-delay fuses with ampere ratings as indicated on the drawings except as modified by these specifications.
- B. Fuses for motor branch circuits 600 amperes and below, whether individual or grouped (MCC), shall be class RK1 fuses.
  1. To determine fuse ratings for motor branch circuits use actual full-load currents of motors provided, not by NEC Table of Standard Motor Full Load Ampere.
  2. EXCEPTION
     - a. Fuses in motor control centers may be time-delay Class CC fuses if MCC manufacturer's standard designs are for these fuses.
     - b. Follow the fuse manufacturer's recommendations for Class CC fuses.

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C. Fuses for motor branch circuits requiring fuses over 601 amps, whether individual or grouped (MCC), shall be Class L fuses.
D. Fuse holders shall be able to simultaneously disconnect all ungrounded conductors of the branch circuit by means of an adjacent disconnect or a multi-pole fuse holder.

2.2 FUSING OF CONTROL CIRCUITS
A. General: Fuses shall be RK1 or time-delay Class CC fuses installed in Class CC fuse blocks.
B. Control Power Transformers:
1. Primary circuit of all control power transformers shall have proper fuse.
2. Fuse ratings shall be in accordance with NEC requirements.
3. Fuses shall be RK1 or time-delay UL Class CC fuses installed in Class CC fuse blocks.

2.3 FUSING FOR FLUORESCENT AND H.I.D. LIGHTING FIXTURE BALLASTS
A. 300 volt and below fluorescent fixture ballasts, where required, shall be individually fused.
1. Fuse holders and fuses shall be GLR fuses or equal.
B. Provide individual fuses for H.I.D. lighting fixture ballasts, where required, with fuses rated in accordance with fixture manufacturer's recommendation.
1. Fuse holders shall be UL Class CC fuses.
C. Outside pole lights shall have only one fuse holder per branch circuit or switch leg.

2.4 FUSES FOR METERING CENTERS, LOAD CENTERS, AND FOR BACK-UP PRODUCTION OF CIRCUIT BREAKERS
A. Fuses for above purposes shall be RK1 or Class L fuses.
B. Fuse ampere ratings shall not exceed maximum recommended by equipment manufacturer.

2.5 INITIAL START-UP
A. Contractor shall replace all fuses opened during start-up and testing.
B. At contract completion, all fuse holders shall contain serviceable fuses as specified.

PART 3 EXECUTION

3.1 Not Used.

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SECTION 26 28 16
ENCLOSED SWITCHES and CIRCUIT BREAKERS

PART 1 GENERAL

1.1 SECTION INCLUDES
- A. Enclosed molded case circuit breakers

1.2 REFERENCES
- A. FS W-C-375 - Circuit Breakers, Molded Case, Branch Circuit and Service
- B. UL 489 - Molded Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures

1.3 SUBMITTALS
- A. Submit product data under provisions of Section 01 30 00.
- B. Include circuit breaker and current limiter ratings, trip current and let-through current curves, outline dimensions, and terminal lug sizes.

1.4 COMMISSIONING
- A. Commissioning of a system or systems specified in this section is part of the construction process.
- B. Documentation and testing of these systems, as well as training of the Owner's operation and maintenance personnel, is required in cooperation with the Owner's Representative and the Commissioning Authority.
- C. Project Closeout is dependent on successful completion of all commissioning procedures, documentation, and issue closure.
- D. Refer to Section 01 77 00 - Contract Closeout, for substantial completion details.
- E. Refer to Section 01 91 00 - Commissioning, for detailed commissioning requirements.

PART 2 PRODUCTS

2.1 MANUFACTURERS
- A. Square D
- B. General Electric
- C. Cutler Hammer
- D. Siemens/ITE

2.2 MOLDED CASE CIRCUIT BREAKER
- A. Circuit Breaker: UL 489

2.3 RATINGS
- A. UL 489; as scheduled

2.4 TERMINAL LUGS
- A. Provide and install UL 489 as scheduled and suitable for copper.

2.5 CURRENT LIMITERS
- A. Current Limiter: Use devices designed for application with molded case circuit breaker.
- B. Coordinate limiter size with trip rating of circuit breaker to prevent nuisance tripping and to achieve interrupting current rating specified for circuit breaker.
- C. Provide interlocks to trip circuit breaker and prevent closing the circuit breaker when limiter compartment cover off or when one or more limiter is not in place or has operated.

2.6 ENCLOSURE
- A. Enclosure: UL 489 type as required to meet conditions of installation unless indicated on the Drawings.
- B. Fabricate enclosure from steel.
- C. Finish using manufacturer's standard enamel color.

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2.7 ACCESSORIES
- A. Provide accessories as scheduled, to UL 489.
- B. Shunt Trip Device: 120 volts AC
- C. Under voltage Trip Device: 120 volts AC
- D. Auxiliary Switch: 120 volts AC
- E. Alarm Switch: 120 volts AC
- F. Electrical Operator: 120 volts AC
- G. Handle Lock: Include provisions for padlocking.
- H. Provide mechanical trip device.

PART 3 EXECUTION

3.1 EXAMINATION
- A. Verify that surfaces are ready to receive work.
- B. Verify field measurements are as shown on Drawings.
- C. Verify that required utilities are available, in proper location, and ready for use.
- D. Beginning of installation means installer accepts conditions.

3.2 INSTALLATION
- A. Install enclosed circuit breakers where shown on Drawings, in accordance with manufacturer's instructions.

3.3 ADJUSTING
- A. Adjust work under provisions of Section 01 75 00.
- B. Adjust trip settings so that circuit breakers coordinate with other overcurrent protective devices in circuit.
- C. Adjust trip settings to provide adequate protection from overcurrent and fault currents.

3.4 FIELD QUALITY CONTROL
- A. Perform field inspection and testing under provisions of Section 01 40 00.
- B. Inspect and test each circuit breaker to UL 489.
- C. Inspect visually and perform several mechanical ON-OFF operations on each circuit breaker.
- D. Verify circuit continuity on each pole in closed position.

3.5 FUNCTIONAL PERFORMANCE TESTING
- A. System Functional Performance Testing is part of the Commissioning Process.
  1. The Contractor shall perform the Functional Performance Testing and the Commissioning Authority shall witness and document the test.
  2. Refer to Section 01 91 00, Commissioning, for functional performance tests and commissioning requirements.
- B. Systems Readiness Checklists shall be completed and submitted for each piece of equipment included in this section.
- C. Perform the functional performance testing of Enclosed Circuit Breakers as part of the Electrical System Functional Performance testing.

3.6 DEMONSTRATION AND TRAINING
- A. Training of the Owner’s operation and maintenance personnel is required in cooperation with the Owner's Representative.
  1. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems.

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2. Schedule the instruction in coordination with the Owner's Representative after submission and approval of formal training plans.
3. Refer to Section 01 91 00, Commissioning, for further contractor training requirements.

B. Provide demonstration and training for all types of enclosed circuit breakers installed in this project.

END OF SECTION

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SECTION 26 28 39
MOTOR CONTROL

PART 1 GENERAL

1.1 WORK INCLUDED
- A. Manual motor starters
- B. Magnetic motor starters
- C. Combination magnetic motor starters
- D. Motor control centers

1.2 REFERENCES
- A. NEMA ICS 6 - Enclosures
- B. FS W-C -375 - Circuit Breakers, Molded Case; Branch Circuit and Service
- C. UL 489 - Molded Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
- D. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts
- E. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches
- F. NEMA PB 1 - Panelboards
- G. NEMA PB 1.1 – General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or less

1.3 SUBMITTALS
- A. Submit shop drawings and product data under provisions of Section 01 33 00.
- B. Indicate on shop drawings, front and side views of motor control center enclosures with overall dimensions.
  1. Include conduit entrance locations and requirements; nameplate legends; size and number of bus bars per phase, neutral, and ground; electrical characteristics including voltage, frame size and trip ratings, withstand ratings, and time-current curves of all equipment and components.
- C. Provide product data on motor starters and combination motor starters, relays, pilot devices, and switching and over current protection devices.
- D. Submit manufacturers' instructions under provisions of Section 01 33 00.

1.4 OPERATION AND MAINTENANCE DATA
- A. Submit operation and maintenance data under provisions of Section 01 77 00.

1.5 DELIVERY, STORAGE, AND HANDLING
- A. Deliver products to site under provisions of Section 01 60 00.
- B. Deliver in 30" maximum width shipping splits, individually wrapped for protection, and mounted on shipping skids.
- C. Store and protect products under provisions of Section 01 60 00.
- D. Store in a clean, dry space
  1. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- E. Handle in accordance with manufacturer's written instructions.
  1. Lift only with lugs provided for the purpose.
  2. Handle carefully to avoid damage to motor control center components, enclosure, and finish.

1.6 SPARE PARTS
- A. Keys: Furnish two each to Owner.

1.7 COMMISSIONING

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A. Commissioning of a system or systems specified in this section is part of the construction process.
B. Documentation and testing of these systems, as well as training of the Owner's operation and maintenance personnel, is required in cooperation with the Owner's Representative and the Commissioning Authority.
C. Project Closeout is dependent on successful completion of all commissioning procedures, documentation, and issue closure.
D. Refer to Section 01 77 00 - Contract Closeout, for substantial completion details.
E. Refer to Section 01 91 00, Commissioning, for detailed commissioning requirements.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS - MOTOR STARTERS
A. Square D
B. General Electric
C. Cutler Hammer
D. Siemens/ITE
E. Allen Bradley

2.2 MANUAL MOTOR STARTERS
A. Manual Motor Starter: NEMA ICS 2; AC general-purpose Class A manually operated full-voltage controller for induction motors rated in horsepower, with overload relay, red pilot light, auxiliary contact, and push button operator.
B. Fractional Horsepower Manual Starter: NEMA ICS 2; AC general-purpose Class A manually operated, pole, full-voltage controller for fractional horsepower induction motors, with thermal overload unit, red pilot light, and key operator.
C. Motor Starting Switch: NEMA ICS 2 AC general-purpose Class A manually operated pole with full-voltage controller for fractional horsepower induction motors, without thermal overload unit, red pilot light, auxiliary contact, and push button operator.
D. Enclosure: NEMA ICS 6

2.3 MAGNETIC MOTOR STARTERS
A. Magnetic Motor Starters: NEMA ICS 2 AC general-purpose Class A magnetic controller for induction motors rated in horsepower.
B. Full Voltage Starting
C. Reduced Voltage Starting
D. Two-Speed starting with integral time delay transition between FAST and SLOW speeds.
E. Coil Operating Voltage: 120 volts, 60 Hertz
F. Size: NEMA ICS 2; size as shown on Drawings
G. Overload Relay: NEMA ICS 2; melting alloy
H. Enclosure: NEMA ICS 6
I. Combination Motor Starters: Combine motor starters with disconnecting means, type as scheduled.
J. Auxiliary Contacts: NEMA ICS 2 two normally opened and two normally closed contacts in addition to seal-in contact.
K. Indicating Lights: NEMA ICS 2 RUN: red in front cover.
L. Selector Switches: NEMA ICS 2 HAND/OFF/AUTO, in front cover.
M. Relays: NEMA ICS 2
N. Control Power Transformers: 120-volt secondary, capacity as scheduled.

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O. Provide motor starters with overload heaters sized from nameplate full load amperage for each phase, manually reset.
P. Motor starters provided with phase failure-relay protection.
   1. Provide phase failure, under voltage and phase reversal.
   2. Automatic reset between 10 to 20 seconds after fault condition correction.

2.4 CONTROLLER OVERCURRENT PROTECTION AND DISCONNECTING MEANS
A. Molded Case Thermal-Magnetic Circuit Breakers: Provide UL 489 circuit breakers with integral thermal and instantaneous magnetic trip in each pole.
B. Motor Circuit Protector: Provide UL 489 circuit breakers with integral instantaneous magnetic trip in each pole.
C. Non-fusible Switch Assemblies:
   1. NEMA KS 1 quick-make quick-break, load interrupter enclosed knife switch with externally operable handle.
   2. Provide interlock to prevent opening front cover with switch in ON position. (Handle lockable in OFF position.)
D. Fusible Switch Assemblies:
   1. NEMA KS 1 quick-make quick-break load interrupter enclosed knife switch with externally operable handle.
   2. Provide interlock to prevent opening front cover with switch in ON position.
   3. Handle lockable in OFF position.

2.5 ACCEPTABLE MANUFACTURERS - MOTOR CONTROL CENTER
A. Square D
B. General Electric
C. Cutler Hammer
D. Siemens/ITE
E. Allen Bradely

2.6 MOTOR CONTROL CENTER
A. Motor Control Centers: NEMA ICS 2
B. Main Overcurrent Protection: As scheduled.
C. Motor Starters: As scheduled.
D. Feeder Tap Units: As scheduled.
E. Horizontal Bussing: Include copper ground bus entire length of control center.
F. Vertical Bussing: NEMA ICS 2 copper.
G. Configuration: Units front accessible from the front only.
H. Enclosure: ANSI/NEMA ICS 6; Type as required to meet conditions of installation unless indicated on the Drawings.
I. Finish: Provide the Manufacturer's standard enamel color.
J. Provide phase loss protection relay with contacts to de-energize each motor starter in control center.
K. Control Transformer: Provide control transformer in motor control center to provide 120-volt control source for all motor starters in control center.

PART 3 EXECUTION

3.1 INSTALLATION
A. Install motor control equipment in accordance with manufacturer's instructions.
B. Install fuses in fusible switches.

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C. Select and install heater elements in motor starters to match installed motor characteristics.
D. Motor Data: Provide neatly typed label inside each motor starter enclosure door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating.

3.2 FUNCTIONAL PERFORMANCE TESTING

A. System Functional Performance Testing is part of the Commissioning Process.
   1. The Contractor shall perform the Functional Performance Testing and the Commissioning Authority shall witness and document the test.
   2. Refer to Section 01 91 00, Commissioning, for functional performance tests and commissioning requirements.
B. Systems Readiness Checklists shall be completed and submitted for each piece of equipment included in this section.
C. Perform the functional performance testing of Motor Controls as part of the Electrical System Functional Performance testing.

3.3 DEMONSTRATION AND TRAINING

A. Training of the Owner’s operation and maintenance personnel is required in cooperation with the Owner's Representative.
   1. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems.
   2. Schedule the instruction in coordination with the Owner's Representative after submission and approval of formal training plans.
   3. Refer to Section 01 91 00, Commissioning, for further contractor training requirements.
B. Provide demonstration and training for all types of motor controls installed in this project.

END OF SECTION

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SECTION 26 29 10
ELECTRIC CONTROLS AND RELAYS

PART 1 GENERAL

1.1 SECTION INCLUDES
- A) Pushbutton and selector switches
- B) Control stations
- C) Relays
- D) Time-delay relays
- E) Control power transformers
- F) Control panels

1.2 REFERENCES
- A) NEMA ICS 1 - Industrial Control and Systems: General Requirements
- B) NEMA ICS 2 - and Controllers, Contactors and Overload Relays Rated 600 Volts
- C) NEMA ICS 6 - Enclosures
- D) NEMA ST 1 - Specialty Transformers (Except General Purpose Type)

1.3 SUBMITTALS
- A) Submit shop drawings under provisions of Section 01 33 00.
- B) Submit shop drawings to NEMA ICS 1 indicating control panel layouts, wiring connections and diagrams, dimensions, support points.
- C) Submit product data under provisions of Section 01 33 00.
- D) Submit product data for each component specified.

1.4 PROJECT RECORD DOCUMENTS
- A) Submit record documents under provisions of Section 01 77 00.
- B) Accurately record actual locations of control equipment, and revise diagrams included in Drawings to reflect actual control device connections.

1.5 OPERATION AND MAINTENANCE DATA
- A) Submit operation data under provisions of Section 01 77 00.
- B) Include instructions for adjusting and resetting time-delay relays, timers, and counters.
- C) Submit maintenance data under provisions of Section 01 77 00.
- D) Include recommended preventive maintenance procedures and materials.

1.6 QUALIFICATIONS
- A) Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum three years documented experience.

PART 2 PRODUCTS

2.1 CONTROL SWITCHES AND STATIONS
- A. Contacts: NEMA ICS 2 Form C
- B. Contact Ratings: NEMA ICS 2 as scheduled.
- C. Pushbutton Operator: NEMA ICS 2 as scheduled.
- D. Control Stations: NEMA ICS 2 as scheduled.

2.2 CONTROL RELAYS
- A. Contacts: NEMA ICS 2 Form C.
- B. Contact Ratings: NEMA ICS 2 as scheduled.
- C. Coil Voltage: as scheduled.

2.3 TIME-DELAY RELAYS
- A. Contacts: NEMA ICS 2 as scheduled.
- B. Contact Ratings: NEMA ICS 2 Class A150.

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C. Coil Voltage: as scheduled.
D. Time-Delay Relays: NEMA ICS 2 as scheduled.

2.4 CONTROL POWER TRANSFORMERS
A. Transformer: NEMA ST-1 machine tool transformer with isolated secondary winding.
B. Power Rating: 500 VA
C. Voltage Rating: as required

2.5 ENCLOSURES
A. Control Station Enclosure: NEMA ICS 6 Type as required to meet conditions of installation unless indicated on the Drawings.
B. Relay Enclosure: NEMA ICS 6 Type as required to meet conditions of installation unless indicated on the Drawings.

2.6 FABRICATION
A. Control Panels: Shop fabricated control panels to NEMA ICS 1, using cabinets and terminal blocks furnished under the provisions of Section 26 27 16.

PART 3 EXECUTION

3.1 INSTALLATION
A Install devices and equipment in accordance with manufacturer's instructions.
B Install individual relays and time delay relays in enclosures.
C Install cabinets under the provisions of Section 26 27 16.
D Make electrical wiring interconnections as shown on Drawings.

END OF SECTION

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SECTION 26 35 13
GAS ENGINE DRIVE GENERATOR ASSEMBLY

PART 1 GENERAL

1.1 SECTION INCLUDES
- A. Packaged engine generator system
- B. Exhaust silencer and fittings
- C. Fuel lines
- D. Remote control panel
- E. Battery and charger
- F. Weatherproof enclosure

1.2 REFERENCES
- A. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum)
- B. NEMA MG 1 - Motors and Generators
- C. NFPA 70 - National Electrical Code
- D. UL 489 - Molded Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
- E. NFPA 110 – Standard for Emergency And Stand By Power Systems

1.3 SYSTEM DESCRIPTION
- A. Engine generator system to provide source of emergency and standby power
- B. Operation: In accordance with NFPA
- C. Generator shall be installed and shall operate as LEVEL 1 system as defined by NFPA 110

1.4 SUBMITTALS
- A. Submit shop drawings and product data under provisions of Section 0133 00.
- B. Submit shop drawings showing plan and elevation views with overall and interconnection point dimensions, fuel consumption rate-curves at various loads, ventilation and combustion air requirements, and electrical diagrams including schematic and interconnection diagrams.
- C. Submit product data showing dimensions, weights, ratings, interconnection points, and internal wiring diagrams for engine, generator, control panel, battery, battery rack, battery charger, exhaust silencer, vibration isolators, automatic changeover, and remote annunciator.
- D. Submit manufacturer's installation instructions under provisions of Section 01 33 00.

1.5 PROJECT RECORD DOCUMENTS
- A. Submit record documents under provisions of Section 01 77 00.
- B. Accurately record the location of engine generator and mechanical and electrical connections.

1.6 OPERATION AND MAINTENANCE DATA
- A. Submit operation and maintenance data under provisions of Section 01 77 00.
- B. Include instructions for normal operation, routine maintenance requirements, service manuals engine, and emergency maintenance procedures, and complete manufacturer’s diagnostic software package.

1.7 QUALIFICATIONS
- A. Manufacturer: Company specializing in packaged engine generator system with minimum three years documented experience.
- B. Supplier: Shall be an authorized franchised distributor of the engine generator manufacturer with service facilities within 50 miles of project site.

1.8 DELIVERY, STORAGE, AND HANDLING
- A. Deliver products to site under provisions of Section 01 60 00.
- B. Store and protect products under provisions of Section 01 60 00.
- C. Accept packaged engine generator set and accessories on site in crates and verify damage.

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D. Protect equipment from dirt and moisture by securely wrapping in heavy plastic.

1.9 WARRANTY

A. Provide manufacturer's 5-year warranty under provisions of Section 01 77 00.

1.10 MAINTENANCE SERVICE

A. Furnish service and maintenance of packaged engine generator system for 1-year from Date of Substantial Completion.

1.11 COMMISSIONING

A. Commissioning of a system or systems specified in this section is part of the construction process.
B. Documentation and testing of these systems, as well as training of the Owner's operation and maintenance personnel, is required in cooperation with the Owner's Representative and the Commissioning Authority.
C. Project Closeout is dependent on successful completion of all commissioning procedures, documentation, and issue closure.
D. Refer to Section 01 77 00 - Contract Closeout, for substantial completion details.
E. Refer to Section 01 91 00 - Commissioning, for detailed commissioning requirements.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Kohler Generators
B. Caterpillar Inc.
C. Cummins Power Generators
D. AKSA Power Generation
E. Blue Star Power Systems
F. Approved equal

2.2 ENGINE

A. Type: Water-cooled inline or V-type, four-stroke cycle, compression ignition or electric ignition internal combustion engine.
B. Rating: Sufficient to operate at 10% overload for 1-hour at specified elevation and ambient limits.
C. Fuel System: Shall be a dual system of Natural gas and Propane gas (LP gas).
D. Engine Speed: 1800 rpm
E. Governor: Isochronous type to maintain engine speed within 0.5%, steady state, and 5%, no load to full load, with recovery to steady state within 2-seconds following sudden load changes.
    1. Equip governor with means for manual operation and adjustment.
F. Safety Devices
    1. That automatically shuts down the Engine on high water temperature, low oil pressure, over speed, and engine over crank.
    2. The limits as selected by manufacturer.
G. Engine Starting
    1. DC starting system with positive engagement, number, and voltage of starter motors in accordance with manufacturer's instructions.
    2. Include remote starting control circuit, with MANUAL-OFF-REMOTE selector switch on engine-generator control panel.
H. Engine Jacket Heater: A thermal circulation type water heater with integral thermostatic control sized to maintain engine jacket water at 90°F and suitable for operation on 120 volts AC.
I. Radiator: Radiator using glycol coolant, with blower type fan, sized to maintain safe engine temperature in ambient temperature of 110°F.

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1. Radiator Air Flow Restriction: 0.5" of water maximum

J. Engine Accessories
1. Lube oil filter, intake air filter, lube oil cooler, auxiliary fuel pump.
2. Include fuel pressure gage, water temperature gage, and lube oil pressure gage on engine-generator control panel.

2.3 GENERATOR

A. Generator: Provide NEMA MG 1 re-connectible brushless synchronous generator with brushless exciter.
B. Insulation: NEMA MG 1 Class F
C. Temperature Rise: 105°C continuous
D. Enclosure: NEMA MG 1 open drip proof
E. Voltage Regulation: Include generator-mounted volts per Hertz exciter-regulator to match engine and generator characteristics, with voltage regulation +/- 1% from no load to full load.
1. Include manual controls to adjust voltage drop +/- 5% voltage level, and voltage gain.

2.4 ACCESSORIES

A. Unit shall have standard and optional accessory equipment packages including but not limited to the following equipment.
B. Exhaust Silencer: Residential type silencer, with muffler companion flanges and flexible stainless steel exhaust fitting, suitable for horizontal orientation, sized in accordance with engine manufacturer's instructions, exhaust system insulated for heat reduction.
C. Batteries
1. Heavy-duty type, match the battery voltage to starting system.
2. Include necessary cables and clamps.
D. Battery Tray
1. Plastic coated metal or wooden tray treated for electrolyte resistance.
2. Construct to contain spillage of electrolyte.
E. Battery Charger: Current limiting type designed to float at 2.17 volts per cell and equalize at 2.33 volts per cell.
1. Include overload protection with full wave rectifier, DC voltmeter, and ammeter, and 120 volts AC fused input.
2. Provide wall-mounted enclosure to meet NEMA 250, Type 1 requirements.
F. Line Circuit Breaker
1. UL 489 molded case circuit breaker on generator output with integral thermal and instantaneous magnetic trip in each pole; sized in accordance with NFPA 70.
2. Include battery-voltage operated shunt trip, connection to open circuit breaker on engine failure.
3. Mount unit in enclosure to meet NEMA 250, Type 1 requirements.
G. Engine-Generator Control Panel: NEMA 250 Type 1 generator mounted control panel enclosure with engine and generator controls and indicators. Include provision for padlock and the following equipment and features:
1. Frequency Meter: 45-65 Hz range, 3½" dial.
2. AC Output Voltmeter: 3½" dial, 2% accuracy, with phase selector switch.
3. AC Output Ammeter: 3½" dial, 2% accuracy, with phase selector switch.
4. Output voltage adjustment
5. Push-to-test indicator lamps, one each for low oil pressure, high water temperature, over speed, and over crank.
6. Engine start/stop selector switch

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7. Engine running time meter
8. Oil pressure gage
9. Water temperature gage
10. Auxiliary Relay 3PDT operates when engine runs, contact terminals pre-wired to terminal strip.
11. Remote Alarm Contacts: Pre-wire SPCT contacts to terminal strip for remote alarm functions required by ANSI/NFPA.

H. Weather-Protective Housing for units located on the exterior:
1. Provide with reinforced steel or aluminum housing allowing access to control panel and service points, with lockable doors and panels.
2. Weather-Protective Housing shall be hurricane rated and soundproof
3. Include fixed louvers, tail pipe, rain cap kit, battery rack, and silencer.

I. Remote Engine Annunciator Panel:
1. NFPA; to meet NFPA 110 requirements for level-I generator.
2. Shall have color painted finish.

J. Provide for automatic changeover from natural gas to LP gas (for dual rated units).

K. Emergency manual stop break glass station: location to be field determined by School District Representative.

L. Provide BACKNET interface capabilities for the generator to allow remote monitoring of the unit School District Energy Management System and Data NetWork System.

PART 3 EXECUTION

3.1 EXAMINATION

A. Coordinate pre-construction meeting with owner general contractor and others as needed prior to start of installation.

B. Verify that surfaces are ready to receive work and field dimensions are as shown on Drawings.

C. Verify that required utilities are available in proper location and ready for use.

D. Beginning of installation means installer accepts existing conditions.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with NFPA 110.

C. Furnish and install an 18” x 18” x 12” metal cabinet with hinged door in the generator room.
1. Locate in this cabinet a copy of the generator and automatic transfer switches, approved shop drawings, load bank test results.
2. A copy of the power riser diagram-showing generator supplied panels; a copy of the generator warranty information, generator manufacturer supplied wiring diagrams, and initial maintenance logs.
3. Label the cabinet as “Generator Documents”.

3.3 FIELD QUALITY CONTROL

A. Perform all field inspection and testing under the provisions of Section 01400.

B. Simulate power failure including operation of transfer switch, automatic starting cycle, and automatic shutdown, and return to normal.

C. Provide full load test utilizing portable test bank.
1. Notify Owner at least 24 hours prior to the test.
2. A minimum of 4- continues hours at full load, warm up and cool down times are not included in the four hours minimum.
3. Generators with dual fuel system shall be load bank tested for 4-hours on the primary fuel at full load and 1-hour on the backup fuel at full load.

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4. A facility with more than one generator fed from the same fuel source shall be full load tested at the same time.

D. During test, record the following at 20-minute intervals
   1. Kilowatts
   2. Amperes
   3. Voltage
   4. Coolant temperature
   5. Room temperature
   6. Frequency
   7. Oil pressure

E. Test alarm and shutdown circuits by simulating conditions.

F. On existing generators where the new and existing loads exceed 60% of the generators rating, provide a full load test as described in 26 35 13-3.3.

3.4 MANUFACTURER'S FIELD SERVICES

A. Prepare, start, test, and adjust systems under provisions of Section 01 60 00.

B. Contractors' tests shall be scheduled and documented in accordance with the commissioning requirements.
   1. Refer to Section 01 91 00, Commissioning, for further details.

C. Contractor shall provide all labor, tools, and equipment, including resistive load banks, to facilitate testing in accordance with NFPA 110.
   1. This testing shall include the 4-hour load bank test.

3.5 ADJUSTING

A. Adjust work under provisions of Section 01 75 00.

B. Adjust generator output voltage and engine speed.

3.6 CLEANING

A. Clean work under provisions of Section 01 77 00.

B. Clean engine and generator surfaces.

3.7 DEMONSTRATION

A. Provide systems demonstration under provisions of Section 01 60 00.

B. Describe loads connected to emergency and standby system and restrictions for future load additions.

C. Simulate power outage by interrupting normal source, and demonstrate that system operates to provide emergency power.

D. Provide a full tank of fuel at the time of final acceptance.
   1. If LP gas is back up to natural gas, provide LP gas fuel for minimum of 4-hours of full load operation.
   2. If natural gas is not available on the site, provide LP fuel for minimum of 4-hours of full load operation.
   3. Facilities with Enhanced Hurricane Protection Areas (EHPAs) shall have LP fuel for minimum of 24 hours of full load operation.

E. Provide manufacturer’s diagnostic literature and software, and demonstrate their use.

3.8 FUNCTIONAL PERFORMANCE TESTING

A. System Functional Performance Testing is part of the Commissioning Process.
   1. The Contractor shall perform the Functional Performance Testing and the Commissioning Authority shall witness and document the test.
   2. Refer to Section 01 91 00 - Commissioning, for functional performance tests and commissioning requirements.

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B. Systems Readiness Checklists shall be completed and submitted for each piece of equipment included in this section.
C. Functional performance testing of the generator systems will include testing of other emergency systems and sub-systems.
D. The Functional Performance Tests will include a “Loss of Power” test to simulate loss of utility power.
E. The Functional Performance Tests will include testing of all “Hurricane Shelter” systems and sub-systems, including using the emergency generator to provide power to all “Hurricane Shelter” systems for up to 4-hours.

3.9 DEMONSTRATION AND TRAINING

A. Training of the Owner’s operation and maintenance personnel is required in cooperation with the Owner's Representative.
   1. Provide competent, factory authorized personnel to instruct the operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems.
   2. Schedule the instruction in coordination with the Owner's Representative after submission and approval of formal training plans.
   3. Refer to Section 01 91 00, Commissioning, for further contractor training requirements.
B. Provide demonstration and training for all types of generator systems installed in this project.

END OF SECTION

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SECTION 26 36 00
TRANSFER SWITCHES

PART 1 GENERAL

1.1 SECTION INCLUDES
- A. Automatic transfer switch
- B. Manual transfer switch

1.2 REFERENCES
- A. NEMA ICS 1 - Industrial Control and Systems: General Requirements
- B. NEMA ICS 2 - Controllers, Contactors and Overload Relays Rated 600 Volts
- C. NEMA ICS 6 - Enclosures
- D. NFPA 110 – Standards For Emergency And Stand-By Power Systems

1.3 QUALITY ASSURANCE
- A. Manufacturer shall be a company specializing in manufacturing of automatic-transfer equipment with a minimum 3-years of experience.

1.4 SUBMITTALS
- A. Submit product data under provisions of Section 01 30 00.
- B. Submit product data for transfer witches showing overall dimensions, electrical connections, electrical ratings, and environmental requirements.
- C. Submit manufacturer's installation instructions under provisions of Section 01 30 00.

1.5 OPERATION AND MAINTENANCE DATA
- A. Submit operation and maintenance data under provisions of Section 01 77 00.
- B. Include instructions for operating equipment.
- C. Include instructions for operating equipment under emergency conditions.
- D. Identify operating limits, which may result in hazardous or unsafe conditions.
- E. Document the ratings of equipment and each major component.
- F. Include routine preventive maintenance and lubrication schedule.
- G. List the special tools, maintenance materials, and replacement parts.
- H. Submit manufacturer’s diagnostic literature and software package.
- I. See Section 01 91 00 – Commissioning and Section 01 78 23 – Operations and Maintenance Data for additional requirements

1.6 COMMISSIONING
- A. Commissioning of a system or systems specified in this section is part of the construction process.
- B. Documentation and testing of these systems, as well as training of the Owner’s operation and maintenance personnel, is required in cooperation with the Owner's Representative and the Commissioning Authority.
- C. Project Closeout is dependent on successful completion of all commissioning procedures, documentation, and issue closure.
- D. Refer to Section 01 77 00 - Contract Closeout, for substantial completion details.
- E. Refer to Section 01 91 00, Commissioning, for detailed commissioning requirements.

1.7 Warranty
- A. Provide manufacturer's 5-year warranty under provisions of Section 01 77 00.

PART 2 PRODUCTS

2.1 MANUFACTURERS
- A. Kohler Generators
- B. Caterpillar Inc.

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C. Cummins Power Generators
D. ASCO Power Technologies

2.2 AUTOMATIC TRANSFER SWITCH
A. Description: NEMA ICS 2 automatic transfer switch.
B. Configuration: Electrically operated mechanically held transfer switch.

2.3 MANUAL TRANSFER SWITCH
A. Description: NEMA ICS 2 manual transfer switch.
B. Configuration: Electrically operated mechanically held transfer switch.
C. Sequence of Operation: Switch position is to be selected by control switch mounted in switch cover.

2.4 AUTOMATIC SEQUENCE OF OPERATION
A. Initiate time delay to start alternate source engine generator upon initiation by normal source monitor.
B. Time delay to start alternate source engine generator shall be 0 to 10 seconds, adjustable.
C. Initiate transfer load to alternate source upon initiation by normal source monitor and permission by alternate source monitor.
D. Time delay before transfer to alternate power source shall be 0 to 5 minutes, adjustable.
E. Initiate retransfer load to normal source upon permission by normal source monitor.
F. Time delay before transfer to normal power shall be 0 to 30 minutes, adjustable bypass time delay in event of alternate source failure.
G. Time delay before engine shut down shall be 0 to 30 minutes, adjustable of unloaded operation.
H. Engine Exerciser
1. Start engine every 7 days; run for 30 minutes before shutting down.
2. Bypass exerciser control if normal source fails during exercising period.
I. Alternate System Exerciser: Transfer load to alternate source during engine exercise period.
J. All other setting shall be per NFPA 110.

2.5 ENCLOSURE
A. ICS 6 Type as required to meet conditions of installation unless indicated on the Drawings.

2.6 ACCESSORIES
A. Indicating Lights: Mount in cover of enclosure to indicate NORMAL SOURCE AVAILABLE, ALTERNATE SOURCE AVAILABLE, and SWITCH POSITION.
B. Test switch: Mount in cover of enclosure to simulate failure of normal source.
C. Return to normal switch: Mount in cover of enclosure to initiate manual transfer from alternate to normal source.
D. Transfer switch auxiliary contacts: One normally open and one normally closed.
E. Normal Source Monitor: Monitor each line of normal source voltage and frequency; initiate transfer when voltage drops below 90% or frequency varies more than 3% from rated nominal value.
F. Alternate Source Monitor: Monitor alternate source voltage and frequency; inhibit transfer when voltage is below 90% or frequency varies more than 3% from rated nominal voltage.
G. In-Phase Monitor
H. Switched Neutral: Non-Overlapping contacts

PART 3 EXECUTION

3.1 EXAMINATION
A. Verify that surfaces are ready to receive work.
B. Verify field measurements are as shown on Drawings.
C. Verify that required utilities are available, in proper location, and ready for use.
D. Beginning of installation means acceptance of existing conditions.

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3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.
B. Install in accordance with NFPA 110.

3.3 FUNCTIONAL PERFORMANCE TESTING

A. System Functional Performance Testing is part of the Commissioning Process.
   1. The Contractor shall perform the Functional Performance Testing and the Commissioning Authority shall witness and document the test.
   2. Refer to Section 01 91 00, for functional performance tests and commissioning requirements.
B. Complete and submit the systems readiness checklist for each piece of equipment in this section.
C. Perform the functional performance testing of Panelboards as part of the Emergency Generator System Functional Performance testing.

3.4 DEMONSTRATION AND TRAINING

A. Training of the Owner’s operation and maintenance personnel is required in cooperation with the Owner's Representative.
   1. Competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems.
   2. Schedule the instruction in coordination with the Owner's Representative after submission and approval of formal training plans.
   3. Refer to Section 01 91 00, Commissioning, for further contractor training requirements
B. Provide demonstration and training for all types of transfer switches installed in this project.

END OF SECTION

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SECTION 26 41 00
LIGHTNING PROTECTION for STRUCTURES

PART 1 GENERAL

1.1 SECTION INCLUDES
- A. Grounding and bonding for lightning protection
- B. Air terminals and interconnecting conductors

1.2 RELATED SECTIONS
- A. Section 07 52 00 - Roofing systems

1.3 REFERENCES
- A. LPI-175 - Lightning Protection Installation Standard
- B. LPI-177 – Inspection Guide for LPI Certified Systems
- C. NFPA 780 – Lightning Protection Code
- D. UL 96 – Standard for Lightning Protection Components
- E. UL 96A – Standard for Installation Requirements for Lightning Protection Systems

1.4 SYSTEM DESCRIPTION
- A. Lightning Protection systems: Provide conductor system protecting roofs consisting of air terminals on roofs, roof-mounted mechanical equipment, chimneys, stacks, steeple, parapets, and penthouse roofs; bonding of structure and other metal objects; grounding electrodes; interconnecting conductors, and irrigation pumps and structure.

1.5 SUBMITTALS
- A. Section 01 33 00 – Submittals Procedures for submittals.
- B. Shop Drawings:
  1. Indicate layout of air terminals, grounding electrodes, and bonding connections to structure and other metal objects.
  2. Include terminal, electrode, and conductor sizes and connection and termination details.
- C. Product Data: Provide dimensions and materials of each component, and include indication of listing in accordance with UL 96.

1.6 PROJECT RECORD DOCUMENTS
- A. Submit under Provisions of Section 01 33 00.
- B. Record the actual locations of air terminals, grounding electrodes, bonding connections, and routing of system conductors in project record documents.

1.7 QUALITY ASSURANCE
- A. Perform work in accordance with NFPA 780.
- B. Perform work in accordance with UL 96A and provide master label.
- C. Perform work in accordance with LPI-175 and provide LPI certification.
- D. Maintain one copy of each document on site.

1.8 QUALIFICATIONS
- A. Manufacturer: Company specializing in lightning protection equipment with minimum three years documented experience and member of the Lightning Protection Institute.
- B. Installer: Authorized installer of manufacturer with minimum three years documented experience and certified by the Lightning Protection Institute.

1.9 FIELD MEASUREMENTS
- A. Verify that field measurements are as indicated on shop drawings.

1.10 COORDINATION
- A. Coordinate work with roofing, exterior, and interior finish installations.

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PART 2 PRODUCTS

2.1 COMPONENTS

A. Air Terminals: Provide either solid copper or aluminum with adhesive bases for single-ply roof installations.
B. Air Terminal for Chimney: Lead-coated copper
C. Decorations: Ball
D. Grounding Rods: Solid copper
E. Ground Plate: Copper
F. Grounding down conductors and grounding ring electrodes: Copper.
G. Conductors except those noted above copper or aluminum.
H. Connectors and Splicers: Bronze

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with NFPA 780, UL 96A, and LPI-175.
B. Connect conductors using exothermic welding process.
    1. Protect adjacent construction elements and finishes from damage.
C. Bond exterior metal bodies on building to the lightning protection system, and provide intermediate level interconnecting loops 60' (18 m) on center.
D. Do not install copper lightning protection materials on aluminum roofing, siding, or other aluminum surfaces.
E. Do not install aluminum lightning protection materials on copper surfaces.
F. Protect copper components installed within 24" of the top of a chimney or vent emitting corrosive gases by a hot-dipped lead coating or equivalent.
G. Down conductors shall be routed concealed in PVC sleeves installed in the structure.
H. Connect conductor to metal bodies of conductance located within 6' by secondary conductor.
I. Provide lightning protection for buildings, covered walkways, press boxes, scoreboards, and all other structures required by NFPA 780.

3.2 FIELD QUALITY CONTROL

A. Obtain the services of Underwriters Laboratories, Inc. to provide inspection and labeling of the lightning protection system in accordance with UL 96A.
B. Perform inspection and testing in accordance with NFPA 780.
C. Provide owner with an Underwriters Laboratories final certification of the lightning protection system.
D. Contractors' tests shall be scheduled and documented in accordance with the commissioning requirements.
    1. Refer to Section 01 91 00 - Commissioning, for further details.

3.3 DEMONSTRATION AND TRAINING

A. Training of the Owner’s operation and maintenance personnel is required in cooperation with the Owner's Representative.
    1. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems.
    2. Schedule the instruction in coordination with the Owner's Representative after submission and approval of formal training plans.

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3. Refer to Section 01 91 00, Commissioning, for further contractor training requirements.

B. Provide demonstration and training for all types of lightning protection systems installed in this project.

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SECTION 26 43 00
SURGE PROTECTIVE DEVICES

PART 1 GENERAL

1.1 SECTION INCLUDES
- A. Surge protection devices (SPD's) for service entrance switchboard and other panel boards.

1.2 REFERENCES
- A. UL 96A-Standard for Installation Requirements for Lightning Protection System
- B. UL 1363- Standard for Relocatable Power Taps
- C. UL 1449 Standard for Surge Protection Devices
- D. IEEE C62.33- Standard test specifications for Varistor Surge Protection Devices
- E. IEEE C62.41 (IEEE 587) - Recommended Practice on Characterization of Surge in Low-Voltage (1000V and Less) AC Power Circuits Corrigendum
- F. IEEE C62.45- Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage AC Power Circuits

1.3 SYSTEM DESCRIPTION
- A. The work required under this division shall include all materials, labor, and auxiliaries required to furnish and install complete surge protection.
  1. Formerly known as Transient Voltage Surge Suppressors (TVSS) or simply Suppressors for the protection of building electrical and electronics systems from the effects of line induced transient voltage surge and lightning discharge as indicated on drawings or specified in this section.
- B. Provide surge protective devices (SPD's) for the equipment described herein:
  1. On the electrical service entrance switchboards and panels.
  2. On the distribution and branch circuit panels as indicated on drawings.

1.4 SUBMITTALS
- A. Submit product data under provisions of Section 01 33 00.
- B. Schematic data on each suppressor type indicating component types.
- C. Dimension drawing of each suppressor type.
- D. Provide the manufacturer's performance data on each suppressor type.
- E. Provide the Underwriters Laboratories approval compliance letter.
- F. Provide the manufacturer's performance data on each suppressor type.

1.5 QUALITY ASSURANCE
- A. A company normally engaged in the design, development, and manufacture of such devices for electrical and electronics system equipment shall manufacture all SPD's.
  1. The said firm shall have minimum of 5-years documented experience in manufacturing surge protection devices.
- B. The SPD manufacturer shall offer technical assistance through support by a factory representative and local stocking distributor.

1.6 WARRANTY
- A. Provide 10-year warranty on all SPD's covering defects in materials and workmanship under normal use in accordance with the instructions.
- B. The manufacturer and installer shall repair or replace any SPD, showing evidence of failure or incorrect operation during the warranty period.

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PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Cooper Crouse Hinds-MTL/Atlantic Scientific Inc
B. LEA International
C. APT
D. Square D

2.2 SURGE PROTECTION DEVICES

A. Surge Protective Devices shall be UL Type 1 or Type 2 rated and supplied in accordance with their intended installation location.
B. Provide Surge Protective Devices listed in accordance with UL 1449, Third Edition- marked in accordance with referenced standard and approved for the installed location in.
C. Surge Protective Devices shall be either close nippled to the device being protected or mounted internally in a position which minimizes lead length between suppressor and the panel circuit breaker to which the suppressor manufacturer's recommended maximum lead length is not exceeded without specific approval of the Engineer.
D. Surge Protective Devices shall be designed for the specific type and voltage of electrical service and shall have interrupting rating (AIC) equal to or greater than the available fault currents at the terminal of the panel that is being protected but the unit AIC shall not be less than 25,000 amps, symmetrical.
E. Provide Surge Protective Devices designed to withstand a maximum continuous operating voltage of not less than 115% of nominal RMS line voltage.
F. Provide Surge Protective Devices containing internal safety surge rated fusing designed to disconnect the suppressor from the electrical source if the suppressor fails.
G. Surge Protective Devices shall be failsafe, shall have no holdover current, shall have repeated surge capability, shall be solid state and self-restoring, and shall be fully automatic.
H. Surge Protective Devices shall contain a visual indication on the front door of the enclosure of the SPD unit to verify either that the suppressor has failed or that the suppressor is operational and functional.
I. Surge Protective Devices shall have an operating temperature range of (-40°C) to (+60°C.)
J. All SDP's shall have a UL 1449, third edition "In" rating of 20KA, qualifying for LPS master labeling under UL 96A.

2.3 SUPPRESSOR CRITERIA

A. Surge Protective Device for service entrance equipment (switchboard/panel board):
    1. 277/480 volt, 3 phase, 4 wire, WYE
        a. Provide seven modes protection, line to neutral, line to ground, and neutral to ground.
        b. Suppression voltage of 1200 volts maximum.
        c. Surge capacity of 100,000 AMPS
        d. Modular per mode unit audible alarm after failure
    2. 120/208 volt, 3 phase, 4 wire, WYE
        a. Provide seven modes protection, line to neutral, line to ground and neutral to ground.
        b. Suppression voltage of 600 volts maximum.
        c. Surge capacity of 100,000 AMPS
        d. Modular per mode unit audible alarm after failure
B. Surge Protective Device for distribution and branch panels:
    1. 277/480 volt, 3 phase, 4 wire, WYE
        a. Provide normal modes protection: line to neutral, line to ground, and neutral to ground.

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b. Suppression voltage of 1200 volts maximum.
c. Surge capacity of 70,000 AMPS

2. 120/208 volt, 3 phase, 4 wire, WYE
   a. Provide normal modes protection: line to neutral, line to ground, and neutral to ground.
   b. Suppression voltage of 600 volts maximum.
   c. Surge capacity of 70,000 AMPS

PART 3 EXECUTION

3.1 INSTALLATION

A. Install the suppressors as close as practical or mount internally to the electric panel or electronic equipment to be protected, consistent with available spaces.

B. Install the suppressors in a neat, competent manner.
   1. Provide a lead length as short (36" maximum length) and as straight as possible.
   2. Consistent with industry requirements for the type of system installed.

C. Use #6 AWG copper conductor and approved connections for supplementary grounding and bonding connections required between the bonding bus or ground plane for each equipment cluster and other locations as indicated unless otherwise noted.

D. Install Surge Protective Devices and locate in accordance with requirements of all applicable NFPA codes.

3.2 DEMONSTRATION AND TRAINING

A. Training of the Owner’s operation and maintenance personnel is required in cooperation with the Owner's Representative.
   1. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems.
   2. Schedule the instruction in coordination with the Owner's Representative after submission and approval of formal training plans.
   3. Refer to Section 01 91 00, Commissioning, for further contractor training requirements.

B. Provide demonstration and training for all types of SPD’s installed in this project.

END OF SECTION

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SECTION 26 51 00
INTERIOR LIGHTING

PART 1 GENERAL

1.1 SECTION INCLUDES
- A. Interior luminaries and accessories
- B. Exterior luminaries and accessories
- C. LED's/Drivers

1.2 REFERENCES
- A. NEMA ANSI C82.1 - For Lamp Ballast – Line Frequency Fluorescent Lamp Ballast
- B. ANSI C82.4 - Ballasts for High-Intensity-Discharge and Low Pressure Sodium Lamp (Multiple Supply Type)

1.3 SUBMITTALS
- A. Submit product data under provisions of Section 01 33 00.
- B. Include outline drawings, lamp and ballast data, support points, weights, and accessory information for each luminary type.
- C. Submit manufacturer's installation instructions under provisions of Section 01 33 00.

1.4 DELIVERY, STORAGE, AND HANDLING
- A. Deliver products to site under provisions of Section 01 60 00.
- B. Store and protect products under provision of Section 01 60 00.
- C. Handle metal poles carefully to prevent breakage and damage to finish.

PART 2 PRODUCTS

2.1 INTERIOR LUMINARIES AND ACCESSORIES
- A. Luminaries: Provide hinged frames with latches, and thick virgin acrylic lenses.
- B. Recessed Luminaries: Provide trim type and accessories required for installation in ceiling system installed.
- C. Exit Signs: Stencil face, 6" high red letters on white background, directional arrows as indicated, wall mounting type unless otherwise indicated, LED type with maximum wattage of 4 watts.
- D. Lighting Busway: Provide 20-ampere lighting bus way for surface or recessed mounting by a manufacturer of busway-mounted luminaries with matte white paint factory finish.
- E. Provide in-line fuses in all fixtures on emergency power.
- F. Provide 10-year manufacturer's warranty for all LED's.
- G. Provide 10-year manufacturer's warranty for all Drivers.
- H. Acoustical T-bar Support Clips:
  1. Surface mounted fixtures, use Caddy type IDS, or equal.
  2. Surface mounted track lighting, use Caddy type 4-G-8, or equal.
- I. All LED's and Drivers shall be listed by Electric Testing Laboratories.
- J. Protect exposed bare lamps with wire guards or a protective tubular shield.
- K. Provide all light fixtures in Gymnasiums and cafeteria with impact resistant Polycarbonate Lens and safety cable.

2.2 EXTERIOR LUMINARIES AND ACCESSORIES
- A. Enclosures: Complete with gaskets to form weatherproof assembly.

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2.3 ACCEPTABLE MANUFACTURERS
- A. Furnish products as specified on Drawings
- B. Substitutions: Under provisions of Section 01 60 00

2.4 LED's
- A. LED: 4000K, 80 CRI minimum.

PART 3 EXECUTION

3.1 INSTALLATION
- A. LED's/Drivers in housings if not assembled.
- B. Support surface-mounted luminaries directly from building structure.
  1. Fasten to T-bars using screws, or approved ceiling framing member clips.
- C. Install recessed luminaries to permit removal from the bottom.
  1. Use plaster frames or install grid clips.
- D. High Bay Luminaries: Use hangers rated 500 pounds minimum or provide safety chain between ballast and structure.
  1. Provide safety chain between reflector and ballast.
- E. Lay-in type recessed fixtures in suspended acoustical ceiling:
  1. Fasten to T-bars using screws, or approved ceiling framing member clips.
  2. Support T-bar at each end of fixture with #12-gauge support wire.
- F. Cut-in type recessed fixtures in suspended acoustical ceiling; secure fixture to T-bars.
  1. Support T-bars at each end of fixture with #12-gauge support wire.
- G. Install pipe or stem mounted continuous row fixtures to channel iron similar to Unistrut, mounted to permanent ceiling structure.
- H. Install lamp guards on fixtures with exposed lamps.
- I. Install the light fixtures in the stairs on the walls in the landing areas.
  1. Bottom of the fixtures shall be at no more than 10' above finished floor/landing.

3.2 ADJUSTING AND CLEANING
- A. Align luminaries and clean lenses and diffusers at completion of work.
  1. Clean paint splatters, dirt, and debris from installed luminaries.
- B. Touch up luminaries finish at completion of work.

END OF SECTION

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SECTION 26 52 00
EMERGENCY LIGHTING

PART 1 GENERAL

1.1 WORK INCLUDED
- A. Emergency lighting units
- B. Emergency LED exit signs
- C. Emergency fluorescent lamp power supplies

1.2 REFERENCES
- A. NFPA 101 - Code for Safety to Life from Fire in Buildings and Structures
- B. NEMA 5-WD1 - General-Purpose Wiring Devices

1.3 SUBMITTALS
- A. Submit product data under provisions of Section 01 33 00.
- B. Provide product data on emergency lighting units, exit signs, and emergency fluorescent lamp power supply units.

1.4 COMMISSIONING
- A. Commissioning of a system or systems specified in this section is part of the construction process.
- B. Documentation and testing of these systems, as well as training of the Owner's operation and maintenance personnel, is required in cooperation with the Owner's Representative and the Commissioning Authority.
- C. Project Closeout is dependent on successful completion of all commissioning procedures, documentation, and issue closure.
- D. Refer to Section 01 77 00 - Contract Closeout, for substantial completion details.
- E. Refer to Section 01 91 00 - Commissioning, for detailed commissioning requirements.

PART 2 PRODUCTS

2.1 INCANDESCENT EMERGENCY LIGHTING UNITS
- A. Emergency Lighting Unit: Self-contained unit with rechargeable storage batteries, charger, and lamps.
- B. Battery: 6-volt nickel-cadmium type, with 1.5-hour capacity to supply the connected lamp load.
- C. Charger: Dual-rate charger, capable of maintaining the battery in a full-charge state during normal conditions and capable of recharging discharged battery to full charged within 12 hours.
- D. Lamps: 8-Watt minimum, sealed beam type PAR 36.
- E. Remote Lamps: Match lamps on unit.
- F. Unit Housing: Provide steel with bronze hammer tone finish.
- G. Indicators: Provide lamps to indicate AC ON and RECHARGING.
- H. Provide switch to transfer unit from normal supply to battery supply.
- I. Electrical Connection: Provide knockout for conduit connection.

2.2 SELF-CONTAINED EMERGENCY POWER LED EXIT SIGNS
- A. Type: Exit signs with integral battery-operated emergency power supply, including power failure relay, test switch, AC ON pilot light, battery, and fully automatic two-rate charger.
- B. Battery: Provide a sealed lead acid or lead calcium cell requiring no maintenance or replacement for 10 years under normal conditions.

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PART 3 EXECUTION

3.1 INSTALLATION

A. Install units plumb and level.
B. Aim directional lamp heads as directed.
C. Control devices for legally required fixtures shall be fail-safe; failure of the control device shall cause the light to turn on.

3.2 FUNCTIONAL PERFORMANCE TESTING

A. System Functional Performance Testing is part of the Commissioning Process.
   1. The Contractor shall perform the Functional Performance Testing and the Commissioning Authority shall witness and document the test.
   2. Refer to Section 01 91 00, Commissioning, for functional performance tests and commissioning requirements.
B. Systems Readiness Checklists shall be completed and submitted for each piece of equipment included in this section.
C. Perform the functional performance testing of Panelboards as part of the Emergency Generator System Functional Performance testing.

3.3 DEMONSTRATION AND TRAINING

A. Training of the Owner’s operation and maintenance personnel is required in cooperation with the Owner's Representative.
   1. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems.
   2. Schedule the instruction in coordination with the Owner's Representative after submission and approval of formal training plans.
   3. Refer to Section 01 91 00, Commissioning, for further contractor training requirements.
B. Provide demonstration and training for all types of emergency lighting installed in this project.

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SECTION 26 55 61
THEATRICAL LIGHTING

PART 1 GENERAL

1.1 SECTION INCLUDES
- A. Theatrical lighting units
- B. Lamps
- C. Dimmers and control units
- D. Accessories

1.2 SUBMITTALS
- A. Submit under provisions of Section 01 33 00.
- B. Shop Drawings: Indicate layout of rack-mounted equipment and details and diagrams of interconnecting wiring.
- C. Product Data: Provide for each item of equipment, showing sizes and ratings.
- D. Manufacturer Installation Instructions: Indicate handling and installation methods.

1.3 PROJECT RECORD DOCUMENTS
- A. Submit under provisions of Section 01 77 00.
- B. Accurately record the locations of dimmer outlets and circuiting arrangements.

1.4 OPERATION AND MAINTENANCE DATA
- A. Submit under provisions of Sec 01 91 00 Commissioning and 01 78 23 Operations and Maintenance Data.
- B. Operation Data: Include the following:
  1. Instructions for operating lighting control system.
  2. Instructions for operating the system under normal conditions and under emergency life safety conditions exist.
  3. Operating limits which may result in hazardous or unsafe conditions, or in equipment damage.
  4. Document the ratings of the system and of each major component.
- C. Maintenance Data: Include the following:
  1. Provide copy of outline of the preventive maintenance schedule.
  2. Provide a list special tools, maintenance materials, and replacement parts.
  3. Repair instructions for procedures to check, repair, and test equipment during typical malfunctions.
  4. Provide copy of recommended cleaning methods, frequency, and materials.

1.5 EXTRA MATERIALS
- A. Furnish under provisions of Section 01 77 00.
- B. Provide two of each size and type lamp.
- C. Provide two of each size dimmer.
- D. Provide two of each size filter holder.
- E. Provide two of each size, type, and color filter.
- F. Provide minimum of four sq ft of gel material of each color.
- G. Provide two of each size and type patch connectors.

PART 2 PRODUCTS

2.1 THEATRICAL LIGHTING SYSTEM
- A. Description: Provide a lighting dimming and control system for stage area and house lighting.
- B. Configuration
  1. Provide an electronic memory system with minimum of two-scene control.

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2. Dimmers: Cabinet mounted.
3. Lighting Circuit Connections: Provide a permanent connection to dedicated dimmers.

2.2 DIMMERS

A. Description: Provide dimming unit suitable for mounting at lighting unit or modular dimming unit (as shown on the drawings) suitable for mounting in standard electronic rack.
B. Ratings:
1. Voltage: As noted on the drawings
2. Capacity: As noted on the drawings
3. Duty Cycle: Continuous
C. Include integral circuit breaker in each dimmer.
D. Provide adequate forced air ventilation.
E. Emergency lighting dimmed during normal operation shall automatically activate at full brilliance in case of a power failure or during an emergency alarm mode of the fire alarm system.

2.3 CONTROL CONSOLE

A. Fixed or portable control console with integral dimmers and/or for remote control of dimmers.
B. Controls
1. Grand master
2. Independent master with bump switch for each scene
3. Split scene faders with automatic cross fading
4. Independent Master Timed Fade: Adjustable 0 to 100 seconds
5. House light faders
6. Channel faders
7. Blackout switch
C. Provide disk drive for removable mass memory.

2.4 LIGHTING UNITS AND ACCESSORIES

A. Provide lighting units, with lamps, as scheduled.
B. Provide a safety cable with spring clip for each theatrical lighting fixture.
C. Theatrical lighting fixtures wider than two feet shall have a safety cable at each end.

2.5 Theatre architectural lighting controls

A. Control locations
1. Lobby: Additional 3-way or 4-way pilot lights line voltage switch or low voltage control for lobby lights shall be in the control booth.
2. House: Provide low voltage push button control near each set of seating area entrance doors.
3. Stage
a. Fader control station (minimum 8 faders) with master fader near the stage managers location, without the ability to record.
b. Low voltage push button control for house lights, near the stage managers location.
4. Control Booth
a. Provide fader control for house lights.
b. Additional fader control station (minimum 8 faders) with master fader.
c. Control station may be an LCD display panel instead of separate fader stations.
5. Push button control stations shall have a lockable cover.
B. Operation
1. The last control location used shall take over control.
2. Low voltage push button controls shall turn lights on and off.
a. Trim house light fader controls to 80% maximum.
b. Dimmer curve to remain up to 100% output.

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3. Control of House lights is by push button(s) in house seating area, by push button at stage managers location and fader in control booth.
4. Fader control station with master fader in the control booth shall be able to record snapshot lighting looks setup on main lighting console. (Including stage and house lights)
5. Fader control station with master fader on the stage shall recall looks recorded on the fader control station with master fader in control booth.
    a. Fader control station on the stage shall not be able to record.

2.6 House Lights

A. Ceiling and wall mounted light fixtures shall be dimmable LED type.
B. LED light fixtures shall be listed by a nationally recognized Testing lab such as UL, as approved by Authority Having Jurisdiction.
C. LED light fixtures shall have color temperature of 4000-4500 Kelvin with minimum 90 CPR.
D. LED lights fixtures shall provide full dimming range of 0% -100% without exhibiting flicker or stepping.
E. LED light fixtures shall have lens.
F. LED light fixtures angle to be adjustable to throw the light straight down, even on sloped ceilings.
G. LED light fixtures to have beam angle of 40 to 50 degrees.
H. Electrical panel(s) supplying the LED house lights shall be provided with surge protection devices.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install equipment in accordance with manufacturer's instructions.

3.2 MANUFACTURER'S FIELD SERVICES

A. Prepare and start systems under provisions of Section 01 40 00.

3.3 DEMONSTRATION

A. Provide systems demonstration under provisions of Section 01 75 00.

3.4 DEMONSTRATION AND TRAINING

A. Training of the Owner’s operation and maintenance personnel is required in cooperation with the Owner's Representative.
    1. Provide competent, factory authorized personnel for the instructing of operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems.
    2. Schedule the instruction in coordination with the Owner's Representative after submission and approval of formal training plans.
    3. Refer to Section 01 91 00, Commissioning, for further contractor training requirements.
B. Provide demonstration and training for all types of theatrical lighting and controls installed in this project.

END OF SECTION

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SECTION 26 56 29
EXTERIOR LIGHTING

PART 1 GENERAL

1.1 SECTION INCLUDES
- A. Exterior LED luminaries and accessories
- B. Poles

1.2 REFERENCES
- A. ANSI C78.379 - - Classification of Beam Patterns of Reflector Lamps
- B. NFPA 70 - National Electrical Code
- C. IES RP-8 - Roadway Lighting
- D. IES RP-20 - Lighting for Parking Facilities
- E. ASCE 7 – Minimum Design Loads for Buildings and Other Structures

1.3 DESIGN REQUIREMENTS
- A. Roadway: IES RP-8, classification as indicated on Drawings
- B. Parking Lot: IES RP-20, [low] [medium] [high] activity level

1.4 SUBMITTALS
- A. Submit under provisions of Section 01 33 00.
- B. Shop Drawings: Indicate dimensions and components for each luminary, which is not a standard product of the manufacturer.
- C. Product Data: Provide dimensions, ratings, and performance data.
- D. Test Reports: Indicate measured illumination levels.
- E. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product-testing agency specified under "Regulatory Requirements".

1.5 PROJECT RECORD DOCUMENTS
- A. Submit under provisions of Section 01 77 00.
- B. Accurately record the actual locations of each luminary.

1.6 OPERATION AND MAINTENANCE DATA
- A. Submit under provisions of Section 01 77 00.
- B. Maintenance Data: Include instructions for maintaining luminaries.

1.7 QUALIFICATIONS
- A. Manufacturing company specializing in manufacturing products specified in this Section with minimum 3-years of experience.

1.8 DELIVERY, STORAGE, AND HANDLING
- A. Deliver, store, protect, and handle products to site under provisions of Section 01 60 00.
- B. Accept products on site and inspect for damage.
- C. Protect poles from finish damage by handling carefully.

1.9 COORDINATION
- A. Furnish bolt templates and pole mounting accessories to installer of pole foundations.

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PART 2 PRODUCTS

2.1 LUMINAIRES

A. LED type, 5000 kelvin color temperature
B. Furnish products as specified on Drawings.
C. Substitutions: Under provisions of Section 01 60 00

2.2 POLES

A. Height: As indicated on Drawings.
B. Hand hole: Removable weatherproof cover installed 18"-36" above finish grade.
C. Other Requirements
    1. Provide poles designed for wind loading based on ASCE 7 for velocity of 170 mph (embedment of pole shall be in accordance with actual soil condition) while supporting luminaries having effective project areas indicated.
        a. Poles shall be direct burial type designed for use with underground supply conductors.
    2. All poles shall have two conduits concealed within the pole extended down from handhole for incoming and outgoing branch circuit wiring.
    3. Install a 5/8" x 10' ground rod at each pole and exothermic weld grounding conductor to pole.
    4. Contractor shall submit certified wind load calculation signed and sealed by a Florida Professional Engineer with pole submittal.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine excavation and concrete foundation for lighting poles.
B. Examine each luminary to determine suitability for lamps specified.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.
B. Install lighting poles at locations indicated.
C. Embedded Luminary Poles to the depth as indicated, and install plumb.
D. Install lamps in each luminary.
E. Bond luminaries, metal accessories, and metal poles to branch circuit equipment grounding conductor.
    1. Provide supplementary ground rod at each pole.
F. Luminary Pole Bases:
    1. Size and constructed as indicated on Drawings.
    2. Project anchor bolts 3" minimum above base.
    3. Install poles on bases plumb; provide double nuts for adjustment, and grout around pole base.
    4. Provide manufacturer's covers for bolts at base.
G. Use belt slings or non-chafing ropes to raise and set pre-finished luminary poles.
H. Provide one weatherproof fuse per phase.
    1. Install fuse(s) in the cast-in hand hole.
    2. Fuses not permitted in the fixture head.
    3. Fuse holder shall incorporate a rubber boot assembly.
I. Install all conductor splices in the cast-in hand hole.
    1. If required, the contractor may extend the hand hole outward using a weatherproof junction box.
J. Coat the attachment bolts or set screws with an anti-seizing / lubricating compound.

3.3 FIELD QUALITY CONTROL

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A. Operate each luminary after installation and connection.
   1. Inspect for improper connections and operation.
B. Measure illumination levels to verify conformance with performance requirements.
C. Take measurements during night sky, without moon or with heavy overcast clouds effectively obscuring moon.

3.4 ADJUSTING

A. Adjust work under provisions of Section 01 77 00.
B. Aim and adjust luminaries to provide illumination levels and distribution as directed.
C. Re-lamp luminaries that have failed lamps at Date of Substantial Completion.

3.5 CLEANING

A. Clean work under provisions of Section 01 77 00.
B. Clean electrical parts to remove conductive and deleterious materials.
C. Remove dirt and debris from enclosure.
D. Clean photometric control surfaces as recommended by manufacturer.
E. Clean finishes and touch up damage.

END OF SECTION

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SECTION 26 58 68
EXTERIOR ATHLETIC LIGHTING

PART 1 GENERAL

1.1 SECTION INCLUDES
- A. Sports luminaries and accessories
- B. Poles

1.2 REFERENCES
- A. ANSI C78.379 - Classification of Beam Patterns of Reflector Lamps
- B. ANSI C82.1 – For Lamp Ballasts - Line Frequency Fluorescent Lamps Ballast
- C. ANSI C82.4 - Ballasts for High – Intensity - Discharge and Low - Pressure Sodium Lamps (Multiple - Supply Type)
- D. NFPA 70 - National Electrical Code
- E. IES RP-6 - Sports and Recreational Area Lighting
- F. ASCE 7 – Minimum Design Loads for Buildings and Other Structures
- G. UL 489 – Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures
- H. IES TM-36-18 Technical Memorandum on the use of Solid State Lighting Applications

1.3 DESIGN REQUIREMENTS
- A. Design and layout lighting systems in conformance with IES recommended procedures for Sports lighting for Class II for Competition Play with Spectators.
- B. Contractor shall document the final light level and the Engineer of Record shall certify the document.

1.4 SUBMITTALS
- A. Product Data: Submit manufacturer's data on sports lighting units including, but not limited to, poles and standards, mounting arm assemblies, brackets, lamps, lighting fixture-mounting heights, and wiring/cable connections.
- B. Shop Drawings: Submit dimensioned layout drawings of sports lighting units including poles and standards, mounting arm assemblies, brackets, lamps, lighting fixture mounting heights, and wiring/cable connections.
- C. The light levels shall meet IES recommended for Sports lighting.
  1. State the light levels in the numeric values. These values must be maintained and guaranteed for the length of the warranty from the manufacture only. Third party warranties will Not be Allowed. The manufacture must show proof of providing this level of warranty for at least 5 years. A list of 5 customers in Palm Beach County must be provided prior to approval.
  2. Provide computer generated point-by-point light scans based on LED technology.
  3. Stadium photometrics shall include bleachers and the tracks.
  4. Stadium bleachers shall have minimum of 10-footcandle lighting.
  5. Photometrics shall extend to 3'-0" minimum onto any adjacent residential property.
  6. Point by point data shall clearly indicated levels of spill lighting with proposed system.
  7. Manufacture to provide ITL or Certified candela reports for each fixture type provided on each lighting scan.
  8. Lighting Manufacture will provide Candella readings at each property line per field and provide in the case of Baseball -Softball candella values showing these values at home plate
  9. Manufacturers must provide a spreadsheet showing every Five years dates and times to check light levels and provide a report back to the school board showing compliance to the specifications. The school board Engineer must be notified before beginning testing
  10. Manufacture to provide Candella reading not to exceed 7500 on all property lines.

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11. Manufacture to provide contactor cabinets and controls to monitor when lights go out . System to be able to set schedules to turn on and off from a wireless system. Note turning on/off the lighting system with Breakers will not be allowed.

APPLICATION	INITIAL FOOTCANDLE LEVELS	MAINTAINED FOOTCANDLE LEVELS (0.8MF)	UNIFORMITY MAXIMUM	GRID
Stadium Field	50	50	2:1	30' x 30'
Stadium Track	30	30	4:1	30' x 30'
Baseball field	50	50	2:1	30' x 30'
Basketball Courts	50	50	2:1	10' x 10'
Tennis Court	30	30	2:1	20' x 20'

D. Concrete or Steel Pole Design
   1. Submit engineering design calculations for the concrete or steel poles, including foundation design, designed by a structural engineer licensed by the State of Florida.
   2. Base the wind loading design in accordance with the provisions of the FBC and ASCE 7.
   3. Design shall account for supporting mounting arm assemblies, brackets, luminaires, etc.
   4. Base pole foundations on the FBC provisions for poles embedded in earth employing lateral soil bearing.
   5. Design calculations shall bear the impressed seal and original signature of the Specialty Engineer responsible for the design and licensed to practice by the State of Florida.
   6. Specialty Engineer shall submit calculations in conformance with the Florida Department of Professional Regulation.

E. Geotechnical Report
   1. Submit geotechnical engineering report indicating subsurface soil conditions and presenting the pole foundation design parameters.
   2. Provide SPT soil boring data for at least four field locations within 25' of the proposed light poles to a depth of 15'.
   3. Geotechnical report shall bear the impressed seal and original signature of the geotechnical engineer responsible for the report and licensed to practice by the State of Florida.

F. Certificates: Submit certificates and test reports indicating concrete 28-day compressive strength and pre-stress strand strength.

G. Manufacturer's Warranty: Submit manufacturer's warranty.

H. Provide 15-year warranty for the spots lighting system starting from date of project completion.
   1. The manufacture only will Warranty the LED fixtures and system from failure for 15-years from date of project completion.
   2. Replace and install at no cost to the Owner any system failure, which fails during the warranty period.
   3. The manufacturer only shall warranty the alignment of the luminaire assembly for a period of 15 years from the date of installation against movement.
   4. Labor charges for re-aiming during the warranty period are the manufacturer's responsibility.

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5. The warranty includes all: Parts, Labor, and Equipment (Cranes / Trucks) necessary to provide above warranty. Any Damage done on any school board property will be the responsibility of the Manufacture.

1.5 PROJECT RECORD DOCUMENTS
- A. Submit under provisions of Section 01 77 00.
- B. Accurately record the actual locations of each pole and luminaire.

1.6 OPERATION AND MAINTENANCE DATA
- A. Submit under provisions of Section 01 77 00.
- B. Maintenance Data: Include instructions for maintaining luminaires.

1.7 QUALIFICATIONS
- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum 7 years of experience.

1.8 DELIVERY, STORAGE, AND HANDLING
- A. Deliver, store, protect, and handle products to site under provisions of Section 01 60 00.
- B. Accept products on site. Inspect for damage.
- C. Protect poles from finish damage by handling carefully.

1.9 COORDINATION
- A. Furnish bolt templates and pole mounting accessories to installer of pole foundation

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS
- A. Furnish products as specified on Drawings.
- B. Substitutions: Under provisions of Section 01 60 00

2.2 POLES AND OTHER REQUIREMENTS
- A. Height as indicated on Drawings.
- B. Hand hole
- C. Removable weatherproof cover installed 18" + or - above finish grade.
- D. Provide sports lighting units of sizes, types and ratings indicated, complete with, but not limited to, poles/standards, brackets, mounting arm assemblies, luminaires and other components and accessories required for complete lighting systems.
- E. Prestressed Spun Concrete Lighting Standards: For stadium lighting, provide pre-stressed spun concrete, raceway-type lighting poles and standards of sizes and types indicated, comprised of shafts and brackets, and constructed with the following construction features:
- F. Configuration
  1. Embedded type base and reinforcing sleeve with hand and cable entrance holes where indicated.
  2. Provide service platform for stadium poles and climbing rungs for all poles if needed Manufacture is responsible to provide equipment necessary to perform there warranty for the length of time per this specification.
- G. For baseball, softball, tennis, and basketball facilities provide standard pre-stressed concrete poles with similar features.

2.3 LIGHTING BRACKETS
- A. Metal Brackets for Steel, Aluminum and Prestressed Concrete Lighting Standards:
  1. Provide corrosion-resistant, metal brackets, cantilevered without under braces, of sizes and styles indicated with attaching hardware.
  2. Construct in compliance with NEMA Pub Number SH5; and with the following construction features.

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3. Material: Use a hot dipped galvanized steel process after unit fabrication.
4. Thickness: Minimum is 3 Mills.

B. All hardware for mounting shall be Type 316 stainless steel.

2.4 LUMINAIRES

A. General:
1. Provide corrosion-resistant, aluminum luminaires of sizes, types, and styles indicated; equip with 5000 kelvin color temperatures LEDs, 480 line volts.

B. The aiming shall be factory pre-set and marked with visibly engraved process.
1. Provide top-visors on all fixtures. Note Manufacture must comply with all of site vales and candles readings.
2. Employ glare control equal to sports lighting fixtures in place at park adjacent to campus.
3. The sports lighting shall not exceed one vertical foot-candle or ½ horizontal foot-candle on any residential property.
4. Manufacture must provide showing compliance with International Dark Skies Community Friendly Outdoor Sports Lighting Program. The Manufacture is responsible for providing this document for each field or court provided.
5. Lighting Program. The Manufacture is responsible for providing this document for each field or court provided.

C. Mount all Drivers remotely from the Fixture.
1. All remote drivers shall be located in a driver enclosure located 15' above grade on the pole.

D. Each pole shall have located inside the driver enclosure, a lockable thermal disconnect device.

E. The pole, the cage, and the complete assembly must be UL listed, or OSHA approved.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine excavation and concrete foundation for sports lighting poles.

B. Examine each luminaire to determine suitability for lamps specified.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install lighting poles at locations indicated.

C. Embedded Luminaire Poles plumb and to the depth indicated on plans.

D. Bond luminaires, metal accessories, and metal poles to the branch circuit equipment grounding conductor.
1. Provide supplementary ground rod at each pole.

E. Luminaire Pole Bases
1. Size and constructed as indicated on Drawings.
2. Project anchor bolts 3" minimum above base.
3. Install poles on bases plumb; provide double nuts for adjustment.
4. Grout around pole base.
5. Provide manufacturer's covers for bolts at base.

F. Adjust fixtures per the requirements of the aiming diagrams provided by fixture manufacturer.

G. Provide all required conduit, wiring, junction boxes, contactors, and control panels for connection to a panel board provided by others.
1. Feed each pole with 480v, 3-phase power from the location shown on the drawings.

H. Poles shall not be located in front of stadium bleachers.

3.3 FIELD QUALITY CONTROL

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A. Upon completion the installation of the lighting, and after energizing the lighting circuitry with normal power source, test lighting system to demonstrate capability and compliance with requirements.
   1. The Manufacturer and Contractor in the presence of the Owner or his representative shall perform the tests.
   2. Where possible, correct malfunctioning units at the site, then retest to demonstrate compliance; otherwise, remove and replace with new units and proceed with retesting.

B. Test and Measurement Procedures - Field Lighting:
   1. Complete all testing with entire facility illuminated.
   2. Horizontal Foot-candle Readings: The test cell shall be positioned horizontal
   3. 36" above the playing surface for all field foot-candle readings.

C. Take measurements during night sky, without moon or with heavy overcast clouds effectively obscuring moon.

3.4 ADJUSTING

A. Adjust work under provisions of Section 01 77 00.

B. Aim and adjust luminaires to provide illumination levels and distribution as directed.

C. Replace LED fixture luminaries, which have failed lamps at Date of Substantial Completion.

3.5 CLEANING

A. Molded Case Circuit Breakers: UL 489 provides circuit breakers with integral thermal and instantaneous magnetic trip in each pole.

3.6 DEMONSTRATION AND TRAINING

A. Training of the Owner’s operation and maintenance personnel is required in cooperation with the Owner's Representative.
   1. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems.
   2. Schedule the instruction in coordination with the Owner's Representative after submission and approval of formal training plans.
   3. Refer to Section 01 91 00, Commissioning, for further contractor training requirements.

B. Provide demonstration and training for all types of sports lighting equipment installed in this project.

END OF SECTION

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SECTION 27 10 00
COMMUNICATIONS SYSTEM
(Data and Voice)

PART 1 GENERAL

1.1 SECTION INCLUDES
- A. Raceway system
- B. Supportive equipment such as grounding and plywood backboards
- C. Empty Communication Outlets
- D. Power requirements

1.2 REFERENCES
- A. SDPBC - School District of Palm Beach County
- B. DOE - The Florida Department of Education
- C. EIA/TIA - Electronic Industries Association/Telecommunication Industry Association
- D. NEC - National Electrical Code (NFPA 70)
- E. UL - Underwriters Laboratories
- F. NEMA - National Electrical Manufacturer's Association

1.3 SYSTEMS DESCRIPTION
- A. Provide materials and labor for complete raceway system and power distribution; including conduits, pull wire, junction boxes, empty outlet boxes, backboards, power receptacles, and grounding for communication and multi-media Instructional Technology program for Data and Voice Systems.
- B. Owner shall furnish and install the fiber optic cables, unshielded twisted pair cables, telephone cables, termination racks, communication outlets, and final terminations of cables.

1.4 ELECTRICAL STANDARDS
- A. Work shall comply with requirements of FBC.
- B. Use electrical products, tested, listed and labeled by an approved testing Laboratory such as UL and comply with NEMA.
- C. Telephone Utility Company is AT&T.
- D. Install service entrance in accordance with Telephone Utility Company's requirements.

1.5 SUBMITTAL
- A. Submit under provisions of Section 01 33 00.

1.6 RELATED WORK
- A. See Division 23 and HVAC Design Criteria for Air Conditioning requirements.
- B. Communication Service Room shall have air conditioning from local AHU for normal business hours and dedicated DX air conditioning for after normal business hours and holidays.
- C. Communication Closet shall have air conditioning from local AHU.

1.7 ALLOWANCES
- A. Provide 20 additional empty communication outlets as directed in field.
- B. Allowance includes purchase, delivery, and installation of empty box, 100' of conduit for each outlet.

1.8 PROJECT RECORD DOCUMENTS
- A. Submit product data under provisions of Section 01 77 00.
- B. Accurately record the location of service entrance conduits and all conduits feeding from the main backboard to each terminal backboard location. Dimension from permanent physical features.

PART 2 PRODUCTS

2.1 Plywood backboards shall be 4' x 8' x 3/4" seven A-C grade plywood painted grey.

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2.2 See riser diagram on drawings for details.

PART 3 EXECUTION

3.1 INSTALLATION

A Communication Service Room shall be the entry point for communication cables coming to the facility and the origination point of the communication systems in the facility.
1 The size of Communication Service Room for the elementary school shall be a minimum of 168 SF (12' x 14') and for middle schools/high schools a minimum 320 SF (16' x 20').

B Use a communication closet on each floor in each building for distribution of communication system to the Communication Outlets in each space.
1 Size of Communication Closet shall be a minimum of 8' wide x 6' deep, with no other systems in this room.

C Connect each Communication Closet to the Communication Service Room with two-2" minimum size conduits.

D Connect each communication outlet with one ¾" conduit.
1 Provide one 1" conduit home run to the nearest Communication Closet for each two Communication Outlets.
2 Contractor may connect eight Communication Outlets with one 2" conduit to the Communication Closet.
3 For classroom outlets, fed by an overhead 2" conduit, only one ceiling junction box is required.

E Install conduits from Communication Outlet to Communication Closet overhead above ceilings and walls.
1 For any approved floor outlet, connect each floor outlet with a 1" home-run conduit.
2 DO NOT install these conduits underground unless approved by School District.
3 Contact Gary Carpentier 561-723-0968.

F The maximum conduit distance from the Communication closet to the Communication outlet is 250'.
1 Run conduits using the shortest distance possible.

G Conduit installations shall meet the requirements of Section 26 05 33.

H Provide manholes, junction boxes and painted plywood backboards.

I Conduit installation shall not contain more than two 90° bends.
1 Use pull boxes or junction boxes in place of 90° bends.
2 The conduit distance between boxes shall not exceed 125' for above the ceiling conduits.
3 See Section 26 05 33 for boxes.

J Conceal conduit runs in finished areas from view.

K Identify communication junction box covers with yellow marking.

L Provide two-2" conduits from Communication Service Room to 10' outside of building for future use, cap conduits in manhole, and mark "FOR FUTURE COMMUNICATIONS".

M Terminate overhead conduits installed to the Communication Service Room and Communication Closets on power strut at 9’ above finish floor.

N Provide smooth plastic bushings on conduits that terminate in the Communication rooms (for slab and rack conduits) and at manhole locations, before installing cables.

O Provide a #6 AWG stranded copper insulated grounding conductor, installed in a 1" conduit (PVC), from CER/Service Entrance backboard and each Communication Closet backboard to the building grounding electrode system, provide buss bar.

P Install pull wires, 200 lb. minimum, in all empty raceways and secure at each end.

Q Support conduits, backboards, wiring gutters and outlets under provisions of Sections 16190.

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R Cash Register Data Outlets: Provide a ¾-inch conduit from the cafeteria manager's outlet to the data backboard location.
1 Provide a ¾-inch conduit from each register to the data backboard.
2 At multi-register locations, provide a 1" conduit back to the data backboard.
3 Contractor may route these conduits in slab.

S Provide a 125 volts, 20 amps quad receptacle outlet within 12" of Communication Outlet.

T 125 volts, 20 amps receptacles designated for Communication Systems (noted above) shall be gray color. See Section 26 27 26 for wiring devices.

U Receptacles for Communication Systems shall be on separate circuits from other loads with maximum of two quad receptacles on each branch circuit.
1 Provided a dedicated neutral on each branch circuit

V Install Communication Outlets no closer than 5-linear feet and no further than 6-linear feet from another Communication Outlet located on the same wall.

W Provide two-surge protection type, quad, 125 volts, 20 amp receptacles, and two 125 volts, 30-amp twist-lock receptacles in the Communication Service Room.
1 Provide two-surge protection type, quad, 125 volts, and 20 amp receptacles in each of the Communication Closets.
2 Serve each outlet from a separate branch circuit with dedicated neutral and ground conductor.
3 See details for exact locations for these power outlets.

X All installations shall be first class, professional, and as judged by the Engineer and the owner.

Y Owner shall furnish and install communication cabinets/racks.

Z Install terminal backboards plumb and attach securely at each corner.

AA Provide one 2" conduit from each telephone terminal backboard to an accessible location above the ceiling, for future use.

BB Provide a ¾" conduit to the following special purpose communication outlets for the Electric utility meter location, Main Energy Management System cabinet, Main Security cabinet, Main Card Access cabinet, Main Video Surveillance cabinet, Kitchen bell location, and the Elevator equipment location.

CC Provide a 1" conduit to pay telephone locations.
1 Provide 120-volt power at each pay phone location.
2 Coordinate height of power junction box and telephone outlet with pay telephone vendor.
3 Do not use base pedestal type telephones and surface conduit.

DD Mark ceiling grid below J-box locations with yellow color tag per Section 26 05 53.

EE Install an outlet for a telephone bell in the kitchen area and in the serving area, 7' above the finished floor.

FF Install an outlet for a telephone bell, outside of the P.E. office, in the covered play area for Elementary Schools, at 7' above the finished floor.

GG Coordinate installation with all trades.

HH In communication rooms, do not install the light fixtures on top of the center island rack.

II Provide and install a mule-tape 2500-pound test pull string in each of the service conduit for Bellsouth.

JJ Floor outlets not allowed.

KK Cable trays not allowed.

LL Install vinyl tile flooring in Communication Service Room (CER / MDF).

MM Install a 1-1/2" conduit from each sign to the nearest data backboard.

NN Each data backboard requires a quad power outlet at 7' above finish floor.

3.2 DEMONSTRATION AND TRAINING

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A Training of the Owner’s operation and maintenance personnel is required in cooperation with the Owner's Representative.
   1 Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems.
   2 Schedule the instruction shall in coordination with the Owner's Representative after submission and approval of formal training plans.
   3 Refer to Section 01 91 00, Commissioning, for further contractor training requirements.

B Provide demonstration and training for all types of communications systems installed in this project.

END OF SECTION

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SECTION 27 24 10
PROJECTOR SYSTEM

PART 1 GENERAL

1.1 SECTION INCLUDES
- A. Conduit, cables, connectors, and boxes
- B. Power wiring and receptacles
- C. Provide complete wiring system to operate all electronic equipment in instructional spaces per codes, educational specifications, approved drawings, and DMS.

1.2 SYSTEM DESCRIPTION
- A. Projector system shall include the furnishing and installation of junction boxes, outlets, cables, conduits, connectors and 20 amp receptacles and other equipment shown on the drawings.
- B. Refer to details on the drawings for additional information. Architect shall obtain the latest copy of ceiling projector installation detail from the Educational Technology Department.

1.3 SUBMITTAL
- A. Submit under the provisions of Section 01 33 00.
- B. Shop Drawings: Indicate layout, raceway diagrams, cables, connectors, cut sheets, and other necessary components for a complete projector system.
  1. Work shall not commence, before the shop drawings are approved by the School District.
- C. Product Data: Provide data sheets for each item shown on the shop drawings.

1.4 RECORD DRAWINGS
- A. Submit under the provisions of Section 01 77 00.
- B. Accurately indicate actual locations of boxes, cables, and conduit runs.

PART 2 PRODUCTS

2.1 CONDUIT, CABLES, CONNECTORS, AND BOXES
- A. Provide 2-quad outlets connected to computer power, 1-data outlet, and 1-RJ45 connector with CAT5E cable to the projector, 1-VGA outlet, and 1-active USB type “A” cable at the teacher station.
- B. In instructional spaces such as science-labs with a fixed demonstration-desk and the instructor’s desk positioned adjacent to the demonstration desk, install the teacher station outlets mentioned in Item A on the side of the demonstration desk at the opposite end from the sink.
- C. Provide one RCA cable, one data outlet, two quad receptacles connected to computer power.
  1. On the wall behind the multimedia cabinet
  2. Refer to installation detail on the drawings
- D. Provide 1-RCA cable, 1-CAT5E cable, 1-active USB type “B” cable, 1-3.5 mm stereo audio cable, and 1-VGA cable with male connectors and 10 feet slack at the projector location.
  1. Also, provide one 120 volts, 20 amps duplex receptacle at each projector location.
  2. See details on the drawings for all outlet locations and additional requirements.
- E. Provide a 3.5 mm stereo audio cable from a wall box at the teacher station to a wall box on the wall behind the multimedia cabinet.
- F. Overall VGA cable must have 125% aluminum Mylar shielding and 90% Braided Tinned Copper shielding and contain three 28 AWG internal mini-coax lines each with Braided Tinned Copper shielding for VGA, three 24 AWG twisted pair, and a single 24 AWG pair.
  1. Cable to support UXGA resolutions including 1600x1200 and 1920x1080 (WUXGA)

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2. VGA cable or lead ends Ferrite protected against EMI/RFI interference.
3. Replaceable, provide threaded flying leads on both ends slip connectors are not acceptable.
4. Connector equipped with a protective pulling cap rated at 30 pounds pulling tension.
5. Provide manufacturer Lifetime Warranty.
6. Use cable manufactured by "RapidRun" as specified here or approved equal:
   a. 60005 - 50ft RapidRun Multi-Format Runner Cable CMG-rated.
   b. 60081 - 1.5ft RapidRun Multi-Format Flying Lead HD15 Male (VGA), need one for each end.
   c. 60004 - 35ft RapidRun Multi-Format Runner Cable CMG-rated, shorter for small rooms/conference rooms.
   d. 60018 - 1.5ft Rapid-Run Multi Format Flying Lead HD15 Male (VGA) + 3.5mm + Composite Video (RCA) + Stereo Audio (RCA.

G. Cafetorium, Media Center, Conference Rooms and Similar Spaces:
1. Control station shall have data outlet, CAT-5E with RJ-45 connector, VGA connector, one RCA cable for cafeteria public address system, microphone jack, and two quad receptacles.
2. Refer to wiring detail, if the drawings do not have wiring detail; obtain it from Educational Technology Department.
3. Satellite control station shall have data outlet, and receptacle, microphone jack for cafeteria public address system, 3.5 mm audio connection, and VGA connection.

2.2 POWER FEED
A. Wall mounted projectors, install receptacle 6 inches below ceiling (typical classrooms).
B. Ceiling mounted projectors, install receptacle in the cutout of the ceiling tile.
C. Refer to the details on the drawings.

PART 3 EXECUTION

3.1 INSTALLATION
A. Install system in accordance with NECA "Standard of Installation" and Sections 26 05 33, and 26 27 26 of the project specifications.
B. Installation in large areas such as cafeteria and media center will be different from general Classrooms.
1. Submit shop drawings for review prior to installation.
C. Keep the row of ceiling tiles in line with the center of the projection screen clear of fire sprinklers, air conditioning diffusers, and light fixtures 4' in each direction from the location of the projector.
1. This will provide some room to adjust the distance between the projector and the projection screen.
D. Installer shall be licensed in this field and have minimum of 5-years successful experience.
E. Classroom technology wiring system shall be capable to receive SDPBC Educational Network Channels.
1. See other specification sections.

3.2 DEMONSTRATION AND TRAINING
A. Training of the Owner’s operation and maintenance personnel is required in cooperation with the Owner's Representative.

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1. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems.
2. Schedule the instruction in coordination with the Owner's Representative after submission and approval of formal training plans.
3. Refer to Section 01 91 00, Commissioning, for further contractor training requirements.

B. Provide demonstration and training for all types of ceiling projector installed in this project.

END OF SECTION

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SECTION 27 41 00
MASTER TELEVISION SYSTEM (MTS)

PART 1 GENERAL

1.1 SCOPE OF WORK

A. The extent of the master television system (MTS) work is hereby defined to include (but not by way of limitation) the furnishing and installing of a system.

1.2 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in the manufacture of master television distribution components (MTDC) of the type required, and which have been in satisfactory use for not less than five-years in similar services.

B. Electrical Standards: Provide tested, listed, and labeled UL electrical products complying with NEMA standards.

C. Installation and testing of the system shall be verified by a SCTE (Society of Telecommunications Engineers) certified BCT (Broadband Communications Technician) or BDS (Broadband Distribution Specialist) certified installer.

1.3 SUBMITTALS

A. Submittals on MTDC systems are required as follows

1. Shop Drawings
2. Riser Diagram
3. Wiring Diagram
4. Manufacturer's Data
5. Manufacturer's Product Warranty
6. Operating Instructions
7. Maintenance Manuals

PART 2 PRODUCTS

2.1 Provide the required MTDC system products in the sizes and capacities indicated, complying with the manufacturer's published product information.

2.2 Apply complete weatherproofing methods at the time of installations.

A. Do not leave any coaxial fittings uncovered or exposed at any time during installation.

B. Use a non-hardening silicone base compound.

2.3 Provide head-end cabinet or equipment rack shall be 48” H x 30” W x 32” D, with locking ventilated front door, to be located in Media Center (see drawings for exact location).

A. Cabinet shall have cable management, features like high-flow mesh on all mesh doors, and dual universal PDU mounting brackets, heavy-duty, welded steel construction, and anti-tip legs with standard keyed locks on doors that can be replaced by a combination lock.

2.4 Provide a 3-inch conduit with pull-wire from MTS head-end cabinet to the property line for future cable connection. Verify and coordinate exact location of the conduit termination point at property line with local cable television provider.

2.5 Install one (1) communication/data outlet in the head-end cabinet.

2.6 Install 125 volts, 20 amps quad-receptacle outlet, supplied by building optional branch panel of generator in the head-end cabinet.

2.7 Extend 1” conduits with RG-6 cables from head-end cabinet to media center, cafetorium, and gymnasium.

A. Terminate in origination TV outlets (in 75-ohm devices).

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B. Exact termination locations to be determined by The Education Network Senior Logistics Engineer or equivalent personnel from TEN.
C. All feeder lines shall have a 30db return loss @ VHF when terminated in 75 Ohm.

2.8 RG-6 cables shall be UL rated for indoor/outdoor use, 18AWG, Keystone Cable Model KEYRG6SDDBO.
2.9 Provide a Set Top Box, AMINO A140 IPTV Set Top Box, MPEG 2 or 4/H.264 in the head-end cabinet.
2.10 Provide a Digital Encoder Blade-QTY 1- VBRICK XPS 9000 Encoding AVM SD 1 CH/SDI/HDMI/YPbPr/Composite, Part number 9300-4211-000 in the head-end cabinet.
2.11 Provide a Digital Encoder Blade enclosure-QTY 1- VBRICK 9000 Series Education Enclosure, Part number 9302-0000E000 in the head-end cabinet.

PART 3 EXECUTION

3.1 WIRING OF NEW/REMODELED/RENOVATED BUILDINGS
A. Extend 1" conduits with RG-6 cables from head-end cabinet to cafeteria, media center, and auditorium.
B. Signal testing of the head-end trunk lines shall be accomplished prior to contract completion using appropriate test equipment to meet desired specifications.
1 May use a CATV signal of 175 MHZ to 405 MHZ
2 Test all outlets, including origination outlets.
3 Provide the signal readings to the Senior Logistics Engineer or equivalent at The Education Network.
C. The installer shall have minimum of 5-years successful experience in CATV distribution Cabling and CAT 5e and CAT 6 terminations.

3.2 ADDITIONAL SPECIFICATIONS
A No cross-modulation, co-channel, or adjacent channel or any type of interference shall be noticeable at any trunk line termination points, using a standard color TV set or equivalent video signal test generator providing 1 V P-P for video viewed by a trained observer.
B Any substitutions for equipment listed in this specification must have the same degree of repair ability as well as the same technical characteristics or better.
1 School District TEN Department must approve substitutions in writing before installation.
C Provide a drawing of the grounding system as installed to the Project Manager and a copy sent to the TEN Department.
D Install a 3" conduit with pull-wire from ITV head-end cabinet to the property for future cable television connection or tower location.
1 Verify and coordinate exact location of the conduit termination point at property line with local cable television provider.

3.3 DEMONSTRATION AND TRAINING
A Training of the Owner's operation and maintenance personnel is required in cooperation with the Owner's Representative.
B Provide demonstration and training for all types of MTS installed in this project.

END OF SECTION

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SECTION 27 51 16
PUBLIC ADDRESS SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES
- A. Amplifier and control equipment
- B. Input equipment
- C. Raceways and communications cable
- D. List of equipment for gym PA system
- E. List of equipment for cafeteria PA system
- F. List of equipment for cafetorium PA system
- G. List of equipment for stadium PA system

1.2 SYSTEM DESCRIPTION
- A. Public address systems for voice and music with microphones and distribution of background music

1.3 SUBMITTALS
- A. Submit under provisions of Section 01 33 00.
- B. Shop Drawings: Indicate layout of equipment mounted in racks and cabinets, component interconnecting wiring and wiring diagrams of field wiring to speakers and remote input devices.
- C. Product Data: Provide for components and accessories.
- D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Article REGULATORY REQUIREMENTS.
- E. Manufacturer's Instructions: Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.
- F. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- G. Manufacturer Field Reports: Submit under provisions of Section 01 40 00.
- H. Manufacturer Field Reports: Indicate that installation is complete and system performs according to specified requirements.

1.4 PROJECT RECORD DOCUMENTS
- A. Submit under provisions of Section 01 77 00.
- B. Accurately record the actual locations of speakers, control equipment, and outlets for input/output connectors.

1.5 OPERATION AND MAINTENANCE DATA
- A. Submit under provisions of Section 01 77 00.
- B. Operation Data: Include instructions for adjusting, operating, and extending the system.
- C. Maintenance Data: Include repair procedures, repair parts lists, service manuals, and schematics on each component in the system.

1.6 QUALIFICATIONS
- A. Manufacturer shall be a company specializing in public address system with 5-years of experience.
- B. Supplier shall be an authorized distributor of amplifier/control equipment manufacturer.
- C. Installer shall be an authorized installer of amplifier/control equipment manufacturer with 5-years of experience and a service facility within 150 miles of Project.

1.7 REGULATORY REQUIREMENTS
- A. Conform to requirements of NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.
- C. Conform to requirements of Federal Communications Commission.

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1.8 MAINTENANCE SERVICE

A. Furnish service and maintenance of public address system for one year from Date of Substantial Completion.

PART 2 PRODUCTS

2.1 AMPLIFICATION/CONTROL EQUIPMENT

A. Manufacturers: Use current model.
   1. Dukane
   2. Crown Audio, Inc
   3. Electro-Voice
   4. JBL
   5. Mackie
   6. Shure
   7. Tascam
   8. Atlas Sound
   9. DBX
   10. Community
   11. Soundcraft
   12. Middle Atlantic
   13. Whirlwind

B. Microphone Inputs
   1. Stadiums, and Courtyard System, provide two low impedance inputs with 600-microvolt sensitivity and noise level at least 55 dB below rated output.
   2. Cafeteria and Gymnasium System, provide four low impedance inputs with 600-microvolt sensitivity and noise level at least 55 dB below rated output.

C. Auxiliary Inputs: Provide one high impedance input with 0.4-volt sensitivity and noise level at least 70 dB below rated output.

D. System Frequency Response: 50 - 15,000 Hz. + 2dB.

E. System Distortion: Less than 1.5%, 100 to 100,000 Hz. at rated power.

F. System Output Power: - rms
   1. Courtyard Sound Systems – 100-Watts
   2. Cafeteria Sound System – 1200-Watts
   3. Cafetorium Sound System – 1200 Watts
   4. Gymnasium Sound System – 2400-Watts
   5. Stadium Sound System – 2400-Watts

G. Volume Controls: Provide one for each input and one master volume.

H. Bass Control: +8 dB to -12 dB at 50 Hz

I. Treble Control: +8 dB to -12 at 10,000 Hz

J. Program Selector: Provide program and mode selector switches.

K. System Cabinet
   1. Media Center System – Vented surface mounted lockable media cabinet as used in typical classroom.
   2. Cafeteria, Cafetorium, and Gymnasium System -Vented, wall mounted lockable metal construction.
   3. Stadium System - Surface mounted thoroughly vented, lockable metal construction.
   4. Courtyard System - If installed on the exterior shall be rated weatherproof enclosure.

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L. Cafeteria, Cafetorium, and Media Center PA console shall be connected to audio inputs from DVD player, auxiliary input source, and computer.
   1. PA system in cafeteria, cafetorium, and media center will provide audio amplification of the ceiling projector system from both the projector control station and projector satellite control station.

M. PA console shall have mute circuit connected to the campus intercom system to mute the PA speakers when campus intercom speakers are activated.

N. New or upgraded PA systems, except for stadiums, shall have a rack power off circuit, controlled by the fire alarm system. The PA system shall power off when the fire alarm is in emergency mode. The PA system rack power circuit shall require a manual reset, after the fire alarm is reset, accessible from the PA rack. Provide one sequenced power control system to power off the PA system in the event of a fire alarm, Middle Atlantic PDS-620R or approved equal. Provide any other component(s) necessary for satisfactory operation of the system.

O. DBX Zone Control configured with speaker protection (limits) and feedback supression.

P. PA console shall have one line out with RCA female labeled “ALD” for Assisted Listening Device from a mono summing output.

Q. PA console shall have one input cable connected to system terminating with 1/8” TRS (3.5 mm stereo) male with 3 ft. of coiled slack secured with hood and loop Velcro cable fastener at front of rack labeled “Auxiliary” or “Aux”.

2.2 PA SYSTEM EQUIPMENT LIST FOR CAFETERIA (Typical High School)

A. This list contains main components of a PA system for a cafeteria.
   1. One Atlas WMA35-23 Wall Cabinet or approved equal.
   2. One locking door installed in rack, 2RU (two rack unit) size.
   3. Four JBL PRX 415 wall mounted speakers or approved equal.
   4. Two Crown XTI 2002 Power Amplifiers or approved equal.
      a. Integrate the amplifier with the projector system and physically locate in the media cabinet at the projector control station.
   5. One Tascam CD-200SB CD/MP3 player, rack mounted or approved equal.
   6. One Digital Zone Processor System, 12 total inputs to include:
      a. One DBX ZonePRO 1261m rack mounted or approved equal.
      b. One DBX ZC3 wall mounted or approved equal.
      c. Seven DBX ZC1 wall mounted or approved equal.
   7. One 12 input mixer installed upright, integrated into Zone Processor System: Soundcraft EFX 12 or approved equal.
   8. Two Shure SLX4 wireless microphone receivers rack mounted or approved equal.
   9. Two Shure SLX2/58 handheld transmitter or approved equal.
   10. Two Shure SLX1 body pack transmitter or approved equal.
   11. Two Shure WH30TQG headset microphone or approved equal.
   12. One Atlas ACRL-291 power strip or approved equal.
   13. Two Shure SM58S handheld microphones or approved equal.
   14. Two Atlas MS-10C microphone stands or approved equal.
   15. One DVD player shelf mounted inside rack.
   16. Provide any other component(s) necessary for the satisfactory operation of the system.

B. Contractor shall provide all components for a complete system.

C. If any major part is missing from this list, the bidder shall inform affected parties prior to bid.

D. Installed system shall provide minimum of 10 decibels above the ambient noise at full occupancy.

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2.3 PA SYSTEM EQUIPMENT LIST FOR CAFETORIUM (Typical Elementary and Middle School)

A. This list contains main components of a PA system for a cafetorium.
   1. One Atlas WMA35-23 Wall Cabinet or approved equal.
   2. One locking drawer installed in rack, 2 RU (rack unit) size.
   3. Four JBL PRX 415 Wall Mounted Speakers (Main) or approved equal
   4. Two JBL JRX 212 Wall Mounted Speakers (Monitor) or approved equal.
   5. Two Crown XTI 2002 Power Amplifier (Main) rack mounted or approved equal.
      a. Integrate the amplifier with the projector system and physically locate in the media cabinet at the projector control station.
   6. One Crown XTI 1002 Power Amplifier (Monitor) rack mounted or approved equal.
      a. Integrate the amplifier with the projector system and physically locate in the media cabinet at the projector control station.
   7. One Tascam CD-200SB, rack mounted or approved equal.
   8. One Digital Zone Processor System, 12 total inputs to include.
      a. One DBX ZonePRO 1261m rack mounted or approved equal.
      b. One DBX ZC3 wall mounted or approved equal.
      c. Seven DBX ZC1 wall mounted or approved equal.
   9. One 16 input mixer on sliding rack shelf, integrated into Zone Processor System: Soundcraft FX16ii or approved equal.
   10. Two Shure SLX4 Wireless microphone receivers rack mounted or approved equal.
   11. Two Shure SLX2/58 Handheld transmitter or approved equal.
   12. Two Shure SLX1 Bodypack transmitter or approved equal.
   13. Two Shure WH30TQG Headset microphone or approved equal.
   14. One Atlas ACRL-291 Power Strip rack mounted or approved equal.
   15. Two Shure SM58S Handheld Microphones or approved equal.
   16. Three Shure MX202BP/C Hanging ceiling microphones or approved equal.
   17. Two Atlas MS-10C Microphone Stands or approved equal.
   18. One DVD shelf mounted inside rack
   19. Provide any other component(s) necessary for the satisfactory operation of the system.

B. Contractor shall provide all components for a complete system.

C. If any major part is missing from this list, the bidder shall inform affected parties prior to bid.

D. Installed system shall provide minimum of 10 decibels above the ambient noise at full occupancy.

2.4 PA SYSTEM EQUIPMENT LIST FOR GYMANISIUM

A. This list contains main components of a PA system for a gym.
   1. One Atlas WMA35-23 Wall Cabinet or approved equal.
   2. One locking drawer installed in rack, 2 RU (rack unit) size.
   3. Eight JBL PRX 415 M, 4 speakers mounted above center of court in two clusters facing bleachers or approved equal.
   4. Two Crown XTI 4002 Power Amplifiers rack mounted or approved equal.
   5. One Tascam CD-200SB, rack mounted or approved equal.
   6. One Digital Zone Processor System, 12 total inputs to include:
      a. One DBX Zone PRO 1261m rack mounted or approved equal.
      b. One DBX ZC3 wall mounted or approved equal.
      c. Four DBX ZC1 wall mounted or approved equal.
   7. One 12 input mixer installed upright, integrated into Zone Processor System: Soundcraft EFX 12 or approved equal.

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8. Two Shure SLX4 Wireless microphone receivers rack mounted or approved equal.
9. Two Shure SLX2/58 Handheld transmitter or approved equal.
10. Two Shure SLX1 Body pack transmitter or approved equal.
11. Two Shure WH30TQG Headset microphone or approved equal.
12. One Atlas ACRL-291 Power Strip rack mounted or approved equal.
13. Two Shure SM58S Handheld Microphones or approved equal.
14. Two Atlas MS-10C Microphone Stands or approved equal.
15. Provide any other component necessary for the satisfactory operation of the system.

B. Contractor shall provide all components for a complete system.
C. If any major part is missing from this list, the bidder shall inform affected parties prior to bid.
D. Installed system shall provide minimum of 15 decibels above the ambient noise at full occupancy.

2.5 PA SYSTEM EQUIPMENT LIST FOR STADIUM

A. This list contains main components of a PA system for a stadium.
1. One Atlas Cabinet or approved equal.
2. One Community R2-52Z Speaker (aimed at visitor side) or approved equal.
3. Two Community R2-474Z Speakers (aimed at home side) or approved equal.
4. One Community R2-694Z Speaker (aimed at home side) or approved equal.
5. Two Crown XTI 2002 Power Amplifiers rack mounted or approved equal.
6. One Tascam CD-200SB, rack mounted or approved equal.
7. One Digital Zone Processor System, 12 total inputs to include
   a. One DBX Zone PRO 1261m rack mounted or approved equal
   b. One DBX ZC3 wall mounted or approved equal.
   c. Seven DBX ZC1 wall mounted or approved equal.
8. One 12 input mixer installed upright, integrated into Zone Processor System: Soundcraft EFX 12 or approved equal.
9. Two Shure SLX4 Wireless microphone receivers rack mounted or approved equal.
10. Two Shure SLX2/58 Handheld transmitter or approved equal.
11. Two Shure SLX1 Body pack transmitter or approved equal.
12. Two Shure WH30TQG Headset microphone or approved equal.
13. One Atlas ACRL-291 Power Strip rack mounted or approved equal.
14. Two Shure SM58S Handheld Microphones or approved equal.
15. One Shure 450 Series II push to talk announcer microphone or approved equal.
16. Two Atlas MS-10C Microphone Stands or approved equal.
17. Provide any other component necessary for the satisfactory operation of the system.

B. Contractor shall provide all components for a complete system.
C. If any major part is missing from this list, the bidder shall inform affected parties prior to bid.
D. Installed system shall provide minimum of 15 decibels above the ambient noise at full occupancy.

2.6 ACCESSORIES

A. Microphones, stands and cabling
1. Quantity (4) for each system Whirlwind MK425 25’ microphone cables with XLR connectors for the microphone and input jacks or approved equal.
2. Quantity (2) for each system Whirlwind MK450 50’ microphone cables with XLR connectors for the microphones and input jacks or approved equal.

B. Speakers and Stadium Driver/Horns
1. As recommended by the amplifier manufacturer for the particular application required.

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2. The maximum power rating shall not be less than the peak power available from the amplifier.

C. Microphone Cord
1. 20-AWG stranded copper conductor, 600-volt insulation, rated 60°C, two conductor shielded cable with rubber jacket.

D. Input Cable
1. 22-AWG copper conductors, 300-volt insulation, rated 60°C, paired conductors twisted together, shielded, and covered with a PVC jacket.

E. Speaker Wire and Cable
1. Media Center System - 20 AWG copper conductors, 300-volt insulation, rated 60°C, paired conductors twisted together, shielded, and covered with a PVC jacket.
2. Stadium, Cafeteria and Gymnasium System - 12 AWG copper conductor, 600-volt insulation, rated 60°C.

F. Provide raceway for all sound system conductors under the provisions of Section 26 05 33.

G. Microphone input connectors: 3-pin male cannon connectors.

H. Microphone outlets in the Gymnasium shall not be floor mounted.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install equipment in accordance with manufacturer's instructions.

B. Splice cable only in accessible terminal block units.

C. Make cable shields continuous at splices and connect speaker circuit shield to equipment ground only at amplifier.

D. Install input circuits in separate cable and raceways from output circuits.

E. Leave 12" excess cable at each termination at microphone, volume pad, speaker, and other system outlet.

F. Leave 6' excess cable at each termination at system cabinet.

G. Provide protection for exposed cables where subject to damage.

H. Use armored cable for outside speaker circuits.

I. Use suitable cable fittings and connectors.

J. Connect reproducers to amplifier with matching transformers.

K. Install system cabinets in locations shown; arrange to provide adequate ventilation and access.

L. Install amplifiers per manufacturer specification with appropriate spacing and ventilation above and below.

M. Speaker lines in Gyms, Auditoriums, and Cafeterias shall be paralleled at the Amplifier and NOT at the speakers.

N. Speaker lines on Football Fields, Softball Fields, and Stadiums shall be paralleled at the bottom of the pole in waterproof junction boxes and NOT on the top of the pole at the speakers.

O. Provide surge protection devices on all stadium public address system cables that enter or leave the press box.
1. Provide surge protection device on 120-volt power circuit serving the stadium public address consol.

3.2 INTERFACE WITH OTHER PRODUCTS

A. Coordinate locations of outlet boxes provided under Section 26 05 33 to obtain mounting heights specified and indicated on Drawings.

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3.3 MANUFACTURER'S FIELD SERVICES
- A. Provide manufacturer's field services under provisions of Section 01 40 00.
- B. Include making final wiring connections, inspection, adjusting of completed installation and systems demonstration.
- C. Certify that installation is complete and performs according to specified requirements.

3.4 FIELD QUALITY CONTROL
- A. Measure and record sound power levels at designated locations.

3.5 ADJUSTING
- A. Adjust transformer taps for appropriate sound level.
- B. Adjust devices and wall plates to be flush and level.

3.6 DEMONSTRATION
- A. Demonstrate system to designated Owner personnel under provision of Section 01 77 00.
- B. Conduct walking tour of Project; briefly describe function, operation, and maintenance of each component.
- C. Provide detailed operation and maintenance instruction and training.
- D. Provide local training for Owner personnel.
- E. Use submitted operation and maintenance manual as reference during demonstration and training.

3.7 DEMONSTRATION AND TRAINING
- A. Training of the Owner’s operation and maintenance personnel is required in cooperation with the Owner's Representative.
  1. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems.
  2. Schedule the instruction in coordination with the Owner's Representative after submission and approval of formal training plans.
  3. Refer to Section 01 91 00, Commissioning, for further contractor training requirements.
- B. Provide demonstration and training for all types of panelboards installed in this project.
- C. Invite the SDPBC Intercom Shop Foreman to participate in the demonstration/acceptance of the public address system.
  1. Forward a copy of sign-in sheet of the participants to the SDPBC Project Coordinator.

END OF SECTION

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SECTION 27 51 24
INTERCOM SYSTEMS
(NEW and MODERNIZED SCHOOLS)

PART 1 GENERAL

1.1 SECTION INCLUDES
- A. Intercom equipment
- B. Intercom cable
- C. Accessories
- D. Surge Protection

1.2 REGULATORY REQUIREMENTS
- A. System: Listed by UL, ETL, or FM

1.3 SYSTEM DESCRIPTIONS
- A. The system shall consist of integrated IP based & intercommunication equipment, network distribution equipment, software-controlled system, power supply, overhead paging system, station loudspeaker assemblies, call-in switches, a UPS system, surge suppression, and all associated material, hardware, wiring, and options as described herein to provide a complete working system that shall meet the specified requirements.
- B. The system shall provide the following communications functions:
  1. Communication between classrooms and administrative areas utilizing VoIP (Voice over Internet Protocol)
  2. Communication between all offices, corridors, restrooms, exterior locations, cafeteria, gymnasium, auditorium, and all administrative spaces.
  3. System shall provide VoIP, overhead paging, emergency paging, class change time tones and program material.
  4. Remote activation of emergency tones
- C. The system shall provide the facilities for paging or sounding emergency signals or time event signals to selected groups or to all remote speakers.
- D. The system shall provide facilities for the control and distribution of up to two program channels to individual, selected groups or all remote speakers.
- E. The system shall include a built-in master clock and programmer capable of correcting appropriate secondary clock displays and controlling events based on user-programmed time schedules.
- F. The system will use industry standard 25-volt Technology to the classroom speakers.
- G. Furnish and install a UPS system to provide 90 minutes standby operation.
  1. UPS shall maintain continuous battery power through the inverter at all times.
- H. Surge suppression for each intercom conductor terminated in the main intercom terminal cabinet.
  1. Provide manufacturer recommended transient absorption devices.
  2. Each terminal point at the main console shall have individual surge suppression.
- I. Additions to an existing system shall be compatible to the existing manufacturer's control specifications.
- J. The ability to be distributed via a fiber 10/100/1000Mb switched, VLAN (Virtual Local Area Network) enabled network or 10/100/1000Mb switched stand-alone intercom network. It shall be possible to eliminate the need for copper feeder cables between the Main and Intermediate distribution frames using fiber optic cabling.

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K. Shall have SIP (Session Initiation Protocol) Integration to connect all talk-paths to the VoIP phone system of choice. This shall support registering as an extension on the system or through the use of a SIP Trunk.
L. The system shall provide the ability to support a SIP tunnel from the building's VoIP phone system to provide two-way communication from all administrative telephones to any location equipped with a talkback speaker or audio system with room microphone.
M. System shall interface with any VoIP telephone system using SIP type integration thus allowing the school(s) to upgrade or replace their telephone system without suffering a requirement to replace, or lose any feature of, their internal communications (intercom) system. Any system that limits system features based upon any selected telephone system and is not SIP based shall not be acceptable.
N. Automatically sound a tone over any loudspeaker connected for two-way communication to alert the classroom teacher that this 2-way call has been established. This is intended to prevent unauthorized monitoring.
O. Distribution of emergency announcement(s) from any authorized telephone to all areas furnished with a loudspeaker. Emergency announcements shall have the highest system priority.
P. Distribution of general announcements from any administrative telephone, staff telephone, or classroom telephone. The system shall be capable of providing all-call, group call, or multiple group call.
Q. Classroom speakers or audio systems with room microphone shall be software assignable to unlimited paging groups.
R. System shall support a strobe light to be used in conjunction with audible messages for loud areas.
S. The system shall provide an administrative console for the front office, consisting of a touch screen interface no less than 22" diagonal interface.

1.4 SUBMITTALS
A. Submit under provisions of Section 01 33 00.
B. Shop Drawings: Indicate cable routing and connections.
C. Submit product data for each item of equipment.
D. Submit manufacturer's installation instructions.

1.5 PROJECT RECORD DOCUMENTS
A. Submit under provisions of Section 01 77 00.
B. Provide as built AUTOCAD drawings; indicating actual locations of all devices, terminal boxes, junction boxes, as well as the conduit run, wiring and point-to-point wiring diagrams.

1.6 OPERATION AND MAINTENANCE DATA
A. Submit under provisions of Sections 01 77 00 and 01 78 23.
B. Operation Data: Include instructions for routine operation of master and remote stations.
C. Maintenance Data: Include instructions for repair trouble-shooting (with replacement parts list), preventive maintenance, and cleaning of all equipment supplied.
D. Include manufacturer representative's letter stating that the system is fully tested and operational.
E. Provide one set of factory service and installation manuals, which shall include schematics on each component in the system.

1.7 EXTRA MATERIALS
A. Provide six sets of any keys used in the system.
B. Provide two complete complements of spare fuses used in the system.
C. Provide one spare CPU card, one auto-routing card, and one auto-switching card.

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1. Deliver all cards and pertinent information on the intercom system to the M&PO Intercom Shop upon substantial completion.

1.8 QUALIFICATIONS

A. Manufacturer
   1. Company specializing in manufacturing the products specified in this Section with minimum 5-years of experience.
   2. Company shall have a representative within 150 miles of Palm Beach County School District.
B. Supplier: Company authorized by manufacturer and specializing in supplying products specified in this Section with minimum 5-years of experience.
C. Installer: A company specializing in installing the products specified in this Section with minimum 5-years of experience and factory trained.

1.9 TRAINING

A. Provide minimum of six hours classroom instructions and training for school center.
B. Schedule the training times with school principal.
C. Provide minimum of six hours classroom instruction and training on programming and troubleshooting to the School District Maintenance Department Electronic Technicians.

1.10 WARRANTY

A. The manufacturer and installation contractor shall guarantee the system, equipment and all its components for a minimum of one (1) year from date of final acceptance of the system as documented by the Architect / Engineer. This guarantee shall cover the replacement of all parts and labor to replace the same made necessary by normal usage and wear.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Audio Enhancement – EPIC (Education Paging & Intercom Communications) System
B. Substitutions: Under provisions of Section 01 60 00

2.2 GENERAL REQUIREMENTS:

A. Intercom Paging System:
   1. The system shall be a software-controlled system, whose primary interface is a web-based portal, accessible from any authorized computer.
   2. The system shall provide a simple calendar-based scheduling system for bells. It shall provide the ability to have an unlimited number of bell schedules.
   3. The system shall provide a map-based User Interface. All major functions, including Intercom, Paging, Notifications and Alerts shall be done using the map as the foundation for those actions. Paging shall clearly show on the map where the page audio will be transmitted to.
   4. Bell Schedules shall be easily assigned to days and changed simply with authenticated access to the system through any browser-based device. Bell schedules shall be able to be changed even if a current schedule is active in the system same day and apply immediately.
   5. The system shall support utilizing a shared data network and support (VLAN [Virtual Local Area Network] enabled) or dedicated network as means of distribution for all voice overhead paging, emergency paging, emergency tones, intercom, and class change tones. System shall support routing of traffic across multiple subnets and network segments.
   6. The system shall be capable of accessing all classrooms including portables, and temporary classrooms etc. via IP interface or room audio system with room microphone. This shall

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provide intercom, class change tones, emergency tones, and normal / emergency paging via a wired network to these remote locations.

7. Exterior speakers shall be capable of being on separate zones and programmed separately.
8. The system shall have the ability to produce user defined tone signals for time tones or emergency tones.
9. The system shall have SIP Integration to connect all talk-paths to the VoIP phone system of choice.
10. The system shall provide the ability to support a SIP trunk from the building's VoIP phone system to provide two-way communication from all administrative telephones to any location equipped with a talkback speaker or audio system with room microphone.
11. The system shall interface with any VoIP telephone system using SIP type integration thus allowing the school (s) to upgrade or replace their telephone system without suffering a requirement to replace, or lose any feature of, their internal communications (intercom) system.
12. The system shall provide its own SIP environment, and in the case of a failure of the schools VoIP telephone system, be capable of operating completely independently for all functions, save access from the handsets connected to the schools VoIP system.
13. The system shall not be reliant on WAN or internet connectivity for operation.
14. The system shall provide web access, which will give ability to monitor operations and functions of the system.
15. The system monitors the status of all connected devices for health, SIP connectivity and connected devices including the XD receiver. If a device becomes in a degraded or offline state, the system will monitor a technical contact via email and or SMS as well as show status on the map of the console.
16. The system shall provide web-based off-site programming and diagnostics of the system. It shall also be capable of determining basic circuit faults.
17. The system shall have a Web based administration programming tool which allows the administrative personnel to easily manage Audio Sources, Class Change schedules, paging groups, time updates, holiday schedules and day/night mode operation from an internet browser. System shall support HTML5.
18. The system shall provide calendar-based scheduling up to four years in advance. The system shall be capable of displaying a fully year calendar and differentiating which bell program is scheduled to run on each day. The calendar shall be based on a standard school year and provide a selectable start month for example, it can be configured to run from August to July.
19. The system shall provide discreet control over roles for the system. Roles shall be definable down to the individual feature level and provide the district with the ability to restrict or grant access to any roll individual features or groups of features.
20. The system shall provide web browser access to the system specifically for a teacher. The Teacher screen shall provide information specific to the room that the teacher is assigned to. That information shall consist of, but not limited to, the next scheduled event for the

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room (Bell, Announcement, etc.), Audio/Visual Controls for their classroom technology, Teacher Name, Room Number, an Intercom Call button, and an Emergency call button.

21. The system shall have the ability to carry IP Communications to the edge of the classroom Audio/visual Systems. It shall be able to control connected A/V Devices, provided that those devices are controllable by RS-232
22. The system shall provide 2-way handsfree communication in each classroom.
23. System Classroom and Common Zone network interfaces shall be capable of utilizing standard Cat 6/6a infrastructure for installation from the Telecommunications Closets only to the classroom and/or zone, thus allowing for only one type of wiring infrastructure within the school. Distribution of all voice signaling shall utilize a shared or dedicated network. Systems that require homerun, dedicated, 18 gauge shielded wiring shall not be acceptable.
24. The system shall provide a flexible and robust event engine. In addition to pre-programmed events and actions, the event engine shall be capable of accepting Java-based programming to accomplish advanced integrations and functions.
25. The system shall automatically broadcast page emergency instructions throughout an entire school when an alarm (e.g. lockdown, lockout, security, fire) is tripped or manually activated. The emergency instructions shall be preprogrammed and require no user intervention. The system shall provide redundant alarm annunciation over intercom/paging speakers and is not meant to replace primary fire alarm or security systems.
26. The system shall provide the ability for the school to upload their own recorded files for both Bell Tones, and Notifications
27. The system shall provide the ability to initiate school safety paging announcements, evacuation tones and take cover tones from any telephone within the facility or outside the facility to any other location within the facility or district.
28. IP-enabled two-way voice communication shall be available from any provided telephone or administrative console through any speaker in the system. This shall allow hands-free communication to any classroom or any individual loudspeaker unit. A pre-announce tone shall sound immediately before the intercom path is opened.
29. The system shall provide for a complete personal alert function for each teacher. The alert functionality shall be an integrated part of the administrative head end software and shall not require any separate application or hardware to support this functionality.
30. The teacher personal alert functionality shall be integrated into the classroom microphones and the teacher web screen.
31. The system shall be capable of displaying on the map the location of the alert in the case of a microphone that is within range of its paired receiver, or from the teacher’s web access screen. The system shall also be capable of approximately locating the location of the alert in the case of a microphone that is not in range of its paired receiver. A system, either the microphone system, or the administrative system that is not capable of receiving an alert from a microphone that is not within range of its paired receiver shall not be considered.
32. Upon alert, the system shall have the ability to provide notification on the dedicated console at the front office, or on any other computer which is currently logged into the administrative interface and has the appropriate credentials. The system shall provide both

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an audible tone, and a change on the screen that clearly indicates that an emergency alert has been received.

33. Upon alert, the system shall also be capable of sending e-mail and SMS Text messages to the designated school personnel. These alerts shall include a web link to the administrative console.
34. If cameras are installed in the classrooms, the system shall be capable of showing a live video from the classroom that received an alert. This shall only be shown in the case of an alert where the microphone is within range of its paired receiver.
35. The system shall have the ability to acknowledge the receipt of the alert by changing the indicators on the classroom microphone receiver in the room where the alert was received from. In the case of an alert received from a microphone not in range of its paired receiver, no acknowledge shall be sent.
36. The system shall have the capability of maintaining a record of all alerts that are received and provide appropriate school personnel the capability to enter information about the alert, which shall be maintained in the systems database. That information shall also be made available to appropriate school personnel in the form of a report that shows all alerts that have occurred, their date, time, and the end alert information.
37. The system shall support digital message displays that provide visual feedback in the form of scrolling messages via an LCD or LED display all controlled from the network.
38. The system shall allow for integration into classroom audio system including teacher microphone as required by design. This includes integration to ensure that system notifications, pages and intercom calls take priority over classroom audio sources.

B. Intercom Paging System Network Intercom Interface:

1. Shall allow users to install intercom paging systems spanning multiple building or facilities connected through a VLAN.
2. Network Requirements:
   a. 100/1000 Ethernet switch port configured on a dedicated VLAN.

C. Intercom Paging System Power:

1. All Network interfaces used in the classroom and for the common zones shall be powered via PoE (Power over Ethernet) from the district provided network switches.
   a. PoE switches and network cabling from MDF (Main Distribution Frame) and IDF (Intermediate Distribution Frame) to devices provided by others.
2. All network switches shall include an uninterruptable power source to provide adequate runtime. In the event the school has a generator the UPS systems shall hold the switches long enough until generator power can be provided. Customer to provide all necessary UPS for network switches.

D. Intercom Paging System Administrative Console:

1. The administrative console shall be customizable, flexible and provide full access to the intercom paging system.
2. Console shall be micro-computer based running a Linux OS and run in a Kiosk mode locking the user into the intercom screen.

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3. The supplier is required to provide a dedicated touch screen console for the front office, with a minimum size of 22" Diagonally. The Console shall not require the district to provide any additional hardware, software or licensing. The Console shall also provide a boom microphone attached via USB to the console for paging/intercom use.
4. Administrative access to the system shall be browser based and shall also be capable of being any administrative computer.
5. Functionality to provide full access to all features such as all call, paging groups, emergency tones, control music, WAV file distribution, test rooms, crisis mode, schedules, etc…

E. SAFE SYSTEM & NETWORK PAGING INTERFACE - Audio Enhancement, MS-300
   1. Provide a Network Interface with performance as follows:
      a. Full-Duplex, Hands Free communications on Intercom Call
      b. Amplifier powered only by the PoE power source for emergency paging applications
      c. Mounting Bracket as required
      d. Connections – The following connections shall be available:
         i. Line Output for connecting to auxiliary amplifiers
         ii. 2 External I/O Connections – Terminal Block
            1. Ability to support relay output for interface into other systems.
         iii. RJ45 for PoE Network Connection
         iv. Serial interface for connecting to other equipment or SAFE Compatible equipment.
      e. 1 speaker connection
         i. The system shall provide a speaker connection which is powered exclusively by the PoE power from the network
         ii. Can power up to 2 speakers per device.
      f. Network Connection
         i. The system shall have a network connection with PoE power.
         ii. PoE shall be present on the system in order to provide power for the amplifier during a power emergency
      g. Integrated Network Based Communications
         i. The System shall support the following protocols:
            1. Directed UDP (User Datagram Protocol)
            2. Unicast Audio
            3. Multicast Audio
            4. SIP
            5. TCP Control
               h. Integrated Serial Tunnel over TCP
               i. The system shall have integrated SIP communications and be able to communication bi-directionally with any VoIP communications system that follows the standard SIP protocols.
               j. The system shall also have the ability to operate with multi-cast IP messages as well.
            2. Serial Gateway for Control via the network

F. Analog Intercom System Cabling:
   1. West Penn
   2. Belden

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3. General Cable
4. Mohawk
5. Accepted substitute

G. Intercom Paging System Volume control:

1. Volume control shall be capable of controlling the volume of up to one hundred-fifty (150) 1-way speakers.
2. Volume control shall be mounted on a brushed stainless-steel single gang wall plate with the plate being embossed with a dial scale of “0 through 10.”
3. Volume control shall be equipped with a skirted black knob with white position indicator.
4. Volume control shall include a stainless-steel mounting box and hardware.

H. Intercom Paging System Ceiling Speaker.

1. Ceiling Speaker Specifications

a. Lay-in ceiling speaker shall consist of a white 13.5” grill, a speaker and integral back box or equivalent ceiling speaker with appropriate backbox, grille and tile bridge.
b. Integrated 25/70/100V Transformer with tap settings accessible without disassembling speaker from 1.25W to 15W or 8Ohm bypass.
c. The speaker shall be capable of handling minimum 50 watts continuous power.
d. Sound pressure level at 1 meter on axis with a 1 Watt input shall be 96 dB.
e. The frequency response shall be 86 Hz to 16 kHz.
f. The baffle shall be constructed with a single piece of perforated steel with a white baked on acrylic enamel finish.
g. Shall support seismic cabling from 3 points.
h. The back box shall meet or exceeds UL 2043 for installation in a plenum space
i. Basis of Design Audio Enhancement SP-0300.

I. Intercom Paging System Surface Wall Speaker:

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1. Wall speaker shall consist of a speaker, volume settings and sloped baffle.
2. The speaker, housing and hardware shall be electrically and acoustically matched for a frequency response of 60 Hz to 12 kHz.
3. The speaker shall be 8" (20.32 cm) in diameter and have a ceramic magnet weighing 5 ounces.
4. The voice coil shall be .75" (1.91 cm) in diameter.
5. Voice coil impedance shall be 45 ohm.
6. Operating temperature shall be -20 to + 55 °C (-4 to + 131 °F).
7. The baffle shall be constructed of gray painted steel with a black cloth grille.
8. Maximum dimensions of the housing shall be 10.13" (25.73 cm) H x 12.31" (31.27 cm) W x 4.63" (11.75 cm) D.

J. Intercom Paging System Paging Horn:
1. The paging horn shall be a weather-resistant, high efficiency reentrant type horn speaker.
2. The paging horn shall be equipped with an amplifier and externally accessible volume control.
3. The paging horn shall include an adjustable swivel base.
4. The frequency response shall be 275 Hz to 14 kHz.
5. Dispersion shall be 90° horizontal and 90° vertical.
6. Sound pressure level shall be 121 dB measured at 4 feet (1.22 m) on axis with an input to the amplifier module being -10 dBm at 1 kHz.
7. Distortion shall be less than 2.0% at rated output of 15 watts RMS.
8. Input impedance shall be 600 ohms nominal.
9. The amplifier shall operate on a -24 Vdc nominal, positive ground power supply.
10. Operating current shall be 900 mA at -24Vdc
11. Operating temperature shall be -20 to 55 °C (-4 to 131 °F).

K. Intercom Paging System Volume Control
1. The volume control must support a rotary selector switch with 11 positions.
2. Volume control shall be white in color and be sized to fit a decora style plate.
3. Inputs on control shall support incoming 25/70V signal on both the + and – with outgoing signal on + and -. Support for up to 12 AWG Wire.
4. 25W RMS
5. Basis of Design EPIC-V70v

L. Classroom Sound Reinforcement System:
1. Audio Enhancement – Optimum System
2. A classroom sound reinforcement system shall be installed in all areas of the building as shown on the drawings and as listed in the specifications.
3. Classroom sound reinforcement system shall be fully interfaced to the intercom paging system.
4. The output of the intercom paging system shall directly interface to the classroom sound reinforcement system.
5. The sound reinforcement system shall be capable of integration with the facility intercom/paging system. All sound reinforcement systems shall allow the facility intercom/paging system to directly mute them. The Receiver Module shall have the capability to sense a paging signal from the facility communications system. When a

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page has been sensed, the classroom sound system shall mute local audio to facilitate hearing the facility page.

6. This integration shall give positive control when interfaced to the classroom sound reinforcement system within the system as to cut off or duck all sources within the classroom when an intercom or page announcement is made from anywhere within the school.
7. The classroom sound reinforcement speakers shall be used as the intercom paging system speakers.
8. The intercom paging system speakers shall be connected to receive audio from any of the in-room sources and receive audio from the intercom paging system.
9. The classroom sound reinforcement system shall be mounted in a wall mount enclosure, specifically designed which allows the microphone receiver to remain visible through the door of the enclosure
10. The DECT (Digital Enhanced Cordless Telecommunications) based microphone receiver shall be capable of being mounted directly to the enclosure and connecting to the amplifier utilizing Cat. 6/6a cable.
11. Each microphone input shall have a carrier detect indicator to verify the input is active.
12. The classroom sound reinforcement system shall have a secondary line level output to connect to self-amplified speakers or other audio equipment if needed.
13. The classroom sound reinforcement system shall have an emergency cut-off input that when interfaced to the fire alarm relay contact output shall silence all audio devices within the room in the event of a fire as to help lower the overall decibels levels to help the students and staff hear the audible fire alarm tones / instructions within that room.
14. The classroom sound reinforcement system shall be capable with interfacing to future classroom cameras to capture lesson video and audio together on one recording.
15. The Wireless Microphone shall be capable of adjusting the volume of external audio sources that are connected to the Main Control Unit. The Wireless Microphone shall be powered by a single rechargeable LiON (Lithium-ion) battery which can be charged inside the microphone via a standard USB cable. The Wireless Microphone shall be able to operate for up to a typical eight (8) hour workday on a single charge.
16. Each classroom sound reinforcement system shall include but not limited to the following components:
    a. DECT Based receiver
    b. Amplifier & Network Interface
    c. One wireless microphone with rechargeable LiON batteries
    d. Four ceiling speakers
        i. CS12 – Round Ceiling
        ii. FS17 – Drop in 1’ X 2’

M. Classroom Sound Amplification System (CSAS) EQUIPMENT:

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AMPLIFIER - Audio Enhancement MS-500 Amplifier/Network Interface:

1. Provide a fully PoE Powered Receiver/Amplifier with ability to provide functions described above with performance as follows:
    a. Audio Power: 30 watts RMS mains powered amplifier
    b. 92% Efficient Class D Amplifier
    c. 1% percent THD across full frequency range of amplifier
    d. Frequency Response: 20 Hz to 20 kHz
    e. Power Requirements: PoE 802.3af/at 25.5W Maximum
    f. Signal-to-noise: >89dB
    g. Integrated mounting tabs
    h. Thermal and short circuited protected
2. Controls:
    a. The primary control of the system shall be done through the teacher microphone.
    b. The following functions shall be available via USB connection for setup during installation:
        i. Input Control for multi-media sources and mixed IR source
        ii. Equalizer Controls
        iii. Discreet Output volume controls for each input
    c. RS-232 Control
        i. Provide RS-232 control of the amplifier, and an additional RS-232 port which provides pass through control of a downstream device such as a projector
        ii. RS-232 processor shall be capable of differentiating between commands destined for the amplifier, and responding to those commands, and commands intended for the downstream and passing those commands through to the secondary RS-232 port
        iii. Command pass through shall be bi-directional

    d. Connections – The following connections shall be available:
        i. Four (4) Multi-Media inputs
        ii. Dedicated Line output – for Assistive Listening Device Connection
        iii. Color Coded Connection
        iv. 8P8C RJ45 Connection for Intercom Paging Wall plate
        v. Support for Touch Based Wall Controller on Remote Port
        vi. General Purpose I/O Output on 8P8C RJ45

N. DECT Technology RF Receiver – Audio Enhancement SRC-14

1. The Receiver shall utilize DECT technology. DECT is a radio technology for voice applications. DECT is ideal for the classroom because the use of both frequency and time domain is ideally suited to smaller areas with a large number of users. In each classroom, it will be an independent system, with all necessary electronics to support the receiving & pairing functionality mounted on the wall near the amplifier or in the ceiling. The receiver will be connected to the amplifier through a universal twisted pair

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cable, using balanced audio connections. Power for the receiver shall be provided through the same cable as the balanced audio connections.

2. The receiver shall provide the following functionality. These features shall be included on board the receiver, and not require any external support to perform these functions.
    a. Three Channel DECT based reception
    b. The receiver shall provide both a low and high-power mode selectable via a DIP (Dual In-line Package) switch
    c. Pairing Button for Linking microphone to the receiver
    d. External contacts to allow for a remote pairing button
    e. Stereo Auxiliary Input
    f. Auxiliary Line Level Output – Un-Balanced
    g. Remote control of both microphone channels, and the auxiliary input from the teacher microphone
    h. Public address system mute terminals – This is a contact closure connection when closed, it mutes the audio output from the receiver
    i. Advanced Feedback Blocker
        i. The system shall have the ability to actively control feedback. This shall be done via an analog circuit that provides up to five active filters to control specific frequencies,
        ii. The Feedback Blocker shall also have the ability to lower the overall of the system by up to 6dB, during a user error situation where the overall system gain is manually turned up too high
        iii. The Feedback Blocker system shall automatically remove the filtering upon resolution of the user-initiated error condition
        iv. The Feedback Blocker shall be of an analog design – in order to avoid the detrimental effects of digital sampling, only analog systems shall be considered in order to implement this feature.

    j. Audio Output
        i. The system shall have the ability to provide both three (3) independent audio signals (Ch 1, Ch 2, and Aux) or with the change of a DIP switch, provide a mixed signal
        ii. The system shall provide an audible tone when the remote volume control on the teacher microphone is used. It will also provide a low & high output level, and an on/off selection via a DIP switch setting
        iii. The system shall have the capability of attenuating its output level by -10 dB with a DIP switch setting
    b. Emergency Alert Contacts
        i. The system shall provide a trigger signal when the teacher presses and holds a button on her transmitter for more than two (2) seconds.
        ii. The system shall be capable of providing a visual indication of three (3) red LED's when the teacher initiates a trigger signal
        iii. The system shall also be capable of receiving a trigger acknowledgement signal back from an external source, and altering the visual indicator from three (3) red LED's to two (2) Green and one

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(1) red LED

c. Recording Contacts
   i. The system shall provide for a secondary notification that can be used for future applications such as signaling an NDVR (Network Digital Video Recorder) to start a recording
d. Control System Integration
   i. The system shall have on board the capability of being controlled via RS-232 protocol.
   ii. The system shall also have the capability of broadcasting RS-232 commands when the teacher presses the up/down volume controls on their microphone
e. Power Requirements: 24Vdc, Power Supplied from the amplifier.
f. Operating Frequency – 1.9 GHz Band
g. Receiver Type: DECT
h. Mounting Bracket as required
   i. The receiver shall be capable of being mounted on the ceiling or a wall
   ii. Bracket shall provide mounting to standard electrical boxes
   iii. Controls: System shall have available the following controls
      1. Channel 1 Volume Control – Fully controllable from the teacher microphone remotely through the DECT system
      2. Channel 2 Volume Control – Fully controllable from the teacher microphone remotely through the DECT system
      3. Auxiliary Input Volume Control – Fully controllable from the teacher microphone remotely through the DECT system
      4. Alert Controls on Teacher Microphone – Two (2) buttons on the sides of the microphone
      5. Recording Control on Teacher Microphone – One (1) button on the front of the microphone

O. Teacher Body Pack Transmitter Audio Enhancement STD-14
   1. Provide a body pack transmitter with performance as follows:
      a. Operating frequency – 1.9 GHz - DECT
      b. Audio distortion: <1.0% (±40kHz deviation @ 1kHz)
      c. Integrated microphone
      d. Internal charger circuit
      e. Micro USB Charging Port – shall be capable of being charged from a standard USB port – including a port on a computer
      f. Power button functionality
      g. Power on – turns the microphone on when microphone is off and button is pressed
      h. Mute – mutes the microphone when pressed and released once microphone is turned on
      i. Power Off – push and hold to turn power off
   2. Additional Function (F) Button Features
      a. SAFE Alert Functionality – Provides security alert when the two (2) buttons on the sides of the microphone are pressed and held for more than two (2) seconds
      b. Recording Functionality – Provides simple logic signal when the REC button is pressed

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on the face of the microphone which activates terminals on the receiver

3. External Inputs
   a. Provide an input for an external microphone
   b. Provide an input for a stereo auxiliary input (Mixed to Mono in microphone)
4. Microphone Element – The teacher microphone shall utilize a 10mm microphone element to insure optimum frequency response and maximum pickup of teacher's voice.
5. Power 1 - LiON Long Life Battery (Systems using two (2) batteries will not be considered)
   a. Battery style shall be common between handheld microphone and teacher transmitter. Systems that use different batteries in the handheld vs teacher microphone shall not be considered.
6. Provide remote volume control for the system from the teacher's transmitter
   a. Volume control via the wireless microphone system to allow the teachers to remotely adjust their own volume level.
   b. Volume control for the other channel from the teacher's microphone
   c. Volume control for the auxiliary inputs from the teacher's microphone
   d. Side Alert Buttons – Provide remote control functionality that allows for enabling additional multi-use functions from the teacher microphone.
   e. REC Button – Provide a button on the face of the microphone that can be used for multiple purposes

P. Classroom Intercom Call Button WPA-504/502
   1. Reference technology floor plans for device locations
   2. Single gang decora style call button white in color
   3. Black button for intercom call
   4. 8P8C (RJ45) connection
   5. Matching white decora style face plate
   6. WPA-502 includes red emergency button for alerting

Q. Ceiling Enclosure specifications OPTIONAL
   1. Provide a ceiling enclosure that is sized appropriately for the equipment being installed in each classroom
   2. Ceiling enclosure shall be plenum rated and UL Listed
   3. Overall dimensions shall be to fit in a standard drop tile ceiling.
   4. Enclosure shall support power and data as necessary for equipment.
   5. Cover of enclosure shall support mounting of Audio Enhancement XD Receiver, WPA-501 Microphone, and EduCam360 and be lockable.
   6. Enclosure shall be pre-assembled with equipment by the manufacture

R. Wall Mount Enclosure OPTIONAL

1. Provide a ceiling enclosure that is sized appropriate and specific to house the Audio Enhancement amplifier, Audio Enhancement XD Receiver, AVConnect Receiver and WPA-502/504 Wall Plate. Audio Enhancement receiver shall be seen from the front of the enclosure with accessible buttons.
2. Enclosure shall be wall mountable and support enclosing a single gang 120V electrical outlet.
3. Enclosure shall have a swinging door and a cam or key lock.
4. Enclosure shall be white in color.

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S. HDBaseT HDMI extender Wall Plate specifications (Audio Enhancement AVConnect Kit) OPTIONAL
   a. HDMI: 3D, Deep Color
   b. HDMI Extender Distance: Up to 30m/100ft with
   c. Cat5e UTP. Use Cat6 STP (shielded) if extending 30m/100ft – 70m/230ft. Plenum Rated
   d. Provide USB connection from transmitter at teacher workstation to receiver for passing HID information to interactive technology
   e. Provide an audio line output at the teachers work-station – audio line output shall provide all classroom program material and classroom microphone audio from the amplifier to allow connection of personal assistive listening devices
   f. Input/Output: HDMI Type A female connector
   g. Digital video: Up to 1080p @ 60Hz/50Hz
   h. PC Resolution: Up to 1920x1200 WUXGA
   i. HDCP (High-bandwidth Digital Content Protection) Compliant
   j. HDBaseT Class B Compliant
   k. EDID (Extended Display Identification Data) Support
   l. Provide for an additional VGA (Video Graphics Array) plus 3.5mm audio connection. Connection can be integrated with HDBaseT wall plate extender
   m. resolution: Up to UXGA (1600x1200)
   n. HDMI, VGA, USB and Audio Return shall all be transmitted over a single CAT 6 cable

T. Classroom Intercom, Emergency Alert & A/V Touch Panel Control – Audio Enhancement – Capacitive Touch Control Module (ITC1-M) OPTIONAL
   a. For all locations where an MS-500 Classroom Amplifier/Network Interface is specified.
   b. Coordinate with electrical contractor to make sure a double gang electrical box is available – or use an acceptable double gang mounting ring
   c. Provide a simple, standardized control interface for projectors, monitors, display devices, or other AV devices in a compact double-gang form factor. A CUSTOMIZABLE INTERFACE which will allow for a variety of configurations including full color graphical representations of equipment and buttons as well as multi-page capability.
   d. Package Type: Double-Gang Back Lit Capacitive Touch Screen
   e. Dimensions: 4.5” (L) x 4.5” (W) x 1.25” (D)
   f. Display: 3.5” Capacitive Touch Display
   g. Weight: 6.4 oz
   h. Power Supply: 24Vdc – Powered from GL-300 Amplifier (External Power Supply Not acceptable)
   i. Communications: bi-directional RS232

U. Speaker Station Volume Controls
   1. Single gang decora style call button white in color
   2. 8P8C (RJ45) connection
   3. Output to speaker shall be adjustable from zero to maximum output from amplifier
   4. Knob shall have graduated indications with a designated (off mode)
   5. Install speaker volume controls in the office and staff only areas

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6. Volume control not allowed in the student occupied areas.

2.3 SYSTEM RACEWAY AND MOUNTING BOXES

A. Install all raceway necessary to provide specified equipment function and per print sheets as under the provisions of Sections 26 05 33, 26 05 13, 26 27 16, 26 05 53, and 27 60 00.
   1. Conduit fill shall not exceed 40%.
   2. Provide a pull string in all intercom home run conduits.
B. Install an underground pull box every 400', splices not allowed underground.
C. Install all wiring throughout the intercommunications system in conduit raceway.
D. Install a 24" x 24" x 6" minimum size cabinet with painted wood backboard and screw type terminal strips in point of entry room to each building.
   1. All cabinets shall have a minimum of 24" of excess wire.
   2. All wiring shall terminate through the terminal strips, one wire per connector screw.
   3. Cabinet shall have a hinged latchable cover.
E. Label the conduit at each terminal cabinet as to its destination.
   1. Labeling shall be inside the cabinet in which the conduit terminates.
   2. Label building number, direction, interior or exterior.
F. Permanently label all Intercom system terminal boxes, as (Intercom System).
G. Paint all intercom system junction box covers blue and install a blue round self-adhesive dot on the ceiling tile grid below all intercom junction boxes.
H. Recess the wall speaker back-boxes shall be flush mounted, with recessed baffles having a baked semi-gloss white enamel finish.
I. Call-Origination switch enclosures and speaker volume control-boxes shall be flush single gang boxes, 42" AFF mounted vertically in locations as depicted on the drawings.
   1. Do not install in tack boards or chalkboards.
J. Ceiling speakers for areas with hard ceiling: Ceiling speaker station back boxes shall be recessed with T-bar bridge bracing to prevent ceiling tile sag.
   1. Provide recessed trim ring baffles finished with white enamel.
K. Exterior wall speakers:
   1. Recessed square protective rust proofed back boxes and a white square recessed aluminum alloy, vandal proof grill with tamper proof hardware.
   2. Locate as high as possible, minimum of 8'-2" AFF.
L. Clean inside the terminal cabinets and other enclosures of wire cuts and other installation debris**.**

2.4 CIRCUITING GUIDELINES and INTERCOMMUNICATION SYSTEM WIRING AND CABLE

A. All wiring shall be Cat. 6/6a for connections to speakers, call switches, etc… for future migration to a complete IP (Internet Protocol) based intercom paging system. Cabling from the MDF or IDF to each classroom enclosure shall be provided by others. A patch cable, providing connectivity from the work outlet faceplate to the MS-500 shall be provided by others to the AV contractor for connection to the network.
B. Each classroom / education space to have a dedicated network connection to the intercom paging system head-end to provide 2-way communications from the integrated paging system console as well as the district IP based phone system.
C. Each office / administrative space to have 2-way communications from the paging system and be capable to being addressed from the building telephone system handset.

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D. Media center, cafeteria and gymnasium to have 2-way communications from the paging system and be capable of being addressed from the building telephone system handset
E. Each corridor / common space / exterior space, restrooms, and playfields to have 1-way communications from the paging system and be capable of being addressed from the building telephone system.
F. All wiring shall be in accordance with the Manufacturers specifications and certified for performance.

PART 3 **EXECUTION**

3.1 EXAMINATION

A. Verify that surfaces are ready to receive work.
B. Verify field measurements are as shown on drawings and as instructed by manufacturer.
C. Verify that required utilities are available, in proper location, and ready for use.
D. Verify and coordinate mounting height and exact locations of all mounting boxes with architectural details, furniture layout, and elevations prior to installation.
E. Beginning of installation means installer accepts conditions.

3.2 INSTALLATION

A. The entire system shall be installed in a workmanlike manner, in accordance with approved manufacturers wiring diagrams and these specifications. The contractor shall furnish all conduits, cable tray, surface raceway, wiring, outlet boxes, junction boxes, cabinets etc… as well as all required miscellaneous materials and labor necessary for the complete installation of the cable support / pathway system.
B. Wiring may be in conduits or opened wired in cable tray or "J" hooks above accessible suspended lay-in ceilings. Wiring in walls or exposed on walls shall be enclosed in EMT conduit, see section 26 60 00 for open wiring requirements.
C. Equipment: Equipment shall be neatly and firmly mounted plumb and square with adjacent surfaces with fasteners recommended by the product manufacturer.
D. All equipment shall be mounted with sufficient clearance for observation, servicing, testing and accessible from either the floor or ladder. If any device is installed in a location that is deemed inaccessible by the Owner and or Architect / Engineer, it will be moved to an accessible location by the contractor at no additional cost to the Owner.
E. It shall be the responsibility of the contractor to wire and connect ancillary devices to this system as listed in this specification section.
F. Additions or alterations:
    1. Where additions to or alterations in existing schools involve new wire in existing raceways, remove all the wire in the existing raceways and do not reuse.
    2. Pull new wire in for both new and existing circuits.
G. All cabling and devices shall be labeled with type written labels. Device labels and cable labels shall match the labeling information that is documented on the as-built drawings. Contractor to coordinate labeling schemes and labeling requirements with A/E prior to commencing with final labeling. Labeling system shall be by Brady or Panduit.
H. Install protective wire cages around the intercom station speakers located in the gymnasium and locker rooms and as further noted on the print sheets.
I. Program the system for All Page as well as Zone Pages for the Cafeteria, Media Center, and Auditorium speakers to be able to disconnect the speakers from these areas as needed.
J. The corridor and hallway speakers shall be on separate circuits/zones from speakers on the exterior of the buildings.

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K. Any circuits leaving the building to the outside shall be protected by the appropriate transient protection devices as required by the manufacturer to avoid damage to the system if transient surges are inducted on to these circuits (i.e., lighting strikes).
L. Intercom system and Public Address system (section 27 51 16) shall not share speakers.
M. All junction boxes shall be clearly marked and labeled for easy identification. Flexible connectors shall be used for all devices mounted in suspended lay-in ceiling panels. All conduits, outlet boxes, junction boxes and panels shall be securely installed and anchored with appropriate fittings and connectors to insure positive grounding throughout the entire system.

3.3 FIELD QUALITY CONTROL
A. Perform the field inspection and testing under provisions of Section 01 40 00 and 01 45 00.
B. Perform operational test on completed installation to verify proper operation.
C. Replace equipment, components, and wiring to eliminate audible noise, clicks, pops, or hum when system is in standby or operation.

3.4 MANUFACTURER'S FIELD SERVICES
A. Prepare and start systems under provisions of Section 01 60 00 and 01 75 00.
B. Make final connections to units.
C. Perform field inspection and testing.
D. Demonstrate system operation.

3.5 ADJUSTING
A. Adjust work under provisions of Section 01 75 00.
B. Adjust controls and configuration switches for operation as indicated.

3.6 DEMONSTRATION
A. Provide systems demonstration and instructions under provisions of Section 01 75 00.
B. Employ manufacturer's field representative to demonstrate system operation to Owner's personnel.
C. Conduct walking tour of Project and describe function, operation, and maintenance of each component as well as proof testing of each component.
D. Use submitted operation and maintenance manual as reference during demonstration and training.

3.7 DEMONSTRATION AND TRAINING
A. Training of the Owner’s operation and maintenance personnel is required in cooperation with the Owner's Representative.
1. Provide competent, factory authorized personnel to instruct the operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems.
2. Schedule the instruction in coordination with the Owner's Representative after submission and approval of formal training plans.
B. Provide demonstration and training for all types of intercom systems installed in this project.

END OF SECTION

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SECTION 27 53 09
EMERGENCY SERVICES COMMUNICATIONS

PART 1 GENERAL

1.1 SECTION INCLUDES
- A. Conduits, terminal cabinets, and boxes
- B. Power wiring

1.2 SYSTEM DESCRIPTION
- A. Emergency radio communications systems shall include the furnishing and installation of raceway systems and power feeds for the emergency broadcast receiver, radio communications repeater-station, hurricane shelter communications and wireless propagation enhancement systems.
- B. Raceways, cabinets, and power feeds for the emergency radio communication system shall be designed and installed to allow installation of future Bi Directional Amplifier Systems (BDA) and/or Distributed Antenna Systems (DAS) as required by NFPA 1, NFPA 72, and NFPA 1225.

1.3 SUBMITTALS
- A. Submit under the provisions of Section 01 33 00.
- B. Shop Drawings: Indicate layout, raceway diagrams, and equipment dimensions.
- C. Product Data: Provide data sheets for each item of equipment, depicting equipment capacity.

1.4 RECORD DRAWINGS
- A. Submit under the provisions of Section 01 77 00.
- B. Accurately indicate actual locations of power receptacles, boxes, and conduit runs.

1.5 REGULATORY REQUIREMENTS
- A. System: Listed by UL, ETL, or FM
- B. NFPA 1225

PART 2 PRODUCTS

2.1 DESIGN
- A. Design loads for structure and accessories, auxiliary and collateral loads shall comply with FBC and ASCE7.
  1. Use exposure category C, Risk Category III, for wind design.

2.2 CONDUIT AND BOXES
- A. ALL SITES
  1. Provide & install a 1½" raceway to the outside of building through the roof at the Emergency Broadcast Receiver/Repeater antenna location, terminate with a weather head.
  2. The penetrating portion of conduit shall be a contiguous 10' piece of rigid, with 6' firmly supported at two joist points below the roof penetration and 4 feet above the roof.
  3. Continue this raceway and terminate into a 6" x 6" x 4" box located just above the ceiling at the designated Emergency Broadcast Receiver/Repeater "head-end" room location.
  4. Provide and install two ¾" conduits run from the 6" x 6" x 4" box and terminate into two flush mounted 4-11/16" x 4-11/16" x 1½" boxes with single gang mud rings and single gang covers 48" AFF in their respective locations in the designated "head-end" room.
  5. Minimum conduit size shall be ¾".
- B. ALL BUILDINGS
  1. Provide & install a 1½" raceway to outside of building through the roof at the buildings Wireless Propagation Enhancement location and terminate with a weather head.

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2. The penetrating portion of conduit shall be a contiguous 10' piece of rigid, with 6' firmly supported at two joist points below the roof penetration and 4' above the roof.
3. Continue this raceway and terminate into a 6" x 6" x 4" box located just above the ceiling at the designated Wireless Propagation Enhancement "head-end" room location.
4. For each floor of the respective building, provide and install one ¾" conduit run from the 6" x 6" x 4" box and terminate into one flush mounted 4-11/16" x 4-11/16" x 1 ½" box with single gang mud rings and single gang covers 48" AFF in their respective locations in the designated "head-end" room.

C. HURRICANE SHELTERS

1. Provide and install an antenna mounting structure located next to the Hurricane Shelter antenna stub-out location.
   a. Design the antenna mounting structure to support an antenna array of six 6-element Yagi 9dBd gain antennas model #460-6.
   b. Structure shall meet ASCE-78 requirements.
   c. Top of structure shall be at least 49' (15 Meters) above grade.
2. Provide & install a 2" raceway to outside of building at the designated Hurricane Shelter antenna mounting structure location and terminated with a weather head.
   a. Continue this raceway and terminate into a 6" x 6" x 4" box located just above the ceiling at the designated Hurricane Shelter "head-end" room location.
   b. Provide and install (2) ¾" conduits run from the 6" x 6" x 4" box and terminate into two flush mounted 4-11/16" x 4-11/16" x 1½" boxes with single gang mud rings and single gang covers.
   c. Locate these boxes 80" AFF, parallel with 4" between each in the designated "head-end" room.

2.2 POWER FEEDS

A. Provide and install a dedicated duplex 120-volt power receptacle fed from the life safety branch of emergency generator power source in each of the designated emergency broadcast receiver, radio communications repeater-station, hurricane shelter communications and wireless propagation enhancement systems "head-end" locations.

B. Locate adjacent to the "head-end" single gang boxes.

2.3 TESTING

A. Pre-Enhancement Testing Procedures/RF Survey:

1. The test/RF Survey must be conducted by a qualified and FCC GROL-licensed technician.
2. Testing time and date must be approved by the Building Code Services Department (BCS). Notification must be made to the department a minimum of 72 hours before the test. A representative of the department may be on site to witness the test.
3. Upon completion of all testing, a final report shall be submitted to BCS for review. At a minimum, this report shall include a floor plan identifying each tested area, the location of the test point within the area, dBm reading of each area, uplink and downlink signal Strength with a minimum DAQ = 3.0 or greater voice communication (NFPA 1225-18.9.1 & 2), whether the area Passed or Failed, and a complete spreadsheet with all testing information, including testing method, testing equipment, and weather conditions during testing.

B. Testing Criteria

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1. In all new and existing buildings and structures, a minimum radio signal strength of –95 dBm in the frequency band of 806-821/851-866 MHz is required. Before RF survey, the testing contractor shall verify the frequency band with the local fire department.

2.4 DESIGN AND INSTALLATION

A. Design and installation of Two-Way Radio Communication Enhancement Systems, components, cabling, and other equipment, shall comply with NFPA 70, NFPA 72, NFPA 1221, and NFPA 1225.

B. Two-way Radio Communication Enhancement Systems shall be monitored by the building fire alarm panel and a dedicated annunciator shall be provided.

C. Systems shall have lightning protection that complies with NFPA 780.

D. A construction permit for the installation of, or modification to, Two-Way Radio Communication Enhancement Systems and related equipment is required. The installation must be performed by either a Certified Electrical Contractor, Certified or Registered Alarm Contractor I, or a Two-Way Radio Enhancement Systems Specialty Contractor.

2.5 ACCEPTANCE TEST PROCEDURE AND CERTIFICATION

A. A report shall be submitted to BCS at the conclusion of acceptance testing, containing a floor plan, the signal strength at each location tested, and other relevant information, including as-built drawings.

2.6 ANNUAL TEST REPORT

A. The annual test report shall be maintained with the fire alarm logbook and copies shall be submitted to BCS.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install systems in accordance with NECA "Standard of Installation" and Section 26 05 33.

B. Obtain a detail book from the S.D.P.B.C. School Police Department Security Section for system specifics.

C. Install a 200 lb strength pull string throughout the raceway systems.

D. Mount all junction boxes located above ceiling with the opening facing down, and with a reasonable immediate access pathway provided.

1. Note: The requiring of the removing of a light fixture or other similar ceiling equipment is not a reasonable access pathway).

E. Antenna raceways shall not exceed 100' from the weather head to the designated "head-end" locations.

3.2 DEMONSTRATION AND TRAINING

A. Training of the Owner’s operation and maintenance personnel is required in cooperation with the Owner's Representative.

1. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems.
2. Schedule the instruction in coordination with the Owner's Representative after submission and approval of formal training plans.
3. Refer to Section 01 91 00, Commissioning, for further contractor training requirements.

B. Provide demonstration and training for all types of emergency communications systems installed in this project.

END OF SECTION

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SECTION 27 53 11
FACILITY RADIO REPEATER SYSTEM

PART 1 GENERAL

1.1 SECTION INCLUDES
- A. Conduit and boxes
- B. Power wiring

1.2 SYSTEM DESCRIPTION
- A. Facility Radio Repeater Systems shall include the furnishing and installation of raceway systems, Data, Power feeds, grounding bar, weather head, and Facility Radio Repeater backboard at each Radio Repeater System location.

1.3 SUBMITTALS
- A. Submit under the provisions of Section 01 33 00.
- B. Shop Drawings: Indicate layout, raceway diagrams, and equipment dimensions.
- C. Product Data: Provide data sheets for each item of equipment, depicting equipment capacity.

1.4 RECORD DRAWINGS
- A. Submit under the provisions of Section 01 77 00.
- B. Accurately indicate actual locations of power receptacles, boxes, and conduit runs.

PART 2 PRODUCTS

2.1 CONDUIT AND BOXES
- A. ALL SITES IN ALL BUILDINGS
  1. Provide & install a 1½" raceway to the outside of building through the roof at each Facility Radio Repeater Systems Repeater antenna location, terminate with a weather head.
  2. The penetrating portion of conduit shall be a contiguous 10' piece of rigid, with 6' firmly supported at two joist points below the roof penetration and 4’ above the roof. This conduit shall act as an antenna support and be firmly attached to joist to meet or exceed all Hurricane certification requirements.
  3. Continue this raceway and terminate with a 1-1/2-inch chase nipple with a plastic bushing centered and at 4-inches below the top of the Facility Radio Repeater backboard in building with a single floor.
  4. In buildings with multiple floors provide a 1-1/2-inch conduit from the center and at 4-inches above the bottom of this floors Facility Radio Repeater backboard and terminate with a 1-1/2-inch chase nipple with a plastic bushing. Continue the 1-1/2-inch conduit from this backboard to the top of the next down floor Facility Radio Repeater backboard and terminate with a 1-1/2-inch chase nipple with a plastic bushing. Continue until each floor has a Facility Radio Repeater backboard with a 1-1/2-inch conduit between floors.

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5. Provide and install a Facility Radio Repeater Backboard typically a ¾ -inch 8'H x 4' W fireproof plywood board painted light gray, mounted vertical at all Facility Radio Repeater System locations. *(Typically located in Electrical Rooms in each Building and on each floor of a building. Data rooms could also possibly be used, But only with the approval of the District's Data Services Department. Also if approved the Radio Equipment shall be in its own data rack separate from all other data equipment)*

2.2 POWER FEEDS

A. Provide and install a dedicated duplex 120-volt power receptacle fed from the life safety branch of emergency generator power source in each of the designated Facility Radio Repeater System locations.
B. Locate on the Facility Radio Repeater System backboard at typical electrical outlet mounting height.

2.3 DATA JACK

A. Provide and install a Data Jack at each Facility Radio Repeater System backboard location and above the electrical outlet.

2.4 GROUND BAR

A. Provide and install a 6 lug ground bar at the right hand top of each Facility Radio Repeater System backboard with a #10 green ground wire connected to building electrical ground,

PART 3 EXECUTION

3.1 INSTALLATION

A. Install systems in accordance with NECA "Standard of Installation" and Section 26 05 33.
B. Obtain a copy of the Facility Radio Repeater systems detail drawing from the S.D.P.B.C. School Police Department Security Section for system specifics.
C. Install a 200 lb. strength pull string throughout the raceway systems.
D. Mount all junction boxes located above ceiling with the opening facing down, and with a reasonable immediate access pathway provided.
   1. Note: The requiring of the removing of a light fixture or other similar ceiling equipment is not a reasonable access pathway).
E. Antenna raceways shall not exceed 100' from the weather head to the designated "head-end" locations.

3.2 AVALABLE SPACE FOR RF EQUPMENT

A. Insure that there is available space reserved to install a data rack in front of the Facility Radio Repeater System backboard at each location and adequate space to provide services and repair of the equipment (Typical a 4' x 4' feet square area.)

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3.3 DEMONSTRATION AND TRAINING

A. Training of the Owner’s operation and maintenance personnel is required in cooperation with the Owner's Representative.
   1. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems.
   2. Schedule the instruction in coordination with the Owner's Representative after submission and approval of formal training plans.
   3. Refer to Section 01 91 00, Commissioning, for further contractor training requirements.

B. Provide demonstration and training for all types of emergency communications systems installed in this project.

END OF SECTION

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SECTION 27 53 13
GPS WIRELESS CLOCK SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES
- A. G.P.S. Receiver
- B. Primary Transmitter
- C. Satellite Transmitter
- D. Analog Clocks
- E. Digital Clocks

1.2 REGULATORY REQUIREMENTS
- A. System: Listed by UL, ETL, or FM
- B. Transmitter and receiver shall comply with Part 90 of FCC rules
- C. Transmitter frequency shall be governed by FCC Part 90.35
- D. Transmitter output power shall be governed by FCC Part 90.257 (b)
- E. Obtain operating license for the transmitter from the FCC
- F. Equipment operating at 450 MHz to 480 MHz and 900 MHz will not be installed.

1.3 SYSTEM DESCRIPTIONS
- A. The GPS wireless clock system shall continually synchronize clocks throughout the facility, and shall be capable of clock readouts in multiple time zones where desired.
- B. The system shall synchronize all clocks to each other.
  1. The system shall utilize GPS technology to provide atomic time.
  2. The system shall not require hard wiring.
  3. Clocks shall automatically adjust for Daylight Savings Time.
- C. The Analog Clocks shall be synchronized to within 10-20 milliseconds 4-6 times per day, and the system shall have an internal oscillator that maintains plus or minus one second per day between synchronizations, so that clock accuracy shall not exceed plus or minus 0.2 seconds.
- D. The system shall include an internal clock reference so that failure of the GPS signal shall not cause the clocks to fail in indicating time.
- E. The system shall incorporate a “fail-safe” design so that failure of any component shall not cause failure of the system.
  1. Upon restoration of power or repair of failed component, the system shall resume normal operation without the need to reset the system or any component thereof.
- F. Clock locations shall be as indicated, and clocks shall be fully portable, capable of relocation at any time.

1.4 SUBMITTALS
- A. Submit under provisions of Section 01 33 00.
- B. Shop Drawings: Indicate cable routing and connections.
- C. Submit product data for each item of equipment.
- D. Submit manufacturer's installation instructions.
- E. Submit location of all transmitters and receivers.

1.5 WARRANTIES
- A. Provide manufacturer’s 4-year warranty extension, for a total of 5-year manufacturer’s warranty (transmitter and clocks).

1.6 OPERATION AND MAINTENANCE DATA
- A. Submit under provisions of Sections 01 77 00 and 01 78 23.
- B. Operation Data: Include instructions for routine operation of master and remote stations.

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C. Maintenance Data: Include instructions for repair trouble-shooting (with replacement parts list), preventive maintenance, and cleaning of all equipment supplied.
D. Include manufacturer representative's letter stating that the system is fully tested and operational.
E. Provide one set of factory service and installation manuals, which shall include schematics on each component in the system.

1.7 EXTRA MATERIALS
A. Provide six extra clocks to the owner.
B. Provide twenty (20) extra manufacturer's batteries for the clocks to the owner.

1.8 DEFINITIONS
A. GPS - Global Positioning System, a worldwide system that employs 24 satellites in an integrated network to determine geographic location anywhere in the world, and which employs and transmits atomic time, the most accurate and reliable time.

1.9 QUALITY ASSURANCE
A. Manufacturer shall be a company specializing in manufacturing commercial time systems with a minimum of five continuous years of documented experience.
B. Installer shall be a company with documented experience in the installation of commercial time systems.

1.10 SEQUENCE OF OPERATION
A. Transmitter Operation
1. When power is first applied to the transmitter, it checks for and displays the software version.
2. It then checks the position of the switches and stores their position in memory.
3. The transmitter looks for the GPS time signal.
4. Once the transmitter has received the GPS time, it sets its internal clock to that time.
5. The transmitter then starts to transmit its internal time once every second.
6. The transmitter updates its internal clock every time it receives valid time data from the GPS.
B. After initial setup, the clock will shut off the receiver.
1. Four to six times each day, the microprocessor will activate the receiver and starting with the stored channel, it will again look for a valid time signal.
2. If necessary, the clocks will resynchronize to the correct time.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS
A. Primex Wireless Clocks
B. Rauland-Borg.
C. Sapling
D. Substitutions: Under provisions of Section 01 60 00

2.2 GENERAL REQUIREMENTS
A. General: The clock system shall include a transmitter, a roof mounted GPS receiver (if required system manufacturer), indicating clocks, and all accessories for complete operation.
B. GPS Receiver: GPS roof mounted, with 15-foot cable attached. Provide 50' GPS cable extension.
1. The GPS Receiver shall be a complete GPS receiver including antenna in a waterproof case, 3-7/8 inches by 4-3/16 inches by 2 inches, designed for roof or outdoor mounting.
2. Provide mounting bracket for attachment to roof.
C. Transmitters: Primex 5-watt Wireless **Model 72XR572MHZ XR05EM,** (and/or additional 1 watt Model 14144 Satellite Transmitters, consisting of wireless transmitter with GPS receiver, a built-in

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surge suppressor. Unit shall obtain current NIST-time from satellite. The clock system shall transmit time to all clocks in the system. The Contractor shall provide mounting shelf.

1. Transmission: Frequency Range: 72.100 to 72.400 MHz or other Frequency Ranges as approved by Palm Beach School District, Transmission Range: one mile, open field. Radio technology: narrowband FM. Channel bandwidth: 20 kHz maximum. Transition mode: one-way communication, Data rate: 2-KBps. Operating range: 0 degrees C. to 70 degrees C.
2. Transmitter: Transmitter output power: +26 to +30 dBm. Frequency deviation: +/- 4-kHz. Transmitter power requirements: 120 VAC 60 Hz. Internal power requirements: 5-VDC. Carrier frequency stability: +/- 20-ppm.
3. Transmitter shall have 16 selectable channels to assure interference-free reception.
4. Transmitter shall have the following switches: Time zone adjustment switches for all time zones in the world, including all US time zones: Eastern, Central, Mountain, Pacific, Alaska, and Hawaii. Daylight Saving Time bypass switch. 2-hour or 24-hour display.
5. Transmitter housing shall be black metal case.
6. Transmitter housing shall incorporate a display which shall include the following: Time readout, AM and PM indicator if 12-hour time display is set, Day and date readout, Indicator for daylight savings or standard time, LED which shall flash red in event of reception problem, GPS reception indicator.

D. Antenna shall be commercial type, mounted minimum 46-inches above roof level.

E. Power supply: Primex Wireless **Model 14003** (included) Input: 120 volt AC 50/60 Hz, 0.4 amps, Output: 9 volt DC, 1.5 amps.

F. Cable Connection Sealant: Radio Shack Coaxial Cable Connector Sealant 278-1645, or approved electrical grade silicone sealant.

G. The Wireless Receiver Switches (as may be required): Switches shall receive time packets from the Master Transmitter and relay the synchronized time to the Satellite Transmitter connected to it. The unit shall include the following:

1. Antenna mounted on top of the switch housing, minimum 11-1/2 inches long.
2. Power Supply: Input 120 VAC 50/60 Hz, 0.4 amps Output: 9 volt DC, 1.5 amps.
3. RS 232 data cable, minimum 5 feet long.
4. Daylight Savings Time bypass switch.

H. Satellite Transmitters (as may be required) Primex Wireless Model **14401**: Satellite Transmitters shall receive the signal from the Wireless Receiver Switches and transmit the signal to the devices in its vicinity, which are out of the range from the Master Transmitter. The unit shall include the following:

1. Antenna mounted on top of the housing, minimum 46 inches long.
2. Power Supply: Input: 120 VAC, 50/60 Hz, 0.4 amp Output: 9 volt DC, 1.5 amps
3. 6 foot cord
4. Surge Suppressor/Battery Backup
5. Mounting Shelf
6. Approximately one Watt transmission
7. 72 MHz frequency

I. Traditional analog clocks: Each classroom shall be provided with Primex Wireless analog clocks, 12-1/2 inch diameter, Primex Model **14155,** or The Media Center, and Cafeteria shall be provided with a 16-inch diameter clock, Primex Wireless Model **14157.** Analog clocks shall be wall mounted using the manufacturer's supplied hardware. Clocks shall have polycarbonate frame and polycarbonate lens. Face shall be white. Hour and minute hands shall be black. Analog clocks shall be provided with red sweep second hand.

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1. Analog clocks shall be capable of automatically adjusting for Daylight Saving Time. An on-off switch located on the transmitter shall disable this function if desired
2. Time shall be automatically updated from the transmitter 6 times per day
3. Analog clocks shall remember the time during changing of batteries
4. Provide manufacturer's two (2) alkaline batteries per clock.
5. Analog clock receivers shall be as follow: Receiver power: two alkaline batteries and Antenna type: internal.

2.3 ADDITIONAL REQUIREMENTS

A. If transmitter stops transmitting valid time signals due to power failure, the clocks will continue to function as accurate quartz clocks until a valid time signal is decoded.
B. Analog clock faces shall bear Owner's logo as indicated, where required.
C. Provide 16-inch diameter analog clocks for media centers, cafeterias, and gymnasiums.
D. Wire guards: Provide Model No. **14123**, 18 by 18 inch size, wire guards for clocks installed in gymnasiums.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that construction is complete in spaces to receive equipment and that rooms are clean and dry.
B. Verify that 120-volt electrical outlet is located within 6-feet of location of transmitter and the outlet is operational and properly grounded.
C. Verify and coordinate mounting height and exact locations of all clocks with architectural details, furniture layout, and elevations prior to installation.

3.2 INSTALLATION

A. The local manufacturer's direct employee shall approve completed installation, and a written statement signed by such individual provided to the Owner certifying installation is working properly and installed in accordance with manufacturer's recommendations.
B. System shall be installed in compliance with local and state authorities having jurisdiction.
C. At completion of installation and prior to final acceptance, turn on the equipment; ensure that all equipment is operating properly, and that all clocks are functioning.

3.3 FIELD QUALITY CONTROL

A. Perform the field inspection and testing under provisions of Section 01 40 00 and 01 45 00.
B. Perform operational test on completed installation to verify proper operation.
C. This device must accept interference received, including interference that may cause undesired.
D. This equipment may not cause harmful interference.
E. System shall be installed in compliance with local and state authorities having jurisdiction.

3.4 MANUFACTURER'S FIELD SERVICES

A. Prepare and start systems under provisions of Section 01 60 00 and 01 75 00.
B. Make final connections to units.
C. Perform field inspection and testing.
D. Demonstrate system operation.

3.5 ADJUSTING

A. Adjust work under provisions of Section 01 75 00.
B. After initial setup, the clock will shut off the receiver. Six times each day, the microprocessor will activate the receiver and starting with the stored channel, it will again look for a valid time signal. If necessary, the clocks will resynchronize to the correct time.

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C. If the clock has not decoded a valid time signal a pre-determined number of days, it will go to a step mode. Non-signal reception can be caused by low battery voltage. If this occurs, replace the batteries.
D. Provide manufacturer's lithium batteries in clock and follow set up procedures detailed in manufacturer's instructions.

3.6 DEMONSTRATION

A. Provide systems demonstration and instructions under provisions of Section 01 75 00.
B. Employ manufacturer's field representative to demonstrate system operation to Owner's personnel.
C. Conduct walking tour of Project and describe function, operation, and maintenance of each component as well as proof testing of each component.
D. Use submitted operation and maintenance manual as reference during demonstration and training.

3.7 DEMONSTRATION AND TRAINING

A. Training of the Owner's operation and maintenance personnel is required in cooperation with the Owner's Representative.
    1. Provide competent, factory authorized personnel to instruct the operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems.
    2. Schedule the instruction in coordination with the Owner's Representative after submission and approval of formal training plans.
    3. Provide minimum of two hours classroom instructions and training for school center. Schedule the training times with school principal.
    4. Provide minimum of two hours classroom instruction and training on programming and troubleshooting to the School District maintenance Department Electronic Technicians.

END OF SECTION

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SECTION 27 60 00
OPEN WIRING

PART 1 GENERAL

1.1 CONDITIONS

A. Open wiring or wiring installed without the use of raceways is permitted in new and existing buildings only when specifically approved by Palm Beach School District Building Department and shown on the approved drawings.
B. Installation of open wiring shall meet the following requirements and restrictions of this section.

1.2 REFERENCES

A. ANSI/EIA/TIA 569
B. NFPA 70 – National Electric Code

PART 2 PRODUCTS

2.1 Not Used

PART 3 EXECUTION

3.1 INSTALLATION

A. Open wiring may be installed only for the following systems: data, telephone, ITV, security, video, card access, weather bug, intercom, EMCS, and other non-life safety control voltage wiring as approved by Building Department.
B. Open wiring not allowed for life safety systems such as fire alarm and voice alarm systems.
C. Open wiring not allowed for power and light systems.
D. Open wiring not allowed where in violation of applicable NFPA codes and standards.
E. Open wiring allowed only above accessible ceiling spaces.
F. Conductors installed within walls, on walls exposed to view, and on the exterior surfaces shall be in approved raceways:
    1. Conductors shall be within walls in raceways.
        a. Raceways shall be supported on top to an approved junction box located above ceiling and on the bottom to a 2/1/2” deep outlet box flush mounted into the wall at required height.
    2. Conductors may be installed on walls exposed to view in surface raceways (wiremold) upon obtaining approval from School District Project Manager.
G. All cables installed shall be parallel or at right angles to the building walls or other construction lines in a neat and orderly manner.
H. Suspend J-hooks and bridal rings cabling supports from or attached to the structural ceiling or walls with hardware specifically designed to support their weight.
    1. Supports shall be structurally independent of the suspended ceiling.
    2. Maintain a minimum 12" separation between cables supports and suspended ceiling.
    3. Horizontal cables shall not rest directly on ceiling panels of the suspended ceiling or any equipment.
    4. Separate systems using same J-hooks shall be grouped by tie wire or different color conductors
I. Install J-hook or bridal ring hanging supports located within 5 feet centers maximum.
    1. Provide supports as required to adequately support and distribute the weight of the cable.
    2. Utilize supports specifically designed to support the required cable weight and volume.
    3. Provide a minimum of two hangers or bridal rings at all 90" bends.

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4. Provide a hanger to support the extra cable loop at the outlet location.
5. Submit the installation details for review and approval to the building department.

J. Do not install or use trapeze hangers as cable supports.
1. Tie wraps shall not be used as cable supports

K. Utilize flex tray or cable tray where the cable quantity exceeds the design amount for a J-hook.
1. Any area with 40 or more cables shall utilize a cable tray.
2. The school district project manager shall approve the use of multiple J-hooks.
3. Do not exceed the cable installation area of the J-hook or bridal ring.
4. Support the cable where it comes off the cable tray.
5. Use of ceiling tiles and ceiling grid hanger wires for support of cables is prohibited.

L. Route station cables and tie cables installed within ceiling spaces through these spaces at right angles to electrical power circuits and supported only from the structure.

M. The contractor shall adhere *to* the manufacturer requirements for bending radius and pulling tension of all systems cables.
1. Minimize cable tensions in suspended cable runs by using suitable equipment and practices.
2. Comply with the ANSI/TIA/EIA cable tension requirements

N. Ensure to maintain the proper firestopping at all fire rated walls, floors, and ceilings.
1. All conduit sleeves and penetrations shall be firestopped using an approved system

O. Cables installed above ceiling spaces that are being used for air plenum shall be UL listed and labeled as plenum rated cables.
1. Contractor shall verify existing ceiling spaces before ordering cables.

P. Flexible metal conduits may be used within existing interior walls to extend cables from above ceilings down to outlets on the walls.
1. Terminate flexible conduits above ceilings in approved junction.

Q. Provide conduits from terminal cabinets in the systems and electrical rooms to within corridors.
1. Locate conductors above corridors ceilings for extended runs.
2. Only conductors that terminate in classroom or other instructional space or office may be installed above same room ceiling

R. Installers must consider electromagnetic interference (EMI) as outlined in Section 10.4 of ANSI/EIA/TIA 569. Pathways shall avoid sources of EMI
1. Separate open wiring on pathways by at least 12" from fluorescent light fixtures.
2. Separate open wiring pathways by at least 12" from electrical power and lighting conduits.
3. Pathways shall cross perpendicular to fluorescent lighting and electrical power conduits.
4. Open wiring pathways shall be separated at least 4' from HVAC equipment motors and electrical transformers.
5. Open wiring shall be separated and routed away from any cable that passes through or is adjacent to the outside of the building or subject to lightning strikes or power surges.

S. The penetration of partitions and/or horizontal assemblies with open wiring must confirm with the appropriate following conditions:
1. Through penetrations of walls/partitions and horizontal fire assemblies whether fire-resistant rated or non-fire resistant rated (including smoke partitions) shall be sleeved with electrical metallic tubing (EMT) sleeves.
2. Membrane penetrations or through penetrations of fire resistant rated partitions or horizontal assemblies shall be protected by an approved through penetration fire stop system.
3. Regarding the penetration or smoke partitions, fill the space around penetrations with an approved material to limit the free passage of smoke.

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4. Regarding the penetration of non-fire resistant rated horizontal assemblies: penetrations that connect not more than 2-stories are permitted provided the annular space is filled with an approved material to resist free passage of flame and products of combustion.

3.2 INTERFACE WITH OTHER PRODUCTS

A. Identify other systems and equipment above ceiling before installing new wires.

END OF SECTION

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SECTION 28 13 00
ACCESS CONTROL

PART 1 GENERAL

1.1 SECTION INCLUDES
- A. Conduit and boxes
- B. Power wiring

1.2 SYSTEM DESCRIPTION
- A. Card access system shall include the furnishing and installation as noted here:
  1. Conduit system and power feeds.
  2. Installation and Connecting of Door Hardware Power Supplies.
  3. Wiring and Connecting of Electric Door Hardware.
  4. Wiring and connecting of elevators.

1.3 SUBMITTALS
- A. Submit under the provisions of Section 01 33 00.
- B. Shop Drawings: Indicate layout, raceway diagrams, and equipment dimensions.
- C. Product Data: Provide data sheets for each item of equipment, depicting equipment capacity.

1.4 RECORD DRAWINGS
- A. Submit under the provisions of Section 01 77 00.
- B. Accurately indicate actual locations of cabinets, boxes, and conduit runs.

PART 2 PRODUCTS

2.1 MAIN terminal board
- A. Surface mounted on ½" thick plywood backboard painted tan.

2.2 CONDUIT AND BOXES
- A. Provide and install for each building according to the following criteria:
  1. There must be one Access Control Panel within 200' of edge device.
  2. Each eight (8) controlled devices and the cabinet must be located on the same floor as the controlled devices.
  3. Raceway shall not exceed 400' without a pull box.
  4. Do not provide 1/2” conduits, minimum conduit size shall be ¾".
- B. Provide and install ¾" conduits from Access Control Panel and distribute to feed the junction and mounting boxes designated for the area.
  1. Each separate ¾" feed will supply no more than two Controlled Device/Card Reader Feed locations.
- C. Provide and install an elevator interface cabinet, 12” x 12” x 4” with hinged lockable cover and a ½" plywood backboard painted tan with a 10 - lug terminal strip mounted on the board at all designated elevator control panel locations.
  1. Feed this interface box from the ¾" card access raceway.
  2. Provide and install a separate ¾" raceway from the box into elevator control panel.
  3. Label this box “Card Access/Elevator Interface”.
  4. The Elevator Contractor shall extend his control wiring from the elevator control panel to this interface box.
- D. Provide 4-11/16" x 4-11/16" x 2⅛" flush mounted box with single gang mud ring and weatherproof cover at each elevator stop.
  1. Mount the box adjacent to the elevator call-button box and use a ¾" conduit to connect the two boxes.

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2. Run a ¾" conduit from the 4-11/16" x 4-11/16" x 2⅛" box back to the nearest Card Access terminal cabinet and terminate.

E. At each externally controlled door, install the electric hardware's power supply above drop ceiling within 50' of the hardware.
   1. In "separate" raceway, supply 120V feed to the power supply.
   2. Provide and install a ¾" conduit from the supply box to a neutral 6" x 6" x 4" distribution box located next to the supply. Feed this box from the ¾" card-access system raceway.
   3. Provide and install from box in 2.2-E-2 an additional ¾" raceway along with (8) 18AWG and (2) 12AWG conductors run from the supply box to feed the electrical power transfer device
   4. Supply box noted in 2.2-E, connect the electric hardware through the electrical power transfer device.

F. At each internally controlled door, install the electric hardware's power supply above drop ceiling within 200' of the hardware.
   1. In "separate" raceway, supply 120V feed to the power supply.
   2. Provide and install a ¾" conduit from the supply box to a neutral 6" x 6" x 4" distribution box located next to the supply.
   3. Feed this box from the ¾" card-access system raceway.
   4. From this box provide and install an additional ¾" raceway along with (8) 18AWG and (2) 12AWG conductors run from the supply box to feed the electrical power transfer device.
   5. From the supply, using that wiring, connect the electric hardware through the electrical power transfer device.

G. Provide and extend raceway to feed 4-11/16" x 4-11/16" x 2⅛" flush mounted boxes with single gang mud ring and weatherproof covers; mounted with the opening vertical, at all designated card reader locations.
   1. Locate to the strike side of single doors, and as designated for double doors, elevator control, and gates.
   2. Center 4' above finished floor.

H. Provide and install a 2" conduit from the closest IDF/MDF room to a brooks box located at designated entry gates.
   1. Exact location determined during plan review.

I. Provide and install a 4-11/16" x 4-11/16" x 2⅛" card access feed junction box with cover, at the interior side of all designated card access door locations.
   1. If the area location has removable ceiling tile, the box shall be located above the tile.
   2. If the location has a structure of fixed ceiling material then flush-mount the box with a square to round mud ring & cover.

J. Provide and install a 4-11/16" x 4-11/16" x 2⅛" flush mounted box with single gang mud ring and weatherproof cover; mounted with the opening vertical at 48" AFF as the designated "TeleEntry" mounting box.

K. Provide and install a 4-11/16" x 4-11/16" x 2⅛" flush mounted box with single gang mud ring and weatherproof cover; mounted with the opening vertical at 60" AFF as the designated "Master Key Control Box" mounting box, and provide a 24" x 24" free space for mounting the Key Box.

L. Provide and install a ¾" conduit from the IDF/MDF room Access Control Panel.

M. Provide and install six additional recessed mounted 4-11/16" x 4-11/16" x 2-1/8" boxes with flush single gang ring and cover; mount the opening vertical with ¾"-conduit run to nearest card access junction box, (estimate 100' of conduit for each run).
   1. Wall mounted locations directed in the field during construction prior to final above ceiling inspection.

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POWER FEEDS

N. Provide a double duplex, dedicated 120-volt power receptacle fed from the optional branch of emergency generator power source, adjacent to the lower portion of the main terminal cabinet and each distribution cabinet.

O. Provide and install dedicated 120-volt power feeds from the optional branch of emergency generator source to all Electric Hardware Power supplies.

2.5 CARD ACCESS SYSTEM FOR THE ELEVATOR

A. The Electrical Contractor shall provide and install a 1" conduit with string from the Card Access/Elevator Interface cabinet to the Elevator Machine Room Cabinet.
   a. The Electrical Contractor shall provide and install a 4-11/16" x 4-11/16" x 2⅛" flush mounted box with single gang mud ring and weatherproof cover at each elevator stop.
   b. Mount the box adjacent to, within 8" of the elevator call button box, and use a ¾" conduit to connect the two boxes.
   c. Run a ¾" conduit from the 4-11/16" x 4-11/16" x 2⅛" box on the first floor to the second and third floor.
   d. From the first-floor box provide and install a 1" conduit with string to the Card Access/Elevator Interface cabinet.
   e. Provide and install a double duplex, dedicated 120-volt power receptacle fed from the optional branch of emergency generator power source, adjacent to the lower portion of the Card Access/Elevator Interface cabinet.

B. The Elevator Contractor shall provide and install a HID ProxPro Reader-Wiegand/Clock and Data 5355/8A in each elevator cab.
   a. The Elevator Contractor shall provide and install all necessary wiring to ensure that the card access system can control each elevator floor stop location.
   b. Elevator cabling and card reader cabling shall meet the manufacturer's requirements and the code.
   c. If drawings do not provide installation detail, obtain installation detail from the School Police Department.
   d. The Elevator Contractor shall provide and install a terminal strip inside the Card Access/Elevator Interface Cabinet and land the card reader wiring and elevator control wiring here and label each.
   e. The Elevator Contractor shall install a temporary shorting bar to act as a closed switch for each elevator floor stop in the Card Access/Elevator Interface Cabinet.
   f. The Elevator Contractor shall at each elevator call station located at each elevator stop; provide and install a two conductor wires from the elevator call station box.
   g. These wires shall pass through the ¾" conduit between the elevator call station box and into the 4-11/16" x 4-11/16"x 2-1/8" card access junction box adjacent to the elevator call box (refer to installation detail).
   h. In the elevator call station box disconnect the wire from one leg of the call button then connect one of the wires to the open leg of the call button.
   i. Then connect the other wire to the wire removed from the call button leg.
   j. In the card access junction box, connect the two wires coming from the elevator station call box together using a wire nut.
   k. At the completion of the work the elevator shall perform the following functions:

C. Inside the Cab
   a. The card reader in the cab shall control each floor stop button.

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b. The cab shall have an override key operated switch that will override the in cab card reader and allow access to each floor stop button.
c. The cab shall have an override key operated switch that will override the cab card reader, allow access to each floor stop button, and provide elevator cab capture for emergency responses forces.
d. The elevator function shall meet the elevator code.

D. Elevator call box station
a. The card reader at each elevator call box station location shall control the call button.
b. The elevator call box station on each floor shall include an override key operated switch that will override the card access system and allow the call button to activate the elevator.
c. The elevator call box station on each floor shall include an override key operated switch that will override the card access system and allow the call button to activate for emergency responses forces.
d. The elevator function shall meet the elevator code.

2.6 Cabling
A. Use of the composite cable is approved, however it must follow the same codes and manufactures spec as though they were running independently.

PART 3 EXECUTION

3.1 INSTALLATION
A. Install system in accordance with NECA "Standard of Installation" and Section 26 05 33.
B. Obtain a detail book from the SDPBC School Police Department Security Section for system specifics.
C. Permanently label all conduits as to plan room number destination, at all Control panels and power supplies.
D. Paint all Card access system junction box covers tan.
E. Install ½" (tan round indicators) of paper construction on ceiling tile grid work at all locations where card access system boxes are located above the drop ceiling.
F. Install 200 lb strength pull string throughout the raceway system.
G. The Card Access System raceway shall be a separate raceway and shall not interconnect with or be used by any other system without the authorization of the SDPBC School Police Department Security Section or per DMS sections 28 16 00, 28 33 00, 27 53 10.
H. Mount all junction boxes located above ceiling with the opening facing down, and with a reasonable immediate access pathway provided.
1. Note: The requiring of removing of a light fixture or other similar ceiling equipment is not a reasonable access pathway).
I. All conduit runs shall be as direct as possible in order to save on wiring costs and to reduce poor performance due to cable loss.
J. Refer to SDPBC DMS Section 08 71 00 for Card Access Door preparation.

3.2 LOCATIONS
A. Provide a card reader/controlled device at the following locations:
1. Administrative main entry
2. Main entry door to facility
3. Principal’s office
4. Police Officers office
5. Nurses station
6. Bookkeeper’s /treasurer’s office

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7. Drop safe location
8. Media center
9. A/V storage room
10. CCTV studio area
11. Cafeteria main entry
12. Cafeteria receiving
13. Cafeteria dry food storage area
14. Cafeteria manager’s office
15. Elevator entry on all floors
16. Gymnasium
17. Auditorium
18. Custodial receiving
19. Video Surveillance Control Room Door
20. MDF Room
21. Playgrounds/athletic fields
22. Other areas as defined in the SDPBC plan specific review process.

3.3 DEMONSTRATION AND TRAINING

A. Training of the Owner’s operation and maintenance personnel is required in cooperation with the Owner's Representative.
   1. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems.
   2. Schedule the instruction in coordination with the Owner's Representative after submission and approval of formal training plans.
   3. Refer to Section 01 91 00, Commissioning, for further contractor training requirements.

B. Provide demonstration and training for all types of card access systems installed in this project.

END OF SECTION

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SECTION 28 16 00
INTRUSION DETECTION

PART 1 GENERAL

1.1 SECTION INCLUDES
- A. Main cabinet
- B. Terminal cabinets
- C. Conduit and boxes
- D. Power wiring

1.2 SYSTEM DESCRIPTION
- A. Security system shall include the furnishing and installation of main and distribution terminal cabinets, conduit system and power feeds.
- B. Knox Box for School Police Department and Fire Department

1.3 SUBMITTALS
- A. Submit under the provisions of Section 01 33 00.
- B. Shop Drawings: Indicate layout, raceway diagrams, and equipment dimensions.
- C. Product Data: Provide data sheets for each item of equipment, depicting equipment capacity.

1.4 RECORD DRAWINGS
- A. Submit under the provisions of Section 01 77 00.
- B. Accurately indicate actual locations of cabinets, boxes, and conduit runs.

PART 2 PRODUCTS

2.1 MAIN CABINET
- A. Steel construction #14 gauge 36" x 36" x 6" cabinet with hinged lockable cover on ½" thick plywood backboard painted light gray.
  1. Also, allow a 4' x 4' empty space above or to either side of the main cabinet at a centerline of 7' for additional security equipment.
- B. Main cabinet shall be surfaces mounted.
- C. Locate the Main Security Cabinet in the Video Control room; however, Section 2.3A has priority.
- D. The location of the main, Ahead-end@, security terminal cabinet shall not exceed 95' from the antenna weather head.

2.2 BUILDING & FLOOR DISTRIBUTION CABINETS
- A. Steel construction #14 gauge 12" x 18" x 6" cabinet with hinged lockable cover on ½" thick plywood backboard painted light gray.
- B. All distribution cabinets shall be surfaces mounted.

2.3 CONDUIT AND BOXES
- A. Criteria for security antenna stub out location:
  1. This location will be based on the Radio Frequency assigned to the site and the direct line of site from the antenna to the repeater location and will be selected at time of review.
  2. The security system radio has a direct line of sight antenna to the repeater located at Latitude (26, 35, 20 N) and Longitude (080, 12, 43 W) US441 and Lantana Road.
- B. Provide & install a 3” raceway to outside at the antenna mounting structure designated location and terminated with a weather head.
  1. The penetrating portion of conduit shall be a contiguous 10' piece of rigid, with 6' firmly supported at two joist points below the roof penetration and 4' above the roof.

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2. The raceway shall continue and terminate against the wall below the ceiling 90" AFF over the main Ahead-end@ Terminal Cabinet capped with an EMT set screw connector and fiber bushing.

C. Provide and install an antenna mounting structure locate next to the antenna stub-out (see B).
   1. Design the antenna mounting structure to support an antenna array of six 6-element Yagi 9dBd gain antennas model #460-6.
   2. Structure shall meet ASCE-78 requirements.
   3. Top of structure shall be at least 49' (15 Meters) above grade.

D. Provide & install a building distribution cabinet for each building.
   1. Provide & install a separate 2" raceway from the main head-end@ cabinet for each building distribution cabinet.
   2. For buildings with more than one level, provide a floor distribution cabinet for each additional floor level.
   3. Feed each of these cabinets with a separate 2” conduit from the main building distribution cabinet.
   4. If any floor level area is greater than 20,000 sq ft, provide additional floor distribution cabinets; with no one cabinet feeding more than 20,000 sq ft.
   5. Raceway shall not exceed 400' without a pull box.

E. Provide & install ¾" conduits from the distribution cabinets and distribute to feed all junction and mounting boxes in the distribution area.
   1. Each ¾" conduit shall feed no more than 16 wall sensor mounting box locations.
   2. Each of these conduit runs shall leave and return to the cabinet, (looped).

F. Provide & install a separate ¾" conduit from the main security terminal cabinet to the fire alarm main terminal cabinet.

G. Provide & install a separate ¾" conduit from the nearest security distribution cabinet to all walk-in refrigeration units, and terminate this conduit to the unit’s temperature-sensor relay enclosure.

H. Provide & install a separate ¾" conduit from the nearest security distribution cabinet to the emergency electric generator control panel.

I. Provide & install a recessed mounted 4-11/16" x 4-11/16" x 2-1/8" boxes with flush single gang ring and single gang cover; mounted with the opening vertical, located 12" to the side of the intercom speaker or clock; in rooms where clocks or speakers are designated.
   1. Refer to the prototype classroom layout.
   2. If a projection screen will block the security device in this location, move the security junction box to clear the blockage to either side of the projection screen.

J. Provide & install recessed mounted 4-11/16" x 4-11/16" x 2-1/8" sensor mounting boxes with single gang ring and single gang cover; mounted with the opening vertical, 90" above the floor and 15' from any exterior doors or exterior glass (susceptible to entry) at the following locations:
   1. All interior corridors
   2. In rooms that do not have a clock or speaker but have exterior doors or glass.
   3. Electrical rooms, mechanical rooms, storage rooms, etc. That may allow access through them to the interior of the building.

K. Provide & install recessed mounted 4-11/16" x 4-11/16" x 2-1/8" sensor mounting boxes with single gang ring and single gang cover; mounted with the opening vertical, 90" above the floor and 15' from the entry/exit doors in the following areas:
   1. Cafeteria manager’s office
   2. Media CCTV studio

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3. Media CCTV storage room
4. P.E. storage room
5. P.E. office
6. Main Telephone Equipment Room
7. Clinic

L. Provide & install an additional 4-11/16" x 4-11/16" x 2-1/8" box above suspended ceiling directly above each wall sensor-mounting box.
   1. Locate the box no higher than 36” above the ceiling, in the same room as the wall mounted boxes.

M. Provided and install two recessed mount Knox-Box with UL listed tamper switches, ¼" plate steel housing, ⅛" thick door with interior gasket seal.
   1. Both boxes and locks shall have 2" steel dust cover with tamper seal mounting capability.
   2. Finish color shall be Aluminum for Police and Black for Fire.
   3. Mount boxes at 4 feet AFF.
      a. Use Knox-Box as, Manufactured by The Knox Company, Model 3221 for Fire Department and 3225 for Police Department with the recessed mounting kit (3240).
         i) All recessed mounting kit shell housings, including the cover plate and screw heads, is flush with the finish wall.
         ii) Install the housing plumb to insure vertical alignment of the vault.
      b. Provided and install a ¾" conduit from the back of the Knox Box to a 4-11/16" x 4-11/16" x 2-1/8" box with cover, located above the nearest removable ceiling tile.
         i) Continue the conduit run to the nearest security terminal cabinet.
      c. The District's Senior Project Manager shall coordinate with the Department of School Police and the Contractor in transmitting the Knox authorization forms completed by the Department of School Police to assure it is keyed to the SDPBC AMaster@.
      d. Obtain the Knox authorization form for the Fire Department Knox box from the Fire Department having jurisdiction.

N. Provide & install a separate ¾" conduit from the back of the Fire Departments (Knox Box) enclosures to a 4-11/16" x 4-11/16" x 2-1/8" box with cover, located above the nearest removable ceiling tile.
   1. Continue the conduit run to the nearest security distribution cabinet.

O. Provide & install a separate ¾" conduit from the main security cabinet to the main telephone room terminal-board.

P. Provide & install a ¾" conduit between all security distribution cabinets and all card-access distribution cabinets, at all terminal cabinet locations.

Q. Provide & install six additional recessed mounted 4-11/16” x 4-11/16” x 2-1/8" sensor mounting boxes with flush single gang ring and single gang cover; with the opening mounting vertical with ¾" conduit run to nearest security junction box, (Estimate 100' of conduit for each run.)
   1. District shall direct the wall mount locations in field during construction prior to final above ceiling inspection.

R. Do not provide ½” conduits, minimum conduit size shall be ¾”.

2.4 POWER FEED

A. Provide & install a dedicated 120-volt normal power duplex outlet located adjacent to the upper portion of the main security system's cabinet.

B. Provide & install a dedicated 120-volt duplex outlet fed from the optional branch of the generator power source, adjacent to the normal power receptacle.

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PART 3 EXECUTION

3.1 INSTALLATION

A. Install system in accordance with NECA "Standard of Installation" and Section 26 05 33.
B. Obtain a detail book from the S.D.P.B.C. School Police Department Security Section for system specifics.
C. Permanently label all conduits as to plan room number destination, at all terminal cabinets.
D. Paint all Security system junction box covers black.
E. Install ½" (black round indicators) of paper construction on ceiling tile grid work at all locations where security system boxes are located above the drop ceiling.
F. Permanently label all the security-system terminal cabinets, "security system".
G. Install 200 lb strength pull string throughout the raceway system.
H. Mount all junction boxes located above ceiling with the opening facing down, and with a reasonable immediate access pathway provided.
    1. Note: Requiring the removal of a light fixture or other similar ceiling equipment is not a reasonable access pathway).
I. The Security system raceway shall be a separate raceway system and shall not interconnect with or be used by any other system without the authorization of the Department of School Police Security System Section or per DMS sections 28 33 00, 27 53 10, and 28 13 00.
J. All conduit runs shall be as direct as possible in order to save on wiring cost and to reduce poor performance due to cable voltage loss.

3.2 DEMONSTRATION AND TRAINING

A. Training of the Owner’s operation and maintenance personnel is required in cooperation with the Owner's Representative.
    1. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems.
    2. Schedule the instruction in coordination with the Owner's Representative after submission and approval of formal training plans.
    3. Refer to Section 01 91 00, Commissioning, for further contractor training requirements.
B. Provide demonstration and training for all types of intrusion detection systems installed in this project.

END OF SECTION

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SECTION 28 31 00
FIRE ALARM and SMOKE DETECTION SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES
- A. Fire alarm with emergency voice evacuation notification and smoke detection systems

1.2 REFERENCES
- A. NFPA 72
- B. NFPA 101
- C. NFPA 1

1.3 REGULATORY REQUIREMENTS
- A. System: UL listed
- B. Conform to requirements of NFPA 101
- C. Conform to requirements of NFPA 72
- D. Conform to requirements of NFPA 1
- E. Florida Building Code (FBC)
- F. Americans with Disabilities Act (ADA)
- G. Life Safety Code NFPA 101: Positive Alarm Sequence is required by SDPBC.
- H. National Fire Alarm and Signaling Code NFPA 72, Article [23.8.1.2.1]: Positive Alarm Sequence is approved and permitted by the authority having jurisdiction, SDPBC.

1.4 SYSTEM DESCRIPTION
- A. Fire alarm/Emergency Voice Communication Panel: Non-coded, supervised, electrically impulse, manually operated fire alarm system with voice evacuation notification.
- B. Additions to a system: U.L. listed for use with the existing system manufacturer's control panel.
- C. System Supervision
  1. Provide electrically supervised system, with supervised alarm initiating and alarm signaling circuits.
  2. Occurrence of single ground or open condition in initiating or signaling circuit places circuit in TROUBLE mode.
  3. Component or power supply failure places system in TROUBLE mode.
  4. Occurrence of single ground or open condition on alarm initiating circuit does not disable that circuit from transmitting in ALARM.
  5. Occurrence of single ground or open condition on signaling circuit does not disable that circuit from transmitting in ALARM.
- D. A newly installed, replaced, or upgraded fire alarm system shall be programmed for Positive Alarm Sequence, in accordance with NFPA 72-Chapter 23-Article [23.8.1.2].
- E. Alarm Sequence of Operation: Actuation of manual fire alarm station or automatic initiating device causes system to enter ALARM, which includes the following operations:
  1. Sound and display local fire alarm signaling devices with non-coded march time signal.
  2. Transmit non-coded signal to remote security monitoring equipment.
  3. Indicate location of device that is in alarm on fire alarm control panel and the alarm zone on remote annunciator panel.
  4. Transmit signals to building elevator control panel to initiate return to main floor or alternate floor.
  5. Transmit signal to building mechanical systems to initiate shutdown of fans and damper operation.
  6. Transmit signal to release door hold-open devices.
  7. Transmit signal to all gas-valve shutoff devices, and other auxiliary equipment.

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8. Accomplish all incidental functions required by FBC, NFPA 72, and NFPA 101.
9. The system shall provide a three-pulse temporal signal to the horns or voice evacuation system. A switch shall be provided on the control panel for silencing the alarm devices. Any additional incoming alarm shall operate normally. Each alarm shall be represented on the control panel by an audio and visual indication.

F. Alarm Reset: Key-accessible RESET function resets alarm system out of ALARM if alarm-initiating circuits have cleared.

G. Trouble Sequence of Operation: System trouble, including grounding or open circuit of supervised circuits, or power or system failure causes system to enter TROUBLE mode, including the following:
1. Visual and audible trouble alarm by specific device at control panel
2. Visual common trouble signal at annunciator panel
3. Manual ACKNOWLEDGE function at control panel silences audible trouble alarm; visual alarm is displayed until initiating trouble is cleared.
4. Transmit common trouble signal to remote security monitor control.

H. Lamp Test: Manual LAMP TEST function causes alarm indication at each zone at fire alarm control panel and at annunciator panel.

I. A connection to the chemical fire extinguisher system of the kitchen so that the auxiliary alarm contacts of the extinguisher control initiates the fire alarm system.

J. Provide for future circuit wiring a compliment of all the conductors needed for all types of initiation, signal, and auxiliary functions from the control panel to designated future portable locations.
1. Provide the termination point in the closest building terminal boxes to the future site.
2. Provide one extra initiation point or address for future feeds in the program.
3. Provide one extra notification circuit for future feeds in the program.

1.5 QUALIFICATIONS

A. Manufacturer:
1. Fire alarm/Emergency Voice Communication Panel:
a. "Simplex Model 4100ES", Or latest available model of 4100ES
b. "Notifier Model NFS2-3030, Or latest available model of NFS2-3030
c. “Edwards Systems Technology EST4”, Or latest available model of EST
d. "Cerberus Pyrotronics Model Desigo with 2500 points

2. Vendor must be capable of providing local training and service support to SDPBC fire alarm personnel.
3. The Fire alarm/Emergency Voice Communication Panel shall be of a type previously installed in SDPBC and operating satisfactorily for at least three-years, unless SDPBC grants in writing an exception.

B. Installer
1. A company specializing in smoke detection and fire alarm systems with 5-years of experience, certified by the State of Florida's Licensing Board as fire alarm installing contractor.
2. Proof of appropriate certification and registration is required.

1.6 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 01 33 00.

B. Provide system wiring diagrams and conduit layout, complete battery load calculation, wiring and conduit sizes, wiring color codes, data sheets, and equipment ratings, layout, dimensions, and finishes.

C. Submit manufacturer's installation instructions under provisions of Section 01 33 00.

D. Submit manufacturer's certificate under provisions of Section 01 40 00 that system meets or exceeds specified requirements.

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E. On construction projects and renovations done in phases, Fire Alarm Shop (FAS) requires a Pre-Construction Agreement for each phase of the work prior to the contractor starting the project.
   1. The FAS requires (24) hour notice prior, to the start of each phase.
      a. FAS will dispatch a technician to meet with the contractor on the job site and jointly establish the status of the F/A panel at the start of the project.
      b. Problems which appear later that were not there at the start of the project, must be fixed by the contractor.
   2. If the contractor(s) start the work without a Pre-Construction Agreement, they are accountable for the F/A system function and repairs.

1.7 PROJECT RECORD DRAWINGS
   A. Submit documents under the provisions of Section 01 77 00.
   B. Provide accurately indicated locations of terminal boxes, junction boxes and all peripheral devices as well as the conduit run and point-to-point connection diagrams on disk in "AutoCAD" file format.

1.8 OPERATION AND MAINTENANCE DATA
   A. Submit data under provision of Sections 01 77 00 and 01 78 23.
   B. Include operating instructions, and maintenance and repair procedures.
   C. Include manufacturer representative's letter stating that system has been inspected, tested and is certified as fully operational as specified by NFPA 72.

1.9 DELIVERY, STORAGE, AND HANDLING
   A. Deliver products to site under provisions of Section 01 60 00.
   B. Store and protect products under provisions of Section 01 60 00.

1.10 EXTRA MATERIALS
   A. Provide spare parts under provisions of Section 01 77 00.
   B. Provide twelve keys of each type.

1.11 ALLOWANCES
   A. Provide for ten (10) additional Alarm Lights (strobe lights) installed as directed in the field.
   B. Provide for ten (10) additional Speaker/Strobe Lights installed as directed in the field
   C. Provide for five (5) additional Manual Stations installed as directed in the field.
   D. Provide for five (5) additional Ceiling Mounted Smoke or Heat Detectors installed as directed in the field.
   E. Allowance includes purchase, delivery, and installation of box, fire alarm device, and 100 feet of conduit and cables for each device.

1.12 COMMISSIONING
   A. Commissioning of a system or systems specified in this section is part of the construction process.
   B. Documentation and testing of these systems, as well as training of the Owner’s operation and maintenance personnel is required in cooperation with the Owner's Representative and the Commissioning Authority.
   C. Project Closeout is dependent on successful completion of all commissioning procedures, documentation, and issue closure.
   D. Refer to Section 01 77 00 - Contract Closeout, for substantial completion details.
   E. Refer to Section 01 91 00 - Commissioning, for detailed commissioning requirements.

PART 2 PRODUCTS

2.1 ADDITIONS TO EXISTING SYSTEMS NOT REQUIRING A NEW CONTROL PANEL
   A. All products shall match the existing system exactly.
   B. In lieu of an exact match, products compatible to the existing system are acceptable only with documentation from the control system manufacturer's authorized representative, stating compatibility as well as the UL cross-listing.

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C. In additions and renovations where fire alarm system is up-graded (new fire alarm panel is provided), all the fire alarm devices including the fire alarm devices in the relocatables shall be compatible with the up-graded fire alarm system.
D. Bidder shall visit the site and verify all existing conditions, and shall include in his bid all the work necessary for a fully functional fire alarm system.
E. New fire alarm system devices may be connected to existing loop, circuit or wiring.
   1. However, existing loop, circuit, or wiring shall be upgraded to fully meet the requirements of the fire alarm system and these specifications.
   2. In lieu of upgrading existing loop, circuit or wiring contractor may choose to provide new loop, circuit and wiring for new devices.
F. Additions and renovations of fire alarm system up-grades (new fire alarm panel); submittals to Building Department shall include circuit capacity of all existing fire alarm system circuits.
   1. Successful bidder must visit the site and fully survey and analyze the existing system in preparation of required submittals.

2.2 FIRE ALARM AND SMOKE DETECTION CONTROL PANEL

A. Control Panel: The control panel shall provide power, annunciation, supervision, and control for the detection and alarm system and shall be modular in construction, and contain all modules necessary to operate according with this section.
   1. The detection system shall remain 100% operational and capable of responding to an alarm condition while in the routine maintenance mode.
      a. The system shall be capable of having the entire total number of detection devices in alarm at the same time, without any loss of function.
      b. The control panel shall be capable of supporting non-addressable as well as addressable detection devices.
      c. The panel annunciator shall be a minimum, 32-character alphanumeric display, providing an optional user definable message associated with each detection device or zone.
   2. The control system shall provide the supervision of system electronics, wiring, devices, and software.
      a. Monitor for the failure of system hardware or wiring with an independent hardware watchdog, which will indicate their failure.
      b. The system shall provide failsafe operation, i.e. incoming alarms shall automatically override all other modes of operation, and the panel shall automatically return to normal operating mode from any operator initiated mode.
      c. Provide ground fault detection for all initiating and audible circuits.
   3. Provide lamp test capability to test all visual panel indicators and associated software.
      a. Make provisions for remote trouble and remote alarm silencing switches.
      b. The control panel shall be equipped with a silence before reset feature, designed to prevent accidental system reset during an alarm condition.
   4. The system alarm lamp shall flash upon receipt of any alarm condition.
      a. Acknowledgement of the alarm by operation of the silence switch shall silence the audible alarm and cause the alarm lamp to light steadily.
      b. Receipt of subsequent alarms shall cause the audible devices to resound and the alarm lamp to flash.
   5. The system trouble lamp shall flash and an integral trouble buzzer shall sound upon the occurrence of any trouble condition.
      a. Acknowledgement of the trouble condition by operation of the silence switch shall silence the audible alarm and cause the trouble lamp to light steadily.

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   b. Receipt of subsequent troubles shall cause the trouble buzzer to resound and the trouble lamp to flash.
6. Use the same pair of wires to perform the individual input and output device addressability.
   a. The system shall be capable of having all addressable devices in alarm simultaneously.
7. The service mode shall permit the arming and disarming of individual input or output devices as well as manually operating output devices.
   a. Provide one-step function switches to allow the disarming & arming of groups of inputs or outputs, according to the grouping requirements of the School District.
   b. The control panel shall display the status of these devices upon command.
   c. The panel shall automatically return to normal mode in the event the panel remains unattended in the service mode for more than 4-hours.
   d. The panel shall be capable of receiving and processing alarms even when in the service mode.
8. The control shall operate from a three-wire 120 VA supply and internal 24V back-up battery.
   a. Separately fuse all power connections whether AC or DC within the control unit.
   b. Include light emitting diodes (LED's) to indicate (green) system power, (yellow) trouble, and (red) alarm; with trouble and alarm annunciated on an alphanumeric display, giving device number and location plus diagnosis of trouble.
   c. Momentary contact switches shall provide for Locate, Next Alarm, Next Trouble, Acknowledge/Silence, and Reset.
   d. An audible device shall sound within the control for alarm or trouble.
   e. This device shall have two distinct sounds, and shall be silence able by the acknowledge/silence switch.
   f. Alarms shall override any trouble condition.
9. The control CPU and power supply shall be capable of powering up to 960 addressable early warning detectors and up to 960 addressable auxiliary relays.
   a. All system expansion modules shall interconnect through a card edge connector and shall require no inter-module wiring.
   b. The control shall be capable of measuring and adjusting the sensitivity of detectors.
   c. Provide an alphanumeric display, to display custom messages and give readings of detector sensitivity, detector by detector.
   d. The system shall check each device on an addressable initiating circuit continuously for the following: sensitivity, response, open shorts, ground faults, functionality, and status.
   e. The control CPU shall report the failure of a device's transmitting component(s) for open or shorts on an addressable initiating circuit.
   f. Recognize and identify the device by location with the circuit to the specific device, and all other devices shall continue to function properly.
10. The control shall report, by specific device number, any device removed from an addressable initiating circuit and all other devices shall continue to function.
11. The control shall allow changing the status of configured circuits (arming or disarming and changing status of relays).
   a. If any change in status degrades system operation as configured, a trouble condition shall be reported and remain until system operation again meets configured status.
12. FACP shall include the necessary hardware to provide remote access via an Internet/Intranet Interface.
   a. The Internet Interface shall provide an alternative access to system information using the familiar interface of a standard Internet browser.

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b. Remotely located authorized personnel can use this access to analyze control panel status during non-alarm conditions and to assist responder during alarm conditions.
c. The Internet Interface shall provide single user access for multi-user accounts each with separate password.
    i) Provide programmable lockout to prevent excessive login attempts by unauthorized users.
    ii) Provide a built-in email feature that will automatically notify user accounts of individually selected status changes
    iii) (i.e.: Alarm, Trouble, Supervisory, Sensor Sensitivity Status, and Historical Logs, for the same, on demand or via a selectable schedule-weekly, bi-weekly, or monthly).

13. The control shall allow for expansion and shall be configurable without system inter-wiring.
    a. Leave 20% of points or addresses on each mapnet loop available for future additions on fire alarm system.
    b. Leave capacity for one additional NAC panel per loop for future expansion.
        i) For example if one loop can support five NAC panels, use no more than four and leave one NAC panel capacity for future use.
14. The manufacturer shall provide all system software, configuration software, training, licensing and required certification that is necessary in order to allow the SDPBC Fire Alarm Shop to perform their own modifications, additions, and deletions to the fire alarm system.
15. The system shall have capability to provide a level III access to view all past trouble and alarm events on site.
16. The system shall be capable of providing a hardcopy written record of all alarms, troubles, and system activity by means of full carriage width terminal to print detection device designations and location messages on a single line of up to 128 characters wherein 32 are reserved for device or zone custom identification. Printer is not required.
17. New unacknowledged alarms and troubles shall be distinctively displayed on the visual display and differentiated from previous alarm and troubles.
18. The system shall automatically indicate the total quantity of alarms and of troubles, which have occurred prior to reset at the control unit.
19. No alarm or trouble indication shall be re-settable until acknowledged.
20. It shall not be possible to reset the system without acknowledging all alarms, it shall be possible to display up to 250 alarms and up to 250 trouble indications one at a time on the digital annunciator, which shall be capable of listing, upon request:
    a. Alarms with time, date, and location
    b. Troubles with time, date, and location
    c. Status of output functions, "on" or "off"
    d. Sensitivity of addressable smoke detectors
    e. Device number, type and location
    f. Status of remote relays, "on" or "off"
21. The fire alarm system's programmed database of initiation devices shall be "hard burned" (stored in permanent memory) not reliant on a power source of any form.

B. Power Supply: Adequate to serve control panel modules, remote detectors, remote annunciator(s), door holders, smoke dampers, relays, and alarm signaling devices and 20% spare capacity.
C. Connect the system to the life safety branch of emergency generator.
    1. The system shall have battery backup.
    2. Size the batteries to provide 24-hours of standby operation followed by five-minutes of alarm.
    3. Provide a dual rate battery charger, which is capable of recharging the batteries to 80% capacity in 12-hours.

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4. Loss of commercial power shall annunciate as a system trouble.
5. System trouble shall indicate for over or under voltage conditions, blown fuse or disconnected batteries.
6. The system shall indicate visually and audibly when operating from standby power.
7. The system shall automatically restart upon the return of power.

D. Detection Circuits:
1. Addressable device input supervisory modules capable of Class A or Class B supervision, Class B is allowed with the following conditions:
   a. Total number of devices on any circuit shall not exceed 80% of manufacturer's recommended capacity.
   b. The end line resistors shall be located in the fire alarm terminal cabinets.
   c. Any construction on an active campus requires hand excavation in locations within 10' of any known or suspected location of utility or wiring.
2. For Class A fire alarm system the minimum separation between the outgoing and return conduits shall be 18" where the conduits are horizontal and 6" where the conduits are vertical.
3. Addressable devices shall be monitored, each device uniquely identifiable.
4. Capable of supporting non-addressable initiating devices through installation of additional modules.
5. Sized and programmed, suitable for all initiating devices connected to the system and an additional 100 possible future expansion devices.

E. Signal Circuits
1. Supervised march time signal modules, sufficient for signal devices connected to system and two additional unused circuits, tested, installed and programmed for future expansion.
   a. All shall be designed for use with audible circuit operation with Class A or Class B supervision, Class B is allowed with the following conditions:
      i) Total number of devices on any circuit shall not exceed 80% of manufacturer's recommended capacity.
      ii) The end line resistors shall be located in the fire alarm terminal cabinets.
      iii) Any construction on an active campus requires hand excavation in locations within 10' of any known or suspected location of utility or wiring.
   b. For Class A fire alarm system the minimum separation between the outgoing and return conduits shall be 18" where the conduits are horizontal and 6" where the conduits are vertical.

F. Remote Station Outputs: Provide a self-restoring relay to output common trouble conditions and a re-settable relay to output common alarm conditions to the Owner's security interface equipment.

G. Auxiliary Relays: Provide sufficient SPDT auxiliary relay contacts to provide accessory functions specified. Relays shall be wired fail-safe. Failure of the relay or circuit shall cause the controlled device to go into a safe condition.

H. Provide one-step, panel mounted RECALL switch.

I. Do not provide panel with DRILL switches.

J. Supervised booster panels, or remote power supplies may be used to power and supervise the notification appliance circuits.
1. Install Manufacturer recommended transient absorption devices at booster panels.
2. Install remote booster panels or remote power supplies in electrical or mechanical rooms.
3. Do not install fire alarm system equipment in locations that are not readily accessible.
4. Connect booster panels and remote power supplies to the life safety branch of generator.

2.3 INITIATING DEVICES

A. Manual Station

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1. Semi-flush mounted, double action manual station equipped with an addressable interface module that interfaces the manual station and the addressable initiating circuit.
2. It shall be field programmable.
3. The double action product shall not be of the type, which uses disposable components, (i.e.: break glass).

B. Heat Detectors
1. Combination rate-of-rise and fixed temperature, rated 135°F and temperature rate of rise of 15°F or 190°F (fixed only), as specified.
2. Addressable and controlled by the system control panel.
3. Each detector to be uniquely identifiable and be field programmed.
4. Calibration and device identification monitored by the system control panel.
5. Heat detectors shall be self-restoring type.

C. Ceiling Mounted Smoke Detector
1. Addressable detector controlled by the system control panel.
2. Photoelectric type with adjustable sensitivity, removable from base, auxiliary relay contact, and visual indication of detector actuation, suitable for mounting on 4" (100 mm) outlet box, and each detector shall be uniquely identifiable and field programmable.
3. The system control panel shall monitor calibration, device identification, and sensitivity.
4. The sensitivity controlled by and reading received by the system control panel upon request.
5. Exceptions
    a. In Additions to Existing Systems, where the control panel is a non-addressable type:
        i) The ceiling mounted smoke detectors shall be compatible to the existing system and the smoke detector shall be removable from its base.
        ii) The base shall accommodate both ionization and photoelectric type area smoke detectors.

D. Duct Mounted Smoke Detector
1. Photoelectric type with auxiliary SPDT relay contact duct-sampling tubes extending width of duct and visual indication of detector actuation in duct-mounted housing.
2. Provide remote test station with key switch and red LED status indicator.
    a. Wire the remote test station to the duct smoke detector via remote relay.
    b. Mount the remote test stations 48" AFF.
    c. Group all remote test stations at one place inside the mechanical room.

E. The sensitivity controlled by and reading received by the system control panel upon request.

F. In Additions to Existing Systems where the control panel is a non-addressable type, the duct detector must be compatible with the existing system and the housing shall be molded plastic.
1. An integral filter system shall be included to reduce dust and residue effects on the detector and housing.
2. Sampling tubes shall be easy to install after the mounting the housing to the duct, by passing through the duct housing.
3. The smoke detector shall be removable from the base and the base shall accommodate either ionization or photoelectric smoke detectors.
4. The unit shall also accommodate a remote key operated test switch with visual remote indicator.

2.4 NOTIFICATION DEVICES

A. Alarm Lights: Strobe lamp and flasher with red lettered FIRE on white lens.

B. Alarm Horn
1. Flush type with wall trim plate (interior), surface type (exterior), and fire alarm horn.
2. Provide additional integral strobe lamp and flasher with red lettered FIRE on white lens.

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C. Speaker/Alarm Lights
   1. Flush type with wall trim plate (interior), surface type (exterior), and fire alarm speaker.
   2. Provide additional integral strobe lamp and flasher with red lettered FIRE on white lens.

D. Remote smoke detector alarm lamp assembly: flush mounted with red LED to indicate remote (above ceiling or obscured from normal view) detectors alarm status.

E. Voice Alarm Panel: Provide and install a new voice alarm panel. System shall be capable of distributing voice messages throughout the building via an audio amplifier and fire alarm speakers. Provide the following features:
   1. Multiplexed audio wiring.
   2. Distributed audio.
   3. Pre-recorded evacuation message using solid-state electronics. May provide different message or tones on events.
   4. Remote All-Call page option.
   5. Medium system capacity.
   6. Multiple channel capability for up to 4 audio channels.
   7. Style Y or Style Z speaker circuit operation.
   8. Speaker and telephone on/off manual switches with custom labels.
   9. 30 watt and 120 watt audio amplifiers with switch-mode power supplies.
   10. All-call switch and indicator.
   11. Field recorded message option.
   12. Zone-coded voice options.

F. Audio Amplifier: provides up to 120 watts of 25 VRMS audio power, low-power standby mode for low battery drain, high-efficiency switched regulation, plug-in terminal strips and cable connectors, and 10-position level adjust and indicator LED's, and includes a built –in automatic tone generator (slow whoop on high/low).

2.5 AUXILIARY DEVICES

A. Door Release: Door closer as specified in Section 08 71-00

B. Provide magnetic door holder with integral diodes to reduce buzzing 24 VAC coil voltage.

C. Mount the armature with bolts extending through the entire depth of the door, (through bolted).

D. Devices shall be wired failsafe. Failure of the device or circuit shall cause the controlled device to go to a safe condition.

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2.6 SYSTEM RACEWAY

A. Install all raceway necessary to provide specified equipment function and per print sheets as under the provisions of Sections 26-05-33, 26-27-16 and 26-05-53.
B. Install flexible conduit to duct detectors.
C. Install an 24" x 24" x 6" minimum size cabinet with hinged and lockable cover and with internal wood backboard and screw type terminals in point of entry room to each building.
    1. All wiring shall terminate through the terminal strips, one wire per connector screw.
    2. Mount all ends of line devices (resistors) in these cabinets.
D. Install a 36" x 36" x 6" minimum size cabinet with hinged, lockable cover, wood backboard and terminal strips. Locate cabinet within 25’ of fire alarm control panel but not in the main administration reception area.
    1. All system field wiring shall terminate through terminal connections in this cabinet.
    2. Use one wire per connector screw.
E. Label conduit at each terminal cabinet as to its destination, building number, direction interior or exterior.
F. Provide a grounding bar in every terminal cabinet and bond to the main building grounding system with a #8 AWG.
G. Permanently label all fire alarm terminal boxes, panels and relay enclosures (Fire Alarm).
H. Paint all fire alarm junction box covers orange and install an orange round dot on the ceiling tile grid below all fire alarm junction boxes and equipment located above the ceiling.
I. All conduit connections to terminal cabinets and control cabinet shall have bushings installed.
J. Raceway shall not exceed 400' without a pull box.
K. Maximum Number of conductors in a conduit shall not exceed 40% conduit fill.

2.7 FIRE ALARM WIRE AND CABLE

A. Fire Alarm Power Branch Circuits: Building wire as specified in Section 26 05 13.
B. Initiating Circuits and Auxiliary Control
    1. Building wire as specified in Section 26-05 13.
    2. Non-power limited fire-protective signaling cable, copper conductor, Class 1, 600-volt insulation and Article 760 of NEC Power limited circuits.
    3. Constructed shall be in accordance with articles 318, 340, 500 & 501 of NEC.
    4. Passing VW-1 Vertical Flame Test
    5. If stranded annunciator point wiring, maximum of seven strands
C. Signal Circuits, Door Holder and Annunciator point wiring: Building wire as specified in section 26-05 13, 600 volt insulation, Type THWN stranded (maximum of 19 strands), and in accordance with NEC 310.
D. Each separate circuit, initiation, signal and auxiliary shall have a specific number.
    1. Label each conductor by this circuit number at the control connections and at each terminal connection in the terminal boxes.
E. Install a grounding conductor through the entire conduit system and bonded to each device, junction box, terminal box, and control panel.
F. Use cables listed for wet locations below grade.

2.8 SURGE SUPPRESSION

A. Provide surge protection devices on all wires that enter and leave the fire alarm control panels and the fire alarm booster panels.
    1. Provide surge protection devices on all 120-volt power circuits serving the fire alarm control panels and the fire alarm booster panels.
    2. Provide a dedicated cabinet to house the surge protection devices. Locate cabinet within 5’ to 25’ of the fire alarm panel or booster panels.

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PART 3 EXECUTION

3.1 INSTALLATION

A. Install system in accordance with manufacturer's instructions.
B. All terminal connections in terminal cabinets and in equipment shall be made using solder less block spade connectors suitable for use with the wire gauge and screw terminal applied to.
C. Mount end-of-line devices (resistors) in the building terminal cabinet nearest the circuit.
D. Mount outlet box for electric door holder to withstand 80 pounds (36.3 kg) pulling force.
    1. Wall magnet mounting boxes shall have solid backing support behind.
E. Make conduit and wiring connections to door release devices, sprinkler flow switches, sprinkler valve tamper switches, fire-suppression system control panels, duct smoke detectors, and all other specified peripherals.
F. Install duct access panels at all locations of sampling tubes locations.
G. Install all exterior equipment, mounting boxes and junction boxes with all precautions necessary to insure the wiring and equipment is "weatherproof".
H. In additions to existing systems, the contractor shall phase the contract with the concurrence of the Owner; to assure that the minimum amount of manipulation events occur to the existing fire alarm system.
    1. Schedule all modifications and additions to the existing fire alarm panel or circuits in advance with the concurrence of the Owner, to allow them to observe the code required re-acceptance inspection.
I. Install duct smoke detectors within mechanical rooms at heights accessible for service, usually no more than 20' AFF.
J. Clean the inside of the terminal cabinets and other enclosures from wire cuts and other installation debris.
K. Fire alarm visual alarm signal devices (strobe lights) shall be set at 80” to 96” to the bottom of the devices’ above finished floor.
L. Speaker sound levels in gymnasiums, auditoriums, cafeterias, and kitchen shall be minimum 85 db and maximum 110 db.

3.2 FIELD QUALITY CONTROL

A. Perform field inspection and testing under provisions of Section 01 40 00.
B. Test in accordance with NFPA 72 and additional owner requirements.

3.3 MANUFACTURER'S FIELD SERVICES

A. Provide manufacturer's field services under provisions of Section 01 40 00.
B. Include services of certified technician to supervise installation, adjustments, final connections, and system testing and field service certification per NFPA 72.
C. The equipment installer and/or manufacturer as required by NFPA 72 shall prepare a certificate of completion.
    1. Complete parts 1, 2, and 4 through 10 after installing the system and checking installation wiring.
    2. Complete part 3 after completing the operational acceptance tests.
    3. Provide a filled-out preliminary copy of the certificate to the Owner after the completion of the installation wiring tests.
    4. Submit a final copy to the Owner, after completion of the operational acceptance tests.
D. After each re-acceptance test and after final acceptance testing, the Contractor shall provide the Owner with completed NFPA 72 inspection and test forms, verifying that the system passes the testing requirements of NFPA 72 and is thereby "operational".

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E. Upon final acceptance of the systems, the Contractor shall provide the Owner with an operator's manual.
   1. Installation instructions covering all new system equipment with PDF files and an AutoCAD computer disk of the fire alarm system "As-Built".
   2. Depicting architectural room along with fire alarm device layout, fire alarm riser diagrams depicting point to point conduit runs with wiring counts, wire gauge, wire color, and function noted on each conduit run
   3. Provide a second copy of the as-build (fire alarm) to the Fire Alarm shop.

3.4 FIRE ALARM WIRE AND CABLE COLOR CODE

A. Provide fire alarm circuit conductors with color-coded insulation as follows:
   1. Additions to Existing Systems
      a. Match existing gauges and color code, except for signal circuits that shall be as for new systems.
      b. If non-addressable devices are used, use Purple and Blue for initiation devices and Pink (positive) and Grey (negative) for A/C shut down and gas shut down.
   2. New Systems
      a. Initiating Device Circuit and field relay controls: 1-pair #18 gauge shielded Cable, Red casing.
      b. SDPBC requires the initiating device circuits wiring for the underground installations to be twisted/shielded cable.
      c. Initiating device circuits wiring for the above ground installations shall be twisted/shielded cable, if required by the equipment manufacturer.
         i) Horn Circuit: #12 AWG Orange (positive), #12 AWG Brown (negative).
            a) For longer than 200’ wire run, increase wire gauge to comply with manufacturer’s requirements.
         ii) Strobe Circuit: #12 AWG Yellow (positive), #12 AWG Gray (negative).
            a) For longer than 200' wire run, increase wire gauge to comply with manufacturer’s requirements.
         iii) Door Release: #12 AWG Yellow (positive), #12 AWG blue (negative).
         iv) Speaker Circuit: 1-pair #18 gauge shielded Cable, Green casing
         v) Annunciator Point Wiring Power use #14 AWG Orange, positive and #14 AWG brown, negative.
            a) Processor connection #18 AWG shielded pair.
         vi) Equipment Grounding Conductor: #12 AWG Green.
         vii) Spares: Provide 4 #10 AWG, White spare wires and one spare data cable in each fire alarm system terminal cabinet.

3.5 DEMONSTRATION

A. Provide systems demonstration and instructions under provisions of Section 01 75 00.
B. Employ manufacturer's field representative to demonstrate system operation to Owner's personnel.
C. Conduct walking tour of Project; describe function, operation, and maintenance of each component.
D. Use submitted operation and maintenance manual as reference during demonstration and training.

3.6 FUNCTIONAL PERFORMANCE TESTING

A. System Functional Performance Testing is part of the Commissioning Process.
   1. The Contractor shall perform the Functional Performance Testing and the Commissioning Authority shall witness and document the test.
   2. Refer to Section 01 91 00, Commissioning, for functional performance tests and commissioning requirements.

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B. Systems Readiness Checklists shall be completed and submitted for each piece of equipment included in this section.
C. Perform the functional performance testing of Panelboards as part of the Fire Alarm System Functional Performance testing.

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3.7 DEMONSTRATION AND TRAINING

A. Training of the Owner’s operation and maintenance personnel is required in cooperation with the Owner's Representative.
   1. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems.
   2. Schedule the instruction in coordination with the Owner's Representative after submission and approval of formal training plans.
   3. Refer to Section 01 91 00, Commissioning, for further contractor training requirements.

B. Provide demonstration and training for all types of fire alarm installed in this project.

END OF SECTION

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SECTION 28 33 00
VIDEO SURVEILLANCE SYSTEM

PART 1 GENERAL

1.1 SECTION INCLUDES
- A. Distribution cabinet
- B. Conduit and boxes
- C. Power wiring

1.2 SYSTEM DESCRIPTION
- A. Video surveillance system shall include the furnishing and installation of conduit system, mounting hardware, and power feeds.

1.3 SUBMITTALS
- A. Submit under the provisions of Section 01 33 00.
- B. Shop Drawings: Indicate layout, raceway diagrams, and equipment dimensions.
- C. Product Data: Provide data sheets for each item of equipment, depicting equipment capacity.

1.4 RECORD DRAWINGS
- A. Submit under the provisions of Section 01 77 00.
- B. Accurately indicate actual locations of cabinets, boxes, and conduit runs.

PART 2 PRODUCTS

2.1 CONDUIT AND BOXES

- A. Provide & install feed conduits from each IDF/MDF rooms to feed the mounting boxes designated for the area, size each of the separate feeds as follows:
  1. 3/4" for a maximum of 2 mounting boxes
  2. 1" for a maximum of 4 mounting boxes
  3. 1¼" for a maximum of 6 mounting boxes
  4. 1½" for a maximum of 8 mounting boxes
  5. Do not provide ½” conduits, minimum conduit size shall be ¾”.
- B. Provide & install 4-11/16" x 4-11/16" x 2⅛" mounting boxes with covers at designated interior locations.
  1. If the area location has removable ceiling tile, the box shall be located above the tile.
  2. If the location has a structure of fixed ceiling material, then flush mount the box with a double gang mud ring & cover.
- C. Provide & install 4-11/16" x 4-11/16" x 2⅛" flush mounted mounting boxes with double gang mud ring and weatherproof covers; mounted with the opening vertical, at all designated exterior locations fed from additional 4-11/16" x 4-11/16" x 2⅛" boxes at the interior feed penetrations through the exterior walls.
- D. Provide and install a 2" conduit from the IDF/MDF rooms to a brooks box located at the designated entry gates.
  1. The exact location determined at plan review by the School Police.
- E. Provide and install an additional 4-11/16" x 4-11/16" x 2⅛" box above suspended ceiling directly above each wall video-mounting box.
  1. Locate j-box no higher than 36” above the ceiling in the same room as the wall-mounted box.

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PART 3 EXECUTION

3.1 INSTALLATION

A. Install system in accordance with NECA "Standard of Installation", Section 26 05 33.
B. Cables shall be orange color, CAT 6 or greater.
C. Obtain a detail book from the SDPBC School Police Department Security Section for system specifics.
D. Permanently label all conduits as to plan room number destination, at all junction boxes.
E. Paint all Video surveillance system junction box covers gold.
F. If camera is located on a metal walkway or the surface is conductive in nature then isolation will be needed.
G. Install ½" (gold round indicators) of paper construction on ceiling tile grid work at all locations where video surveillance system boxes are located above the drop ceiling.
H. Install 200 lb strength pull string throughout the raceway system.
I. Mount all junction boxes mounted above ceiling with the opening facing down, and provide a reasonable immediate access pathway.
    1. Note: The requirement of removing a light fixture or other similar ceiling equipment is not a reasonable access pathway.
J. Provide and install 6 additional 4-11/16" x 4-11/16" x 2⅛" mounting boxes with flush single gang ring and single gang cover; with the opening mounting vertical with 3/4" conduit run to the nearest IDF/MDF rooms or junction box.
    1. (Allow 100’ of conduit for each run) Mounting locations field directed during construction/installation, prior to final above ceiling final inspection.

3.2 LOCATION

A. Provide video junction boxes in the following locations.
    1. At all card reader locations
    2. Safes/Drop boxes
    3. Cafeteria main dining room
    4. Cafeteria/Custodial Receiving
    5. Courtyard
    6. Bus loop
    7. Main office reception area
    8. Main Entry/Single Point of Entry
    9. In all corridors/Walkways
    10. Student pick-up/drop off
    11. Parking areas
    12. Gymnasium/Play Areas
    13. Field/Stadium
    14. Auditorium
    15. Other areas as defined in the project specific review process, by the SDPBC

3.3 DEMONSTRATION AND TRAINING

A. Training of the Owner’s operation and maintenance personnel is required in cooperation with the Owner's Representative.
    1. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems.

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2. Schedule the instruction in coordination with the Owner's Representative after submission and approval of formal training plans.
3. Refer to Section 01 91 00, Commissioning, for further contractor training requirements.

B. Provide demonstration and training for all types of video surveillance systems installed in this project.

END OF SECTION

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SECTION 31 10 00
SITE CLEARING

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

A. Site clearing includes, but is not limited to
   1. Protection of existing trees
   2. Removal of trees and other vegetation
   3. Topsoil stripping
   4. Clearing and grubbing
   5. Removing above-grade improvements
   6. Removing below-grade improvements

B. Related work specified elsewhere
   1. Demolition

1.2 JOB CONDITIONS

A. Protection of Existing Improvements
   1. Provide protection necessary to prevent damage to existing improvements indicated to remain in place.
   2. Protect improvements on adjoining properties and on Owner's property.
   3. Restore damaged improvements to their original condition, as acceptable to parties having jurisdiction.

B. Protection of Existing Trees and Vegetation
   1. Protect existing trees and other vegetation indicated to remain in place, against unnecessary cutting, breaking or skinning of roots, skinning and bruising of bark, smothering of trees by stockpiling construction materials or excavation materials within drip line, excess foot, or vehicular traffic, or parking of vehicles within drip line.
      a. Provide temporary guards to protect trees and vegetation to remain.
   2. Water trees and other vegetation to remain within limits of contract work as required maintaining their health during course of construction operations.
   3. Provide protection for roots over 1½" diameter cut during construction operations.
      a. Coat cut faces with emulsified asphalt, or other acceptable coating, formulated for use on damaged plant tissues.
      b. Temporarily cover exposed roots with wet burlap to prevent roots from drying out; cover with earth as soon as possible.
   4. Replace protected trees and vegetation damaged during construction with like kind.

C. Improvements on Adjoining Property: Owner will obtain authority to perform removal and alteration work on adjoining property prior to award of contract.

D. Salvaged Improvements: Carefully remove items indicated as salvageable, and store on Owner's premises as directed.

E. Occupancy During Construction
   1. Provide secure barriers to separate the Owner's staff and students from the construction area, per the requirements of section 453 FBC.
   2. Provide a secure double fence with 10' between, when using heavy machinery is on site.
   3. Contractor shall coordinate the barrier location and type with the Owner and Architect.

PART 2 PRODUCTS

2.1 Not Used.

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PART 3 EXECUTION

3.1 SITE CLEARING

A. General
   1. All work shall conform to the South Florida Water Management District Surface Water Management Permit, Palm Beach County requirements, and with State of Florida Department of Environmental Protection requirements.
   2. Remove improvements or obstructions interfering with installation of new construction. Remove such items elsewhere on site or premises as specifically indicated.
      a. Removal includes digging out stumps and roots.
      b. Carefully and cleanly, cut roots and branches of existing trees indicated to remain, only where such roots and branches obstruct new construction.

B. Topsoil is the friable clay-loam surface soil found in a depth of not less than four inches.
   1. Satisfactory topsoil is reasonably free of subsoil, clay lumps, stones, and other objects over two inches in diameter, and without weeds, roots, and other objectionable material.
   2. Strip topsoil to whatever depths encountered in a manner to prevent intermingling with underlying subsoil or other objectionable material.
   3. Remove heavy growths of grass from areas before stripping.
   4. Stop topsoil stripping at the start of the tree canopy of remaining trees to prevent damage of main root system.
   5. Stockpile topsoil in storage piles in areas shown, or where directed.
      a. Construct storage piles to freely drain any surface water.
      b. Cover storage piles if required to prevent wind-blown dust.

C. Dispose of unsuitable or excess topsoil same as waste material, herein specified.

D. Clear site of trees, shrubs and other vegetation, except for those indicated to remain.
   1. Completely remove stumps, roots, and other debris protruding through ground surface.
   2. Use only hand methods for grubbing inside drip line of existing trees to remain.
   3. Once all excavation or earthwork is completed, fill depressions caused by clearing and grubbing operations with satisfactory soil material.
   4. Place fill material in horizontal layers not exceeding six inches loose depth, and thoroughly compact to a density equal to adjacent original ground.

E. Removal of Improvements
   1. Remove existing above-grade and below-grade improvements necessary to permit construction, and other work as indicated.
   2. Abandonment or removal of underground pipe or conduits shown on mechanical or electrical drawings is included under work of those sections.
      a. Removal of abandoned underground piping or conduit interfering with construction is included under this section.

3.2 DISPOSAL OF WASTE MATERIALS

A. DO NOT burn debris on Owner’s property.

B. Remove waste materials and unsuitable and excess topsoil from Owner’s property and dispose of off-site in a legal manner.

END OF SECTION

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SECTION 31 20 00
EARTH MOVING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following
   1. Preparing sub-grades for slabs-on-grade, foundations, walks, pavements, and lawns.
   2. Excavating and backfilling for buildings and structures.
   3. Excavating and backfilling trenches within building lines.
   4. Excavating and backfilling trenches for buried mechanical and electrical utilities and pits for buried utility structures.

1.3 REFERENCES

A. ASTM D1556 – Standard Test Method for Density and Weight of Soil in Place by Sand-Cone Method
B. ASTM D1557 –Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Effort (56,000 ft-lbs/ft3 (27000 kN-m/m3))
C. ASTM D1586 – Standard Test Method for Standard Penetration Test (STP) and Split-Barrel Sampling of Soils
D. ASTM D2167 – Standard Test Method for Density and Unit Weight of Soil in Place by Rubber Balloon Method
E. ASTM D2487 – Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
F. ASTM D2937 – Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method
G. ASTM D2940 – Standard Specification for Graded Aggregate Material For Bases or Subbases for Highways or Airports
H. ASTM D3740 – Standard Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
I. ASTM D6938 – Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
J. ASTM E329 – Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection
K. ASTM E548 – Standard Guide for General Criteria Used for Evaluating Laboratory Competence

1.4 DEFINITIONS

A. Backfill: Soil materials used to fill an excavation.
   1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
   2. Final Backfill: Backfill placed over initial backfill to fill a trench.
B. Bedding Course: Layer placed over the excavated sub-grade in a trench before laying pipe.
C. Borrow: Satisfactory soil imported from off-site for use as fill or backfill.
D. Excavation: Removal of material encountered above sub-grade elevations.
   1. Additional Excavation:
      a. Excavation below sub-grade elevations as directed by Owner.
      b. Additional work paid per contract provisions.

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2. Bulk Excavation: Excavations more than 10' wide and pits more than 30' length or width.
3. Unauthorized Excavation:
    a. Excavation below sub-grade elevations or beyond indicated dimensions without direction by Owner.
    b. Unauthorized excavation, as well as remedial work directed by Owner, shall be without additional compensation.

E. Fill: Soil materials used to raise existing grades.

F. Rock: Rock material in beds, ledges, un-stratified masses, and conglomerate deposits and boulders or rock material ¾-cy. or more in volume that when tested by an independent geo-technical testing agency, according to ASTM D1586, exceeds a standard penetration resistance of 100 blows/2".

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

H. Sub-grade: Surface or elevation remaining after completing excavating, or top surface of a fill or backfill immediately below base or topsoil materials.

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

1.5 SUBMITTALS

A. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:
1. Classification according to ASTM D2487 of each on-site or borrow soil material proposed for fill and backfill.
2. Laboratory compaction curve according to ASTM D1557 for each on-site or borrow soil material proposed for fill and backfill.

1.6 QUALITY ASSURANCE

A. Geo-technical Testing Agency Qualifications: Owner will engage and pay for an independent testing agency qualified according to ASTM E329 to conduct soil materials and rock-definition testing, as documented according to ASTM D3740 and ASTM E548.

1.7 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Owner and then only after arranging to provide temporary utility services according to requirements indicated:
1. Notify Owner not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Owner's written permission.
3. Contact utility-locator service before excavating. (Sunshine 1-800-432-4770)

B. Demolish and completely remove from site existing underground utilities indicated for removal, coordinate with utility companies to shut off services if lines are active.

1.8 TRENCH SAFETY

A. In accordance with Florida Statute 553.63, trench excavations in excess of 5' deep shall require the Contractor to submit in writing.
1. Reference to the trench safety standards that will be in effect during the period of construction of the project.
2. Written assurance that Contractor will comply with the applicable trench safety standards.
3. Identify the cost of compliance with the applicable trench safety standards.

B. As a minimum the Contractor shall:

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1. Comply with the excavation safety standards applicable to the project.
2. Adhere to any special shoring requirement, which may be applicable to such a project.

PART 2 PRODUCTS

2.1 SOIL MATERIALS

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

B. Satisfactory Soils: ASTM D2487 soil classification groups GW, GP, GM, SW, SP, and SM, or a combination of these group symbols; free of rock or gravel larger than 3" in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.
   1. The top 6 inches of satisfactory soil shall be free of all debris and any rock or gravel larger than ¼ inch in any dimension.

C. Unsatisfactory Soils: ASTM D2487 soil classification groups GC, SC, ML, MH, CL, CH, OL, OH, and PT, or a combination of these group symbols.
   1. Unsatisfactory soils also include satisfactory soils not maintained within 2% of optimum moisture content at time of compaction.

D. Backfill and Fill: Satisfactory soil materials.

E. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940; maximum material size of 3" with at least 95% passing a 1-1/2" sieve and not more than 5% passing a No. 200 sieve.

F. Bedding: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940; except with 100% passing a 1" sieve and not more than 8% passing a No. 200 sieve.

2.2 ACCESSORIES

A. Detectable Warning Tape: Acid and alkali resistant polyethylene film warning tape manufactured for making and identifying underground utilities, minimum 6" wide and 4-mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30" deep; colored as follows:
   1. Red: Electric
   2. Yellow: Gas, oil, steam, and dangerous materials
   3. Orange: Telephone and other communications
   4. Blue: Water systems
   5. Green: Sewer systems
   6. Purple: Reclaimed water system

2.3 CONCRETE

A. Concrete formulation using type I cement and having a 28-day compressive strength of at least 3,000 psi.

PART 3 EXECUTION

3.1 PREPARATION

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

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

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3.2 DEWATERING

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

B. Protect sub-grades from softening, undermining, washout, and damage by rain or water accumulation.

1. Reroute surface water runoff away from excavated areas.
    a. Do not allow water to accumulate in excavations.
    b. Do not use excavated trenches as temporary drainage ditches.
2. Install a dewatering system to keep sub-grades dry and convey ground water away from excavations.
    a. Maintain until dewatering is no longer required.
    b. Draw down the water table 1' below the bottom of any excavation or compaction surface.

C. Comply with South Florida Water Management District requirements for dewatering systems.

3.3 EXPLOSIVES

A. Explosives: Do not use explosives.

3.4 EXCAVATION, GENERAL

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

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

3.5 EXCAVATION FOR STRUCTURES

A. Excavate to required elevations and dimensions within a tolerance of plus or minus 1".

1. Extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
2. Do not disturb bottom of excavation for Footings and Foundations.
    a. Excavate by hand to final grade just before placing concrete reinforcement.
    b. Trim bottoms to required lines and grades to leave solid base to receive other work.
3. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures:
    a. Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1".
    b. Do not disturb bottom of excavations intended for bearing surface.

B. Use the following building pad preparation procedures to achieve the required design soil bearing.

1. Clearing and grubbing shall consist of the complete removal of all trees, roots, stumps, grass, shrubbery, rubbish, building materials, and debris on the surface of the ground or beneath the surface of the ground or the excavated areas or beneath the excavated areas.
    a. Rubbish, etc., if found, shall be removed entirely at whatever depth found.
    b. Roots, 2" and larger shall be removed to a depth of 4' below the surface, below the bottom of the excavation or below the bottom of the footing.
    c. Roots less than 2" shall be removed to a depth of 2' below the bottom of the footing.
    d. Extend the clearing and grubbing area outside the building pad by 5' in all directions.
2. Excavate the entire building pad, plus 5’, to 4’ below the existing grade, unless the geotechnical report identifies other limits.

3.6 EXCAVATION FOR WALKS

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

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3.7 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.
B. Excavate trenches to uniform widths to provide a working clearance on each side of pipe or conduit.
C. Excavate trench walls vertically from trench bottom to 12" higher than top of pipe or conduit, unless otherwise indicated.
    1. Clearance: 12" on each side of pipe or conduit.
D. Trench Bottoms: Excavate trenches 4" deeper than bottom of pipe elevation to allow for bedding course. Hand excavate for bell of pipe.
    1. Excavate trenches 6" deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

3.8 APPROVAL OF SUB-GRADE

A. Notify Owner when excavations have reached required sub-grade.
B. If Owner determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
    1. Additional excavation and replacement material paid per contract provisions.
C. Proof roll sub-grade with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding.
    1. Do not proof roll wet or saturated sub-grades.
D. Reconstruct sub-grades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Owner.

3.9 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation.
    1. Fill unauthorized excavations under other construction or utility pipe as directed by Owner.

3.10 STORAGE OF SOIL MATERIALS

A. Stockpile borrow materials and satisfactory excavated soil materials.
    1. Stockpile soil materials without intermixing.
    2. Place, grade, and shape stockpiles to drain surface water.
    3. Cover to prevent windblown dust.
    4. Stockpile soil materials away from edge of excavations and out of the drip line of remaining trees.

3.11 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:
    1. Construction below finish grade including, where applicable damp-proofing, waterproofing, and perimeter insulation.
    2. Surveying locations of underground utilities for record documents.
    3. Inspecting and testing underground utilities.
    4. Removing concrete formwork.
    5. Removing trash and debris.
    6. Removing temporary shoring and bracing, and sheeting.
    7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

3.12 UTILITY TRENCH BACKFILL

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

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B. Backfill trenches excavated under footings and within 18" of bottom of footings; fill with concrete to elevation of bottom of footings.
C. Provide 4" thick, concrete-base slab support for piping or conduit less than 30" below surface of roadways.
    1. After installing and testing, completely encase piping or conduit in a minimum of 4" of concrete before backfilling or placing roadway sub-base.
D. Place and compact initial backfill of sub-base material, with soil no more than 8% passing the number. 200 sieve, with a maximum particle size of 1".
    1. Place the trench backfill in maximum loose lifts of 6" and compacted to at least 98% of the modified Proctor maximum dry density, to a height of 12" over the utility pipe or conduit.
    2. Carefully compact material under pipe haunches bringing backfill up evenly on both sides and along the full length of utility piping or conduit to avoid damage or displacement of utilities.
E. Coordinate backfilling with utilities testing.
F. Fill voids with approved backfill materials while removing sheeting, shoring and bracing.
G. Place and compact final backfill of satisfactory soil material to final sub-grade.
H. Install warning tape directly above utilities, 12" below finished grade, except 6" below sub-grade under pavements and slabs.

3.13 FILL

A. Preparation: Remove vegetation, topsoil, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface before placing fills.
B. Plow, scarify, bench, or break up sloped surface steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
C. Place and compact fill material in layers to required elevations as follows:
    1. Under building slabs, use engineered fill.
    2. Under footings and foundations, use engineered fill.
    3. Under grass and planted areas, use satisfactory soil material.
    4. Under walks, use engineered fill.

3.14 MOISTURE CONTROL

A. Uniformly moisten or aerate sub-grade and each subsequent fill or backfill layer before compaction to within 2% of optimum moisture content.
    1. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
    2. Remove and replace, or scarify and air-dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2% and is too wet to compact to specified dry unit weight.

3.15 COMPACTION OF BACKFILLS AND FILLS

A. Following building pad preparation procedures and, perform the following:
    1. Provide soil compaction using a 20-ton self-propelled non-vibratory roller to provide 98% compaction to a depth of 2' below the surface.
        a. Subject each section of the building sub-grade to at least ten overlapping (20% overlap) passes of the compactor traveling at a speed of no more than 1.5 MPH.
        b. Densification operations shall continue until no further settlement is visually discernible at the excavation bottom and the in-site soils at the cut grade are compacted to 98% of the ASTM D 1557 maximum dry density.
        c. Frequent wetting of the rolled sub-grade may be necessary to prevent drying and loosening of the upper 6" to 12" of soil.

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d. Contractor shall monitor nearby structures before and during proof-compaction operations, taking care to ensure that vibrations induced by the compaction operations does not cause any distress to nearby structures.

2. Place the structural fill raising the site to the building's design grades in thin lifts (12" thick loose measure); near the optimum moisture content for compaction, and compact to at least 98% of maximum dry density (ASTM D1557).
3. A SDPBC building inspector shall inspect the footing excavation bottoms.
4. Compact the footing bottoms to 98% of the ASTM D1557 maximum dry density.
5. Completely remove any soft or organic soils detected in the footing bottoms, and replaced with clean granular fill compacted to the degree specified above.

B. 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 6" in loose depth for material compacted by hand-operated tampers.

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

3.16 GRADING

A. General: Uniformly grade areas to a smooth surface, free from irregular surface changes.

B. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
1. Provide a smooth transition between adjacent existing grades and new grades.
2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

C. Site Grading: Slope grades to direct water away from buildings and to prevent ponding.

D. Finish sub-grades to required elevations within the following tolerances:
1. Lawn, Walks, or Unpaved Areas: Plus or minus 1".

E. Grading inside Building Lines: Finish sub-grades to a tolerance of ½" when tested with a 10' straightedge.

3.17 FIELD QUALITY CONTROL

A. Soil Borings: If the School District did not provide soil borings for this site, the Contractor shall take a series of standard split spoon soil borings to ascertain the sub-surface soil conditions to verify the acceptability of the sub-grade to support the 2500 psf bearing capacity noted.

B. Testing Agency: Owner will engage a qualified independent geo-technical engineering testing agency to perform field quality- control testing.

C. Testing agency to inspect and test sub-grades and each fill or backfill layer.
1. Contractor may proceed with subsequent earthwork only after test results for previously completed works comply with requirements.

D. Testing Agency will test compaction of soils in place according to ASTM D1556, ASTM D2167, ASTM D6938, and ASTM D2937, as applicable, at the following locations and frequencies:
1. Building Slab Areas: At sub-grade and at each compacted fill and backfill lift, at least one test for every 2500 SF per lift or less of building slab, but in no case fewer than five tests.
2. Foundation Backfill: At each compacted backfill lift, at least one test for each column footings, but no fewer than two tests.
a. One compaction test per 50 linear feet of wall footing with a minimum of one density test per perimeter wall footing.
3. Trench Backfill: Test at each compacted initial and final backfill layer, and at least one test for each 100' or less of trench length, but no fewer than two tests.

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4. General Fill: One density test per 5,000 SF of fill per lift.

E. When testing agency reports that sub-grades, fills, or backfills do not achieve the degree of compaction specified, contractor shall take following action:
   1. Scarify and moisten
   2. aerate or
   3. Remove and replace soil to depth required, re-compact and retest until specified compaction is obtained.
   4. Correction of failing work shall occur without additional cost to the owner. Contractor shall reimburse Owner for all re-testing costs due to failed tests.

3.18 PROTECTION

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

B. Repair and re-establish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
   1. Scarify or remove and replace soil material to depth as directed by Owner; reshape and re-compact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and re-construct surfacing.
   1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to the greatest extent possible.

3.19 DISPOSAL OF SURPLUS AND WASTE MATERIALS

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

END OF SECTION

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SECTION 31 31 16
TERMITE CONTROL

PART 1 GENERAL

1.1 RELATED DOCUMENTS
- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to work in this section.

1.2 DESCRIPTION OF WORK
- A. Provide soil treatment for termite control below grade as specified.

1.3 QUALITY ASSURANCE
- A. In addition to the requirements of these specifications, comply with manufacturer's instructions and recommendations for the work, including preparation of substrate and application.
- B. Engage a professional pest control operator, licensed by the State of Florida for application of soil treatment solution.

1.4 JOB CONDITIONS
- A. Do not apply soil treatment solution until excavating, filling and grading operations are completed except as otherwise required in construction operations.
- B. Ensure penetration; do not apply soil treatment during inclement weather.
- C. Comply with other handling and application instructions of the soil toxicant manufacturer.

1.5 SUBMITTALS
- A. Submit four-copies of manufacturer's technical data and application instructions.
- B. Include toxicants, composition by percentage, dilution schedule, and intended application rate.
- C. Submit copy of Safety Data Sheet

1.6 GUARANTEE
- A. Furnish four-copies of written guarantee certifying that the applied soil poisoning treatment will prevent the infestation of subterranean termites for warranty period.
  1. If subterranean termite activity is discovered during the guarantee period, the Contractor is responsible for re-treat of the soil and repair or replace of damage to the building and its contents caused by termite infestation.
- B. Provide guarantee for a period of 5-years.
- C. The Owner reserves the right to renew warranty for an additional 5-year at an additional cost.

1.7 REGULATORY REQUIREMENTS
- A. Conform to applicable code for requirements and for application in accordance with the EPA.
- B. Comply with the general requirements of the Florida Building Code.

1.8 PROJECT CLOSEOUT
- A. Record the moisture content of soil before application, date, and rate of application, areas of application, diary of toxicity meter readings and corresponding soil coverage.

PART 2 PRODUCTS

2.1 SOIL TREATMENT SOLUTION
- A. EPA and Florida Department of Agriculture & Consumer Services approved emulsible concentrate insecticide for dilution with water, specially formulated to prevent infestation by termites.
- B. Fuel oil is not permitted as a diluent.

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C. Other solutions acceptable to local governing authorities and the EPA may be used.
   1. Use only soil treatment solutions, which are not injurious to planting.

PART 3 EXECUTION

3.1 INSPECTION

A. Before applying soil treatment for termites, examine areas and conditions; notify the Architect in writing of conditions detrimental to the proper and timely completion of the work.
   1. Do not proceed with the work until conditions are satisfactory.

B. Verify that final grading is complete.

3.2 APPLICATION

A. Surface Preparation:
   1. Remove foreign matter that could decrease effectiveness of treatment on areas to be treated.
   2. Loosen, rake and level soil-requiring treatment, except previously compacted areas under slabs and foundations.

B. Application Rates: Apply soil treatment solution as specified and in strict accordance with Manufacturer's recommendation for mixing and application.
   1. Allow not less than 12 hours for drying after application, before beginning concrete placement or other construction activities.
   2. Post signs in the areas of application warning workers of soil poisoning.
      a. Remove signs before other construction covers the area.
   3. Reapply soil treatment solution to areas disturbed by subsequent excavation or other construction activities following initial application.

END OF SECTION

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SECTION 32 12 16
ASPHALT PAVING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. The intent of this specification section is to provide requirements for materials, equipment, and methods for constructing new pavement.

B. Paving work includes:

1. Preparation and compaction of soil sub-grade to proper elevations below the lime rock base.
2. Preparation and compaction of lime rock base, application of prime coat or tack coat, and construction of asphaltic concrete surface course.
3. New asphalt paving and patching work where indicated, is also included.

C. Additional compensation for adjustment of quantities due to extra thickness of base construction and/or extra asphaltic concrete will not be made.

D. Contractor shall coordinate scheduling of construction of planters, landscape areas, paving, irrigation systems, lighting systems and other work.

1.2 SUBGRADE DEFINITION

A. That portion of roadbed immediately below limerock base course and parallel thereto (including below curbs, gutters, driveways and planters within general parking lot perimeter) compacted (or stabilized) to required density to support the paving above.

B. Subgrade shall extend to a depth of 12" below bottom of limerock base and outward to line 12" beyond perimeter of base, pavement, or curbs.

1. Limits shown on plans govern, if different from above requirements.

C. Contractor may construct subgrade deeper for his own convenience and/or equipment needs with prior approval of Engineer and no additional cost to owner.

1.3 APPLICABLE PUBLICATIONS

A. AASHTO T180 – Standard Method of Test for Moisture-Density Relations of Soils Using 10-lb. Rammer and 18" Drop

B. ASTM C131 – Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion & Impact in Los Angles Machine

C. ASTM D422 - Standard Test Method for Particle Size Analysis of Soils

D. ASTM D2419 – Standard Test Method for Sand Equivalent Valve of Soils & Fine Aggregate

E. ASTM D6938 – Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

F. FDOT Std. Spec. – Standard Specifications for Road and Bridge Construction, current edition

1.4 TESTING OF COMPACTION

A. Owner will select and retain a state licensed testing laboratory, and pay all testing cost.

1. Contractor shall reimburse Owner for all re-testing cost due to failed tests.

B. Contractor is responsible for notifying the testing laboratory twenty-four hours in advance when material and/or work is ready for testing.

1. Work of testing laboratory will consist of, but not be limited to, the following:

C. Laboratory maximum density determination, AASHTO T180 Method D – one representative test from each 1000 cubic yards of subgrade fill and 2000 cubic yards of limerock base from both site and borrow pits.

1. Test material from each source separately.
2. If composition from any source changes, a new test is required.

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D. In-place field density tests, ASTM D6938.
   1. At least one test per layer for each 2500 square feet or fraction thereof.
   2. Make test near top of each layer prior to placing subsequent layer.
E. Test reports shall be transmitted directly from laboratory as follows:
   1. One copy to Owner's Representative
   2. Two copies to A/E
   3. Copies as requested to Contractor.
F. Identify test reports by project title, A/E Project Number, project location, location, and depth of each on-site test submitted.

1.5 TESTING OF BITUMINOUS CONCRETE MATERIAL

A. Contractor shall retain a reputable independent testing laboratory to ensure that asphaltic concrete mix meets specifications.
   1. Contractor shall supply samples of mix materials to testing laboratory for analysis and testing.
   2. No plant operations shall begin until testing laboratory certifies, in writing, that mix proposed meets specifications and the A/E receives the certification.
B. During delivery and placement of asphaltic concrete, the testing laboratory shall take samples and test them for compliance with the certified mix.
   1. The mix shall be uniform throughout the project.
   2. The testing laboratory shall test at least one (1) sample from each 50 tons of material or fraction thereof in any one day.

PART 2 PRODUCTS

2.1 MATERIALS

A. Stabilized subgrade shall have a minimum Limerock Bearing Ratio (LBR) of 40 or a Florida Bearing Value (FBV) of 75 psi.
B. Compacted subgrade shall have a minimum density of 98% AASHTO T-180.
C. Base course shall be limerock meeting FDOT Std. Spec., free from subgrade sand.
   1. Base course shall have a minimum Limerock Bearing Ratio (LBR) of 100.
   2. Owner will consider alternate base materials meeting or exceeding the performance of the limerock base material.
D. Prime and tack coats shall be a superpave performance graded asphalt binder, FDOT Type PG 52-28.
   1. Do not use cut back or emulsified asphalt binders.
E. Asphalt concrete shall be FDOT SP-9.5, fine mix.
F. Standard Pavement Section:
   1. 12” thick stabilized subgrade.
   2. 8” thick limerock base.
   3. 2” thick asphalt, placed in two layers, 1" (bottom), and 1" (top).
G. Subgrade source material shall meet for fill and backfill requirements as defined in Section 31 20 00, Earthwork.

PART 3 EXECUTION

3.1 FDOT STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION

A. Execution of all work shall comply with the FDOT Std. Spec., current edition.

END OF SECTION

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SECTION 32 13 13
CONCRETE PAVING

PART 1 GENERAL

1.1 SECTION INCLUDES
- A. Extent of concrete curbs, pavement, and walks, as shown on the drawings
- B. Earthwork and prepared sub-base
- C. Concrete and related materials
- D. Joint Fillers and Sealers

1.2 QUALITY ASSURANCE
- A. Comply with local governing regulations if more stringent than herein specified.

1.3 JOB CONDITIONS
- A. Maintain access for vehicular and pedestrian traffic as require for other construction activities.

PART 2 PRODUCTS

2.1 MATERIALS
- A. Form shall be steel, wood, or other suitable material of size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment until removal.
  1. Use straight forms, free of distortion and defects.
- B. Use flexible spring steel forms or laminated boards to form radius bends as required.
- C. Coat forms with a non-staining form release agent that will not discolor or deface the surface of the concrete.
- D. No Earth Forming allowed.
- E. Concrete Materials: Comply with requirements of applicable sections for concrete materials, admixture, bonding materials, curing materials, and others as required.
- F. Expansion Joint Materials: Comply with requirements of Sections for preformed expansion joint fillers and sealers.

2.2 CONCRETE MIX, DESIGN AND TESTING
- A. Comply with requirements of applicable Section for concrete mix design, sampling and testing, and quality control, and as herein specified.
- B. Design mix to produce standard-weight concrete consisting of Portland cement, aggregate, air-entraining admixture and water to produce the following properties:
  1. Compressive Strength: 3000 psi, minimum at 28 days for sidewalks.
  2. Compressive Strength: 3500 psi, minimum at 28 days for driveways and parking lots.
  3. Slump Range: 2" (slip-formed) to 4" (standard)
  4. Air Content: 5% to 6%

PART 3 EXECUTION

3.1 INSPECTION
- A. Examine the areas and conditions for the installation of concrete curbs, walks, and paving, if there are conditions detrimental to the proper and timely completion; notify the A/E in writing immediately.
- B. Do not proceed with work until unsatisfactory conditions are corrected.

3.2 SURFACE PREPARATION
- A. Remove loose material from the compacted subgrade surface immediately before placing concrete.

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B. Proof-roll prepared subgrade surface to check for unstable areas and need for additional compaction.
C. Do not begin paving work until such conditions correct and ready to receive paving (95%, modified proctor).

3.3 FORM CONSTRUCTION

A. Set forms to the required grades and lines, rigidly braced and secured. Install sufficient quantity of forms to allow continuous progress of work and so that forms can remain in place at least 24 hours after concrete placement.
B. Check completed formwork for grade and alignment to the following tolerances:
C. Top of forms not more than $^{1}/_{8}$" in 10' deviation in alignment.
D. Vertical face on longitudinal axis, not more than ¼" in 10'.
E. Clean forms after each use and coat with form release agent as often as required to ensure separation from concrete without damage.

3.4 REINFORCEMENT

A. Use fibermesh concrete for sidewalks and courtyards unless otherwise noted, following the requirements of Section 03 24 00 "FIBROUS CONCRETE REINFORCING".
B. Concrete roadway pavement may be unreinforced aside from construction joints. See below.
C. Construction Joint Reinforcement
    1. Reinforce construction joints for bus driveways, service yards, and service yard driveways.
    2. Construction joints will have a formed or slipped face.
    3. Reinforce construction joints with rebar, round dowels, square dowels, or plate dowels.
    4. Separate one side of the construction joint reinforcement from the concrete to allow for horizontal movement. Firmly embed the other side of the reinforcement in the concrete.
        a. The engineer’s drawings will show how to create the separation between reinforcement and concrete.

3.5 CONCRETE PLACEMENT

A. General: Comply with the requirements of Sections for mixing and placing concrete, and as specified.
B. Do not place concrete until subgrade and forms are checked and Architect approves for line and grade.
    1. Moisten subgrade if require to provide a uniform dampened condition at the time concrete is placed.
    2. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.
C. Place concrete using methods, which prevent segregation of mix.
    1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator.
    2. Keep vibrator away from joint assemblies, reinforcement, or side forms.
    3. Use only square-faced shovels for hand spreading and consolidation.
    4. Consolidate with care to prevent dislocation of reinforcing, dowels, and joint devices.
D. Deposit and spread concrete in continuous operation between transverse joints, as far as possible.
    1. If interrupted for more than ½- hour, place a construction joint.
E. Curbs and Gutters:
    1. Contractor, with the Architect's approval, may use an automatic machine for curb and gutter placement.

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2. If machine placement is used, submit revise mix design and laboratory test results, which meet or exceed minimums specified.
3. Machine placement must produce curbs and gutters to required cross-section, lines, grades, finish, and jointing as specified for formed concrete.
4. If results are not acceptable, remove and replace with formed concrete as specified.
5. Do not extrude curbs on bituminous paving.

3.6 JOINTS

A. The engineer's drawings will show details for all types of joints.
B. General: Construct expansion, weakened-plane (contraction), and construction joints true-to-line with face perpendicular to surface of the concrete, unless otherwise indicated.
   1. Construct transverse joints at right angles to the centerline, (distance equal to width) unless otherwise indicated.
C. Control (weakened-plane or contraction) Joints: Provide weakened-plane (contraction) joints, sectioning concrete into areas as shown on the drawings or every ten linear feet for curbs.
   1. Control joint spacing (in feet) shall not exceed 2 times the concrete pavement thickness (in inches).
      a. Example: 4" thick conc. pavement, maximum control joint spacing is 8 feet (2 x 4 = 8).
      b. Construct sidewalk control joints at six feet on center.
   2. Construct control joints for a depth equal to at least ¼ of the concrete thickness.
   3. Sawed Joints: Form control joints using powered saws equipped with shatterproof abrasive or diamond-rimmed blades.
      a. Cut joints into hardened concrete as soon as the surface will not be torn, abraded or otherwise damaged by the cutting action, but no later than 48 hours.
D. Construction Joints: Place construction joints at end of all pours and locations where concrete placement operations stop for a period of more than ½- hour, except where such pours terminate at expansion joints.
E. Construct joints as shown or, if not shown, use standard metal key-way section forms.
F. Expansion Joints: Provide pre-molded joint filler for expansion joints abutting concrete curbs, catch basins, manholes, inlets, structures, walks, buildings and other fixed objects, and changes in direction, and as shown on plans.
   1. Extend joint fillers full-width and depth of joint, and not less than ½" or more than 1", and 1" below finished surface for joint sealer.

3.7 CONCRETE FINISHING

A. After striking-off and consolidating concrete, smooth surface by screeding and floating.
   1. Use hand methods only where mechanical floating is not possible.
   2. Adjust floating to compact surface and produce a uniform texture.
B. After floating, test surface for trueness with a ten-foot straight edge.
   1. Distribute concrete as required to remove surface irregularities, and re-float repaired areas to provide a continuous smooth finish.
C. Work edges of slabs, gutters, back top edge of curb, and formed joints with an edging tool, and round to ½" radius, unless otherwise indicated. Eliminate any tool marks on concrete surface.
D. After completion of floating and when excess moisture or surface sheen has disappeared, complete surface finishing, as follows:
E. Broom finish by drawing fine-hair broom across concrete surface perpendicular to line of traffic.
   1. Repeat operation if required to provide a fine line texture acceptable to Architect.
F. Do not remove forms for 24 hours after placing concrete.
   1. After form removal, clean ends of joints and point-up any minor honeycombed areas.

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2. Remove and replace areas or section with major defects, as directed by Architect.

3.8 CURING

A. Protect and cure finished concrete paving, complying with applicable requirements of Division 3 Concrete, using moist-curing methods for initial curing whenever possible.

3.9 REPAIRS AND PROTECTIONS

A. Repair or replace broken or defective concrete, as directed by Architect.
B. Drill test cores when directed by Architect, when necessary to determine magnitude of cracks or defective areas.
   1. Fill drilled core holes in satisfactory pavement areas with portland cement concrete bonded to pavement with suitable bonding agent.
C. Protect concrete from damage until acceptance of work.
   1. Exclude traffic from pavement for at least 14 days after placement.
   2. Once construction traffic resumes, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.
D. Sweep concrete pavement as wash free of stains, discolorations, dirt, and other foreign material just prior to final inspection.
E. Repair/Replace existing sidewalks adjacent to property and on property if broken.

3.10 CONCRETE THICKNESS

A. Sidewalks shall be 4" thick (6"at driveways) on 4" compacted subgrade minimum 6' wide, with 3000-psi fiber mesh reinforcement.
   1. Slopes between 1:12 and 1:20 indicate accessible ramps and shall comply with the requirements of FBC-Accessibility.
   2. Cross slopes on sidewalks shall be a maximum of 1:50.
   3. Extend curbs/sidewalks a minimum 24" from covered walkway columns.
   4. Provide raised sidewalks or curbs to separate students from vehicle traffic.
B. Concrete Pavement for vehicle traffic areas shall be a minimum 6" thick 3500 psi concrete on 6" compacted (98% AASHTO T180, min.) base.
   1. Slope concrete $^{1}/_{8}$" per foot.

3.11 CURB RAMPS AND PASSENGER LOADING ZONES

A. Provide accessible curb ramps meeting the requirements of FBC-Accessibility and the District.
   1. Flush curbs and bollards are not allowed as replacements for passenger loading zones or curb ramps, unless reviewed and approved as part of a construction document submission.
   2. Provide curb ramps at the following locations.
      a. All crosswalks (including perimeter sidewalks)
      b. Bus drop-off area, one per 100 linear feet of drop-off area (minimum two).
      c. Parent drop-off area, two places, and one shall meet the requirements of a passenger-loading zone per District Criteria.
      d. Accessible parking areas and main entrances.

END OF SECTION

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SECTION 32 17 13
PARKING BUMPERS

PART 1 GENERAL

1.1 SECTION INCLUDES:
- A. Precast concrete, recycled plastic, or recycled composite parking bumpers and anchorage.

1.2 REFERENCES
- A. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement
- B. ASTM C33/C33M - Standard Specification for Concrete Aggregates
- C. ASTM C150/C150M – Standard Specification for Portland Cement
- D. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete
- E. ASTM C330/C330M - Standard Specification for Lightweight Aggregates for Structural Concrete

1.3 SUBMITTALS FOR REVIEW
- A. Section 01 30 00 Submittals: Procedures for submittals
- B. Product Data: Provide unit configuration, dimensions

PART 2 PRODUCTS

2.1 CONCRETE BUMPERS
- A. Cement: ASTM C150/C150M, Portland Type I - Normal gray color
- B. Concrete materials: ASTM C33/C33M water and sand
- C. Reinforcing Steel: ASTM A615/A615M deformed steel bars; galvanized finish, strength, and size commensurate with precast unit design
- D. Air Entrainment Admixture: ASTM C260/C260M
- E. Concrete Mix: Minimum 3500 psi, 28-day strength, air entrained 5% to 7%
- F. Use rigid molds, constructed to maintain precast units uniform in shape, size, and finish.
  1. Maintain consistent quality during manufacture.
- G. Embed reinforcing steel, and drill or sleeve for two dowels.
- H. Cure units to develop concrete quality, and to minimize appearance blemishes such as non-uniformity, staining, or surface cracking.
- I. Minor patching in plant is acceptable, providing appearance of units is not impaired.

2.2 RECYCLED PLASTIC/COMPOSITE
- A. Color to be gray.
- B. Recycled Plastic: Recycled plastic, solid wheel stops.
- C. Recycled Composite: As manufactured by Xpotential Products, or equal.
- D. Provide minimum five-year product warranty.
- E. Products shall be chemical and weather resistant.

2.3 CONFIGURATION
- A. Concrete:
  1. Use the FDOT standard wheel stop, refer to FDOT Index 520-001, Sheet 3 of 3. Also refer to the detail at the end of this section. Preferred 5” height.
  2. Alternate wheel stop detail below. Preferred 5” height.
- B. Recycled Profile: Pentagonal section, non-equilateral, nominal size of 4" H x 6" W x 6' L.

2.4 ACCESSORIES
- A. Concrete Stops: Dowels, 2 per stop-Steel, #4 rebar (½" diameter), 18" long.
- B. Recycled Plastic or Composite: Use manufacturers required fasteners, at minimum provide 2-

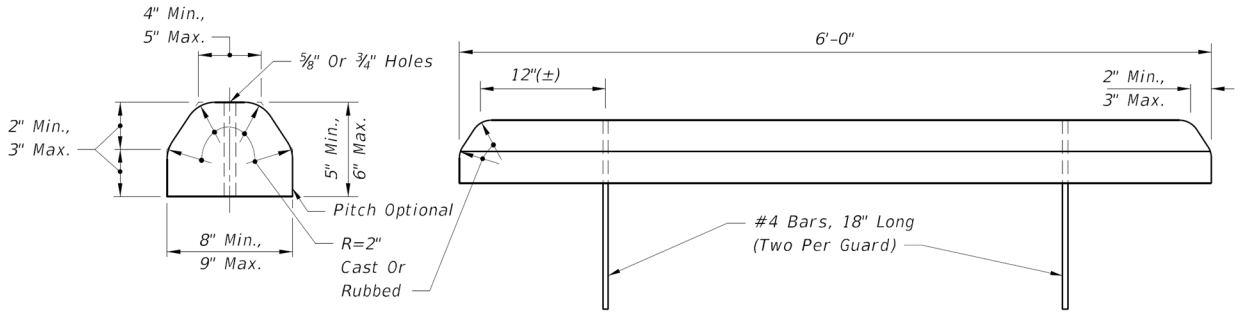
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galvanized steel dowels ½" diameter x 18" long per stop.

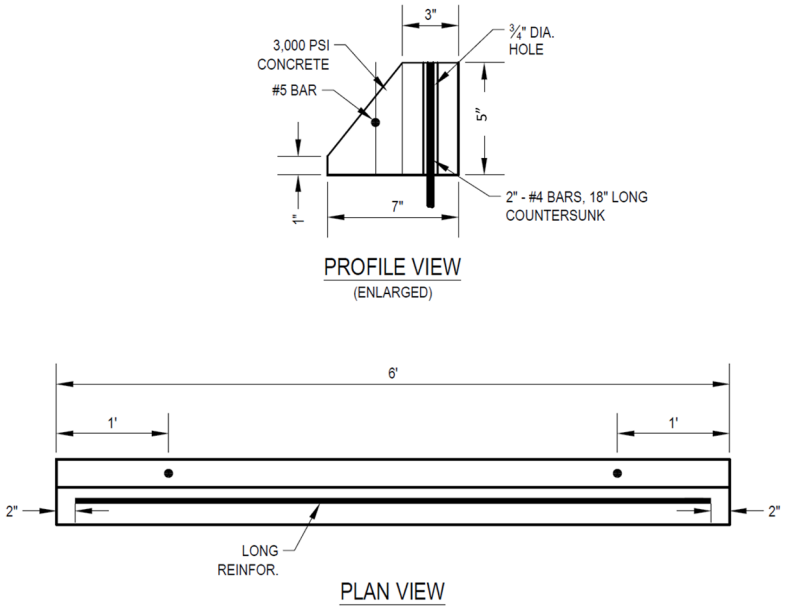
PART 3 EXECUTION

3.1 INSTALLATION

A. Set wheel stop with anchors at each parking space as shown on the plans.
   1. Grout bottom as required for firm bearing.
   2. Install units without damage to shape or finish, replace or repair damaged units.
   3. Install units in alignment with adjacent work.
   4. Fasten units in place with two anchors per unit bumper.
   5. Drive anchors to within 1" of top surface of wheel stop, then using a setting tool drive anchor at least ¼ inch below top of stop and then grout or caulk opening.



FDOT STANDARD CONCRETE WHEEL STOP



ALTERNATE CONCRETE WHEEL STOP

END OF SECTION

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SECTION 32 17 23
PAVEMENT MARKING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. The provisions of the general Conditions, Supplementary Conditions, and the Sections included under Division 1, General Requirements, are included as a part of this Section.

1.2 SUMMARY

A. Provide labor, materials, services, and equipment necessary to furnish and install painted instructions, symbols, and lines on concrete and bituminous surfaces used by vehicular, bicycle, and pedestrian traffic.

B. The term “pavement marking” shall generically apply to lines, symbols, messages, and any other type of guidance information painted on pavement.

1.3 REFERENCES

A. (FDOT) - Standard Specifications for Road and Bridge Construction excluding measurement and payment provisions

B. (FDOT) - Qualified Products List (QPL), most recent edition

C. (FHWA) - Manual on Uniform Traffic Control Devices

D. ASTM D476 - Standard Specification for Dry Pigmentary Titanium Dioxide Pigments

E. ASTM D562 - Standard Test Method for Consistency of Paints Measuring Krebs Unit (KU) Viscosity Using a Stormer-Type Viscometer

F. ASTM D1155 - Standard Test Method for Roundness of Glass Spheres

G. ASTM D1210 - Standard Test Method for Fineness of Dispersion of Pigment-Vehicle Systems by Hegman-Type Gage

H. ASTM D1475 - Standard Test Method for Density of Liquid Coatings, Inks, and Related Products

I. ASTM D2369 - Standard Test Method for Volatile Content of Coatings

J. ASTM D3723 - Standard Test Method for Pigment Content of Water-Emulsion Paints by Low-Temperature Ashing

1.4 SUBMITTALS

A. Submit under provisions of Section 01 33 00.

B. Manufacturer Data: Submit copies of manufacturer’s specifications and installation instructions for items required. Include data substantiating that materials comply with specified requirements. Indicate that installer has received copy of manufacturer’s instructions.

1.5 QUALITY ASSURANCE

A. A Contractor who has a minimum of 5-year successful experience with similar projects must perform installation of pavement markings.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Provide products as listed in the FDOT, QPL.

B. Use approved paint manufacturers listed in FDOT, QPL.

C. This information is available on the Internet website maintained by FDOT.

2.2 PACKAGING AND LABELING

A. Provide materials in strong containers that are plainly labeled with the following information:

1. Weight in pounds per gallon
2. Volume in gallons
3. Color

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4. User information
5. Date of manufacture
6. Batch and DOT Code Number
7. Manufacturer name and address
8. Statement regarding percentage composition of pigment and proportion of pigment to vehicle
9. Special handling and use information or precautions

2.3 HAZARD CLASSIFICATION

A. Use paint classified as non-hazardous, in accordance with Sub-article C rules as defined in the Resource Conservation and Recovery Act (RCRA).
B. Paint shall contain less than 150 g/L of volatile organic compounds.

2.4 MATERIALS

A. Paint: Utilize paint that meets one of the following criteria:
   1. Fast Dry Solvent Traffic Paint:
      a. Fast dry solvent traffic paints shall be single packaged and ready mixed.
      b. When cured, these materials shall produce a reflective, adherent pavement marking which resists deformation by traffic.
   2. Fast Dry Water Borne Traffic Paint:
      a. Fast dry water borne traffic paints shall be single packaged and ready mixed.
      b. When cured, these materials shall produce a reflective, adherent pavement marking which resists deformation by traffic.
      c. It will be possible to clean and flush this material from striping machines with regular tap water and any required rust inhibitors.
   3. Hot-Applied Standard Thermoplastic:
      a. Reference FDOT Standard Specification Section 711, Thermoplastic Pavement Markings
B. These paints will meet the following composition requirements:
   1. Total Solids, by weight (ASTM D2369) – 75% minimum
   2. Pigments by weight (ASTM D3723) – 57% minimum
   3. Vehicle solids, percent on vehicle – 40% minimum
   4. TiO_2, Type II Rutile (white paint only) (ASTM D476) – 1.5 lb/gal
C. Set to bear traffic time shall be two minutes, maximum, for these paints.
D. These paints will match the following physical appearance standards (reflectivity per Fed Std. 141a and Color per Fed Std 595a):
   1. Black – Color No. 37038 – No reflectivity standard.
   2. Yellow – Color No. 33548 – Reflectivity minimum 43%. Yellow pavement markings shall also satisfy FDOT requirements for chromaticity coordinates.
   3. White – Color No. 37875 – Reflectivity minimum 87%
   4. Red – District Standard – No reflectivity standard
   5. Blue – ADA Approved Blue – No reflectivity standard
E. Sharp Silica Sand: This sand, when specified for longitudinal lines and bicycle lane symbols, will meet the following criteria:
   1. Percent passing 20-mil sieve – 100%
   2. Percent passing 50-mil sieve – 0 to 10%
   3. Density (ASTM D1475) – 13.5 lb/gal (+/- 0.37 lb/gal)
   4. Consistency at 170°F (ASTM D562) – 80 KU to 100 KU
   5. Fineness of grind (ASTM D1210) – 65 microns to 75 microns
   6. Dry Opacity (Fed Std. 141a, Method 4121) – 0.96

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7. Bleed Ratio (Fed Spec TT-P-85D) – 0.95
8. Flexibility (Fed Spec TT-P-115D) – Pass
9. Abrasion Resistance 961-10.6.3 – Pass

F. Glass Spheres: Glass spheres, when specified for enhanced night visibility without modification of daytime visibility, shall meet the requirements of AASHTO M 247 and be included in the QPL, and the following characteristics;
1. Roundness (ASTM D1155) – 70% true spheres, min
2. Refractive Index (Becke Line Method) – 1.5, min

PART 3 EXECUTION

3.1 PAINT STORAGE
A. Stored paint which hardens or livers to the extent that remixing will not produce a smooth, uniform consistency, shall be rejected and not used in the Work.

3.2 PAINT MIXING
A. All paint delivered to the work site shall arrive completely mixed.
B. Do not use gasoline as paint thinner under any circumstances.

3.3 APPLICATION EQUIPMENT
A. Use equipment that will produce continuously uniform dimensions for stripes and markings or varying widths.
B. The equipment shall be capable of traveling at a uniform, pre-determined rate of speed and capable of following straight lines and making normal curves.
C. When glass spheres are specified, use equipment that automatically dispenses the spheres.
D. Use equipment with a mechanical paint agitator that applies the paint at the required thickness without thinning the paint.
E. Use spray nozzles equipped with automatic cut-off valves to automatically apply broken lines.

3.4 PAINT APPLICATION
A. Prepare surfaces for painting.
1. Remove of existing pavement markings, if necessary.
a. Repair all scars or other surface blemishes cause by removal of existing markings so they do not interfere with new paint application or visually interfere with the new pavement markings.
2. Remove any other material that would conflict with proper application of the new pavement markings.
3. Establish tack lines for aligning stripes.

B. Apply paint for pavement markings.
1. Thoroughly mix paint prior to pouring paint into application equipment.
2. Apply paint on dry surfaces when the air temperature is at least 40^{o}F and rising, or per more stringent paint manufacturer instructions.
3. Apply paint only when wind speed will not interfere with application or produce spray dust.
4. All markings shall have well defined edges.
5. The Architect and Owner may conduct field-testing in accordance with FM 5-541 or other criteria.
a. The Architect and Owner reserve their right to determine, at their sole discretion, if the completed painting activity is satisfactory and compliant with these specifications and the normal standard of performance.
6. Remove and replace all defective painting Work at no additional cost to the Owner.

C. Paint application rates shall be:

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1. 6" solid stripe – 25 gal/mi
2. 6" skip stripe – 6.2 gal/ gross mi
3. Other stripes shall be applied in direct proportion to the above.

D. The required wet film thickness will be 15 mils.

E. Use black paint to provide contrast on concrete or light asphalt pavement when so directed by the Architect.

F. Dimensions and alignment:
1. Skip striping shall be applied in 10' sections with a 30' gap between sections.
   a. Length tolerance is ± 12" and over tolerance, lengths must balance under tolerance lengths to maintain gross application rates.
2. Line width tolerance is ± 1" for stripes not applied with one pass of the painting equipment.
   a. Maintain gross application rates, as above.
3. Apply longitudinal stripes at least 2" away from parallel construction joints in pavement.
4. Striping shall meet the following tolerances:
   a. Curves of 1° or less – Allowable alignment deviation, 1" maximum
   b. Curves greater than 1° – Allowable alignment deviation, 2" max.
   c. Linear – Neither less than 2" nor more than 4" from the edge of pavement without noticeable breaks or deviations
      i) Not more than 1" in 40' deviation from tack line.

G. Correction rates for pavement markings that do not meet dimensional tolerances shall be:
1. Width correction – Not more than ½" per 10 linear feet
2. Alignment correction – Not more than 1" per 25 linear feet

3.5 GLASS SPHERE APPLICATION

A. Apply the glass spheres, when specified for enhanced night visibility, at the rate of 6 lb/gallon of pigmented paint material.

3.6 NEW PAINT PROTECTION

A. Protect new paint from traffic until sufficiently dry so crossing vehicles will not damage pavement markings.

END OF SECTION

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SECTION 32 18 16
PLAYGROUNDS

PART 1 GENERAL

1.1 SECTION INCLUDES
- A. Playgrounds and associated work.

1.2 REFERENCES
- A. ADA/ABA Accessibility Guidelines
- B. ANSI Z535.1 –Safety Colors
- C. ANSI Z535.2 –Environmental and Facility Safety Signs
- D. ANSI Z535.4 – Product Safety Signs and Labels
- E. ASTM F1292-17 – Standards for Impact Attenuation for PG Surfacing
- F. ASTM F1487-21 – Standard Consumer Safety Performance Specification for Playground Equipment for Public Use
- G. ASTM F2049-11 – Standard Safety Performance Specification for Fences/Barriers for Public, Commercial, and Multi-Family Residential Use Outdoor Play Areas
- H. ASTM F2223-15 – Standards on Playground Surfacing
- I. ASTM F3351-19 – Standard Test Method for Playground Surface Impact Testing in Laboratory at Specified Test Height
- J. CPSC (Consumer Product Safety Council) – Public Playground Safety Handbook
- K. CSA Z614:20 – Children's playground equipment and surfacing
- L. IPEMA (International Playground Equipment Manufacturers Association)

1.3 SUBMITTALS FOR REVIEW
- A. Section 01 33 00 - Submittals Procedures
- B. District certified playground safety inspector (CPSI) from Risk Management must approve and sign off on product for compliance with national standards prior to product/manufacturer acceptance.
- C. Shop Drawings:
  1. 3-Dimensional drawing
     - a. With a 180-degree view shoring the type and color of surfacing.
     - b. State the grade level on the drawing, under the school's name.
     - c. Show the fall/use zone measurements, height of equipment and ADA access route.
     - d. List the number and name of the playground components meeting ADA requirements for lower and upper level components.
  2. 2-Dimensional drawing
     - a. Shall be on 11"x17" paper with No font being less than 1/8".
     - b. List the number and name of the playground components meeting ADA requirements for lower and upper level components.
     - c. Identify "North" on the drawing.
     - d. Include a scale on the drawing.
     - e. State the grade level on the drawing, under the school's name.
     - f. An identifying symbol shall be added to indicate that a curb will surround the playgrounds (4" for poured in place).
  3. (M)SDS forms and IPEMA (The International Playground Equipment Manufacturers Association) certification for the surfacing.
  4. A letter of compliance from the manufacturer describing their compliance with 16 CFR Part 1303 and Section 3 Federal Hazardous Substances Act with regard to led, and Section 8 of the Consumer Product Safety Act with regard to phthalates.

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1.4 SUBMITTALS FOR INFORMATION

A. Section 01 33 00 - Submittals Procedures
B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
C. Warranty
   1. A minimum of 5 years warranty shall be in effect for all equipment, installations, ADA surfacing, concrete curbing and sidewalks.
   2. Artificial Turf shall have a minimum of 7 years warranty.
   3. Recapping poured in place surfacing shall be warranted for a minimum of 3 years.
   4. Sealer over poured in place surfacing shall be warranted for a minimum of 1 year
   5. Damage due to vandalism is exempt from warranty.

1.5 DESIGN REQUIREMENTS

A. General
   1. Design shall comply with the FBC, ADA, ASTM, CPSC, and IPEMA.
   2. An effort shall be made to include at least one ASD friendly activity on each playground equipment project.
   3. Equipment for Pre-K shall not exceed four feet in height.
   4. Equipment for primary students shall not exceed six feet.
   5. Equipment for intermediate students shall not exceed eight feet in height unless designed for uses other than climbing.
   6. Outdoor fitness equipment shall be age appropriate.
   7. Equipment shall be free of points, sharp edges and protrusions that may cut or puncture.
   8. Equipment shall be free of protrusions and other elements that may snag clothing or body parts.
   9. Equipment shall be free of angles or openings that may entrap body parts.
   10. Equipment shall be free of pinch or crush points.
   11. Equipment shall be free of splinters and not be subject to future splintering.
   12. Equipment shall have slip resistant walking and climbing surfaces.
   13. Equipment shall have components that drain freely and do not collect water.
   14. Equipment shall have steps and hand holds of proper size, spacing and incline where necessary to assist climbing.
   15. Closed risers shall be placed at all steps.
   16. Equipment shall have all moving parts constructed of materials that minimize the potential for impact injuries.
   17. Equipment shall have handrails, raised edges and other barriers where necessary to minimize the potential for falls.
   18. Equipment shall have vandal-proof connectors that cannot be loosened or unfastened without special tools.
   19. Equipment shall permit easy access by adults for maintenance and emergencies.
   20. Equipment shall provide more than one means of access and exit.
   21. Equipment shall be designed to support the maximum possible load able to be imposed on the apparatus.
   22. Equipment shall be designed to be permanently anchored in place.
   23. Equipment shall be constructed of non-rusting and nontoxic materials and paints.
   24. Equipment shall be constructed of materials that will remain durable in an outdoor environment.
   25. All main (in-ground) support posts shall be powder coated aluminum. Steel will be allowed for posts supporting structural loads such as shade structures or activities that require steel for added strength.
   26. Equipment shall not be constructed of wood or contain wooden components.

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27. There shall be no tether balls or benches (or other seating) placed inside either the playground area or outdoor fitness equipment area.
28. There shall be no walls, grates, drains, valves or any other possible obstruction within a 6 foot perimeter of any playground unless protected by a six foot high (black vinyl) 9 Ga. Fence, or one that matches existing chain link 6 foot high fences.
29. All playgrounds shall be ADA compliant including having code compliant sidewalks to the ADA surfacing.
30. Equipment repairs, revisions or replacements by the vendor shall require prior approval from Risk Management.

B. Surfacing
1. Install per manufacturer's specifications to ensure proper drainage.
2. Surfacing for all playgrounds shall be poured in place rubber or other IPEMA Certified and ADA compliant fall protection system, with the exception of some Pre-K playgrounds where the District may approve artificial turf.
3. A copy of the IPEMA certification shall be provided.
4. Loose fill type surfacing is not allowed for playgrounds.
5. Provide and install clean fill as needed, compacted to 2,500 psf, to ensure positive drainage away from playground. Submit compaction test results.
6. The EDPM layer will be 5/8" .
7. Artificial Turf seams will be secured with Velcro and adhesive. The turf will be secured firmly so that it cannot be lifted in any manner.

C. Curbs for Playgrounds
1. For PIP or other IPEMA Certified and ADA Compliant fall protection surfacing: Installer shall provide and install 4 inch wide by 12 inch deep new concrete curb at playground perimeter, with curb cuts for drainage. Installer shall submit a proposed curb detail for approval for monolithic slab installation.
2. For Artificial turf – Installer shall provide and install 6 inch wide x 12 inch deep new concrete curb at playground perimeter, saw cut every 10 feet. Installer shall submit a proposed curb detail for approval for monolithic slab installation.

D. Fencing
1. All Pre-K, kindergarten and ESE (ADA) playgrounds will be surrounded with a 6 foot high, 9 Ga black vinyl double knuckle chain link fence, or one that matches existing chain link 6 foot high fences.
2. When the playground is located inside a school's existing 6 foot high perimeter fence, a 4 foot high fence may be allowed, at the District's discretion.
3. Fences surrounding K-2 playgrounds are required to have on gate equipped with panic hardware if under 2500 square feet and if over 2500 square feet two gates equipped with panic hardware are required.
4. Fencing shall comply with Section 32 31 13 – Chain Link Fencing and Gates.

E. Signs
1. Signage for all playgrounds shall be provided and installed in compliance with ASTM standards.
2. The District may also purchase signs for existing playgrounds.
3. Signs shall state the student's age level of equipment, student grade level of equipment as determined by the District, the words, "Adult Supervision Required" and ASTM warnings for removal of drawstrings, Hot Surfaces, hard surface hazards and Supervision of helmets. These warnings must conform to ANSI Z535.1 and either ANSI Z535.2 or ANSI Z535.4.

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F. Replacement parts
   1. Replacement parts, whether under warranty or not, must be available in the United States or the vendor must give the District an option of delivery by Priority shipping or overnight delivery, payable by the District.
   2. Replacement parts shall be new.

1.6 QUALITY ASSURANCE
   A. Submit copy of IPEMA certification.
   B. Submit clean fill subgrade compaction testing meeting 2,500 psf.
   C. Pre and Post drop test will be performed by the District's Risk Management Certified Playground Safety Inspector (CPSI) when surfacing repairs encompass the entire area to ensure it conforms with ASTM F-1292 requirements.
   D. Any playground equipment or surfacing installed on Palm Beach County Schools' property not complying with safety regulations and all requirements in this bid shall be removed or replaced (at sole discretion of the District) at no cost to the District.

PART 2 PRODUCTS

2.1 SAMPLES
   A. Product specifications, (M) SDS and samples, must be provided within 24 hours of request.
   B. A sampling of the surface material that is installed may be tested to be certain its quality and consistency matches submitted product specifications.
   C. A random sample will be collected by District staff and tested at an independent lab to verify that the proper amount of binder is used.
      1. If it fails, the Contractor agrees to provide a seal coating in 2 years or increase the length of the warranty and will reimburse the District for testing.

PART 3 EXECUTION

3.1 PLACEMENT
   A. Locate utilities prior to installation. Notify District of potential conflicts.
   B. Repairs to utilities as a result of construction damages is the responsibility of the Contractor.
   C. Erect and maintain a barrier around the entire playground until it has passed inspection by the District's Risk Management CPSI and released for use.

3.2 FIELD QUALITY CONTROL
   A. District certified playground safety inspector (CPSI) from Risk Management must inspect the product for compliance with national standards prior to final approval and acceptance.
   B. A "Certificate of Completion" from the Building Department or permitted work is required prior to Risk Management issuance of a final approval letter.

END OF SECTION

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SECTION 32 30 00
EXTERIOR ATHLETIC EQUIPMENT & FIELD MARKERS

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 work in this section.
B. Section 01 60 00 - Material/Equipment and Approved Equals
C. Section 31 20 00 – Earth Moving
D. Section 03 30 00 - Cast-in-place Concrete
E. Section 09 91 13 – Exterior Painting

1.2 DESCRIPTION OF WORK

A. Provide labor, materials and equipment necessary for the complete installation of the following items as shown on the drawings and specified herein.
B. Work in this section includes, but is not limited to the following:
   1. Soccer goals
   2. Field lining and reference monuments for soccer.

1.3 QUALITY ASSURANCE

A. In addition to the requirements of these specifications, comply with manufacturer's instructions and recommendations for the work, including preparation of substrate and application.

1.4 SUBMITTALS

A. Submit under provisions of Section 01 33 00.
B. Product Data: Submit current copies of the manufacturer's current product literature for each item specified herein.
   1. Include types of materials, construction details, sizes and layout, and complete information on hardware and accessories.
C. Shop drawings: Submit shop drawings for all items not fully described by standard product literature.

1.5 QUALITY ASSURANCE

A. Preliminary Coordination Conference: As soon as possible after the award of site improvement work, meet with the installer, and installers of substrate construction, and other related work including penetrating work such as playground equipment, the Architect, and the Owner.
   1. Review requirements (Contract Documents), submittals, status of coordinating work, availability of materials, and installation of facilities and establish a preliminary installation schedule.
   2. Review requirements for inspections, tests, certifications, forecasted weather conditions, governing regulations, and proposed installation procedures.

1.6 REGULATORY REQUIREMENTS

A. Conform to the Florida Building Code, and State and Local Regulations, these requirements supersede the Technical Specifications in this section.

PART 2 PRODUCTS

2.1 SOCCER GOALS

A. Portable Soccer Goal

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1. Provide portable soccer goals as manufactured by Jaypro Sports, of the following sizes with wheel kits.
   a. 7'H x 21'W x 3'B x 8'D
   b. 6-1/2'H x 18-1/2'W x 2'B x 6'D
   c. Use 4" x 2" steel uprights with an aluminum crossbar to prevent goal from being top heavy.
   d. Uprights and crossbar are to have a factory painted white finish.
   e. Backstays and rear ground crossbar are to be 2" O.D. galvanized steel.
2. Provide 14" steel auger anchor system including steel wire lanyard as manufactured by Jaypro Sports, Model No SAS-95.
3. Provide nets of coordinating sizes as manufactured by Jaypro Sports.
4. See Section 11 65 00 for other approved manufacturer equals.

2.2 SPORT FIELD MARKING SUPPLIES

A. Ground sockets shall be as manufactured by Markers, Inc. or equal.
   1. Provide plastic plus for all ground sockets.
      a. Provide four lining plugs for setting string lines for each field.
      b. The lining plugs shall also fit in the ground sockets.

B. Use acrylic latex field marking paint for field line marking.
   1. The paint shall be “Super Craft Latex Field Marking Paint 165” as manufactured by Benjamin Moore & Co., or equal.

C. Provide four soccer corner flags for each field on the school campus.
   1. The corner flags will be spring loaded soccer flags as manufactured by Markers, Inc. or equal.

PART 3 EXECUTION

3.1 PREPARATION

A. Make such arrangements as are necessary to provide scaffolding to perform work under this section.
   1. The Contractor, at his expense, shall correct any damage to floors and/or equipment and the like.

B. Layout equipment as indicated on the drawings and in the referenced official standards.

3.2 INSTALLATION

A. Install in accordance with manufacturer's printed instructions, drawings, specifications, and final shop drawings.

3.3 INITIAL SPORT FIELD MARKING

A. The Contractor shall provide initial sport field marking and reference monuments as noted on the soccer field diagrams, see diagrams at the end of this section.
   2. Soccer Fields
      a. Marking – Provide chalk marking for all field boundaries (touch lines and goal lines), half-way line, center circle, penalty boxes, goal boxes, penalty kick lines, arc centered on penalty kick line, arc centered on corners. Refer to diagram presented below.
      b. Monuments – Provide ground sockets set in the ground at the locations identified on the field diagram and explained below:
         1) Bubble 1 – Center of entire field.

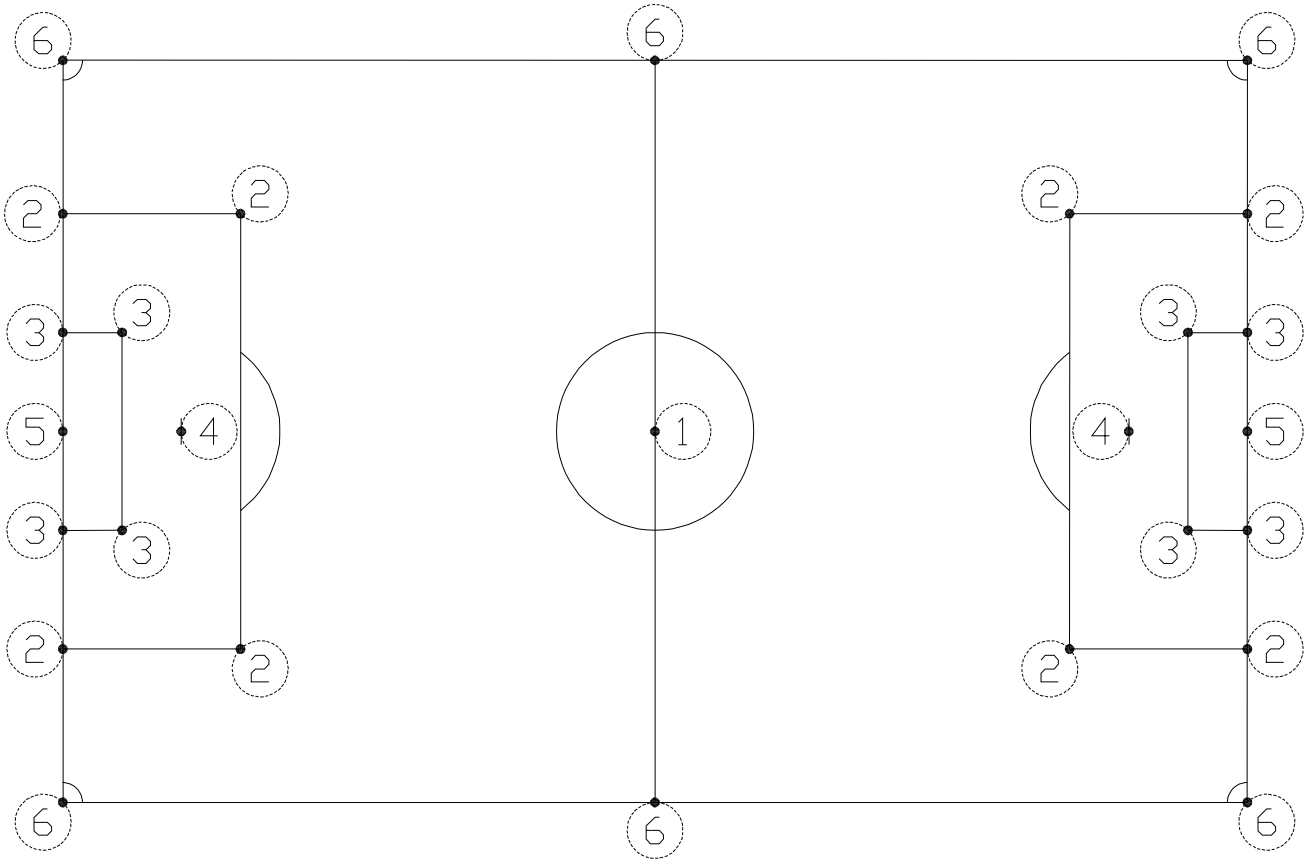
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2) Bubble 2 – Corners of penalty box.
3) Bubble 3 – Corners of goal box.
4) Bubble 4 – Center of penalty kick line and arc.
5) Bubble 5 – Middle of goal box, on goal line.
6) Bubble 6 – Center and ends of touch lines.
   a) Ground sockets at ends of touchlines must hold corner flags during play.

c. Securely anchor all soccer goals in accordance with the goal manufacturer's recommendations for 140 mph winds.

3.4 ACCEPTANCE

A. Dispose of all debris and excess unusable materials.
B. Leave all areas and installations clean and in a manner acceptable to the Architect and Owner.



SOCCER FIELD

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SECTION 32 31 13
CHAIN LINK FENCING and GATES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

A. Provide complete chain link fencing for exterior locations as follows.
   1. 6'-0" high fence typical perimeter fencing and separation fences
   2. 8'-0" high fence for bicycle parking enclosures.
   3. 8’-0” high fence for propane tank enclosures.
      a. Provide screening slats in the fence when the propane tank is visible from nearby roadways.
   4. Other heights as indicated for specific locations.
   5. Provide black vinyl coated chain link fencing on property perimeters fronting on streets, bicycle racks, and interior courts; galvanized steel fencing elsewhere.
   6. Aluminum coated chain link fence around athletic facilities, bicycle racks, and interior courtyards as authorized in writing by Program Management.

B. Fence locations:
   1. Provide fences around the site, retention ponds, athletic facilities, bike rack, kindergarten play area, dumpsters, lift station, gas tanks, irrigation well, FPL transformer and condensers.
   2. Provide fences around the water meter, potable water backflow preventer, and fire main backflow preventer.
   3. Provide fences around all wet retention/detention ponds, on site with double gates.
   4. At elementary schools, provide fences around wet and dry retention/detention ponds, swales or depressed areas with open access to drainage pipes over 8" in diameter.
   5. Minimum height of all fences is 6', except around the bike rack is 8' high.
   6. Fencing material will be 9-ga galvanized steel or black vinyl coated steel.
      a. Fence fabric shall have knuckled selvage at both top and bottom.
      b. May use aluminum coating in accordance with A.5 above
   7. In projects on existing school campuses, the fence material will match existing fencing that will remain unless otherwise indicated.
   8. Fences for athletic facilities will be in accordance with Facilities Planning for Physical Activity and Sport (Elementary and Middle Schools), and National Federation Court and Field Diagram Guide (High Schools).

C. Fence Design
   1. The Architect or his designated sub-consultant shall be responsible for proper design of all fencing materials, including verification of the minimum material sizes listed herein.
      a. Include proper detailing in the design for installation of intermediate fence rail sections for all fences with particular attention to fences (including backstops) over six feet in height.
      b. Include line, gate, and corner post details for installation of concrete foundations.
   2. Design all fencing to withstand Risk Category I wind speeds, exposure C.

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1.3 REFERENCES
- A. ASTM A53 – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
- B. ASTM A392 – Standard Specification for Zinc-Coated Steel Chain Link Fence Fabric
- C. ASTM F567 – Standard Practice for Installation of Chain Link Fence
- D. ASTM F668 – Standard Specification for Polyvinyl Chloride (PVC), Polyolefin and Other Polymer-Coated Steel Chain-Link Fence Fabric
- E. ASTM F1043 – Standard Specification for Strength and Protective Coatings on Steel Industrial Fence Framework
- F. ASTM F1083 – Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures
- G. CLFMA – Chain Link Fence Wind Load Guide for the Selection of Line Post and Line Post Spacing

1.4 SUBMITTALS
- A. Shop drawings shall indicate details of fabrication, installation, size, layout, post/foundation details, hardware anchorage, and component schedule.
  1. Show locations of different fence fabrics.
- B. Provide manufacturer's product descriptive data on fabric, posts, accessories, fittings, and hardware.
- C. Manufacturer Installation Instructions: Indicate installation requirements and post foundation anchor bolt templates.

1.5 QUALITY ASSURANCE
- A. Perform work in accordance with the manufacturer’s instructions.

1.6 QUALIFICATIONS
- A. Manufacturer: Company specializing in manufacturing the products specified in this section with a minimum of 5-years of experience.

PART 2 PRODUCTS

2.1 MATERIALS
- A. Materials are listed for a six foot tall chain link fence. Taller fences will require other, heavier materials.
- B. Galvanized steel fabric: 9-ga. steel wire, 2" diamond mesh interwoven wire, top selvage knuckle end closed, bottom selvage knuckle end closed, full-height unless otherwise noted.
- C. Vinyl-coated fabric: 9-ga. steel wire, 2" diamond mesh interwoven wire, top selvage knuckle end closed, bottom selvage-knuckle end closed, full-height unless otherwise noted, color: black.
- D. Aluminum-coated fabric: 9-ga. steel wire, 2" diamond mesh interwoven wire, top selvage knuckle end closed, bottom selvage knuckle end closed, full-height unless otherwise noted.
- E. All pipes are hot dip galvanized steel, schedule 40 dimensions, compliant with ASTM A53 or ASTM F1083. ASTM F1043 applies to the galvanized coating.
  1. ASTM A53 applies to 1” and 3” nominal pipe sizes.
  2. Refer to M, below, for an alternate material specification.
- F. Top and Brace Rail: 1-5/8” O.D. (1-1/4” nominal size, 0.140” wall thickness, 2.27 lb./ft.) pipe, plain end, with outside sleeve-type couplings at least 7" long, one coupling in every five shall have a spring for expansion and contraction of rail.
  1. Finish shall match supported fence fabric.
- G. Corner, Terminal (End) and Pull Posts: 3-1/2" O.D. (minimum) (3” nominal size, 0.216” wall thickness, 7.58 lb./ft.) pipe.
  1. Finish shall match supported fence fabric.

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2. Corner, terminal and pull post foundations shall be minimum 12“-diameter by 36“-deep. Post shall extend to within 6” of the foundation bottom.
3. Equip posts with ¼" x ¾" tension bar 11-ga by 1" wide tension bands and ⅜" dia. carriage bolts and nuts, bands at 14" o.c.

H. Line Posts shall be 2-7/8” O.D. (2-1/2” nominal size, 0.203” wall thickness, 5.79 lb./ft.) pipe.
1. Equip posts with pressed steel top of manufacturer's design; finish shall match supported fence fabric.
2. Line post foundations shall be minimum 10“-diameter by 30“-deep. Post shall extend to within 6” of the foundation bottom.

I. Gate Posts:
1. Refer to Table 1, included in the Appendix at the end of this section for required minimum gate post and post foundation sizes.
2. Finish of gates shall match adjacent fence fabric.

J. Gates:
1. 1-5/8” O.D. SCH 40 (1-1/4” nominal size, 0.140” wall thickness, 2.27 lb./ft.) galvanized steel pipe frames with all welded construction. Provide internal bracing with ⅜" adjustable steel truss rods.
   a. Gates wider than four feet may require heavier frames using larger diameter pipe.
   b. Wide gates must be free of gravity-induced sag when first installed.
2. Heavy-duty type pressed steel hinges, constructed to allow gate to swing 90° to 180°.
   a. Provide min. 2 hinges per leaf, 3 hinges per leaf for all gates over eight feet wide, total width.
   b. Cast iron hinges are not acceptable.
   c. Drill and screw hinges to gateposts on all gates over six feet wide, total width.
      i) Tighten hinges on gateposts before installing screws.
      ii) Use minimum two, ¼” diameter screws per individual hinge.
      iii) Drill through hinge and the gatepost wall, then set the screws.
      iv) The screws are to keep the hinge from rotating on the gate support post.
3. Use pressed steel padlocking device, center rest, and semi-automatic catch to secure all driveway gates in the open position.
   a. Cast iron hardware is not acceptable.
4. Pedestrian gates not located along a means of egress shall be equipped with locking hardware that will allow use of padlocks to secure the gate.
   a. Manufacture locking hardware from pressed steel, not cast iron.
5. Pedestrian gates that are located along a means of egress shall be equipped with panic hardware that allows immediate egress from the school site.
   a. Refer to DMS Section 08 71 00 for acceptable products and manufacturers.
   b. The panic hardware operating mechanism shall be equipped with guards that prevent unauthorized operation by individuals outside the school site.
   c. Manufacture all locking hardware from pressed steel or equivalent materials.
   d. Cast iron hardware is not acceptable.

K. Caps: Vinyl or galvanized steel, depending on location, sized to post diameter, set screw retainer.

L. Accessories: Same finish as framing and fabric.

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M. Alternate Pipe Material
1. It will be acceptable to use pipe material that complies with the SS40 High Strength Fence Framework as noted below:
   a. Material specification conforms to ASTM F1043, Group IC.
   b. 50,000 psi steel yield strength.
   c. High strength steel conforming to ASTM A1011.
   d. O.D. coating Type B and I.D. coating Type D.
   e. As manufactured in the United States by Allied Tube and Conduit, or equal.
   f. Dimensional standards as shown in the following table:

OUTSIDE DIAMETER	NOMINAL PIPE SIZE	DECIMAL OUTSIDE DIAMETER	WALL THICKNESS	MATERIAL WEIGHT (LB./LIN.FT.)	USE
1-5/8”	1-1/4”	1.660	0.111	1.84	Top and Brace Rails Gate Frames
2-7/8”	2-1/2”	2.875	0.160	4.64	Line Posts
3-1/2”	3”	3.500	0.160	5.71	Corner, Terminal (End) and Pull Posts
4”	3-1/2”	4.000	0.160	6.56	Gate Posts *

*See Table 1 in the Appendix

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that preparations in fence locations are complete, without irregularities that would interfere with fence installation, correct unsatisfactory conditions before starting work.

3.2 INSTALLATION

A. Measure and lay out complete fence line, parallel to surface of ground.
   1. Locate line posts 10' o.c. maximum spacing.
   2. Locate corner posts where fence changes directions more than 10°.

B. Provide minimum posthole diameter 3 times outside post diameter.
   1. Set posts minimum of 24" into concrete base, plumb to ¼" in 10'; fill hole with concrete to 2" above grade.
   2. Crown the surface of concrete to slope away from posts.

C. Fence Fabrics:
   1. Stretch fabric tight between terminal posts or at intervals of 100' maximum.
      a. Do not stretch fabric until concrete foundation has cured 28 days min.
   2. Position the bottom of the fabric approximately 2" above ground level at each post.
   3. Cut or splice fabric to form one continuous piece between terminal posts.
   4. Attach fabric to terminal, corner or pull posts using tension bars and tension bands at 14" o.c.
   5. Attach fabric to line posts using wire ties or clips, spacing not to exceed 15" o.c.
   6. Attach top edge of fabric to top rails using wire ties or clips, spacing not to exceed 24" o.c.
   7. Attach bottom edge of fabric to bottom rails using wire ties or clips, spacing not to exceed 24" o.c.
   8. Place fabric on outside of posts and rails.
   9. Install fabric so its bottom edge is two inches above finished grade (+/- ½ inch).

D. Gates:

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1. Use swing gates.
2. When used in emergency egress situations, limit-swinging gate leaves to 4'-0" wide.
3. Provide 2" ground clearance for gate leaves 5'-0" or less and 4" for over 5'-0" wide.
4. Set gate posts at least 1'-8" back from face of curbs.
5. Install gates plumb and level ¼" in 10'.
6. Adjust hardware to provide smooth operation.

E. Brace each gate and corner post to adjacent line post with horizontal center brace rail and diagonal truss rods.
   1. Install brace rail one bay from end and gateposts.

F. Brace tops of all posts installed adjacent to buildings and/or columns with steel brackets substantially secured to building wall and/or columns.

G. Fasten fabric to top rail, posts, braces, and bottom tension wire with tie wire, maximum 15" o.c.

H. Attach fabric to end, corner, and gateposts with tension bars and tension bar clips.

I. Install bottom tension wire stretched taut between terminal posts.

J. Do not attach the hinged side of gate to building walls; provide gateposts.

K. Install gate with fabric to match fence.
   1. Install three hinges per leaf, latch, catches, and drop bolt.

L. Provide concrete center drop to footing depth and drop rod retainers at center of double gate openings.
   1. Do not install drop rod retainers (cane bolts) on gates that that are part of emergency egress routes - provide alternate approved hardware.

3.3 ADJUST AND CLEAN

A. Adjust brace rails and tension rods for rigid installation.

B. Tighten hardware, fasteners, and accessories.

C. Remove excess and waste materials from project site.

D. Adjust gates to alignment, operate freely, and latch properly.

END OF SECTION

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APPENDIX

TABLE 1 – REQUIRED MINIMUM SWING GATE POST AND FOUNDATION SIZES

Size of a Single Gate Section (1)			Nominal Pipe Size (2, 4)	Minimum Foundation Dimensions(3)	
				Diameter	Depth
3’	to	11’	3-1/2”	14”	30”
11’-1”	to	18’	6”	20”	36”
18’-1”	to	21’	6”	24”	36”
21’-1”	to	25’	6”	24”	42”
25’-1”	to	30’	6”	30”	42”

FOOTNOTES:
(1) A gate with a 22 foot total width would have two, single sections, each 11’ wide.
(2) The gate post extends to within 3” of the foundation bottom.
(3) Unless otherwise noted on the plans for a specific gate.
(4) All gateposts shall be hot dip galvanized, SCH 40, having the listed nominal pipe size, unless the design engineer specifies larger pipes. See body of specification for ASTM requirements.

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SECTION 32 31 19
DECORATIVE METAL FENCING AND GATES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

A. Provide complete aluminum ornamental fencing as shown on the drawings and specified herein.

1.3 REFERENCES

A. ASTM B221 – Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes

B. ASCE 7 - Minimum Design Loads for Buildings and Other Structures

1.4 SUBMITTALS

A. Shop Drawings: Indicate details of fabrication and installation, size and layout, post and foundation details, hardware anchorage, and schedule of components

a. Indicate compliance with specified code references.

B. Provide manufacturer's descriptive data on fabric, posts, accessories, fittings, and hardware.

C. Provide manufacturer installation instructions indicate installation requirements, post foundation anchor bolt templates.

1.5 QUALITY ASSURANCE

A. Perform work in accordance with the manufacturer’s instructions.

B. Manufacturer: Company specializing in manufacturing the products specified in this section with a minimum of 5-years of experience.

PART 2 PRODUCTS

2.1 MATERIALS

A. Aluminum Extrusions: All components shall be made of 6063-T5 in accordance with ASTM B221.

B. Stringers: 2" x 2", 0.70", aluminum extrusion, pre-punched to allow the pickets to pass thru the top of the rail. Stringer spacing shall be as shown on the drawings.

C. Line and Gate Posts: 4" x 4", 0.125", aluminum tube, pre-punched to allow stringers to slide in and be attached using stainless steel TEK screws.

1. Provide blunt post caps.

D. Pickets: ¾" square, 0.60", aluminum extrusion, mechanically fastened to top and bottom stringers using stainless steel TEK screws on one side of the stringer only.

1. If required by design, provide blunt picket caps or tops.

E. Gates: Construct gates using the specified materials and shall be fabricated using fully welded construction.

1. Gates shall have a 0.25" aluminum plate welded to the face as shown for mounting of door panic device, with self-closing hinge.

F. Expanded Aluminum Facing: Provide ¾" 9-ga, expanded metal security fencing welded to each gate as shown.

G. Accessories, manufacturer listed or approved equal:

1. Hinges: self-closing, 4½" wide x 4½" high, FBB1191.
2. Closer: LCN 4040

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3. Panic Device: Von Duprin or Monarch, Stainless Steel, standard rim cylinder.

H. Finish: Coat the fence system using polyester powder coating in a color selected by the Architect from the manufacturer's standard color palette.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that preparations in fence locations are complete, without irregularities that would interfere with fence installation.

B. Do not commence work until conditions are satisfactory.

3.2 INSTALLATION

A. Measure and lay out complete fence line, parallel to surface of ground.

1. Locate line posts at maximum 10' o.c. spacing. Locate corner posts at positions where fence changes directions more than 10°.

B. Provide minimum posthole diameter 3 times outside post diameter, set posts plumb to ¼" in 10', fill hole with concrete to 2" above grade, crown concrete surface to slope away from posts.

C. Gates:

1. Install gates plumb and level, ¼" in 10'.
2. Install panic devices on all leaves required for emergency egress.
3. Do not install cane bolts on leaves requiring panic devices.
4. Where both leaves of a gate are required for emergency egress, provide center mullion post or alternate approved egress hardware.
5. Do not attach the hinged side of gate from building wall; provide gateposts.
6. Install three hinges per gate leaf.

D. Provide concrete center drop to footing depth and drop rod retainers at center of double gate openings, unless both leaves are required for emergency egress.

3.3 ADJUST AND CLEAN

A. Tighten hardware, fasteners, and accessories.

1. Remove excess and waste materials from project site.

B. Adjust operating hardware to operate freely and properly as intended.

2. Adjust gates to proper clearances.

END OF SECTION

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SECTION 32 33 13
SITE BICYCLE RACKS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Exterior bicycle racks.

1.2 REFERENCE STANDARDS

A. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2018.

B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

1.3 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.

1.4 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

2.1 MANUFACTURERS

A. Exterior Bicycle Racks:
   1. Basis of Design: Columbia Cascade Company; 2170-9-P-G-C: www.bicycle.columbia-cascade.com.
   2. American Bicycle Security Company: www.ameribike.com/#sle.
   3. Bike Security Racks Co., Inc: www.bikeracks.com.
   4. Huntco Supply, LLC: www.huntco.com/#sle.
   5. MADRAX, a brand of Graber Manufacturing, Inc: www.madrax.com/#sle.
   6. Substitutions: See Section 01 60 00 - Material Equipment and Approved Equals.

2.2 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: 33 bicycles, minimum.
   3. Configuration: As indicated in Drawings.

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4. Mounting, Ground: Pedestal mount, fixed surface.
5. Pedestal Mount Bases: 1/4 inch thick mild steel plate permanently welded to two 1-1/2 inch i.d. schedule 40 pipe sleeves.
6. Accessories: In-ground grout cover, concealing pedestal base and anchor bolts.

B. Materials:
1. Pipe: Carbon steel, ASTM A53/A53M, Schedule 40, minimum 2-inch i.d, hot-dipped galvanized per ASTM A123 after complete fabrication.
2. Finish: Powder coat, maintenance-free and weather-resistant.
a. UV resistant exterior grade polyester powder coating applied to a minimum thickness of 6 mils.
3. Color: As selected by Architect from manufacturer's standard range.

PART 3 EXECUTION

3.1 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.

3.2 PREPARATION

A. Ensure surfaces to receive bicycle racks are clean, flat, and level.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install level, plumb, square, and correctly located as indicated on drawings.

3.4 CLEANING

A. Clean installed work to like-new condition. Do not use cleaning materials or methods that could damage finish.

3.5 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

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SECTION 32 84 23
UNDERGROUND IRRIGATION SYSTEM

PART 1 GENERAL

1.1 SCOPE

A. Provide all labor, material, equipment and services required for the installation of irrigation system as described in the specifications and on the plans.

B. Specifications are intended to include everything required and necessary for proper installation of the irrigation system whether each item is mentioned or not, and Contractor is expected to provide for a complete working system.

1. Size the irrigation zones so that the irrigation pumps are able to supply a full irrigation cycle (flow and volume) for the entire campus within an eight-hour period.
2. Size the irrigation system to deliver sufficient water (1.5 inches) to maintain healthy landscaping and grass cover during two days of watering.
3. Provide separate zones and possible pump, system, and water supply for sports fields with Bermuda grass.
    a. Also, provide separate zones for watering of shrub / ground cover areas.

C. Execute all work in accordance with all applicable, ordinances, laws, regulations, codes, and local conditions, changes or additions shall be at no additional cost to Owner.

1.2 BIDDING

A. Bidders submitting a proposal for this contract shall be responsible to inspect site to acquaint themselves with nature of conditions, which may construction.

B. Bidders shall make themselves aware of all existing and/or proposed utilities in area of work.

1.3 REFERENCES

A. ASTM D1784 - Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds

B. ASTM D2241 - Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)

C. Florida Building Code

1.4 DIMENSIONS

A. All dimensions indicated on the plans are approximate, it is the Contractor's responsibility to verify all dimensions and reporting any variations from the plan to the Architect in writing.

1.5 ORDINANCES, REGULATION, CODES, PERMITS, AND INSPECTIONS

A. All work shall conform to all applicable regulations, ordinances, and codes.

B. Contractor shall acquire and pay for all required permits.

C. Contractor shall arrange for and be present during all required inspections.

D. Any additional work or materials required due to inspection by authorities having jurisdiction shall be at no additional cost to Owner.

1.6 GUARANTEE

A. Contractor shall guarantee the underground irrigation system for one-year from date of final acceptance by Owner and Architect.

B. This includes all material, workmanship, and performance of the system.

1.7 TRAINING OF OWNER'S PERSONNEL

A. The Contractor shall commission the irrigation system according to the design-watering schedule, label the controller for the proper valve stations, and debrief the owner’s representative on the proper operation and maintenance of the system.

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B. The Contractor shall furnish copies of all parts list, trouble-shooting lists, manufactures' specification, or catalog sheets to the Owner and the Architect as a prerequisite to final payment.

1.8 SUPERVISION

A. Contractor shall provide a competent superintendent and any necessary assistants on the project when work is in progress.
B. Contractor shall notify the Owner of any change in the job Superintendent's status on the job
C. Superintendent shall supervise Contractor's employees and is responsible for their actions and conduct on job site.

1.9 PROTECTION OF WORK AND PROPERTY

A. Contractor shall continuously maintain adequate protection of all his work from damage and shall protect Owner's property from injury or loss arising in connection with his work.
B. Contractor shall avoid damage to any existing construction, equipment, piping, pipe coverings, electrical systems, sewers, sidewalks, landscaping, or any other above ground or underground installations or structures on Owner's or adjacent property and is responsible for any damage that occurs as a result of his work as provided and required by law.

1.10 CLEANING PREMISES

A. Contractor shall keep the construction area of the system neat and orderly at all times, providing continual disposal of rubbish and waste material resulting from installation.
B. Upon completion of the system, Contractor shall remove from property, at his own expense, all temporary structures, rubbish, and waste materials resulting from installation.

1.11 SUBMITTALS

A. Provide submittals in accordance with section 01 30 00.
B. The Contractor shall submit shop drawings and product data to the Architect and Owner:
   1. Indicating the actual layout of the well, pump pad and pumping equipment, piping, control equipment, rain sensor, and other irrigation pump station accessories.
   2. All technical data and installation instructions for underground system components.
   3. The Owner and Architect shall approve the shop drawings prior to start of work.
C. The Contractor shall maintain an up to date set of as-built drawings.
   1. Showing the location of well, pump, sprinkler-heads, valves, controller, piping, and any other deviations from the original Architect plan.
   2. Show all mainline isolation valves, splice boxes, and remote control valve locations with accurate dimensions to identifiable reference points.
   3. Complete set of reproducible as-builts of the installed irrigation system upon completion.

1.12 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to work in this section.
B. Section 31 20 00, Earthwork

PART 2 PRODUCTS

2.1 GENERAL

A. Use all new materials without flaws or defects of any type in the system, having a minimum one-year guarantee against material defects or defects in workmanship.
B. Owner shall approve any Contractor substitution of material prior to installation.
   1. Contractor shall supply product specifications/data sheets and material samples, and reason for proposed substitution.

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2.2 PVC PIPE AND FITTINGS

A. Provide continuous marking on all pipes indicating manufacturer, type, class, and size.
B. Plastic pipe for the main water lines shall be schedule 40 un-plasticized polyvinyl chloride solvent weld type for use with schedule 40 PVC fittings as manufactured by don't use over 4" go to DI fittings:
   1. CertainTeed Corporation
   2. Colonial Plastics Mfg. Co
   3. American Pipe and Plastics, Inc.
C. Plastic pipe for sleeves may be schedule 40 or SDR 26 (whichever is thicker).
   1. Same requirements and manufactures as B above.
D. All mainline and sleeve pipefittings less than four inches in diameter shall be schedule 40 PVC.
E. All mainline and sleeve pipefitting's over four inches in diameter shall be compact ductile iron in accordance with AWWA specifications for potable water fittings used with PVC pipe.
F. Plastic pipe for laterals shall be SDR 26 (minimum), un-plasticized polyvinyl chloride, 1120 or 1220 solvent weld type as manufactured by:
   1. CertainTeed Corporation
   2. Colonial Plastics Mfg. Co
   3. American Pipe and Plastics, Inc.
G. Lateral fitting, except as noted, shall be a minimum of schedule 40.
H. Pipes and fittings shall be manufactured from clean virgin NSF approved Type 1, Grade 1, PVC conforming to ASTM resin specifications D1784 and D2241.
I. Make all taps on mains or laterals with tees, if non-tread type, joints shall be socket type, designed for solvent-cement application.
J. Prior to the connection of any joint with PVC glue, treat the fittings and pipes with a high etch PVC cleaner.
   1. The cleaner and solvent used shall be compatible with the PVC pipe.
   2. Make all solvent weld joints as recommended by the pipe and fitting manufacturer.
   3. Make-up the screw joints with an acceptable screw joint pipe joint compound.
   4. Upon completion of glue joints, the irrigation system shall remain out off for the period as specified by the glue manufacturer.

2.3 SWING JOINTS AND RISERS

A. All ½" swing joints shall be flexible thick-walled polyethylene pipe, with inside diameter of approximately 0.490" and outside diameter of approximately 0.700", and withstand a 400-psi burst test.
   1. All fitting shall be barbed and for use with the installed polyethylene pipe.
B. All ¾ and larger swing joints shall be schedule 80 nipples and street elbows of the same size inlet of the sprinkler head threaded together with Teflon (TFE) tape or liquid Teflon.
C. All swing joints nipples and elbows shall be the same size as the inlet of the irrigation head.

2.4 ELECTRIC WIRING

A. All electrical work shall conform to applicable building and electric codes.
B. All electrical components shall be UL listed.

2.5 CONTROL LINES

A. Electrical control wiring:
   1. All control and ground wire shall be irrigation control cable of size as per manufacturer's requirements, except pulse wire min. 14-ga and common wire min. 12-ga.

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2. Wiring for connecting the automatic remote control valves to the automatic controllers shall be type UF 600 volt copper single conductor wire with PVC insulation with UL approval for direct underground burial feeder cable.

B. Insulation shall be 4/64" thick minimum covering for positive waterproof protection of sizes AWG 14 to 10, and 5/64" thick for sizes AWG 8 to 00.

C. Pulse circuit wires shall be a different color for each controller.
1. Extra control line wire shall be a different color than all pulse circuit controller wire.

D. All common wire shall be white.

2.6 SPRINKLER HEADS

A. The Architect's irrigation plans specify the irrigation heads and nozzles.
1. Acceptable substitutes for Toro 570Z series irrigation mist heads are Rainbird 1800 series or Hunter Institutional Spray series.
2. Acceptable substitutes for K Rain RPS series heads is the Hunter PGP series.

B. The head type and performance of all nozzles shall be similar to those shown on the plans.

C. All sprinkler nozzles shall perform to the manufacturer's specifications concerning diameter of throw and gallon-age at given pressure.

D. Do not use adjustable pattern nozzles without prior approval of the District.

2.7 GATE VALVES AND VALVE BOXES

A. Gate valves and isolation valves shall be AWWA brass body 125-pound wedge disc gate valves with non-rising stems as manufactured by Nibco, Matco Products Inc, or Grinnell.

B. Provide a rigid injection molded polyefin valve box of 3.400 psi tensile strength approximately 10" deep x 12" diameter at base and have 9" diameter opening at the top with a green twist lock cover fitting flush with top of box to mainline gate valve.

2.8 LIGHTNING PROTECTION

A. Install lightning protection in accordance with the controller manufacturer's requirements to protect the automatic controllers.

2.9 CONTROL EQUIPMENT

A. Irrigation Controllers: Automatic controller shall be a CALSENSE, Model CS3-XX/CS3-WEN-KIT (CS3000 model with Wi-Fi modem and stubby antenna), mounted at the pump station.

B. Controller Enclosure: CALSENSE Brand Heavy-Duty Stainless Steel Pedestal Enclosure with installed AC line protection (TP-110) and on/off switch (Model S).

C. Alternate Controller Enclosure: CALSENSE Brand Heavy-Duty Stainless Steel Wall Mounted Enclosure (Model WM) with installed Transient Protection Board and TP-110 AC line protection.

D. Flow Sensor Devices: CALSENSE FM Series (installed in strict accordance with the CALSENSE Designers Guide.)
1. If the new controller shares flow with another controller (shared point of connection) or if it does not have a good Wi-Fi connection, please contact the Calsense Factory at 800-572-8608.

E. Automatic control valves shall be Irritrol series 100.
1. Remote control valves shall be electric and compatible with irrigation controller.
2. Provide a rigid injection molded polyefin valve box of 3.400 psi tensile strength approximately 12" deep x 13¼' x 18½" at base and having a 10¼' x 15½' opening at the top with a green lockable cover fitting flush with top of box for each remote control valve. Locking mechanisms shall be two acetal spring locks requiring an unlocking device to open, but not close

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2.10 RAIN SENSORS

A. The rain sensors shall be "mini-clik II", Model 502 by Glen Hilton products, Inc., Aquamiser by Glen Hilton, or Toro Rainswitch.
B. The Contractor shall provide all labor and materials required to install the rain sensing equipment.
C. All materials used for mounting shall be corrosion resistant.
D. The Contractor is responsible for the provision and installation of all electrical components required for the proper operation of the controller in conjunction with the rain interrupt switch, so that the installation fulfills its intended purpose

2.11 SOIL MOISTURE SENSORS

A. Install soil moisture sensors near the control cabinet, as required by the Florida Building Code – Plumbing.

2.12 CHEMICAL INJECTION SYSTEM (RUST INHIBITOR)

A. Chemical injection equipment shall be equal to Rust-master RM-5-7, 65 as manufactured by Florida Water Processing, Inc., Ft. Lauderdale, Florida. Install the system when water contains iron level of 0.3 PPM or greater.
B. The system shall have an adjustable rate positive displacement pump located inside the Pump Station enclosure connected to the pump system control panel and discharge pipe with a ball valve to isolate the injector pump if necessary.
C. The pump shall have a pumping capacity of 6 to 24 gallons per day at up to 100 psi.
D. The pump motor shall be thermally protected and stop pumping if the system backpressure exceeds the pump capacity.
E. Connect the supply pipe to the tank with a bulkhead connector.
F. The tank shall be of polypropylene and with a capacity of 65 gallons.
    1. Secure the refill hatch and with two galvanized steel straps to the pump system skid with bolts or to a concrete pad with one quarter by 1½" long wedge anchors.
G. All components will be resistant to iron precipitate chemicals.
H. The injector pump will start via a relay wired to a dedicated irrigation controller master valve circuit.

2.13 IRON PRECIPITATE CHEMICALS

A. The required iron precipitate chemicals shall be of a manufacturer whose product is readily and economically available in Palm Beach County.
B. The chemicals shall prevent rust stains from forming on plants and other surfaces in all irrigation zones where the chemical injection unit is operating.
C. All chemical precipitate chemicals shall be suitable for its intended purpose and shall not cause damage to piping, plant materials, buildings, or pavements.

2.14 PRESSURE RELIEF VALVE

A. The pressure relief valve shall be a 2" Jayco 312, with 2 through 300 pound spring rating.

2.15 AIR RELIEF VALVE

A. The air relief valve shall be a minimum 1" Bermad model number 4415.

2.16 PUMP STATION

A. Irrigation pump stations shall be pre-manufactured stations supplied by a vendor regularly engaged in the manufacture and supply of such systems.
    1. Pump stations assembled locally from component parts by the irrigation or piping contractor will not be acceptable.

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B. The submersible pump shall be a Goulds Model 225H, or equivalent, as accepted in writing by the Owner or the Architect.
   1. The pump station manufacturer shall coordinate the pump power requirements with the General Contractor.
   2. The pump will use a premium efficiency electric motor.
C. The pump magnetic starter shall be as per the pump motor manufacturer's recommendation, and include properly sized heaters and lightning arresters; with NEMA magnetic starter suitable for the intended purpose enclosed in a UL listed, NEMA 4R aluminum powder coated steel enclosure.
   1. The pump shall operate and retire upon receiving start up and shut down signals from the irrigation controllers.
   2. The relays shall prevent the irrigation controllers from interconnecting with each other.
   3. The Contractor shall provide an appropriately sized transformer relay hookup to the irrigation controllers.
D. The Contractor shall provide and install disconnect switches on a uni-strut frame, provided by the Irrigation Contractor, for the pump motor, controllers, and rust inhibitor unit motor.
   1. Location coordinated between the Irrigation Contractor and the General Contractor.
E. The automatic control valve shall be 3" diameter, flanged, globe type valve with pressure reducing and surge control pilots, fitted with oil filled pressure gauges on both the inlet and discharge sides of the valve as manufactured by Bermad or approved equal.
F. The motor safety control for the submersible pump motor shall be Franklin Electric "Subtrol Plus" or approved equal as recommended for three phase submersible pump protection, complete with all sensors, transmitters, receivers, etc., and sized and designed for the selected pump and motor.
G. The water check valve shall be 4" diameter as manufactured by Flomatic, Model Number 888, or approved equal.
H. The butterfly valve shall be a 3" diameter lever operated cast iron valve as manufactured by Kitz, Code Number 81 or approved equal.
I. The pump drop pipe shall be threaded Schedule 40 galvanized steel or HDPE SDR 11 with 316 SS transition nipples.
J. Securely mount all pump-equipment on a 6" thick concrete pad, sized as necessary to allow sufficient workspace between the system components.
   1. Reinforced the pad with 6" x 6", 10-ga x 10-ga, WWF, and meet all other applicable building codes.
K. Assemble the pump station in a workman like manner with consideration given to convenience of use, maintenance, and future repairs with all intended features working properly and reliably.
   1. All components mountings shall be sturdy and solid, with sufficient clearance to safely access, operate, and repair without significant disassembly of other components.
L. Perform all work in a professional manner utilizing sound and accepted practices using all components in conformance to their respective manufacturer's recommendations.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install all materials and equipment in a neat and workmanlike manner following the material manufacturers' recommendations.

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B. The Owner and Architect retain the right to order removal or replacement of any items, which, in their opinion, do not present a reasonably neat and workmanlike appearance.
C. If any material required removal and replacing, Contractor shall be perform and complete without additional expense to the Owner.

3.2 SLEEVE INSTALLATION

A. All PVC piping and all control lines that cross roadways or pavement more than 5' in width, shall be sleeved and when possible extend 3' beyond the payment edge.
B. All sleeves underneath roadways shall be 24" below grade.
C. All sleeves shall have a diameter equal at least 2.5 times the nominal diameter of the carrier pipe.

3.3 EXCAVATION

A. The Contractor shall perform all necessary excavation and backfilling to install a complete system per section 31 20 00.
B. The minimum depth of cover for all piping and sleeves shall be:
1. Vehicle traffic areas

Pipe Size	Depth of Cover in inches
½"-2½"	18"
3" & 4"	24"
6" & larger	30"

2. Non-Vehicle Traffic Areas

Pipe Size	Depth of Cover in inches
½"-2"	12"
2½" & 3"	18"
4" & larger	24"

C. Excavate trenches to a sufficient depth and width to provide for a minimum of 6" of separation between parallel or crossing pipelines.
D. It is the responsibility of the Contractor to determine exact location of existing underground utilities and to avoid damage to such during construction.
1. In event of damage to existing utilities, the Contractor shall restore same to their original condition.

3.4 INSTALLATION OF PIPE AND EQUIPMENT

A. Protect PVC pipe from direct sunlight during storage.
B. Keep pipe clean and check for presence of organic or foreign material prior to installation.
C. Lay the pipe in accordance with lines shown on the drawings, and in accordance with the manufacturer's recommendations.
D. Protect PVC pipe in trench prior to backfill, form direct sunlight by covering with a layer of clean sandy material.
E. Pipe shall also be covered with fill material, or otherwise anchored, to prevent floating in event water enters trench prior to complete backfilling.
F. Architect shall approve substantial deviations from the piping layout and the Contractor shall record the changes on the as-built plans as work progresses.
G. Installation of system piping shall be in accordance with manufacturer's instructions and shall proceed from point of connection of supply for system pumping station.
H. All piping and equipment joints shall be watertight.
I. Flush and pressure test mainlines for a minimum of four hours after the installation of gate valves and remote control valves.

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J. Test mainlines with remote control valves closed and gate valves open.
K. Thoroughly flush all lateral lines prior to installation of sprinkler heads.
L. Install concrete thrust blocks at any directional change in the main pipelines in accordance with the manufacturer's instructions and the thrust block detail indicated on the drawing.
M. Piping sizing:
1. The size of all main and lateral piping (indicated in inside diameters) shall be as indicated on the plan.
2. If the diameter of the pipe is not indicated on the plan, the following criteria shall be used to determine the pipe size:
a.

Accumulated Theoretical GPM	Pipe Size As Shown On The Head Schedule
0 - 10 GPM	¾"
11 - 15 GPM	1"
16 - 25 GPM	1¼"
26 - 35 GPM	1½
36 - 56 GPM	2"
57 - 85 GPM	2½"
86 - 125 GPM	3"
126 - 210 GPM	4"

3.5 SPRINKLER HEADS
A. Install all sprinkler heads on swing joints as shown on drawings.
B. Install the sprinkler head so that the top is in accordance with the manufacturer's recommendation with respect to the finished grade level.
C. Backfill around swing joints and sprinklers shall be clean sand fill materials free of rocks, significant organics, or other foreign debris.
D. All rotor type sprinkler heads shall be located a minimum of 12" away from the edge of any bed line, building, curb, roadway, or sidewalk.
E. All mist type sprinkler heads shall be located a minimum of 6" away from the edge of any bed line, building, curb, roadway, or sidewalk.
F. Install all 12" pop up mist heads as shown on the drawings.
G. Adjust head to prevent spray onto any building, structures, walks, or paved areas.

3.6 ELECTRIC CONTROL LINES
A. Size all electric control wire as recommended by the controller and valve manufacturer, except as otherwise specified.
1. Install wire in the piping trenches whenever possible and place underneath the piping, and maintain at least 6" vertical separation between the wire and the bottom of the pipe.
2. Tape the control wire together with electrical tape not more than 5' O.C.
3. Control wires shall be snaked into the trench as loosely as possible and with as much slack as possible to allow for expansion and contraction of the wire.
4. When necessary to run control wire in a separate trench, encase the wire in a PVC sleeve and provide a minimum cover of 12".
5. Encase all wire between the bottom of the main or lateral piping and the bottom of the controller in a PVC sleeve.
B. Provide sufficient slack of the wire at all wire connections, remote control valves, and all wire splices, so that in case of repair the valve bonnet or splice may be brought to the surface without disconnecting the wires.

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C. All splicing of wire shall take place in valve boxes, and be of UL listed waterproof wire connectors as recommended by the wire manufacturer.
D. Each remote control valve or group of remote control valves, connected to one station of the controller, shall have wire sizes as recommended by the manufacturer, except as noted.
    1. Connect all remote control valves, connected to the same controller, to a common ground wire of a size recommended by the manufacturer.
    2. Each individual controller shall have a separate common ground wire system entirely independent of the common ground wire system of all other controllers.
    3. Connect only those remote control valves controlled by one specific controller, to the controller's common ground wire system.
    4. Each control valve shall have an independent control line, which terminates at the controller.

3.7 CONTROLLERS
A. Install all controllers per the equipment manufacturer's recommendations.
B. Mount all controllers per the specifications and in accordance with all applicable building and electrical codes, at the locations indicated on the plans.
C. Controllers shall engage the pump magnetic starter through external K-Rain, K-PRS-2-24 relays, or equivalent, so as not to interconnect with each other.
D. Inside each controller, the Contractor shall mount a waterproof listing of each station of that controller, and a written description of the landscape areas irrigated by that station.
E. The controller shall also operate the chemical injection pump.
F. Ground the control as shown on the drawings.
G. The contractor shall provide for a telephone line, through the 1" conduit installed by the others, between the controller location and the nearest EMC Terminal Cabinet, meeting all project specifications and applicable codes.

3.8 ELECTRICAL WORK
A. A licensed electrical contractor having experience in the installation of similar equipment shall install all electrical work including but not limited rain sensors, automatic controllers, and pump starter per all applicable codes and regulations.

3.9 RAIN SENSORS AND SOIL MOISTURE SENSORS
A. The Contractor shall install the rain sensors and soil moisture sensors as per the manufacturer's recommendations.
B. Locate the rain sensors in a position where rain will freely fall on the equipment, and are not affected by irrigation water.
C. The Contractor shall adjust the rain sensing equipment and soil moisture sensing equipment as required for proper adjustment of the newly installed plant materials and other site conditions.
    1. The adjustment of the rain sensing equipment shall be coordinated with the Landscape Contractor.

3.10 REMOTE CONTROL VALVES
A. Install remote control valves as indicated on the drawings and per the manufacturer's recommendations, with a brass gate valve, equal to the size of the remote control valve, on the pressure side of all remote control valves.
B. Adjust the flow control stem on all remote control zone valves downward to minimize any over pressurization before performing any individual nozzle adjustments on the sprinklers.

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3.11 VALVE BOXES AND MARKERS

A. Install all valve boxes, any other miscellaneous markers, or access boxes as shown on the plans, so the top of said structure is at finished grade.
B. Install all groups of valve boxes so that the tops of all boxes are level with each other, and the sides of all boxes are parallel to each other.

3.12 PRESSURE RELIEF AND AIR RELIEF VALVES

A. Final location of the relief valves shall be coordinated with the Architect and Owner.
B. Adjust the pressure relief valves to vent 10-psi higher than the discharge setting of the automatic control valve.

3.13 INSTALLATION OF THE PUMP STATION

A. The pump shall be set in accordance with the well capacity testing to maintain a flooded suction under all operating conditions.
B. Install the pump station in accordance with the drawings and specifications.
C. Pump Station Testing:
    1. The complete pumping station shall operate without appreciable vibration throughout the range of operating conditions.
    2. Perform a running test of normal start and stop operations under load.
    3. During such tests, the pump station shall demonstrate the ability to operate without vibration, overheating and without question, its general fitness for service.
    4. The Contractor at his expense shall make any corrections and adjustments.
    5. Repeat the tests and make adjustments until system works properly.
D. The Contractor shall adjust the automatic control valve as directed by the Architect.

3.14 CHEMICAL INJECTION EQUIPMENT

A. The Contractor is responsible for the submittal to the Architect and Owner of a water analysis showing the amount of soluble iron present in the well.
    1. The Architect and Owner will make a determination as to the necessity of the installation of the rust inhibitor equipment.
B. If required, install the rust inhibitor unit per the manufacturer’s recommendations.
    1. The Contractor shall provide and install the proper amount of RC-100 rust inhibitor until the completion and acceptance of the project by the Owner and Architect.
    2. The Contractor is responsible for any damage caused by water not properly treated until the final acceptance of the work by the Architect and Owner.
C. The Contractor shall fill the tank with RC-100 rust inhibitor immediately upon final acceptance of the work by the Architect and Owner.

3.15 TESTING, BALANCING AND ADJUSTMENTS

A. The Contractor shall test the irrigation system per the following:
    1. Test the irrigation system mainlines for proper operation upon completion of the mainline installation, (allow sufficient time for solvent weld joints to cure).
    2. Flush all air from the irrigation mainlines then test with 100-psi hydrostatic pressure for a minimum of 4 hours.
    3. After the pressure is stabilized in mainlines, no more than 10-psi drop in pressure is allowed over the four-hour period.
    4. Repair or remove and replace any part of the system, not complying with the test, and repeat process until system works properly. In any case, repair any visible leakage regardless of the test results.

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5. The Contractor is not required to pressure test any portions of the mainline not installed under this Contract, but is responsible for providing any necessary isolation valves required to separate the existing mainlines for the new mainlines
6. Test the entire irrigation system upon completion, and after sufficient time passes for solvent weld joints to cure for proper operation.
7. Flush all air from the irrigation system, and check all components for proper operation.

B. The Contractor shall balance and adjust the various components of the sprinkler system so the overall operation of the system is effective.
   1. Balancing and adjustment shall include:
      a. Synchronization of the controllers
      b. Adjustments to the rain sensors
      c. Adjustments to pressure relief valve, sprinkler heads, individual nozzles, automatic control valve, and remote control valves
      d. Individual station adjustments on the controllers and all other components of the system.
   2. The Contractor shall adjust all sprinkler nozzles so that there is minimal overthrow of water onto sidewalks and roadways, and no overthrow onto buildings or automobile parking areas.

END OF SECTION

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SECTION 32 92 23
SODDING

PART 1 GENERAL

1.1 SECTION INCLUDES
- A. Preparation and Placing of subsoil
- B. Fertilizing
- C. Sod installation
- D. Maintenance

1.2 SCOPE
- A. The work consists of performing all grass sodding and related work as indicated on drawings and described in this section.
- B. Unless otherwise indicated, the Contractor is responsible for the repair of any existing lawn areas disturbed during the construction process
- C. The Contractor is responsible for the irrigation of all lawn areas on the project, including those not covered by an irrigation system.
- D. The Contractor is responsible for the all maintenance to the Bermuda grass lawns during a minimum 2-month grow in period.

1.3 BERMUDA GRASS FIELD INSTALLER QUALIFICATIONS
- A. A contractor specializing in the grading and grassing of athletic fields shall grade and install the Bermuda grass field.
- B. The specialty contractor shall submit a list of athletic field projects successfully completed during the past three years, including a list of three similar Bermuda grass sports field projects for the approval of the Architect and the Owner.
- C. Include information concerning the project Owner and references with telephone numbers.

1.4 REFERENCES AND RELATED DOCUMENTS
- A. TPI Turfgrass Producers International – Guideline Specifications to Turfgrass Sodding; formally ASPA (American Sod Producers Association) - Guideline Specifications to Sodding
- B. FS O-F-241 - Fertilizers, Mixed, Commercial
- C. Section 02200 - Earthwork
- D. The provisions of the General Conditions, Supplementary Conditions, and the Sections included under, Division 1, General Requirements, are included as part of this section

1.5 DEFINITIONS
- A. Weeds: Include, but are not limited to Crab Grass, Johnson Grass, Poison Ivy, Nut Sedges, Bindweed, Goose Grass, Crowfoot Grass, Torpedo Grass, Spurges, Spreading Dayflower, Guinea Grass, Bull Paspalum, Sandbur, Love Grass, Finger Grass, Paricum Grasses, Foxtail, Smut Grass, Amaranth, Chickweeds, Ragwood, Smut Grass, Spanish Needles, Thistle, Horseweed, Dogfennel, Cudweed, Hawksbeard, Dollarweed, Pepperweed, Beggarweeds, Sida, Oxalis, Pusley, Penneywort, Matchweed, and Punctureweed.

1.6 SUBMITTALS
- A. Provide submittals per section 01 33 00.
- B. Provide submittals for the following products for the Owner's (Maintenance and Plat Operation Department, SDPBC) approval prior to start of work on the sodding.
  1. Obtain Owner's written approval before Work.
     - a. Working without Owner's approval is solely at the Contractor's risk and unapproved Work is subject to removal and re-installation without additional cost to Owner.

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2. Fertilizer
    a. For the track infield area and all Bermuda grass fields, submit planting soil analyses of the existing and imported soils for approval at no additional cost to the Owner.
        i) If the soil within the track area is uniform, collect cores for a composition sample from approximately six dispersed areas and within the top 6" of the soil.
        ii) The analysis shall show % of organic material in the soil through the loss on Ignition by Volume soil test method, indicate the soil pH and with recommendations from the testing laboratory for additional topsoil, fertilizer type and application rate, and other soil amendments necessary to bring the top 6" of soils in the Bermuda grass areas to the following specified levels:
        iii) Percolation rate: minimum 4" per hour in the top six inches of soil
        iv) PH level: 6.0 - 7.0
        v) Soil Organic Content 5% minimum /20% maximum
        vi) Major and Minor nutrients as recommended by the laboratory
        vii) A South Florida agricultural testing laboratory acceptable to the Architect and the Owner shall perform all testing and recommendations.
3. Herbicides
4. Fire ant certification from the sod supplier
5. Specialty grading and grassing contractor information as noted in Section 1.3 above.

C. Section 01 77 00 - Contract Closeout: Procedures for submittals
D. Operation Data: Submit for continuing Owner maintenance.
E. Maintenance Data: Include maintenance instructions, cutting method and maximum grass height, types, application frequency, and recommended coverage of fertilizer.

1.7 QUALITY ASSURANCE
A. Sod shall be minimum age of 18 months with root development that supports its own weight without tearing when suspended vertically by holding the upper two corners.
B. Submit sod certification for grass species and location of sod source.
C. Sod Producer: Company specializing in sod production and harvesting with minimum 5-years of experience, and certified by the State of Florida.
D. Installer: Company approved by the sod producer.

1.8 REGULATORY REQUIREMENTS
A. Comply with regulatory agencies for fertilizer and herbicide composition.
B. Provide certificate of compliance from authority having jurisdiction indicating approval of fertilizer and herbicide mixture.
C. Contractor shall follow all regulations, ordinance, and code governing the work, including but not limited to permitting and inspections.

1.9 DELIVERY, STORAGE, AND PROTECTION
A. Section 01 60 00 - Material Equipment and approved equal: Transport, handle, store, and protect products.
B. Deliver sod on pallets. Protect exposed roots from dehydration.
C. All sod delivered to the site, shall be laid within 8 hours.

1.10 PROJECT CONDITIONS
A. Contractor shall inspect the site and plans to become aware of the project conditions and requirements before submitting a bid.
B. Section 01 31 00 – Project Management and Coordination.
C. Sequence the installation to ensure orderly and expeditious utility connections.
D. Coordinate with installation of underground sprinkler system pipe and watering heads.

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1.11 CONTRACTOR SUPERVISION

A. The Contractor shall provide a competent superintendent and any necessary assistants on the project when work is in progress.
B. Do not change the superintendent during the project without the consent of the Architect unless the superintendent leaves the Contractor's employment.
C. The superintendent shall represent the Contractor and in the Contractor's absence, all directions given to him by the Architect shall be binding as if given to the Contractor.
D. The Contractor's superintendent shall supervise the Contractor's employees on the job site, be responsible for their actions, and conduct on the job site.

1.12 PROTECTION OF WORK AND PROPERTY

A. The Contractor shall continuously maintain adequate protection of all his work from damage and shall protect the Owner's property from injury or loss arising in connection with his work.
B. The Contractor is responsible for contacting the necessary entities to determine the locations of all underground utilities on the site.
C. The Contractor shall take care to avoid damage to any existing buildings, equipment, piping, pipe coverings, electrical systems, sewers, sidewalks, landscaping, grounds, aboveground or underground installations, or structures of any kind, and shall be responsible for any damage that occurs because of his work.
D. Contractor shall adequately protect his work and all adjacent property as required by law.
E. Utilities noted on the plans are anticipated locations only.
    1. The utilities shown may not include all underground utilities on the site, and the locations indicated may not be as installed.

PART 2 PRODUCTS

2.1 GRASS SOD

A. Sod shall be the recognized Argentine Bahia, St. Augustine Floratam, or Tifway 419 Bermuda, whichever is called for on the drawings.
B. Argentine Bahia and St. Augustine sod shall have well matted with roots; shall have firm tough texture having a compact top growth and heavy root development.
    1. Bahia sod shall be sand based.
    2. St. Augustine sod shall be muck based.
    3. Both types of sod shall contain no significant amounts (more than 2% of canopy) of Bermuda grass, weeds or any other objectionable vegetation.
    4. The soil embedded in the sod shall be free from fungus, vermin, and other diseases and mowed at least three times with an approved lawn mower with final mowing not more than 7 days before the sod is cut.
    5. Provide sod in commercial size rectangles measuring 16" x 24".
    6. The soil base of the sod shall be of a uniform thickness.
C. Tifway 419 Bermuda sod shall have well matted with roots; shall have firm tough texture having a compact top growth and heavy root development.
    1. Bermuda sod shall be sand based, and contain no weed of any type.
    2. The soil embedded in the sod shall be free from fungus, vermin, and other diseases and mowed within 4 days of cutting the sod.
    3. The sod shall be taken up in rolls sized 42" wide and 75' long.
    4. Remove all netting from the back of the sod prior to installation.
    5. The soil base of the sod shall be of a uniform thickness.

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D. Sod shall be sufficiently thick to insure a dense stand of live grass.
   1. Sod shall be live, fresh, and uninjured at the time of planting.
   2. Plant the sod within 48 hours after harvesting.
E. Use only sod certified free of fire ants.
   1. Before delivering any sod to the project, the Contractor shall furnish to the Owner and the Architect written certification from the supplier that the sod is free of fire ants.

2.2 COMMERCIAL FERTILIZERS
A. Commercial fertilizer shall comply with the State Fertilizer Laws.
   1. Numerical designation for fertilizer indicates the minimum percentage respectively of (1) total nitrogen, (2) phosphoric acid, and (3) water soluble potash contained in the fertilizer.
B. Fertilizer for Bermuda grass shall be 15-5-15 with the rate and minor nutrients as recommended by the agricultural laboratory performing the tests on the project topsoil.
C. Fertilizer for Bahia and St. Augustine grass shall be 8-8-8-with appropriate minor nutrients applied at the rate of 16 pounds per 1000 square feet.

2.3 WATER
A. Contractor shall supply and apply all water.

2.4 ROLLER
A. Contractor shall use a roller(s) appropriately sized to achieve the required lawn surface grade.

2.5 FERTILIZER SPREADER
A. Contractor shall use a device for spreading the fertilizer capable of uniformly distributing the material at required rates.

2.6 HERBICIDES
A. The Contractor shall select, provide, and apply all herbicides as required.

2.7 TOPSOIL (soil immediately below the sod)
A. Topsoil for Argentine Bahia and Bermuda Tifway 419 Lawns: Topsoil shall be as required by the recommendations of the agricultural laboratory performing the analysis of the project soil. However, the minimum topsoil preparation, accomplished prior to sod placement shall be placement of eight to twelve inches of an 80%/20% sand/peat root zone mix.
B. Topsoil for St. Augustine Floratam Lawns:
   1. Topsoil shall be comprised of 50% sand and 50% organic muck by volume.
   2. Topsoil shall be as provided by Atlas Peat and Soil, Inc. - Mix 5050, or other equivalent manufactured soil mixture accepted in writing by the Architect.
   3. To propose a substitute, the Contractor shall provide verification from an approved agricultural testing laboratory that the substitute meet the required 50/50 ratio.

2.8 SUBGRADE SOIL (soil layer 12” or less below the finished grade of the lawn surface)
A. All subgrade soil shall be completely free of rocks more than 1” in any dimension, concrete, glass, metal or any other foreign contaminant.
B. Remove all contaminated sub-grade soil from the site and cleaned using soil sieves prior to re-installation or shall be replaced with clean, well-draining fill suitable for good plant growth.

2.9 SOIL FUMIGANTS
A. The Contractor shall select and provide soil fumigants as required to eradicate all soil organisms, all existing vegetation, and all plant seeds and other forms of plant regeneration.
B. Use all soil fumigants and other materials as specified and recommended by the manufacturer(s).
   1. All soil fumigants shall be suitable for their intended purpose.

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PART 3 EXECUTION

3.1 EXAMINATION

A. The Contractor and his Bermuda grass installer shall coordinate and attend a pre-work meeting with School District personnel prior to any Work.

B. Verify that prepared soil base is ready to receive the work of this section.

3.2 GENERAL: The order of work for sod installation shall be as follows:

A. Bahia Grass Lawns:

1. Removal of debris and existing vegetation not noted to remain.
2. The roto-tilling of all compacted areas
3. Removal of all unsuitable materials from the sub-grade soil
4. Sub-grading
5. Removal of additional debris as required.
6. Fine grading using the approved topsoil mix and laser guided grading equipment.
7. Placement of sod
8. Clean up
9. Watering
10. The maintenance including the watering of all areas regardless of whether or not a sprinkler system is operational.
11. Application of fertilizers 30 days after installation of sod
12. Rolling of sod as soon as practical, but no more than four weeks after installation

B. St. Augustine Floratam Lawns

1. Removal of debris and existing vegetation not noted to remain.
2. The roto-tilling of all compacted areas
3. Removal of all unsuitable materials from the sub-grade soil
4. Sub-grading
5. Installation of muck topsoil, including roto-tilling.
6. Fine grading using laser guided grading equipment.
7. Placement of sod
8. Clean up
9. Watering
10. The maintenance including the watering of all areas regardless of whether or not a sprinkler system is operational.
11. Application of fertilizer 30 days after sod installation
12. Rolling of sod as soon as practical

C. Bermuda Grass Lawns:

1. Roto-tilling of all compacted areas
2. Removal of all unsuitable materials from the sub-grade soil
3. Laser sub-grading
4. Installation of topsoil and other soil amendments
5. Soil fumigation
6. Final laser grading in accordance with specific elevations noted in the civil engineering grading plans.
7. Placement of sod
8. Clean up
9. Watering
10. Beginning of the required grow-in period and maintenance
11. Application of fertilizer four and eight weeks after installation

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12. Rolling of sod approximately four weeks after installation

3.3 ROTO-TILLING

A. Roto-till all lawn areas that have become compacted during the construction process as required assuring adequate percolation of water through the soil.

3.4 SUBGRADE

A. Prepare subgrade for all areas receiving sod, as required to produce the finish grades indicated on the grading plans and specifications.
B. Remove all existing shell rock or other road base that encroaches more than 12" into any lawn area, and fill any voids cause by road base removal with clean, well draining, and properly compacted planting soil

3.5 INSTALLATION OF TOPSOIL AND SOIL AMENDMENTS

A. Install additional topsoil and other soil amendments in Bermuda grass areas as required to accommodate the required grades and the recommendations of the testing laboratory.
   1. Roto-till all materials into the existing soil until the top 6" of soil is a homogeneous mixture.
B. Install a minimum 2" thick layer of topsoil in all areas receiving St. Augustine Floratam sod.
   1. Roto-till all topsoil into the existing soil until the top 4" of soil is a homogeneous mixture.

3.6 REMOVAL OF DEBRIS

A. Clean areas receiving grass of all stones larger than ¼ inch in diameter, sticks, stumps, paper, glass, and other debris. The top 6 inches of soil shall be free of any stones larger than ¼ inch in any dimension and all debris.
B. Kill by herbicide and remove all weeds or existing grasses from areas to receive sod.

3.7 FUMIGATION OF THE BERMUDA GRASS LAWN AREAS

A. The Contractor shall fumigate the lawn areas receiving Bermuda grass to eradicate all soil organisms, all existing vegetation is, and all plant seeds and other forms of plant regeneration.
B. The Contractor shall use a soil fumigation method that guarantees all vegetative matter and soil organisms in the soil are eradicated.
C. Use all soil fumigants and other materials as specified and recommended by the manufacturer(s).

3.8 FINE GRADING

A. After removal of debris, perform fine grading as required to bring all areas to receive grass to a smooth, even, and finished grade. Use a laser grader to fine grade all areas. The Contractor shall fine grade areas receiving sod as necessary to achieve a finished grade (top of the sod) as specified in this section.
B. All sodded areas bordered by sidewalks, asphalt pavement, or curbs shall have a finished grade (top of the sod's soil) that is flush (or less than ½" below) with the grade of the adjacent sidewalk, asphalt pavement, or curb.
C. All sodded areas bordered by planting areas shall have a finished grade (top of the sod's soil) that is 1½" above the soil level in the adjacent planting bed.

3.9 PLACING OF SOD

A. The setting of pieces shall be staggered in such a manner as to avoid continuous seams.
   1. Sod shall be moist and placed on a moist earth bed.
   2. Carefully place sod by hand, edge to edge in rows at right angles to the slope, starting at the base of the area and working upward.
   3. On St. Augustine and Bahia lawns, install only full size (16" x 24") pieces of sod (except for cutting-in purposes).

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4. There shall be no voids between sod pieces, no overlapping of the edges of sod pieces, and the finished grade of all sodded areas smooth and even.
5. Use clean sand to fill any developing voids or unevenness in the sod surface.
6. Unless otherwise indicated by the grading plans, the Contractor shall ensure that the finished grade of sod does not vary more than 2" from a 10' long straight edge.

B. Place Bermuda grass sod field as required to produce a smooth and even surface conforming to the grades indicated on the project civil engineering plans.
1. All field areas shall be laser graded as required to produce the required surface finish.
2. The Contractor shall ensure that the finished grade of sod does not vary more than ¼" from a 10' long straight edge.
3. Remove any mesh backing on the Bermuda grass from the sod and from the project site.

C. Carefully place sod located on slopes so that rolling with a power roller is not necessary.
1. Contractor may stake sod located around retention areas, along pavement areas or in swales.
2. The Contractor is responsible for the repair of any erosion or relocation prior to the sod firmly rooting into the existing soil.
3. Stakes, if used, shall not interfere with walking on, or the mowing of, the sodded areas.

D. The Contractor shall ensure that the finished grade of sod placed directly adjacent to buildings or other walls does not vary more than 2" from a 10' long straight edge.

3.10 CLEAN UP

A. Remove all debris, fertilizer bags, pallets etc. from the site upon completion of the work.
B. Thoroughly sweep any paved areas including curbs and sidewalks.

3.11 WATERING

A. Watering of the sodded areas is the Contractor’s responsibility, including projects where a permanent irrigation system is not installed.
B. Water sources (either permanent or temporary) shall be provided by the Contractor and be available and in operation prior to sodding.

3.12 APPLICATION OF FERTILIZER

A. Apply fertilizer as previously specified.
1. The rate of application for St. Augustine and Bahia grass shall be approximately 16 pounds per 1000 sq. ft.
2. The rate of application for Bermuda grass shall be as recommended by the agricultural testing laboratory.
3. Uniformly apply the fertilizer over the area receiving grass by using an approved distribution device calibrated to distribute the appropriate quantity.
4. Do not fertilize when the wind velocity exceeds 15 miles per hour.

B. Fertilize St. Augustine and Bahia sod 30 days after installation, and request an inspection to verify the application of the fertilizer.
C. Fertilize Bermuda sod both 30 and 60 days after installation, and request an inspection to verify the application of the fertilizer.

3.13 Rolling and Topdressing of the Sod

A. Within one month of the laying the sod pieces, firmly press the sod into contact with the sod bed by rolling with a suitably sized mechanical roller or other approved equipment.
1. The rolling operation shall provide a smooth and even surface conforming to the grades shown on the grading plan, and insure knitting of sod without displacement of sod or deformation of the surfaces.

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B. All developed unevenness or depressions in the lawn surfaces shall be top dressed as required to achieve a smooth and even finish.
   1. Top dressing shall not be applied more than 1" thick. In the case that the lawn surface requires more than 1" of correction, remove, re-grade, and re-sod the uneven areas.

3.14 GUARANTEE AND REPLACEMENT

A. Contractor shall guarantee all sod work up until the end of the maintenance period.
B. Contractor shall immediately replace any defective, distressed, or dead grass materials at no additional cost to the Owner.

3.15 COMPLETION AND ACCEPTANCE

A. Completion of work shall mean full compliance and conformity with the provisions expressed or implied in drawings and in the specifications.
B. Upon satisfactory completion of the work, the Architect will perform an inspection of the work to determine if the sodding work is ready for acceptance.

3.16 MAINTENANCE PROVISIONS - ST. AUGUSTINE AND BAHIA GRASS

A. The Contractor shall be responsible for complete maintenance of all St. Augustine and Bahia lawn areas until "Substantial Completion" of the project or final acceptance of the landscape and irrigation work by the Owner and the Architect, whichever is later.
   1. Maintenance shall include, but not be limited to:
      i) Mowing of the lawns areas at least once every other week
      ii) The removal of all visible amounts of grass clippings from the lawn areas
      iii) Do not allow the lawn to exceed 5" in height for St. Augustine grass and 8" in height for Bahia grass.
      b. Edging of all walks, roadways, and planting beds no less than every other week.
      c. Eradication of all harmful insects including ants
      d. Control of all lawn and soil diseases
      e. Watering and fertilizing as specified, and as required to maintain all lawn areas in a good condition for plant growth.
         i) Grass is required to be in a healthy and green condition at the time of final acceptance.
      f. Eradication of all weeds in the lawns as necessary for the grass to conform to the specification in paragraph 2.1

3.17 MAINTENANCE PROVISIONS - BERMUDA GRASS

A. The Contractor shall be responsible for complete maintenance of all bermuda grass until:
   1. Final acceptance of the landscape and irrigation work by the Owner and the Architect, or
   2. Two months after completion of the Bermuda grass lawn installation whichever is later.
B. Maintenance shall include, but not be limited to:
   1. Mowing all lawn areas at least once a week, and removing all visible amounts of grass clippings from the lawn areas.
      a. Do not cut the lawn in more than 1/4" increments.
      b. Mow Bermuda grass to an approximately 3/4" height.
   2. Edging of all pavements and curbs no less than every week
   3. Eradication of all harmful insects including ants
   4. Control of all lawn and soil diseases
   5. Watering and fertilizing as required to maintain all lawn areas in an excellent condition for plant growth and sports field use.
      a. Grass shall be healthy and green at the time of final acceptance.

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6. Eradication of all weeds in the lawns as necessary for the grass to conform to the specification in paragraph 2.1
7. All other work necessary for the Contractor to ensure a high quality sports field turf.

END OF SECTION

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SECTION 32 93 00
TREES, PLANTS, AND GROUND COVER

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Preparation of subsoil and topsoil
B. Topsoil bedding
C. New and Relocation of trees, plants, and ground cover
D. Mulch and fertilizer
E. Maintenance
F. Tree Pruning

1.2 SCOPE

A. The work shall consist of all labor, supplies, equipment and materials necessary to complete the planting of all trees, palms, shrubs and ground covers in the locations shown on the drawings, and all other work associated with and incidental to the landscape planting work as shown on the drawings and specified under this section.
B. Not all plant materials and references in this section are necessarily required on all projects; only that indicated or required by drawings and specifications apply.
C. All plant material shall be of the specific size and quality as indicated on the drawings. Install, maintain, and water in strict accordance with good horticultural practices.
D. The Contractor is responsible for the complete removal of all existing plant material necessary to implement the construction plans.
E. Unless noted, the Contractor is responsible for the replacement of any existing lawn or other landscape area, damaged during the construction process to original or better condition.
F. The Contractor is responsible for the contract growing of all plant materials indicated on the plans that the Contractor cannot guarantee to be available at the time of the project installation.
G. The Contractor is responsible for the complete removal of all non-native vegetation from the site.
H. Contractor submitting a proposal for this contract is responsible to inspect the site to acquaint themselves with the site conditions, including but not limited to existing and proposed utilities in area of work.

1.3 REFERENCES

A. ANSI A300 (part1) - Tree Care Operations - Tree, Shrub and Other Woody Plant Maintenance - Standard Practices - Pruning
B. ANSI A 300 (part2) - Tree Care Operations - Tree, Shrub and Other Woody Plant Maintenance - Standard Practices – Soil Management
C. ANSI A300 (part3) - Tree Care Operations - Tree, Shrub and Other Woody Plant Maintenance: Standard Practices - Part 3 - Tree Support Systems (a. Cabling, Bracing, and Guying) – Supplement Support System
D. ANSI Z60.1 - Nursery Stock
E. TCIA Tree Care Industry Association *formerly* the NAA (National Arborist Association) - Pruning Standards for Shade Trees
F. State of Florida Standards - Nursery Stock

1.4 DEFINITIONS

A. Weeds - Include, but not limited to Crab Grass, Johnson Grass, Poison Ivy, Nut Sedges, Bindweed, Goose Grass, Crowfoot Grass, Torpedo Grass, Spurges, Spreading Dayflower, Guinea Grass, Bull Paspalum, Sandbur, Love Grass, Finger Grass, Paricum Grasses, Foxtail, Smut Grass, Amaranth, Chickweeds, Ragwood, Spanish Needles, Thistle, Horseweed, Dogfennel, Cudweed, Hawksbeard,

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Dollarweed, Pepperweed, Beggarweeds, Sida, Oxalis, Pusley, Penneywort, Matchweed, and Punctureweed.

B. Plants - Living trees, shrubs, and ground cover specified in this Section, and per ANSI Z60.1.

1.5 SUBMITTALS

A. Section 01 77 00 - Contract Closeout: Procedures for submittals
B. Maintenance Data shall include cutting and trimming method; types, application frequency, and recommended coverage of fertilizer.
C. Fertilizer
D. Planting soil: If requesting a substitution, provide documentation from a qualified agricultural testing lab supporting the proposed planting soil meet the requirements of the specifications.
E. Herbicides
F. Water storing polymer
G. Melaleuca, Eucalyptus, or Pine Straw mulch. Pine Straw is used only in elementary schools.
H. Staking and guying materials.

1.6 QUALITY ASSURANCE

A. Nursery Qualifications: Company specializing in growing and cultivating the plants with 3-years documented experience.
B. Installer Qualifications: Company specializing in installing and planting the plants with 5-years documented experience.
C. Tree Pruner Qualifications: Company specializing in pruning trees with proof of Arborist Certification with 3-years documented experience.
D. Tree Pruning: NAA - Pruning Standards for Shade Trees
E. Maintenance Services: Performed by installer

1.7 CONTRACTOR SUPERVISION

A. The Contractor shall provide a competent superintendent and any necessary assistants on the project when work is in progress.
B. Do not change the superintendent during the project without the consent of the Architect unless the superintendent leaves the Contractor's employment.
C. The superintendent shall represent the Contractor and in the Contractor's absence, all directions given to him by the Architect shall be binding as if given to the Contractor.
D. The Contractor's superintendent shall supervise the Contractor's employees on the job site, be responsible for their actions, and conduct on the job site.

1.8 PROTECTION OF WORK AND PROPERTY

A. The Contractor shall continuously maintain adequate protection of all his work from damage and shall protect the Owner's property from injury or loss arising in connection with his work.
B. The Contractor is responsible for contacting the necessary entities to determine the locations of all underground utilities on the site.
C. The Contractor shall take care to avoid damage to any existing buildings, equipment, piping, pipe coverings, electrical systems, sewers, sidewalks, landscaping, grounds, aboveground or underground installations, or structures of any kind, and shall be responsible for any damage that occurs because of his work.
D. Contractor shall adequately protect his work and all adjacent property as required by law.
E. Utilities noted on the plans are anticipated locations only.
    1. The utilities shown may not include all underground utilities on the site, and the locations indicated may not be as installed.

1.9 REGULATORY REQUIREMENTS

A. Comply with regulatory agencies for fertilizer and herbicide composition.

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B. Plant Materials: Certified by State Department of Agriculture.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect, and handle products to site under provisions of Section 01 60 00.
B. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and manufacturer.
C. Protect and maintain plant life until planted.
D. Deliver plant life materials immediately prior to placement. Keep plants moist.

1.11 ENVIRONMENTAL REQUIREMENTS

A. Do not install plant life when ambient temperatures may drop below 35° F.
B. Do not install plants when wind velocity exceeds 30 mph.

1.12 COORDINATION

A. Coordinate work under provisions of Section 01 31 00.
B. Install plant life after and coordinate with installation of underground irrigation system piping and watering heads.

1.13 WARRANTY

A. Provide 1-year warranty under provisions of Section 01 77 00.
B. Include coverage for one continuous growing season; replace dead or unhealthy plants.
C. Replacements: Plants of same size and species as specified, planted in the next growing season, with a new warranty commencing on date of replacement.

1.14 REQUIRED INSPECTIONS

A. During the planting process, the Contractor shall request the following inspections.
    1. Work shall pass required inspections prior to beginning subsequent planting phases.
B. An inspection shall be requested to review:
    1. The quality grade of the trees, root system, and any damage to trunks or limbs caused during the installation process.
        a. Damage to trees will downgrade the materials in accordance with "Grades and Standards Revised".
    2. The finished grade of the tree installation.
    3. Remove binding, bagging, and burlap materials on top of the tree ball in accordance with these specifications.
C. Contractor shall request inspection and receive approval prior to any sodding or mulching work.
    1. All of the above items may be at a single inspection.
D. Architect shall verify the installation of the pre and post emergence herbicides prior to beginning the mulching operation.

PART 2 PRODUCTS

2.1 NOMENCLATURE

A. All plant material shall conform to the names given in Hortus Third, published by the Macmillian Publishing Co., Inc., copyright l976.
B. Names of varieties not included therein shall conform to names accepted in the trade.

2.2 GRADE STANDARDS:

A. All plant material shall be nursery grown, except where specified as collected material, and shall comply with all required inspections, grading standards and plant regulations as set forth by the latest editions of the Florida Department of Agriculture's "Grades and Standards for Nursery Plants, 2nd Edition: February 1998.
B. All plant material shall have a growth habit that is normal for that species and shall be sound, healthy, vigorous, and free from insects, plant diseases, and injuries.

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C. Unless otherwise specified, all plant material shall be Florida No. 1 or better until the expiration of the required maintenance period.
D. Plant materials that show signs of dieback or leaf drop after planting are not acceptable.
E. Plant material shall not have chlorosis in any foliage.

2.3 INSPECTION AND TRANSPORTING

A. Movement of nursery stock shall comply with all Federal and State regulations.

2.4 MULCH

A. Melaleuca Mulch
   1. Melaleuca mulch shall be entirely from the wood and bark of the Melaleuca Quinquinerva Tree.
   2. It shall not contain more than 10% (by volume) bark.
   3. Shreds and chips shall not be larger the ¾" diameter and 1½" in length.
   4. Mulch shall be free of weeds, seeds, and any other organic or inorganic material other than Melaleuca wood and bark.
B. Eucalyptus Mulch
   1. Eucalyptus mulch shall be entirely from Eucalyptus tree heartwood and 100% pure.
   2. The source trees shall be plantation grown.
C. Pine Straw Mulch
   1. Use only at elementary schools.
   2. Pine Straw Mulch shall be premium longleaf pine straw (needles).
   3. Pine Straw Mulch shall be sourced from plantations and guaranteed to be free of contaminants, pests, or invasive species.

2.5 PLANTING SOIL

A. Place all plant material, unless otherwise specified with planting soil consisting of approximately 50% sand and 50% muck by volume.
B. Planting soil shall be as manufactured by Atlas Peat and Soil, Inc. - Mix 5050 or other equivalent manufactured soil mixture.
C. If a substitute is proposed, the Contractor shall provide sufficient analytical information from a qualified testing laboratory that the material is at a 50/50 ratio of muck to sand.
D. Uniformly mix a water-storing polymer within the planting soil at the rates recommended by the polymer manufacturer.

2.6 PLANT REQUIREMENTS

A. Balled and Burlapped Plants:
   1. Properly protect the root ball and kept moist until planted.
   2. Whenever possible, handle the plant only by the earth ball and not by the plant itself.
   3. The diameter of the ball must be sufficient to encompass all of the fibrous and feeding root system necessary for the development of the plant.
B. Container-Grown Plants:
   1. Plants that have become "pot bound" are not acceptable.
   2. Use a container cutter unless the root ball slips easily and unbroken from the container.
   3. Do not remove the plants from the can until immediately before planting.
   4. Containerized trees with circling roots are not acceptable.
C. Collected Plants: Plant material not from active nursery operations shall have, a root ball spread at least 1/3 greater than nursery grown plants and not planted before on site acceptance.
D. Palms:
   1. All palm species except Sabal palmetto shall have roots adequately wrapped before transporting.

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2. All Sabal palms shall be slicks.
3. Sabal palms shall have a hurricane cut.
4. Install Sabal palms on site at the earliest opportunity in the construction process.
5. Palm trees showing signs of dieback or dead fronds are not acceptable.
6. Sabal palms with burn marks are unacceptable.
7. Any damaged palm tree will be rejected.
8. All Sabal palms shall be from Palm Beach County or other sandy soils.
9. All Sabal palms shall be Florida Fancy.
10. The balls of all Sabal palms shall be sufficiently large to support the head of the palm.
11. The Contractor shall treat all palms as required to prevent infestation by the palmetto weevil.

2.7 FERTILIZER

A. All fertilizer shall be a 18-4-12 mix with the approximate following formulation:

1.	Total nitrogen	18.00%
2.	Ammonia cal nitrogen	2.75%
3.	Water soluble organic nitrogen	11.25%
4.	Water insoluble nitrogen	4.00%
5.	Available phosphoric acid	4.00%
6.	Water soluble potash	12.00%
7.	Chlorine - not more than	2.00%
8.	Total water soluble magnesium	1.32%
9.	Manganese	0.07%
10.	Copper	0.03%
11.	Zinc	0.07%
12.	Iron	1.58%

B. Deliver fertilizer in unopened bags, each carrying the manufacturer's name and the chemical makeup, conforming to all applicable governmental regulations, and in dry condition.

2.8 HERBICIDES:

A. Post-emergence herbicide
1. The post-emergence herbicide shall be a foliar applied herbicide, which will control a broad range of annual and perennial grass and broad-leafed weeds plus applicable woody brush and tree species.
2. Herbicide shall kill the entire weeds species, including below ground root or rhizome system.
3. The herbicide shall have no residual soil activity.
4. Apply all herbicide according to the manufacturer's recommendations.

B. Pre-emergence Herbicide:
1. The pre-emergence herbicide shall be a selective pre-emergence herbicide used for the control of annual grasses and broad-leafed weeds in turf and ornamentals.
2. Herbicide shall control weeds by killing the young weed seedlings as they encounter the herbicide during germination.
3. The herbicide shall be in granular form.

2.9 WATER STORING POLYMER

A. The polymer shall be a super absorbent sodium based polymer with chemically identical partial sizes of .5 mm to 2.8 mm.
B. The polymer shall be non-toxic.
C. Incorporate the polymer into all planting soil at the rate recommended by the manufacturer.

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2.10 WATER

A. Contractor shall supply and apply all necessary.
B. All watering shall be by water truck until the irrigation system is in operation.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that prepared subsoil and planters are ready to receive work.
B. Verify that required underground utilities are available, in proper location, and ready for use.

3.2 EXISTING VEGETATION REMOVAL

A. The Contractor shall remove all existing vegetation necessary to implement the project construction plans.

3.3 REMOVAL OF ALL NON-NATIVE VEGETATION

A. The Contractor shall remove all non-native vegetation, as listed in Palm Beach County UDC Article 14.c, from the project site; non-native vegetation shall include, but not be limited to:
    1. Melaleuca – Melaleuca quinquenervia
    2. Australian pine – Casuarine spp.
    3. Brazilian Pepper – Schinus terebinthifolius
    4. Queensland umbrella tree – Schefflera actinophylla
    5. Earleaf Acacia – Acacia auriculiformis
    6. Air Potato – Dioscorea bulbifera
    7. Old World climbing fern – Lygodium microphyllum
    8. Carrotwood – Cupaniopsis anacariodes
    9. Kudzu – Pueria Montana var. lobata
    10. Downy rose myrtle – Rhodomyrtus tomentosa
    11. Love vine – Pseudogynoxis chenopdiodes

3.4 GRADING OF PLANTING AREAS

A. Unless specified, all planting areas bordered by pavement, sidewalk or curb shall have a finished grade (not including mulch) 3" below the adjacent pavement, sidewalk or curb.

3.5 EXCAVATION OF PLANT HOLES

A. Tree Holes:
    1. Tree holes shall be roughly cylindrical in shape with the sides approximately vertical.
    2. All holes shall be deep enough to allow for a 6" layer of planting soil under the ball.
    3. Center the plants in the holes.
    4. Holes to accommodate tree ball sizes less than 24" in diameter shall be at least 18" in diameter greater that the diameter of the ball.
    5. Holes to accommodate balls 2' and larger in diameter must be at least 2' in diameter greater that the diameter of the ball.
    6. Holes to accommodate balls greater than 5' in diameter must be at least 3' in diameter greater than the diameter of the ball.
B. Shrub Holes:
    1. Shrub holes shall be roughly cylindrical in shape with the sides approximately vertical.
    2. All holes shall be deep enough to allow for a 2" layer of planting soil under the ball.
    3. Center the plants in the holes.
    4. Holes to accommodate shrub balls shall be 8" greater in diameter than the size of the ball of the plant supplied.
C. Removal of Subsoil: Dispose of excess subsoil removed from planting excavations.

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D. The Contractor is responsible for the complete removal of all shell rock or other road bases that encroach more than 12" into the planting areas.
   1. Remove or roto-till all compacted soils as required to provide for good soil percolation.
   2. Fill all voids resulting from such excavations with clean, well draining planting soil.

E. Locate plant to maintain a clear line of site, after planting, between 3' and 7' above finished grade.
   1. Locate plant holes so the separation between the hole centerline and the nearest building or structure is at least equal to the mature height of the plant.

3.6 SETTING OF PLANTS

A. Plants shall rest on the prepared hole bottom and final grade around the plant shall conform to the surrounding grade.
   1. Plants shall be set straight and plumb.
   2. Cover the balls of B&B or WB&B plants that cannot be planted immediately with moist soil, mulch, or other protection to prevent drying.
   3. Water all plants as necessary before and after planting.

B. The Contractor should note that there are not individual irrigation bubblers on most of the trees on this project.
   1. The Contractor will be responsible for providing hand watering to properly establish all trees and palms, and to maintain them in a healthy condition until the water provided by the irrigation system is sufficient for that purpose.

C. Cut and remove all metal, wire, rope, nylon, twine or other materials (excluding burlap) from the tops of all root balls.
   1. Do not place mulch before an approved inspection verifying the removal of unwanted materials from the top of the root balls, and the installation of the trees at the proper grade.

D. Plant shrubs so the edge of their mature branch system will be 18” to 24” away from buildings and structures.

E. Plant trees and palms so that their trunk is separated from any structure by their mature height.

3.7 BACKFILLING

A. Use all backfill in planting comprised of the specified planting soil combined with the water-storing polymer.

B. Firmly tamp and settle the backfill by watering to within 1/3 of the top of the planting hole and thoroughly puddle with water to eliminate all air pockets before bringing backfill up to the finished grade.

C. There shall be a 6" high water basin, no smaller or larger than the plant hole, constructed around each plant for watering purposes.

D. Hedge and mass shrub planting should have a dike encompassing the entire grouping of plants.

E. The soil used to make the dike shall consist of planting soil.

F. Remove the dike prior to beginning the mulching or sodding operation.

3.8 INSTALLATION OF GROUND COVERS

A. Sub-grade all areas receiving ground covers to accept a 2" thick layer of clean, weed free, 100% organic pulverized muck.

B. Roto-till or hand-spade the muck into the existing soil to a depth of 4".

C. Plant the ground cover as specified on the drawings.

3.9 FERTILIZING: Fertilize all plant materials at the following rates:

A. Trees - 4-ounces of the specified fertilizer per tree.

B. Shrubs in 3-gallon containers or larger 1-ounce of the specified fertilizer per plant.

C. One gallon sized plants or ground covers: 10 lbs of the specified fertilizer per 1,000 sq ft

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D. Do not apply fertilizer until plants the fourth day after installation and watering.
E. Do not apply fertilizer within 4" of the trunk of any plant material.
F. Water all plant materials immediately following fertilization.
G. Apply all fertilizer prior to beginning the mulching operation.

3.10 STAKING AND GUYING

A. The Contractor shall stake all trees and palms.
    1. The Contractor is responsible for the replacement or adjustment of all trees, palms or shrubs that fall or lean during the guarantee period, regardless of the reason for the plant material's displacement.
    2. The Contractor is responsible for any damage caused by the falling or leaning of trees.
    3. Perform all trees staking in a neat and workmanlike manner.
B. Securely anchor trees as per the tree installation detail on the drawings.
    1. Stakes shall be spaced evenly around the trunk of the trees.
    2. Contractor may use the recommendations in the current edition of Grades and Standards for Nursery Plants.
    3. Do not use wire-guys to stabilize any plants, trees, or shrubs under any conditions.
    4. Use of metallic staking material is forbidden.
    5. All wooden staking material shall be free of sharp edges or projecting fasteners.
        a. The minimum allowable staking lumber size shall be 2”x2”.
    6. Use polyethylene rope, natural rope, or custom manufactured non-metallic guying and strapping materials.
C. Stake Palms as specified in Grades and Standards for Nursery Plants current edition.
    1. Do not use spikes or nails in any Grade of Palm.
D. The Contractor shall maintain all staking and guying until 1 year after substantial completion.
    1. Contractor shall dismantle and remove all staking and guying from the school campus.
    2. Contractor may dismantle and remove staking and guying earlier from established, healthy plants at the Contractor’s sole discretion.
    3. Early removal shall in no way limit the Contractor’s warranty obligations.
    4. Maintenance of staking and guying shall include monthly inspection of all staking and guying left in place during the 1-year period and adjustment or replacement of any materials that are not as originally installed to support the plant materials.
        a. Maintenance shall also include repair or replacement of any staking or guying materials that damaged and present sharp edges, which might injure students.
    5. Dismantling and removal of staking and guying materials shall include removal of all supports, ground stakes, braces, guy ropes, support banding, banding lumber, or any other support or stabilization device and transport of said items completely away from the school campus to a proper storage or disposal site.

3.11 PRUNING

A. Provide smooth clean cut of all broken or damaged roots.
B. Prune the tops of all new or relocated trees in compliance with standard horticultural practices.
C. The Owner or designated representative shall direct all pruning of plants.
D. The Contractor is responsible for the initial pruning of all tree and shrubs as directed by the Owner or designated representative.
E. A certified Arborist shall make all pruning of limbs in excess of 2" in diameter.

3.12 HERBICIDE TREATMENT

A. Prior to beginning the mulching operation, the Contractor shall apply post-emergence herbicide to all weeds that have appeared within the bed lines.

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B. The Contractor shall wait the required time recommended by the manufacturer before beginning the clearing operation.
C. Treat all planting and mulch beds with pre-emergence herbicide prior to beginning the mulching operation.
D. Apply all herbicides in accordance with the manufacturer's recommendations.
E. The Contractor shall be responsible for the removal of all weeds appearing on the site prior to the final acceptance of the work.

3.13 MULCHING

A. Within one week after plant installation, apply mulch material in a minimum 1" thick layer over all tree, shrub, and ground cover planting areas, unless otherwise specified.
    1. All mulch layers shall be of the specified thickness at the time of the final acceptance of the work.
    2. Maintain a 12 inch separation between any mulch bed and all building walls. Contour the soil to create a higher area next to the building and a lower area for the mulch bed.
B. Place a layer of mulch at least 1" in depth in a circle around all trees located in lawn areas.
    1. The circle shall be 18" in diameter larger than the ball of the plant provided.
    2. Pull the mulch away so that it is not in direct contact with the trunk of the tree.

3.14 DISPOSAL OF SURPLUS MATERIALS AND SITE CLEANUP

A. Surplus excavated materials from plant holes shall be properly disposed of off the site.
    1. Remove and properly dispose all debris and other objectionable material created through planting operations and landscape construction completely from the site.
B. Remove all trash and debris form preservation areas.
    1. The Contractor is responsible for the removal of existing trash and debris at the start of construction, as well as materials deposited during the construction process.
C. Remove all rocks and other debris from all planting and lawn areas.

3.15 CONDITIONS OF PLANTING

A. Maintain all plant material by watering, removing dead branches, resetting plants to proper grade or upright position and any other operation necessary to assure good maintenance and compliance with the drawings and specifications.
B. The Contractor shall keep all guy-wires tight and all trees staking properly adjusted.
C. All plants shall remain healthy, vigorous, and undamaged throughout the establishment period.

3.16 ESTABLISHMENT PERIOD

A. The Contractor is responsible for the proper maintenance, survival, and condition of all plantings from the time of installation until the final acceptance of the landscape and irrigation work by the Owner and the Architect.
B. Final acceptance of the landscaping is at "substantial completion" of the entire project.
C. Necessary replacement of plants during the guarantee period is the Contractor's responsibility.
D. All plantings shall be alive and in good growing condition at the time of final acceptance.
E. The rating of each plant according to Florida Grades and Standards shall be equal to or better than that called for on the drawings and specified in this section at the time of final acceptance.

3.17 COMPLETION AND ACCEPTANCE

A. Completion of work means full compliance and conformity with the provisions expressed or implied in the drawings and specifications, and acceptance of the work by the Owner/Architect.
B. Upon satisfactory completion of the work, the Architect will perform an inspection of the work to determine if the planting work is ready for acceptance.

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3.18 GUARANTEE AND REPLACEMENT

A. Contractor shall guarantee all plant material for a minimum of one year after "Substantial Completion" of project or final acceptance of the landscape and irrigation work by the Owner and Architect, whichever is later.
B. The guaranteeing of plant material means complete replacement with plant material of the same species, size, quality, and grade as that of the original material.
C. The Contractor at his expense shall replace plant material not in healthy growing condition or with questionable survival ability at the end of the guarantee period.
D. During the guarantee period, the Contractor is responsible for immediately replacement of any dead material.

3.19 MAINTENANCE PROVISIONS

A. The Contractor is responsible for complete maintenance of all landscaping until "Substantial Completion" of the project or final acceptance of the landscape and irrigation work by the Owner and the Architect, whichever is later.
B. Maintenance shall include, but not be limited to:
    1. Water all plant materials as required; provide proper conditions for plant health and growth.
    2. The immediate eradication of all harmful plant insects including ants and diseases.
    3. Removal of all weeds from the planting beds within one week after their appearance.
    4. Pruning of all shrubs and trees as directed by the Owner or his designated representative.
    5. Fertilize all plant materials as required, to provide conditions for plant health and growth.
    6. Removal of all weeds from clay and warning track areas.
C. Installation of any plant material with thorns or serrated leaf margins is prohibited.
    1. The School District reserves the option to disallow any vegetation that District Staff determines may be a hazard or maintenance problem.

END OF SECTION

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SECTION 33 11 00
WATER DISTRIBUTION SYSTEM

PART 1 GENERAL

1.1 SCOPE

A. The Contractor shall furnish all labor, equipment, and materials and perform all operations necessary to construct a complete, functioning water distribution system.

B. All materials and work performed shall be in accordance with plans, specifications, applicable codes and standards, and of first-class workmanship.

1.2 SAFETY PROVISIONS

A. It shall be the responsibility of the Contractor to protect persons from injury and to avoid property damage.

B. Contractor shall provide and maintain adequate barricades, construction signs, torches, red lanterns and guards during the progress of the construction work and until it is safe for traffic to drive over the trenches in the roadway.

C. Contractor shall perform all construction in a safe manner, specifically, the rules and regulations of the Occupational Safety and Health Administration (OSHA) and the Manual of Uniform Traffic Control Devices (MUTCD).

1.3 REFERENCES

A. Palm Beach County Minimum Engineering and Construction Standards
B. Florida Building Code, all volumes
C. Florida Fire Prevention Code
D. Manual of Uniform Traffic Control Devices (MUTCD)
E. NFPA 24 – Standard for the Installation of Private Fire Service Mains and Their Appurtenances
F. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings
G. ASTM B88 - Standard Specification for Seamless Copper Water Tube
H. ASTM D1248 - Standard Specification for Polyethylene Plastics Extrusion Materials For Wire and Cable
I. ASTM D1599 - Standard Test Method for Resistance to Short-Time Hydraulic Failure Pressure of Plastic Pipe, Tubing, and Fittings
J. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
K. ASTM D2241 - Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
L. ASTM D2737 - Standard Specification for Polyethylene (PE) Plastic Tubing
M. AWWA C110 - Ductile-Iron and Gray-Iron Fittings
N. AWWA C500 - AWWA Standard for Metal-Seated Gate Valves for Water Supply Service - International Restrictions
O. AWWA C600 - Installation of Ductile-Iron Water Mains and their Appurtances - International Restrictions
P. AWWA C651 - Disinfecting Water Mains - International Restrictions
Q. AWWA C800 - Underground Service Line Valves and Fittings - International Restrictions
R. AWWA C900, Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 in. through 12 in.(100 mm Through 300 mm), for Water Transmission and Distribution - International Restrictions

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1.4 EXISTING UTILITIES

A. Contractor shall provide necessary temporary support, adequate protection and maintenance of all underground and surface utility structures, drains, sewers, and other obstructions encountered in the progress of the work at his own expense.

B. Where existing utility structures such as conduits, ducts, pipe branch connections to main sewers, or main drains obstruct the grade or alignment of the pipe, the Contractor shall permanently support, relocate, remove, or reconstruct, the existing structure with the cooperation of the their owners.

1. Do not deviate from the required line or grade except, as directed, in writing by the Architect.

C. The Contractor shall obtain a Sunshine State One Call Center (11 Plantation Road, Debary, FL 32713; Telephone 1-800-638-4097) Certification number and an existing utility field location at least 48 hours prior to beginning any excavation.

D. Prior to beginning construction, the Contractor shall verify the size, location, elevation, and material of all existing utilities within the area of construction by use of record drawings, electronic locating devices, ground penetrating radar, potholing, or other suitable techniques.

E. Existing utility locations shown on these plans are approximate and identified as either "to remain" or "to be removed".

1. The Architect assumes no responsibility for the accuracy of existing utilities shown or for any existing utilities not shown.

F. The Contractor is responsible for repairing any damage done during construction to all existing utilities.

G. If upon excavation, an existing utility is found to be in conflict with the proposed construction or to be of a size or material different from that shown on the plans; the Contractor shall immediately notify the Architect.

H. Provide water services to each building from the underground water main system, and not from adjacent buildings.

1.5 SHOP DRAWINGS AND SUBMITTALS

A. The Contractor shall provide the Architect a copy of all manufacturers' literature and data for materials installed under this section.

1. The Architect shall review and stamp the submittals, "Approved" prior to installation by the Contractor.

B. Prior to final approval and acceptance of work, the Architect and other Regulatory Agencies shall review and accept the Contractors "As-Built" documentation.

1. The Contractor shall provide complete and accurate "As-Built" information relative to manholes, valves, services, fittings, length of pipe, and the like, with the horizontal and vertical information verified by an independent Registered Surveyor to the Architect and other regulatory Agencies.

1.6 APPLICABLE CODES

A. General: All construction and materials shall conform to the Florida Building Code and all local and national codes where applicable.

B. Survey Data: All elevations on the plans or referenced in the specifications shall be based on North American Vertical Datum of 1988 (NAVD).

C. Portable water shall comply with the "Palm Beach County Minimum Engineering and Construction Standards, Water and Sewer Systems," and/or the construction standards of any municipality having, jurisdiction.

D. Submit the "Florida Department of Environmental Protection Domestic Water Permit.

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1.7 RELATED DOCUMENTS

A. The provisions of the General Conditions, Supplementary Conditions, and the Sections included under, Division 1, General Requirements, are included as part of this section.
B. Section 31 20 00 – Earthwork.

PART 2 PRODUCTS

2.1 PIPE

A. OFF-SITE
   1. For water main construction within the public right-of-way and utility easements refer to city, county, or state utility standards and specifications for water main construction within their right-of-way.
B. ON-SITE
   1. The water main shall be either polyvinyl chloride (PVC) pipe or ductile iron pipe (DIP) and shall have push on rubber gasket joints.
   2. Pressure pipe (4" and larger) PVC pipe shall be pressure pipe with iron o.d. class 150 (SDR 18) for domestic water and class 200 (SDR 14) for fire mains, conforming to AWWA C900.
   3. Ductile iron pipe (4" and larger) shall be cement-mortar lined and seal coated, class 150 for domestic water and class 200 for fire mains, mechanical, or push-on joints.
   4. Pressure pipe (under 4") Polyvinyl chloride (PVC) pressure pipe schedule 40 conforming to ASTM D1785 or SDR 21 conforming to ASTM D2241 with cement-solvent welded joints.
   5. Miscellaneous: ¾" threaded tie-rods shall be cadmium plated and painted with a coal tar base paint following installation.

2.2 FITTINGS

A. Fittings for ductile iron and PVC pipes (4" and larger) shall have a pressure rating of 250 psi; use mechanical joints and conform to the latest revision of AWWA C110.
B. Mechanical joint fittings shall conform to the latest revision of AWWA C110.
C. Flanged fittings shall conform to ANSI Specifications for Class 125.
D. Brass fittings shall conform to AWWA C800, with all exposed threads covered with a protective plastic coating.
E. Fittings for PVC pipe shall be cast iron mechanical joint type having a pressure rating of 250 psi and conforming to AWWA C110.

2.3 VALVES

A. Gate valves 2½" or less in size shall be standard 125 pound, non-rising stem, bronze, double-disc, screwed type, equipped with hand wheel.
B. Gate valves over 2½" shall be resilient seat gate valves with iron body, non-rising stem, fully coated disc with rubber seat ring manufactured in accordance with AWWA C500.

2.4 VALVE BOXES

A. Valve boxes shall be of standard extension design manufactured with top cover marked “water.”
B. The top section shall be adjustable for elevation and shall be set to allow equal movement above and below grade.
C. Provide valve box appropriate in size for the required valve.
D. Center the base of valve box over the valve and rest firmly on compacted backfill and the entire assembly shall be plumb.
E. Valve boxes shall be like Figure H-10364, as manufactured by Mueller Company, or an approved equal.

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2.5 HYDRANTS

A. Hydrants shall have a minimum 6" mechanical joint base pipe connection, 5¼" main valve opening, two 2½" hose nozzles, and one 4½" pumper nozzle.
   1. Threads shall be National Standard.
   2. Hydrants shall be cast iron body, fully bronze mounted, suitable for a working pressure of 150 pounds, and shall be in accordance with the latest specification of the AWWA.
   3. They shall be of the O-ring seal type.
   4. Operation nut shall open counter-clockwise and be of the pentagonal shape, measuring 1½" from point to opposite flat.

B. Provide hydrants with a breakaway feature that breaks cleanly upon impact.
   1. This shall consist of a two-part breakable safety flange with a breakable stem coupling.
   2. The upper and lower barrels shall be fluted and ribbed above and below the safety flange or have an extra strength lower barrel.

C. Paint hydrants with one coat of zinc chromate primer and two finish coats of an approved paint of Architect approved color.
   1. Hydrants shall be Number A-423, Traffic type, as manufactured by Mueller Company, or an approved equal.

2.6 SERVICE CONNECTION AND METER

A. The Contractor shall install or have the City install water meters complete with dual backflow preventer, valves and meter vault, at the locations shown on the drawings, and in accordance with the specifications as shown on the drawings.

B. Contractor shall submit shop drawings for meter, valves, and backflow preventer.

C. Contractor is responsible for all costs associated with providing and installing water meters, vaults, backflow preventers, valves, and connections in accordance with the applicable local utility or Palm Beach County Standards.

2.7 SERVICE METERS (3" Maximum)

A. Service water meters shall be of the rotating disc, bronze split case housing type.

B. The meter shall be of the straight reading type, recording flow in gallons, and shall be of the sealed register type.

C. Meters shall conform to applicable specifications of AWWA and shall be as manufactured by Neptune Meter Company, or an approved equal.

2.8 METER BOXES

A. Meter boxes shall be precast concrete with a two-piece reinforced concrete cover including a round concrete reading lid. All meter boxes must also meet local utility company requirements.
   1. Meter boxes for ⅝" or ¾" meters shall be Model 36R, as manufactured by Brooks Products, Inc.
   2. Meter boxes for larger meters shall be of suitable size for the enclosed meter.

B. Contractor shall submit shop drawings for meter boxes larger than ¾".

2.9 BACKFLOW PREVENTERS

A. Backflow preventers shall conform to AWWA Standard C506 and shall be of the "reduced pressure principle type".
   1. Provide the backflow preventer as an assembly from one manufacturer.
   2. The assembly shall include two isolation valves, two check valves, and all other fittings or accessories needed to satisfy referenced design standards.

B. Paint backflow preventers with one coat of zinc chromate primer and two finish coats of an approved paint of Architect approved color.

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C. Provide chain and padlock, then chain and lock valves on all backflow preventers together.
D. Provide 6' high chain link fence around the device with 12' access gate.

2.10 PRESSURE GAGES

A. Pressure Gages: Pressure gages for line pressure measurement shall conform to Federal Specifications GG-G-76, Class 1, Style A, Type 1, 3½" diameter with phenolic case, or as indicated on the drawings.

2.11 CHECK VALVES

A. Check valves shall be AWWA standard for 175-psi working pressure, swing type, iron body, or bronze mounted, leather faced disc, suitable for vertical or horizontal position.
B. Valves shall be Mueller Figure A-2600 or approved equal.
C. Where designated on the plans, check valves shall be spring loaded, double half disc-wafer check valve, manufactured by TRW Mission, or approved equal.
D. Spring shall be of sufficient tension so valve will close without appreciable slam.

2.12 WATER SERVICES

A. Polyethylene Tubing – Material shall comply with ASTM D1248 and the following:
   1. Polyethylene extrusion compound for extruding the polyethylene tubing shall comply with applicable requirements for PE-3406 or 3408 ultra high molecular weight polyethylene plastic material
   2. Tubing shall have a working pressure rating of 160 psi at 73.4°F.
   3. Tubing must be capable of maintaining pressure of 340 psi at 73.4°F for 1,000 hours when tested in accordance with ASTM D1599.
   4. Tubing surfaces shall be free from bumps and irregularities. Materials must be completely homogeneous and uniform in appearance.
   5. Tubing dimensions and tolerances shall correspond with the valves listed in ASTM D2737 with a standard dimension ratio (SDR) of 9.
   6. Provide label on tubing with brand name and manufacturer, NSF Seal, size, type of plastic material, and ASTM applicable designation with which the tubing complies.
B. Copper tubing shall be type “K” and conform to AWWA Specification 75-CR and ASTM B88 with a working pressure rating of 160 psi at 73.4°F.
C. Other service materials may be considered for specific installations, upon submissions of specification and approval by the Architect.
D. Joints:
   1. Joints for polyethylene or copper tubing shall be of the compression type utilizing a totally confined grip seal and coupling nut.
      a. Provide stainless steel tube stiffener insert for P.E. tubing service.
   2. Other type joints may be considered for specific installations, upon submissions of specifications and approval by the Architect.

2.13 METER VALVES

A. Meter valves shall be of bronze construction in accordance with ASTM B62.
B. Meter valves shall be closed bottom design and resilient “o” ring sealed against external leakage at the top.
C. Provide a shut-off with a resilient pressure actuated seal so positioned in the plug as to completely enclose the flow way in the closed position.
D. The inlet side of all meter valves shall have a compression type fitting as detailed in Section C Part 1.
E. Meter valves for meter size 1” and under shall be equipped with a meter-coupling nut on the outlet sides.

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F. Meter valves for 1½" and 2" meters shall have flanged connections on the outlet sides.
G. Provide meter valve over 2" on individual basis for the particular installation.

2.14 CURB STOPS

A. Curb stops shall be of the inverted key type with tee-head shut off.
B. Curb stops shall be made of brass alloy in accordance with ASTM B62.

2.15 CORPORATION STOPS

A. Provide corporation stops manufactured of brass alloy in accordance with ASTM B62.
B. Inlet thread shall be taper thread in all sizes in accordance with AWWA C800.
C. Outlet connections shall have a compression type fitting as detailed in Section C Part 1.

2.16 TAPPING SLEEVES

A. Ductile iron tapping sleeves shall be of the mechanical joint type having a flat-faced ductile iron flange, recessed for a tapping valve with all end and side gaskets totally confined.
B. The contractor shall determine the outside diameter of the existing main before ordering the sleeve.

PART 3 EXECUTION

3.1 UNLOADING MATERIAL

A. The Contractor shall exercise care in unloading and handling pipe, valves, fittings, and all other material.
B. Do not drop pipe from trucks or allow pipe to roll against other pipe.

3.2 EXCAVATION

A. All excavation to conform to Section 31 20 00

3.3 SEPARATION OF WATER AND SEWER MAINS

A. See design plans for water and sewer separation statement and requirements.

3.4 WATER METER

A. Domestic water service; provide a water meter (max. 3") and dual backflow preventer assembly. (Meter bypass with gate valve), (gate valve, meter, gate valve), (bypass reconnection), and (gate valve, backflow preventer, gate valve).
    1. All service pipes for 3" water meter shall be 4" ductile iron pipe with 4" gate valves with flanged fittings for above ground use, and mechanical fittings with retainer glands for underground use.
B. Fire line system; provide a double-detector check valve assembly and a fire department connection.
    1. Provide gate valve, (¾" meter bypass with a gate valve and check valve).
C. Locate both assemblies adjacent to property line, and provide either 6' high chain link fence around the assembly or chain lock the valves as indicated on the plans.

3.5 INSTALLATION OF PIPE

A. Obtain permission of the Health Department, Water Department, and the Fire Department having jurisdiction, before installing water mains.
B. All installation of pipe shall conform to AWWA C600.
    1. Do not roll or push pipe into the trench from the bank.
    2. Contractor shall thoroughly inspect all pipes before lowering into the trench, to insure its sound condition and eliminate the possibility of leakage or bursting under test pressure.
    3. Do not use pipes, valves, fittings or any other materials showing defects.
    4. Remove all such defective materials from the construction site immediately.

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5. Before lowering pipe into the trench, swab or brush it to insure that no dirt or foreign matter is in the finished line.

C. Lay pipe on a flat bottom trench and backfill tamped to 6" above the top of the pipe.
1. Pipe installation shall conform to “Type B Method” as adopted by Committee A21 of the American Standards Association.
2. Provide a firm even bearing throughout the length of each section of pipe.
3. Pipe shall not bear on any un-yielding structures, nor shall it support any other structures.
4. Plug or cap all dead ends, anchor, and hold in place with concrete backing as required.
5. Except while work is in progress, plug all pipe openings to prevent entrance of water or any foreign matter.
6. Remove material deemed unstable for providing adequate support for pipe and replace with a suitable material.
7. Provide an adequate backfill material on the pipe to prevent floating, remove, and relay any pipe that floats as directed by the Architect.

D. Use one of the three following methods to connect new systems to existing mains:
1. Method-A, involves a reduced size temporary connection between the existing main and the new main.
2. Method-B, involves a direct connection between the new and existing mains using two gate valves separated by a sleeve with a vent pipe.
3. Method-C, involves a tap with one gate valve requiring disinfection of the new system prior to conducting the pressure test.

E. The water utility company shall approve and witness the connection method.

3.6 JOINTS

A. All joints shall be suitable for the type of pipe being jointed and shall be made in accordance with manufacturer’s recommendations.

B. Mechanical Joints:
1. Mechanical joints shall be of the stuffing box type.
2. Place the gland, followed by the rubber gasket over the plain end of the pipe inserted into the socket.
3. Then push the gasket into position to evenly seat in the socket.
4. Move the gland into position against the face of the socket, insert bolts, and make finger tight.
5. Using a ratchet wrench suitable to the pipe size, tighten bolts alternately bottom then top, etc., until the joint is complete.

C. Compression Joints:
1. Compression joints shall be a rubber seal joint, made pressure tight by a molded rubber gasket and lubricant to facilitate assembly.
2. Make the joint tight by inserting the plain end into the bell after lubrication.
3. The compression joint shall be similar and equal to “Altite” b as manufactured by Alabama Pipe Company.
4. Follow the manufacturer recommendations in making up the joints.

D. Flanged Joints:
1. Use rubber gaskets to make flanged joints, with bolts having rough square hands and hexagonal nuts made to American Standard rough dimensions that are chamfered and trimmed.
2. Bolts shall be the recommended size for the diameter of pipe being joined and be tightened to evenly distribute the stress in the bolts and bring the pipe in alignment.

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3.7 INSTALLATION OF FITTINGS

A. Applicable portions of these specifications shall apply to installation of fittings.
B. Provide reaction or thrust blocking where changes in pipe diameter occur at reducers or fittings, bends, and tees.
C. Refer to details for concrete strength and dimensions.
D. Provide restrained joints for all fittings in the public right-of-way.

3.8 INSTALLATION OF FIRE HYDRANTS

A. Applicable portions of these specifications shall apply to installation of fire hydrants.
B. All hydrants shall stand plumb and burial line shall be set at finished grade.
C. Place sufficient concrete thrust blocking as shown on the plans or as directed by the Architect.

3.9 INSTALLATION OF VALVES

A. Applicable portions of these specifications shall apply to installation of valves.
    1. All valves shall stand plumb unless otherwise shown on the plans or directed by the Architect.
    2. The operation of installing tapping sleeves and an experienced contractor who has been engaged in this type of work not less than one-year with a representative list of successful installations shall install the valves.
B. Provide appropriate shut-off in a valve box approximately 5' from the building on domestic water line to each building.

3.10 PRESSURE TESTS

A. After adequately backfilling the pipe and at least seven days after placing the last concrete thrust blocking, pressure test all laid pipe for two hours at 150-psi minimum, in accordance with AWWA C600-93.
B. The pressure test shall not vary more than ±5 psi during the test.
C. Remove all air is from the pipe prior to pressure tests.
D. The Contractor shall provide such means of venting the pipe as are required.
E. The Contractor shall replace any material or installation proving defective.
F. A representative of the City/County and the Architect shall witness the pressure test.

3.11 LEAKAGE TESTS

A. Bring the main up to test pressure, and hold at this pressure.
    1. Carefully measure the make-up water, by use of a displacement meter or by pumping the water from a vessel of known volume.
    2. Walk the length of the pipeline and inspect all joints for leakage and movement of pipe.
    3. Repair all visible leaks.
    4. Should any section of pipeline disclose joint leakage greater than that permitted, the Contractor shall at his own expense locate, and repair the defective joints until leakage is within the permitted allowance.
B. All pipe, etc. shall be tested under a constant pressure of 150 psi (fire main at 200 psi) for a minimum test of two hours and shall not exceed the leakage requirements as per AWWA specifications of C600-93 leakage formula:
    1. $Q = \frac{SD\,p5}{133{,}200}$

        Q = allowable leakage in gallons per hour
        S = total length of pipe tested in feet
        D = diameter of the pipe tested in inches
        P = average test pressure in pounds per square inch

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3.12 BACKFILL

A. Backfill shall comply with Section 31 20 00 Earthwork.
B. On completion of pressure and leakage tests, the exposed joints shall be backfilled to a depth of 12" above the top of the pipe.
    1. Backfill shall be carefully compacted until 12" of cover exists over the pipe.
    2. Place the remainder of the backfill and compacted thoroughly by puddling and tamping.
    3. When directed, the contractor may backfill the trench neatly rounded to a sufficient height allowing for settlement to grade after consolidation.

3.13 STERILIZATION OF COMPLETED PIPELINE

A. Before final acceptance of completed pipeline, all requirements of the County and State Board of Health shall be satisfied.
    1. Forward satisfactory bacteriological test results from these agencies to the Architect.
B. Prior to chlorination of mains, remove all dirt and foreign matter by high velocity flushing through fire hydrants or other approved blow-offs.
    1. Disinfect the main in accordance with the application sections of AWWA C651 and with local health department requirements.

3.14 RESTORATION OF SURFACES AND/OR STRUCTURES

A. The Contractor shall restore and/or replace paving, curbing, sidewalks, fences, sod, survey points, or other disturbed surfaces or structures to a condition equal to that before the work was begun and to satisfaction of the Architect, and shall furnish all labor and materials incidental thereto.
B. Restoration of surfaces and/or structures shall comply with all requirements of the applicable governing agencies including City, Town, County, and State.

3.15 CLEANING UP

A. The Contractor shall remove surplus pipeline material, tools, temporary structures, etc., and as directed by the Architect, shall dispose of all dirt, rubbish, and excess earth.
B. The construction site shall be left clean, to the satisfaction of the Architect

3.16 INSPECTIONS

A. The Contractor shall notify the City, Architect, and the Owner 24 hours prior to beginning construction to arrange the required inspection of the water system.

3.17 PROJECT RECORD DOCUMENTS

A. The Contractor shall maintain accurate and complete records of work items completed.
B. Prior to the placement of any asphalt or concrete pavement, the Contractor shall submit to the Architect, “as-built” plans showing water improvements.
    1. Paving operations shall not commence until the Architect has reviewed the “as-built.”
C. All “as-built” information submitted to the Architect shall be sufficiently accurate, clear, and legible to satisfy the Architect that the information provides a true representation of the improvements constructed.
D. Upon completion of construction, the Contractor shall submit to the Architect five complete sets of “as-built” construction drawings and one set of mylars.
    1. Clearly mark these drawings “as-built” show all construction changes and dimensioned locations and elevations of all improvements and signed by the Contractor.
    2. A Professional Land Surveyor registered in the State of Florida shall sign and seal the "As-Built drawings.
E. “As-built” information on the water system shall include vertical and horizontal locations of all valves, fittings, fire hydrants, water services, and connection points.

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1. They shall show the associated pipe size and material type, and must also show the sample points and the sample point numbers must conform to the numbers used on the bacteriological test results.

3.18 FIRE PROTECTION SYSTEM

A. The domestic water system is separate loop from the fire protection system.
B. Buildings with fire pumps; install the Fire Department connection pipe on the discharge side of the pump.
C. Fire line extension from the main to the building, will be installed by a licensed fire sprinkler contractor. Test fire sprinkler pipe to 200 psi.
D. All fire-fighting equipment (fire department connection, hydrants, double detector check valve, and gate valves) to be more than 40' away from the building.
    1. Maintain 7' clearance around each fire hydrant.
E. Provide flow and pressure test reports according to NFPA 24.
F. All points on each building will be within 200' of an existing or proposed fire hydrant.
G. Verify the fire protection water systems and hydrant locations are approved by the fire-fighting authority having, jurisdiction.
H. Multi-building campus; provide to each building or group of buildings a fire service pipe that contains a post indicator valve, backflow device, and a fire department connection, and a fire hydrant within 150'.
I. Use ductile iron pipe for fire hydrant branches, fire main service (from the loop to the building), and fire department connections.

END OF SECTION

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SECTION 33 30 00
SANITARY SEWERAGE UTILITIES

PART 1 GENERAL

1.1 SECTION INCLUDES:
- A. Sanitary sewer pipes & fittings
- B. Excavation for pipe trenches
- C. Manholes, covers, and grease traps
- D. Requirements for documentation

1.2 REFERENCES
- A. AWWA C110 - Ductile-Iron and Gray-Iron Fittings
- B. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast, for Water
- C. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 in. through 12 in (100 mm Through 300 MM), for Water Transmission and Distribution
- D. AWWA C905 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In. through 48 In (350 mm Through 1,200 mm) for Water Transmission and Distribution
- E. ASTM A48/A48M - Standard Specification for Gray Iron Castings
- F. ASTM C62 - Standard Specification for Building Brick (Solid Masonry Units Made From Clay or Shale
- G. ASTM C478 – Standard Specification for Precast Reinforced Concrete Manhole Sections
- H. ASTM D1782 - Standard Test Method for Operating Performance of Particulate Cation-Exchane Materials
- I. ASTM D1784 - Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
- J. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
- K. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings

1.3 EXISTING UTILITIES
- A. The contractor shall obtain a Sunshine State One Call Center Certification number at least 48 hours prior to beginning any excavation. (Call Sunshine 1-800-638-4097)
- B. Prior to beginning construction, the Contractor shall verify the size, location, elevation, and material of all existing utilities within the area of construction by use of record drawings and/or electronic locating devices.
- C. Existing utility locations shown on the plans are approximate and based on available records.
  1. The Contractor is responsible for verifying all utilities, and notifying the Architect of conflicts and variations.
- D. The Contractor is responsible for damage to any existing utilities for which he fails to request locations from the utility owner, and for damage to existing utilities that are properly located.
- E. The Contractor shall immediately notify the Architect, if upon excavation finds the existing utility in conflict with the proposed construction or of a different size or material from that shown on the plans.

1.4 SHOP DRAWINGS AND SUBMITTALS
- A. Submit under provisions of Section 01 33 00.
- B. Prior to installation, the Contractor shall furnish to the Architect the manufacturers' literature and data for all materials installed under this section for his approval.
- C. Complete As-Built information and plans required before final acceptance of the system.

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1. Contractor shall provide accurate record of complete system relative to manholes, cleanouts, services, fittings, pipe size, pipe material, pipe lengths, and the like.
2. Registered Surveyor shall provide all horizontal and vertical information in the Contractor's As-Built information.
3. Provide final approval of the project "As-Built" information from the regulatory agencies having jurisdiction.
4. Contractor shall camera all of the sewer lines and provide the District with a copy of the videotape.

1.5 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to work in this section.
B. Section 31 20 00 – Earthwork

1.6 APPLICABLE CODES

A. General: All construction and materials shall conform to the Florida Building Code-Plumbing, all local and national codes where applicable, and the Palm Beach County Water Utilities Department Minimum Engineering and Construction Standards
B. Construction Safety: Perform all construction in a safe manner; follow (OSHA) and the Manual of Uniform Traffic Control Devices (MUTCD) regulations.
C. Survey Data: All elevations on the plans or referenced in the specifications are based on North American Vertical Datum of 1988 (NAVD).

1.7 SANITARY SEWER SYSTEM

A. Gravity sewer, lift station, and force main shall comply with the Palm Beach County Water Utilities Department Minimum Engineering and Construction, Water and Sewer Systems, or the construction standards of the municipality having jurisdiction.
   1. Submit a copy of the Florida Department of Environmental Protection Permits.

PART 2 PRODUCTS

2.1 SEWER PIPE AND FITTINGS

A. All sewer pipe and fittings shall be non-pressure polyvinyl chloride (PVC) pipe conforming to ASTM D3034, SDR 35, with push-on rubber gasket joints or ductile iron pipe with a ceramic epoxy lining and bituminous exterior coating.
B. Gravity sewer pipes and force mains in wellfield zones #1 and #2.
   1. Contractor shall have permission from before working in a zone 1 wellfield.
   2. Ductile iron pipe AWWA C151/A21.51; ceramic epoxy lined and bituminous exterior coatings.
   3. Polyvinyl chloride pipe, 4" and larger, AWWA C900 and AWWA C905, dimension ratio DR18.
C. Fittings: PVC and DI pipe, over 4", use ductile iron mechanical joint fittings complying with AWWA -C110and having coating/lining per B. Above.
   1. All fittings and accessories shall be as manufactured or supplied by the pipe manufacturer or approved equal.
D. In addition to the above-cited specifications, all PVC sewers shall conform to the following additional requirements:
   1. The PVC sewer piping shall be of a product having a dimension ratio (DR) of 35 and minimum pipe stiffness (PS) of 46 psi.
   2. Joints: Use an integral bell gasket joint, designed so that when assembled, the elastomeric gasket inside the bell is compressed radically on the pipe spigot to form a positive seal.
      a. The joint shall avoid displacement of the gasket when installed in accordance with the manufacturer's recommendation.
   3. Use manufacturer's recommended lubricants for joining of the pipes.

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a. No solvent cement joints accepted.
b. Follow the pipe manufacturer's instructions for the joining of the pipe on the job, complete in the trench unless otherwise directed by the Architect.

4. Gaskets: Mold all gaskets in a circular form or extruded to the proper section and then splice into circular form, and have a properly vulcanized high-grade elastomeric compound.
   a. The basic polymer shall be natural rubber, synthetic elastomer, or a blend of both.
   b. The gaskets shall be of materials resistant to domestic sewage and as recommended by the manufacturer, with an adequate compressive force so as to affect a positive seal under all combinations of joint tolerance, as the gasket shall be the only element depended upon to make the joint flexible and watertight.
5. Pipe and Fittings: The pipe shall be made of PVC plastic having a cell classification of 12454-B or 12454-C or 13364-B (with minimum tensile modulus of 500,000 psi) as defined in ASTM D1784.
   a. The fittings shall be made of PVC plastic having a cell classification of 12454-B, 12454-C, or 13343-C as defined in ASTM D1782.
   b. Compounds that have different cell classifications because one or more properties are superior to those of the specified compounds are also acceptable.
   c. Clean rework material generated by the manufacturers own production may be used so long as the pipe or fittings produced meet all the requirements of the specification.
6. The pipe and fittings shall be homogenous throughout and free from visible cracks, holes, foreign inclusions or other injurious defects.
   a. The pipe shall be as uniform as commercially practical in color, capacity, density, and other physical properties.
   b. PVC pipe and fittings showing signs of ultra-violet degradation are not allowed.
7. Pipe Marking: Clearly mark each standard and random length of pipe in accordance with the following example at intervals of 1.5 M (5') or less:
   a. Manufacturer's Name or Trademark
   b. Nominal Pipe Size
   c. The PVC Cell Classification
   d. The Legend Type e.g.- DR 35 PVC Sewer Pipe
   e. Color: Green
8. Fittings Marking: The fittings in compliance with this standard shall be clearly marked per the following example:
   a. Manufacturer's Name or Trademark
   b. Nominal Pipe Size
   c. The Material Designation PVC PSM
9. Adapters: If field conditions require adapters, install per Architect's direction.
10. Plugs: Service plugs shall be flexible virgin polyvinyl chloride as supplied by Fernco Joint Sealer Company.

PART 3 EXECUTION

3.1 INSTALLATION GENERAL

A. The contractor shall provide for the furnishing of all labor, equipment, and materials to perform all operations necessary to construct and test the wastewater collection system in accordance with the plans and specifications.
B. Obtain permission from the Health Department and utility company having jurisdiction before install the sewerage systems.

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C. Construct on site utilities in accordance with the Palm Beach County Water Utilities Department Minimum Engineering and Construction Standards.
   1. Materials, installation, cleaning, testing, and disinfection
D. Waterproof interior of manholes, do not provide ladder rungs, and label covers.

3.2 EXCAVATIONS

A. Keep trenches as nearly vertical as possible and if required, provide sheeting and bracing.
   1. Keep sheeting in place if in the opinion of the Architect or Contractor, damage could result from its removal.
B. Except in rock, water-bearing earth, or where a granular or concrete base is used, stop mechanical excavation of trenches above the final grade elevation laying of pipe on a firm, undisturbed native earth bed.
   1. If over digging occurs, remove all loosened earth and bring the trench bottom back to grade with granular material.
C. Carry excavations and trenches in rock to a depth of not less than 4" below the pipe bottom, and then fill with granular material or washed rock.
D. Width of trenches shall be such as to provide adequate space for placing and jointing pipe properly, keep trench to a minimum width.
E. Remove any unstable soil encountered and replace with gravel, crushed rock, or rock and sand suitably compacted.
F. All excavations shall be in conformance with Section 31 20 00, Earthwork.

3.3 DEWATERING

A. The Contractor shall provide adequate equipment for the removal of storm or surface water that may accumulate in the excavation areas.
B. If the contractor encounters subsurface water he shall use an approved method, properly dewater the excavation site suitably dry for working, form setting, concrete pouring, and pipe installation.
C. This method shall be in place as necessary to maintain the excavation in a dry condition for such operations.
D. All cost for this equipment and work shall be at the Contractor's expense.

3.4 PREPARATION OF TRENCH BOTTOM

A. Do not allow water in the trenches during preparation of the trench bottom or during installation of pipe, unless authorized by the Architect.
B. Shape a continuous trough to receive the bottom quadrant of the pipe barrel.
   1. Excavate bell holes so that after placement, only the barrel of the pipe receives bearing pressure from the trench bottom.
C. Carefully prepare the trench bottom and place the pipe so that when in final position, the pipe is true to line and grade.
D. When sand, crushed rock, gravel or pea rock are used to support the pipe, place such material in the trench bottom a minimum of 4" below the bottom of the pipe, and form the trough as described above to uniformly support the bottom quadrant of the pipe barrel.

3.5 INSTALLATION OF SEWER PIPE

A. Install sewer pipe in accordance with ASTM D2321 and the Uni-Bell Plastic Pipe Association's Recommended Practice for the Installation of PVC Sewer Pipe.
B. Protect pipe during handling against impact shocks and free falls.
   1. Keep pipe clean at all times and do not use pipe that does not conform to the specifications.
C. Start laying the pipe at the lowest point, with spigot ends pointing in the direction of flow.
   1. Lay all pipes with ends abutting and true to line and grade.
   2. Carefully center pipe so that when laid they will form a sewer with a uniform invert.

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3. Lay pipe in accordance with manufacturer's requirements as reviewed by the Architect.

D. Lay pipe accurately to the line and grade as shown on the plans.
   1. Preparatory to making pipe joints, all surfaces of the portions of the pipe to be jointed or of the factory-made jointing material shall be clean and dry.
   2. Use lubricant, primers, adhesives, etc., as per the pipe or joint manufacturer's specifications.
   3. Place the jointing materials or factory-fabricated joints, fitted, joined, and adjusted in such a manner as to obtain a watertight line.
   4. As soon as possible after making the joint, place sufficient backfill material along each side of the pipe to prevent movement of pipe off line and grade.

E. Properly plug the exposed ends of pipe to prevent earth, water or other substances from entering the pipe when construction is not in progress.

F. Properly grout the Harco or approved equal manhole couplings in place at each pipe connection into a manhole wall.

3.6 BACKFILLING TRENCHES

A. Backfill all trenches and excavations immediately after laying pipe unless directed otherwise.
   1. Do not permit water to rise in open trenches after placement of pipe.
   2. Backfilling shall comply with Section 31 20 00.

B. Backfill trenches with approved material free from large clods, stones or rocks larger than 1" in diameter, and carefully deposited in layers, not exceeding 6", until enough fill is placed to provide a cover of not less than 12" above the pipe.
   1. Place each layer, and then carefully and uniformly tamp, to eliminate the possibility of pipe displacement.
   2. Place the remainder of backfill material, moisten, and compacted, to 95% of AASHTO Specifications T-180 in landscaped areas and 98% of maximum density in paved areas.

C. Refill, compact, smooth, and make to conform to surrounding grade any trenches improperly filled or settled.

D. Unless directed or shown on the plans, backfill trenches in or through roadways as specified above.
   1. Except that the fill above 1' over the pipe shall be deposited in layers not to exceed 12" thickness, moistened, and compacted to density equal to greater than that of adjacent material so that pavement can be placed immediately.

3.7 CONCRETE ENCASEMENT OF SEWER PIPE

A. May use mechanical equipment to completely excavate the trenches for pipe encasements.

B. Prior to formation of the encasement, in at least two places provide temporary supports consisting of timber, wedges, or masonry to support the pipe, one at the bottom of the barrel of the pipe adjacent to the shoulder of the socket, and the other near the spigot end.

C. After the completion of jointing the pipe, uniformly pour concrete beneath and on both sides of the pipe.
   1. Use sufficient concrete so that encasement is at least 4" thick at all points.

3.8 MANHOLES

A. Provide pre-cast concrete manholes with 4000-psi min compressive strength and grade-60 steel.

B. Contractor may use other materials with prior approval of the Architect and the Owner.

C. Construct the manholes to ASTM C478 requirements and the following:
   1. Minimum wall thickness shall be 8", and the inside diameter of base sections 48".
   2. Provide minimum 8" thick pre-cast reinforced base monolithically casted with the bottom section of manhole walls.
      a. Extend the base slab a minimum of 4" from the outside of the manhole.
   3. Lifting holes through the structures are not permitted.

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a. All holes shall be grout filled to a smooth surface.

4. Minimum height of base sections shall be 3' from the bottom of base slab.
5. Join manhole sections with a mastic compound or a round compression ring of neoprene material set in annular spaces cast into the spigot end of a bell spigot-type joint.
   a. Uniformly compress the mastic compound or ring between the sections to form a watertight joint.
   b. After the assembling the sections, point and fill the remaining space in the joint with a dense cement mortar and finish to a smooth, continuous surface inside and outside the wall sections.
6. Pre-cast manhole cones, when used, shall terminate at such elevations as will permit laying up a minimum of two and maximum of four courses of clay brick under the manhole frame to make allowance for future street grade adjustment.
   a. Approved HDPE adjusting rings may be used in-lieu of brick.
   b. Mechanically attach HDPE rings to the marble frame and the cone.
   c. Submit detail for approval prior to construction.
7. Use dense, hard burned, common clay brick conforming to ASTM C62 latest revision for manhole construction, brick absorption shall be between 5 and 25 grams of water in one minute by dried brick, set flat face down, in ⅛" of water.
   a. Thoroughly slush all brick with mortar at every corner.
8. Construction of invert channels shall be:
   a. Smooth and semicircular in shape conforming to inside of adjacent sewer section.
   b. Changes in direction of flow shall be smooth curve of as large a radius as the size of the manhole will permit.
   c. Changes in size and grade of channels shall be gradual and even.
   d. Form invert channels by one of the following methods:
      i) Directly into concrete manhole base, build up with block and mortar, lay half tile in concrete, or
      ii) Lay full section of sewer pipe through manhole and cut out top half after the surrounding concrete has cured; cut shall be smooth and even.
   e. Make the manhole floor outside of channels smooth, and slope toward channels at a slope of 1" per foot.
9. Where shown on the drawings, the contractor shall place stub outs for future extensions, with a plug marked with a metallic locating device.
10. Service laterals not permitted through manhole walls.
11. Outside drop, connections are required when the vertical distance between pipe inverts exceeds 2'.
    a. Cast required drop connections monolithically with the manhole elements.
12. Cover the entire inside of the manhole with two coats (8-mil each) of Koppers 300M Bitumastic Paint.
    a. Remove all dirt, dust, oils, compounds and other foreign matter, and etch the surfaces with 18% to 20% muriatic acid solution.
    b. Then thoroughly rinsed all surfaces with clear water prior to paint application, completely dilute the acid solution prior to removal from the system.
13. Jointing and Plastering, use mortar for jointing and plastering shall consist of one part Portland cement and two parts of find sand.
14. Grout the influent and effluent sewers in place using a waterproof, expanding grout, acceptable to the Architect.
    a. Seal all openings and joints watertight.

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15. Make all castings for manhole frames and covers of clean even grain, tough gray cast iron.
    a. The castings shall be smooth, true to pattern, and free from projects, sand holes, warp, and other defects.
    b. The horizontal surfaces of the frame cover seat and the under surface of the cover which rests upon the cover seat shall be machined.
    c. The cover shall not rock after seating in any position of its associated frame.
    d. Machining is required only on those frames and covers intended for vehicular traffic.
16. Coat castings with coal tar pitch varnish that shall make a smooth coating that is tough and tenacious when cold, but not tacky or brittle.
    a. Iron used for castings shall conform to ASTM A48/A48M for Class 30, gray iron.
17. Cast the words "Sanitary Sewer" and the name of the Owner in the cover.
    a. Set the manhole frames and covers so that the top cover is flush with the finished grade or as indicated on the drawings.
    b. The manhole frame and cover type shall be as indicated on the drawings.
    c. Frames are suitable for future additions of cast iron rings for adjustment of top elevation.
    d. Machine the seating surfaces between frames and covers to fit true.
    e. No plugging or filling is allowed.
    f. Cast pick type lifting holes into lids, but do not go clear through the lid.
18. When a manhole is in low-lying areas or when in the opinion of the Architect an unusual condition exists, a sealed locking type lid may be required.
    a. Installation of this type of lid is as directed by the Architect.

3.9 GREASE TRAPS/OIL SEPARATORS

A. Provide concrete grease trap tanks, 1250-gallon max per tank, with 2½" drop between tanks.
    1. Capacity = seats in dining room x part of day x loading factor.
    2. Internal concrete baffle is not required for multiple tanks.
B. Grease traps shall resist floatation at all times, even when empty.
C. In paved vehicle traffic areas, grease trap shall meet H-20 truck loading requirements.
    1. Place top slab reinforcing in the bottom of the slab, not the top.
D. Connect dumpster pad drain to the grease trap.
E. Place two-way cleanouts before, after, and between tanks.
F. Provide traffic covers and drop pipes as required.
G. Provide a neutralizing tank for acid waste pipes before draining into the sanitary system.
H. The effluent from the oil/water separator for vehicle wash down and garage areas shall drain into the sanitary sewer system.
    1. The tank shall be as manufactured by Highland Tank Co., Storytown, Pa. or approved equal.
    2. The tank shall be doubled wall with a 30-mil thick exterior coating.
    3. Have metallic risers with a corrosion-resistant coating, watertight manhole cover (fiber-lite if over 36" dia.), and an electronic alarm panel installed inside the building.
    4. Contractor to provide the required dead-man anchors

3.10 CROSSING OF WATER LINES WITH SEWERS

A. Use ductile iron pipe in lieu of PVC pipes in the following conditions.
    1. When sewer line is less than 18" under a water line.
    2. When a sewer line is above a water line.
    3. The pipe is less than 4' from the top grade to the invert of the pipe.
    4. When there is less than 10' of horizontal separation between the water and sewer pipes.

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3.11 SEWER TEST

A. On completion of each block or section of sewer, or such other times as the Architect may direct, the block or section of sewer is to be cleaned, tested and lamped.
   1. Each section of the sewer is to show on examination from either end, a full circle of light between manholes.
   2. Each manhole, or other appurtenance to the system, shall be of the specified size and form, to be watertight, neatly and substantially constructed, with the top set permanently to exact position and grade.
   3. Make all repairs shown necessary by the inspection; broken or cracked pipe replaced, all deposits removed, and the sewers left true to line and grade, entirely clean and ready for use.
   4. The Architect of Record and the City/County shall witness the sewer lamping.

B. The allowable limits of infiltration or exfiltration for the system, or any portion thereof, shall not exceed a rate of 100 gallons per inch of inside pipe diameter per mile of pipe per 24 hours.
   1. No additional allowance allowed for house service lines.
   2. The allowable limits of infiltration or exfiltration of manholes shall not exceed a rate of four gallons per manhole per 24 hours.
   3. The Architect may direct testing of part or the entire system for infiltration or exfiltration.
   4. Prior to testing for infiltration, pump out the system so that normal infiltration conditions exist at the time of testing.
   5. The amounts of infiltration or exfiltration shall be determined by pumping into or out of calibrated drums, or other Architect approved methods.

C. Conduct the exfiltration test by filling the portion of the system being tested with water to a level equal to the lowest part of the manhole frame.
   1. Contractor may substitute an air test for the water exfiltration test upon approval by the Architect, the District's Building Department, and the City.

D. Conduct tests on portions of the system not exceeding three manhole sections or 1000'; whichever is greater, unless directed by the Architect.
   1. Run tests continuously for 2 hours.

E. Where infiltration or exfiltration exceeds the allowable limits specified herein, the Contractor shall locate and repair the defective pipe, joints, or other faulty construction.
   1. If the defective portions cannot be located, the Contractor shall remove and reconstruct as much of the work as is necessary in order to conform to the specified allowable limits.
   2. Repair all visible infiltration regardless of test results.

F. Provide mandrel test of all flexible piping systems using a mandrel with an effective outside diameter of at least 95% of the actual pipe inside diameter.
   2. Test will occur 30 days or more after the pipe trench is backfilled.

F. The Contractor shall provide all labor, equipment, and materials and shall conduct all testing required under the direction of the Architect.
   1. The Contractor shall include the cost of this work in the base bid.

3.12 INSPECTIONS

A. The Contractor shall notify the City and the Architect of Record at least 24-hours prior to beginning construction in order to arrange inspection of the sanitary sewer.

3.13 RESTORATION OF SURFACES AND/OR STRUCTURES

A. The Contractor shall restore and/or replace paving, curbing, sidewalks, fences, sod, survey points, or any other disturbed surfaces or structures to a condition equal to that before the work began and to the satisfaction of the Architect and shall furnish all labor and materials incidental thereto.

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B. Restoration of surfaces and/or structures shall comply with all requirements of the applicable governing agencies.

3.14 PROJECT RECORD DOCUMENTS

A. The Contractor shall maintain accurate and complete records of work items completed.
B. All as-built information submitted to the Architect shall be sufficiently accurate, clear, and legible to satisfy the Architect that the information provides a true representation of the improvements constructed.
C. Upon completion of construction, the Contractor shall submit to the Architect one complete set of as-built construction drawings.
    1. These drawings shall be marked to show as-built construction changes and dimensional locations and elevations of all improvements and signed by the Contractor.
D. A registered land surveyor shall certify all as-built information for water and sewer lines and submit in a format acceptable to all local reviewing agencies.
E. Contractors shall camera the sewer lines and provide the District with a copy of the videotape.

END OF SECTION

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SECTION 33 32 19
WASTE WATER PUMP STATION

PART 1 GENERAL

1.1 SECTION INCLUDES
- A. Lift Stations
- B. Force Mains

1.2 REGULATORY REQUIREMENTS
- A. Lift Station and Force Main shall comply with the Palm Beach County Water Utilities Department Minimum Engineering and Construction, Standards, "Potable Water, Reclaimed Water and Wastewater Systems" or by the construction standards of the municipality having jurisdiction.

1.3 REFERENCE DOCUMENTS
- A. ASTM A48/A48M - Standard Specification for Gray Iron Castings
- B. ASTM D1784 - Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
- C. ASTM D2241 - Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
- D. AWWA C210, Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines
- E. AWWA C600 - Installation of Ductile-Iron Water Mains and their Appurtances
- F. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 in. through 12 in (100 mm Through 300 MM), for Water Transmission and Distribution - International Restrictions
- G. AWWA C905, Polyvinyl Chloride (PVC)Pressure Pipe and Fabricated Fittings, 14 In through 48 In (350 mm Through 1,200 mm) for Water Transmission and Distribution

1.4 SUBMITTALS
- A. Submit under provisions of Section 01 33 00.
- B. Prior to installation, the Contractor shall furnish to the Project Consultant the manufacturers' literature and data for all materials installed under this section for his approval.
- C. Complete As-Built information and plans required before final acceptance of the system.
  1. Contractor shall provide accurate record of complete system relative to manholes, cleanouts, services, fittings, pipe size, pipe material, pipe lengths, and the like.
  2. Registered Surveyor shall provide all horizontal and vertical information in the Contractor's As-Built information.
  3. Provide final approval of the project "As-Built" information from the regulatory agencies having jurisdiction.

1.5 RELATED DOCUMENTS
- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to work in this section.
- B. Section 31 20 00 Earthwork

1.6 WARRANTY
- A. The unconditional labor and material warranty period for the lift station (5-years for the corrosion barrier system, 5-years for lift station pump and motor assemblies, and 1-year for all other components) commences with the discharging of wastewater into the lift station.
  1. The warranty for the Owner initiated lift station rehabilitation projects begins at the time of the Owner's final payment to the Contractor and shall cover all materials and labor associated with the rehabilitation project, includes but is not limited to, site restoration, flow by-passing, and temporary power.

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PART 2 PRODUCTS

2.1 PUMPS

A. Barnes No Clog Submersible pumps or owner approved equivalent unit.
   1. Provide a certification from the factory authorized pump supplier confirming compliance with these specifications for each pump application prior to the pre-construction meeting.
   2. In phased construction projects, master lift stations with minimal flows for an extended time shall have temporary impellers of reduced capacity, not less than 50% of a permanent pump.
   3. The electrical equipment, pump housing and motor shall meet the ultimate flow condition.
   4. Provide a second set of impellers for full flow conditions just prior to lift station start-up.
   5. The pumps and electrical system shall allow for a minimum of one future impeller upgrade.

PART 3 EXECUTION

3.1 LIFT STATIONS

A. Provide lift station and force main if conditions require.
   1. Submit details of the lift station and force main in accordance with the details and specifications of the municipality having jurisdiction.
B. Waterproof lift station inside and outside.
   1. Locate lift station adjacent to a public street (for eventual takeover by the utility company.
C. Top of lift station and top of concrete water valve pit to be 6" above finish grade and above 100 year, three-day flood elevation.
D. Lift stations owned by the School District do not require telemetering equipment.
   1. Provide sign, "IN THE EVENT OF TROUBLE CALL *district SPA to provide phone number*".
E. The standard lift station shall be a belowground, submersible pump type with two grinder pumps.
F. No deviation from these standards permitted without prior approval.

3.2 PUMPS

A. Two or more wastewater pumps are required.
   1. When providing only 2-units, each shall be capable of handling the anticipated maximum flow.
   2. The capacity of each pump (discharge flow rate) shall not exceed the ultimate peak wastewater inflow rate by more than 25%.
   3. The hydraulic pump efficiency at operating point under ultimate flow conditions shall be a minimum of 40%.
   4. The pump and impeller shall pass 3" spherical solids.
   5. The Architect shall to ensure that pumps operate satisfactory under the minimum and maximum pressure conditions at the time of the lift station start up.
B. Guide Rail System:
   1. Provide a sliding guide rail system for the easily installation and removal of the pump.
   2. Sealing of the pump at the discharge flange shall be by a single downward linear motion of the pump with the entire weight of the pump guided by two 2" diameter stainless steel guide rails or one 2" stainless steel t-bar guide rail.
   3. Then, pressing against the discharge connection, no part of the pump shall bear directly on the sump floor and no rotary motion of the pump shall be required for sealing.
   4. Sealing at the discharge shall insure and guarantee a positive, leak-proof system under all operating conditions, and for ease of removal of the pump.
   5. Do not use nuts, bolts, or other forms of fastenings for pump connection; prevent the need for personnel to enter the wet well to remove the pumps.
   6. Additional support brackets shall be required for guide rails over 20' long.

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C. External Parts Materials:
   1. Provide a factory-applied coating to all external pump and motor parts to resist mild corrosive liquids and chemical attack.
   2. The design shall use a lifting cover, stator-housing impeller and volute casing constructed of ASTM A48 Class 30 minimum, gray cast iron.
   3. The lifting handle shall be cast iron or stainless steel and be large enough to hook the pump with a standard hook from heights of 20'.
   4. Machine the interfaces between the major castings for metal-to-metal contact, and additionally protect with circular cross section O-rings.
   5. Construct all nuts, bolts, washers, and other fastening devices of stainless steel.
   6. Grommet and O-rings are to be oil resistant.

D. Volutes/Impellers:
   1. Do not use volutes and impellers with parts requiring periodically adjustments to correct tolerances due to normal wear.
   2. "Open" impeller design is not acceptable.
   3. Use a dual wear ring system to provide efficient sealing between the volute and the suction inlet side of the impeller.
   4. Equip each pump with a stainless steel wear ring, or Nitrile rubber coated stainless steel insert driven, fitted into the volute inlet.

E. Seals/General:
   1. The seals shall require neither maintenance nor adjustment and shall be easily replaceable.
   2. Conventional lip seals or double mechanical seals with a single or double spring between the rotating faces, requiring constant differential pressure to effect sealing and subject to opening and penetration by pumping forces are not equal to the tandem seal specified.
   3. Do not use impeller to hold seals in place.
   4. Acceptable Seal Systems:
      a. TYPE "A" – The mechanical shaft seal shall be a balanced tandem-type "Enclosed Block" design, which locates both upper and lower sets of seal faces in one compact AISI type 316 stainless steel casing.
         i) The O-rings used in the enclosed block seal shall be all circular cross section (Viton or Buna-N) material for sealing protection.
         ii) The seal faces shall be of high quality silicon carbide held in place by 2-independent sets of eight AISI type 316 stainless steel coil springs immersed in an oil bath.
         iii) As each set of eight coil springs is equally spaced around the shaft, a balanced spring force is exerted upon the seal faces, which is required if the mechanical seal is to be considered "balanced."
         iv) They shall be completely isolated from the pumped media on the impeller side.
      b. TYPE "B" – Provide each pump with a tandem mechanical shaft seal system.
         i) The upper of the tandem set of seals shall operate in an oil chamber located just below the stator housing.
         ii) This set shall contain one stationary silicone carbide ring and one positively driven rotating carbon ring and shall function as an independent secondary barrier between the pumped liquid and the stator housing.
         iii) The lower of the tandem set of seal's functions as the primary barrier between the pumped liquid and the stator housing.
         iv) This set shall consist of a stationary ring and a positively driven rotating ring both of which shall be silicone carbide.

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v) Hold each seal interface in contact by its own spring system.

F. Shaft Bearings:
1. The oversized pump shaft is to be one piece
2. No couplings or shaft extensions allowed
3. The shaft material shall be AISI type 420 stainless steel
4. No carbon steel shafts or shaft sleeves allowed
5. The bearings shall be all spherical ball rolling type angular contact with minimum 40,000-hour L10 life throughout the pump curve.
6. Bearings shall be permanently lubricated type.
7. The upper bearing shall be a single row ball bearing, the lower bearing shall be a double row thrust ball bearings and protected by a short shaft overhang that limits deflections of the shaft.

G. Pump Motors:
1. Pump motors shall be housed in a water-tight casing constructed of ASTM A48/A48M, Class 30 minimum, gray cast iron, and shall have moisture-resistant Class F insulated copper windings.
2. Motors shall have cooling characteristics suitable to permit continuous operation in totally, partially, or non-submerged conditions.
3. Motors shall be able to withstand 10 starts per hour, voltage fluctuations of + 10% of name plate rating and is a NEMA design B rated at 155°C maximum.
4. Pump motors shall have a minimum 1.15 service factor. All pumps/motors shall have a stainless steel data plate.

H. Cable Entry/Terminal Board:
1. The electric cable entry to the motor shall be watertight and have strain relief.
2. The power and control cables shall enter the motor housing through an isolated chamber that is completely isolated from the stator chamber.
3. Seal the Hypalon power and control cable jackets via a compressible Buna-N grommet flanked by washers forming the first isolation point of the assembly.
4. Terminate the cables on brass terminal lugs of the terminal board, thereby sealing the cable entry chamber completely from the stator housing to the extent that it traps any moisture entering the cable entry chamber.
5. Use a the terminal board designed to short out in the event that moisture has found its way into the cable entry chamber, thus signaling that the motor must have service.
6. Size cables to permit voltage conversion without replacing the cable.

I. Service: Pump suppliers shall have adequate repair/service facilities and parts inventories to ensure parts delivery within 24 hours and efficient repair of all equipment supplied.
1. The pump supplier shall provide a reference list of existing installations upon request.

J. Warranty: Pump manufacturer shall have a minimum of 5 years experience in submersible pump manufacturing and service.

3.3 CONTROLS

A. The pump control system is required.
1. Locate the floats where the flows into the wet well or by the pump suction do affect them.
2. May omit the floats, if it is determined that high flow rates into the wet well may adversely affect their performance.
a. In such a case, only high and low level floats will be required with an approved level sensor for the remaining outputs.

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3. For new lift station installations, the "alarm" float elevation shall be set at a minimum of 6" below the lowest influent level.
4. Design the wet well capacity to provide a minimum of 6" vertical separation between floats.
5. Make provision in the control system to automatically, alternate the pumps in use.

B. The standard duplex control elevations will be:
1. High alarm
2. Lag on
3. Lead on
4. All off
5. Low alarm

C. If a Utility-company owns the lift station, follow their standards for a remote transmitting unit (RTU) is for each station, compatible with the utilities telemetry system.

3.4 VALVES AND PIPING

A. A gate valve is required on the discharge line of each pump with a pressure gauge tap and isolation valve on the discharge side of the gate valve, installed with a double strap saddle.
1. A check valve is required between the pump and gate valve.
2. Use only resilient seated gate valves in force mains.
3. Gate valves shall be right hand close operation, check valves shall have an external weight arm; no springs permitted.

B. Install a 4" or 6" tee and valve with 4" or 6" companion flange and plug on the pump-station discharge (FM) as an emergency by-pass.
1. The emergency by-pass connection with an aluminum male cam-lock with cover shall be the same size as the pump discharge, and shall be accessible above ground level.
2. A gate valve located between valve vault and emergency by-pass connection is required.

3.5 WET WELLS

A. A minimum diameter wet well is 6'.
1. The Utility Department may require the an odor control system if a long cycling time, or close proximity of the lift station to occupied structures may create an odor control problem.

B. The effective capacity of the wet well or utilized capacity shall provide a holding period not to exceed 15 minutes for the design flow.
1. Use pump controls designed to start pumps no more frequently than once every 10 minutes.
2. Use precast units for the underground structures unless otherwise specifically approved.
3. All openings shall be precast.
4. Generally, no core-drilled holes allowed for structures with a solid cast-in liner.
5. The Supplier of the wet well shall certify that calcareous aggregate is in the concrete mix (minimum CaCO3 content: 65% in large aggregate, 50% in concrete screenings).
6. Certification on the submitted shop drawings is acceptable.
7. The wet well floor shall have a minimum slope of one-to-one to the pump intake.
8. A corrosion barrier system is required for the interior of the wet walls and valve vault.

C. All metal hardware in the wet well shall be stainless steel.
1. Wet wells with any leakage are not acceptable.

3.6 POWER SUPPLY

A. Design all lift stations for 460-volt, 3-phase, and 60-cycle electrical service.

B. Each pump shall have horsepower and speed rating (RPM) as shown on the design drawings.

C. Connect District owned lift stations in to the school's emergency power system (480-volt, 3-phase, 60-cycle system).

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D. Provide Utility Company owned lift stations with standby power receptacles on the driveway side of the control panel. Use the Utility Company approved plug and receptacle.
E. Provide phase monitor at all pumping stations.
    1. The maximum length of the electrical conduit from nearest transformer/hand hole to the lift station control panel shall be 50'.
    2. Locate the power supply feed to the lift station within a utility easement and show on record drawings. Electric power and control systems must comply with all local Codes, Ordinances, and National Electric Code requirements.
    3. Show power sources and feeders on the as-built drawings.

3.7 FENCED ENCLOSURES
A. Enclose all lift stations with a 6' high chain link fence with a 12' wide double gate centered on the wet well, may use decorative fencing or landscaping in addition to the chain link fence.
B. Chain link fence, post and gates shall meet the requirements of section 32 31 13 "Chain Link Fence and Gate" of these specification.

3.8 SITE SELECTION AND LAYOUT
A. Provide direct vehicle access for maintenance purposes.
    1. An easement or right-of-way of sufficient size is necessary for access (typically 20' wide).
    2. Design the exterior top of the wet well at or above the 100-year flood elevations and not be more than 1' above the road grade adjacent to the station and in no case shall be at a lower elevation than the adjacent road.
    3. The driveway shall be no less than 30' in length from the edge of the ultimate right-of-way road pavement to the gate with a maximum grade of 3%.
    4. The layout of the station should be such as to provide easy access without interference between control panel and truck access.
    5. Place a plastic vapor barrier with 6" thick concrete pad (broom finish) in the fenced area.
    6. The concrete pad shall extend 12" beyond fenced area.
B. The site for a lift station shall be selected to be easily accessible (preferable not from a major collector or arterial road).

3.9 WATER SERVICE
A. Provide a 1½" un-metered potable water line with a Reduced Pressure Principle Backflow Assembly to each lift station site.
B. The Contractor shall be responsible for the initial testing and certification of the assembly prior to the lift station start-up.
C. The Backflow Prevention Assembly shall be located so that it will not interfere with panel opening or create a tripping hazard.

3.10 LIFT STATION ACCEPTANCE PROCEDURE
A. A representative of the Architect shall be present at final inspections/start-up of a lift station, the following is a basis of acceptance:
    1. The pumps are reasonably pumping on the design-pumping curve.
        a. Revised pumps, electrical systems, and/or impellers may be required if the force main system conditions changed since the initial approval of the pump design.
    2. The installation does not exceed the design amperage.
    3. The telemetry unit is functioning properly, if required.
    4. The station is functioning as designed.
    5. The station is constructed in accordance with these standards.
    6. The Contractor submitted the completed lift station checklist to the Architect prior to the lift station start-up.

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7. Contractor submitted all legal documents.
8. Contractor submitted copy of the latest electric utility bill.
9. Contractor submitted a copy of backflow prevention assembly testing and certification.

3.11 SANITARY FORCE MAINS

A. Force mains (FM) shall generally not be less than 4" ID and with an ultimate design flow velocity of no less than 2.0 FPS nor greater than 4.0 FPS.
   1. The District will consider force mains less than 4" in diameter on a case-by-case basis, with proper justification.
   2. Design standards for FMs will be generally the same as for potable water mains.
   3. FMs shall not enter a manhole from a direction contrary to the flow out of the manhole.

B. Design Standards For Force Mains Are As Follows:
   1. Minimum Cover: Minimum cover to finished grade over FM shall be 36".
      a. Mains installed at depths of more than 60" without justification are not acceptable.
      b. Design and install pipe as level as possible to minimize high points.
   2. Horizontal Separation (Wall to Wall):
      a. 15' to buildings, roof overhangs, canopies, walls, fountains, and other structures
      b. 10' to potable water lines
      c. 5' to other public utility lines
      d. 5' to power poles, light poles and drainage pipes
      e. 3' to drainage structures and reclaimed water lines
   3. Vertical Separation: Maintain minimum 18" separation between all pipes with FM crossing under potable water mains and reclaimed water mains whenever possible.
   4. Layout: Place FM in ROW whenever possible
   5. Valves and Appurtenances (FM):
      a. Provide vales on all systems to facilitate the isolation of each section of pipeline.
      b. All valves 3" or larger shall be gate valves of resilient seat design with right hand closed operation.
      c. Valves 16" and larger may be of eccentric plug valve design.
      d. Locate air release valves at the high points of the force main (2' minimum size).
      e. In all instances, effectiveness of placement shall be the primary criteria in determining valve location.
      f. Valves placed in curbs are not acceptable.
      g. Maintain a minimum clearance of 18" or one pipe diameter, whichever is greater, between all fittings (bells, valves, flanges, etc.).
      h. All isolation valves shall have:
         i) A standard locking type valve box
         ii) Operator nuts centered in the valve box
         iii) Mechanical joint or flanged ends
         iv) Valve operator nuts located 36" or more below final grade shall be equipped with an approved mechanically connected valve extension.
         v) All fittings, bends, crosses, etc., shall have mechanical joint or flanged ends unless previously approved flexible joint restraint is used.
   6. Thrust Restraint:
      a. Restrain all bends, tees, crosses, reducers, valves, and dead ends through an approved means of mechanical or approved flexible joint restraint.

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i) Contractor may use thrust blocks consisting of poured-in-place concrete having a minimum compressive strength of 2,500 psi after 28 days cure only if necessary for connections to existing piping system.
ii) Any line terminated as a construction phase that is a known future extension, shall have a plugged valve placed at the end, and restrained with approved mechanical or flexible joint restraint.

b. An adequate number of pipe lengths shall be restrained using approved mechanical joint restraints (MJ pipe), flexible joint restraints (DIP push-on joint pipe), or pressure pipe bell restraints (PVC or DIP push-on joint pipe) to handle 150-psi working pressure and 250-psi surge pressure.
i) Licensed Engineer shall design the restrained pipe lengths based upon the soil conditions and show the information on the design drawings and record drawings.

c. If flexible joint restraints are utilized, the following requirements must be met:
i) The Architect must witness the installation of flexible joint restraints.
ii) A copy of the material invoice must be available on the job site for review to confirm the shipment of restraining gaskets, etc.

7. Force Main Materials:
a. Force mains greater than 3", less than or equal to 24" in diameter shall be PVC AWWA C900 and AWWA C905 SDR 18 Class 150 pipe.
b. PVC force mains shall be marked with one continuous strip of 6" wide, brown coded magnetic tape imprinted with 2" high lettering reading: "CAUTION – FORCE MAIN BURIED BELOW," and located approximately 12" above the crown of pipe every 3'.
c. Do not encase any force main concrete.
d. Flanged ductile iron pipe is required for exposed installation.

8. PVC Pipe (gasket joint) and Fittings Force Main Application:
a. Pipe 4" or larger in diameter shall conform to the requirements set forth in AWWA C900 and AWWA C905 with dimension ratio DR 18.
i) Make provisions for contraction and expansion at each joint, or with rubber ring and an integral bell as part of each joint or by rubber ring sealed coupling.
ii) Fittings shall be cast or ductile iron.
iii) Pipe shall have cast iron pipe equivalent outside dimensions.
b. All pipes smaller than 4" in diameter shall conform to the Commercial Standard CS 256 and ASTM D2241.
i) Make provisions for contraction and expansion at each joint, with a rubber ring and an integral bell as part of each joint, or by a rubber ring sealed coupling.
ii) Pipe shall be made from SDR 21,200 psi clean, virgin NSF approved Type I, Grade 1 PVC conforming to ASTM D1784; clean reworked material generated from the manufacturer's own pipe production may be used.
iii) Fittings for pipe smaller than 4" in diameter shall be PVC.

9. Coatings: All ductile iron pipe and fittings shall have a ceramic epoxy lining and a bituminous coating on the exterior, per AWWA C210.
a. Apply the coating and lining in accordance with the manufacturer's recommendations.

10. Pressure Tests:
a. The test shall be of 2-hour duration.
b. During the test, the pipe shall maintain a pressure of not less than 150 psi.
c. All pipes shall be pressure tested in accordance with the current AWWA C600 Standard with a no leakage tolerance.

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d. Do not test more than 500' of gravity wastewater main or 1000' of force main at one time.
e. Pressure tested gravity wastewater mains and laterals located in well field zones 1 and 2 shall be PVC AWWA C900 SDR18.
f. The tested portion of the laterals shall end at the "upper" bend using a temporarily mechanical joint restrained cap.

3.12 SANITARY FORCE MAIN CONSTRUCTION

A. Installation:
1. Installation of force main pipe and associated fittings shall be in accordance with current AWWA specifications, and manufacturer's requirements for their particular products.
2. All mains shall have a minimum of 36" clear cover to finished grade.
3. Approved pipe joint restraint shall be required at each fitting involving a change of direction and as specified in plan details.
a. Place all pipes in trenches having a dry and stable bottom.
i) Backfill shall be free of boulders and debris.
ii) Fully support the pipe along its entire length.
iii) Replace all sharp or rocky material encountered in the base with proper bedding.
iv) Place the pipe on line and grade as designed.
b. Changes in pipe alignment are allowable with appropriate fittings or pipe deflection.
i) Pipe deflection at the joint is allowable with ductile iron pipe and with specially designed PVC pipes (see Approved Materials Lists).
ii) The deflection shall not exceed 75% of the Manufacturer's recommended maximum joint deflection.
iii) Joint deflection is not allowable at the joint for PVC pipe unless acceptable by the pipe manufacturer.
iv) Install appropriate bends to align PVC pipe if the manufacturer does not allow joint deflection.
c. Place all valves according to plans unless the Architect approves relocation.
i) As-build drawings shall reflect the actual location of all mains and valves.
ii) All taps must be at least 18" from a fitting or bell.
iii) Do not install force mains in fuel-contaminated areas.
d. All road crossings and pavement cuttings shall be in accordance with the requirements of the particular authority governing the area.

B. Connection to Existing System:
1. Make all connections to existing mains under the inspection of the Architect.
2. Operation of valves on existing mains shall be by Utility Department personnel or under their direct supervision.
3. Using a cut-in tee or a tapping sleeve is an acceptable method of connecting to an existing force main (minimum branch size shall be 4").
4. Tapping sleeve and valve shall be pressure tested prior to tapping.
5. A reverse tap due to pre-existing conditions is acceptable only if previously approved by the Department (construction detail required).
a. The Utility Department requires at least 7-days notice to make necessary notifications if it is necessary to cut to existing Customers.
b. The Contractor or Owner may be required to assist in notifications.
c. In this event, Contractor shall be ready to proceed with as much material pre-assembled as possible at the site to minimize the length of service interruption.

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d. The Utility Department will postpone a service cut-off if the Contractor is not ready to proceed on schedule.
e. Consider such connections be done at night to minimize effects.

C. Cleaning:
1. Keep all foreign material out of pipe or clean from pipe prior to installation.
2. Flush the mains upon completion of installation, and the properly depose the water without creating a nuisance.
3. Cap the open ends of the any pipe at the end of each day with a pipe lug to prevent contamination.

D. Testing:
1. Pressure test all force mains in accordance with the current AWWA C600.
2. Supply water to the main and pump to the required pressure, 150-psi.
3. Test no more than 2,500' of pipeline at a time.
4. The standard test duration is 2-hours.
5. The maximum quantity of water supplied into the subject pipe to maintain pressure within 5 psi of the test pressure shall not exceed 50% of the AWWA C600 Standard.
6. Pressure test the force mains within road rights-of-way and under traffic areas after the installation of the road base/rock and "tack-coat", and before the asphalt installation.

END OF SECTION

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SECTION 33 40 00
STORM DRAINAGE UTILITIES

PART 1 GENERAL

1.1 SYSTEM DESCRIPTION

A. The South Florida Water Management District shall approve drainage system and finish floor elevation.
   1. Do not set finish floor elevation of a new building lower than the existing buildings on the campus without written permission of the Building Official.
   2. Keep buildings and sports-fields a minimum of 12" above adjacent roads and perimeter roads.

B. Design the storm water system like a sanitary sewer system with wye fittings and not with tees and elbows for pipe diameters less than 10 inches.
   1. Yard drains may replace fittings when deemed appropriate by the design engineer.

C. All drainage systems shall have an outfall to a retention pond, canal, city storm sewer, etc.
   1. Provide storm water branches to roof leaders (8" dia, 1% min. slope).
   2. Storm catch basins shall not be located within ten feet of a sidewalk.
   3. Provide a traffic cover as required, place the word “STORM” on the manhole cover.
   4. All storm drain lids to be secured.

D. Interconnect all drainage retention/detention ponds.

E. Connect condensate pipes with backflow valves to the storm drainage system.

F. Contractor shall utilize construction methods and devices such as turbidity curtains and floating silt barricade when necessary to comply with state and local water quality standards.

G. No exfiltration trenches permitted in a municipal or county wellfield.

H. Provide perimeter berms as shown on plan to prevent storm water draining on to adjacent property.

I. Install only concrete pipe below paved areas.

1.2 REFERENCES

A. AASHTO M145 – Standard Specification for Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes

B. AASHTO M252 – Standard Specification for Corrugated Polyethylene Drainage Pipe

C. AASHTO M294 – Standard Specification for Corrugated Polyethylene Pipe, 300- to 1500-mm (12- to 60-in) Diameter

D. AASHTO T180 – Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in) Drop

E. ASTM A48/A48M – Standard Specification for Gray Iron Castings

F. ASTM C76 – Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe

G. ASTM C131 – Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

H. ASTM C443 – Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets

I. ASTM C478 – Standard Specification for Precast Reinforced Concrete Manhole Sections

J. ASTM C923 – Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals

K. ASTM C1450/C1450M – Standard Specification for Non-Asbestos Fiber-Cement Storm Drain Pipe

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L. ASTM C1479 – Standard Practice for Installation of Precast Concrete Sewer, Storm Drain, and Culvert Pipe Using Standard Installations.
M. ASTM D1785 – Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
N. ASTM D2321 – Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
O. ASTM D3034 – Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
P. ASTM D3212 – Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
Q. ASTM D3350 – Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
R. ASTM C1840 – Standard Practice for Inspection and Acceptance of Installed Reinforced Concrete Culvert, Storm Drain, and Storm Sewer Pipe

1.3 SUBMITTALS

A. Submit under provisions of Section 01 33 00.
B. Submit shop drawings with manufacturer's catalog cuts, technical data, certificate(s) of compliance or certified analysis in accordance with applicable standards on the following:
    1. Pre-cast concrete structures and catch basins
    2. Frames and grates
    3. Pipe
    4. Test reports
    5. Plastic filter fabric
C. Submit complete "as-built" information in the form of Project Record Documents.
    1. Maintain accurate, clear, legible, and complete records forming a true representation of the Work completed and in progress.
    2. Provide drawing and specification documentation relative to:
        a. Catch basins, manholes, valves, services, and fittings
        b. The vertical and horizontal locations of all storm drainage structures, drainage lines, and connection points
        c. Pipe length, size, and material type
    3. Registered Surveyor shall be measure, record all horizontal and vertical information, and include the information in the project Record Documents.
    4. Project Record Documents: Signed and sealed by the preparing professional Land Surveyor registered in the State of Florida.
    5. Final pipe inspection, including mandrel inspection, and Engineer of Record review.

1.4 QUALITY ASSURANCE

A. Applicable Codes and Jurisdictional Authorities:
    1. Florida Building Code
    2. Occupational Safety and Health Administration (OSHA)
    3. Manual of Uniform Traffic Control Devices (MUTCD)
    4. South Florida Water Management System, Volume IV
    5. Palm Beach County Department of Natural Resource
    6. Palm Beach County Engineering Department
B. Inspections: The Builder shall notify the municipal or county, Architect, and Owner at least 48 hours prior to arrange the required inspection of the system.
C. Survey Data: All elevations on the plans or referenced in the specifications are based on National Geodetic Vertical Datum (NAVD '88).

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D. Provide a copy of the SFWMD application for the "Surface Water Management Permit."
E. Set parking lot and roadway minimum elevations at the ten-year, one-day storm event.
F. Set playing fields minimum elevations for elementary, middle, and high schools at the ten-year, one-day storm event.
G. If wetland mitigation and/or dredge and fill are required, submit a joint permit application as required by the Florida Department of Environmental Protection and the U.S. Army Corps of Engineers, along with a preliminary mitigation plan.

1.5 RELATED WORK
A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to work in this section.
B. Section 31 20 00 – Earthwork.

PART 2 PRODUCTS

2.1 POLYETHYLENE PIPE AND FITTINGS
A. Provide high-density corrugated polyethylene smooth interior pipe with annular exterior corrugations.
1. Provide pipe fittings and accessories of same material and weight/class as pipes, with adjoining method as indicated.
2. Connect all roof drain with a pre-manufactured welded tee fitting.
3. Per FDOT SSRBC Section 948-2.3.1, post-consumer and post-industrial recycled resins are not allowed.
B. All materials shall comply with AASHTO M294 Type S, AASHTO M252, ASTM D3350, and ASTM D2321. Joints shall be watertight in compliance with ASTM D3212.
C. All pipe and fittings shall be "HI-Q SURE-LOK" as manufactured by Hancor, Inc. or as approved by the Architect.
1. Fittings shall have wye configuration and long radius bends to meet sanitary sewer system dimensional requirements.
D. Do not use polyethylene pipe:
1. Below pavement.
2. Within 5 feet of a major structure.
3. Where structural bearing loads, other than normal burial loads, may be transferred to the pipe.
E. Minimum cover for all pipe 10 inches and larger shall be the greater or 36 inches, or one pipe diameter, per ASTM D2321 Sec. 7.6.

2.2 STORM SEWER PIPE: POLYVINYL CHLORIDE PIPE
A. 6" to 8" diameter shall be PVC: SDR 35 conforming to ASTM D3034, with push-on rubber gasket joints.
B. 10" to 12" diameter and larger PVC: PS 10 Perma-Lock with push-on rubber gasket joints similar to those as manufactured by J-M Manufacturing Company, Inc.
C. Polyvinyl-chloride pipe for use in storm sewers connections to building drains shall conform to the requirements of ASTM D1785, for Type II grade 1, Schedule 40.
1. All PVC pipe used for storm sewer or storm leaders shall be white in color.

2.3 REINFORCED CONCRETE PIPE
A. Conform to ASTM C76, Table 3, Class III, Wall B.
B. Provide all pipes with modified tongue and groove joints, and have rubber gaskets. Gaskets and joints shall comply with ASTM C443.
C. Install only concrete pipe below pavement.

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2.4 PLASTIC FILTER FABRIC
- A. Conform to Section 985 of the FDOT Standard Specifications.
- B. Provide filter fabric similar to Carthage Mills Filter X or Mirafi.

2.5 CEMENT MORTAR
- A. Provide mortar for manhole construction with one part cement and two parts clean sharp sand, may add lime in the amount not over twenty-five percent (25%) volume of cement.
- B. Dry mix and then wet mortar to proper consistency for use.
- C. Do not use mortars that have stood for more than one hour after mixing.

2.6 CASTINGS
- A. Castings for inlets and other items: Conform to the ASTM A48/A48M, Class 25.
- B. Provide castings true to pattern in form and dimensions and free of pouring faults and other defects in positions, which would impair their strength or otherwise make them unfit for the service intended.
- C. Plugging or filling, not allowed

2.7 BALLAST ROCK AND PEA ROCK
- A. Rock shall be clean and free of salinity or any other residue.
- B. When subjected to ASTM C131 tests, loss shall not exceed 40%.
- C. ½" ballast rock: fall within the ½" to ¾" range.
- D. ¾" ballast rock: fall within the ¾" to 2½" range.

2.8 STORM SEWER MANHOLES
- A. General: Provide pre-cast reinforced concrete storm sewer manholes as indicated, complying with ASTM C478.
- B. Top shall be pre-cast concrete, of concentric cone, eccentric cone, or flat slab top type, as indicated.
- C. Base shall be pre-cast concrete, with base riser section and integral floor, as indicated.
- D. Frame and Cover: Ductile-iron, 26"- diameter cover, heavy-duty, indented top design, with lettering cast into top reading “STORM SEWER.”

2.9 CATCH BASINS
- A. General: Provide pre-cast reinforced concrete catch basins as indicated.
- B. Basin: Provide pre-cast reinforced concrete, in accordance with FDOT Standard Specification Section 425, standard index drawings and ASTM C478.
  1. If above water table, provide sump and drain holes in bottom of catch basin.
- C. Frame and Grate: As indicated on drawings, meeting FDOT Standard Specification Section 425
- D. Pipe Connectors for plastic pipe shall be resilient, complying with ASTM C923 and ASTM D2321 Sec. 7.10.

2.10 OUTFALLS
- A. Construct of cast-in-place or pre-cast concrete as indicated, with reinforced headwall, apron, and tapered sides.
  1. Plastic pipe shall use concrete end treatments as required by “FDOT HDPE Pipe Fire Risk Evaluation” and FDOT Standard Plans 430-020 – 022, for fire resilience.
  2. Provide riprap as indicated to prevent washout of outfall discharge.
- B. Backfilling: Provide backfilling under provisions of Section 31 20 00 - Earthwork
- C. Fill Material
  1. Satisfactory fill material: local sand and rock mixture free of organic material placed in 12" thick loose lifts and thoroughly compacted to a density of not less than 98% of maximum density as determined by the AASHO Method T 180.

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2. The maximum size rocks used in the roadway fill: Classified as A-1, A-2-4, or A-3 conforming to AASHTO M-145 and not containing material, which will pass sieve No. 200 by 10% of its total weight.

PART 3 EXECUTION

3.1 PREPARATION

A. Existing Utilities:
   1. Provide temporary support, adequate protection, and maintenance of all underground and surface utility structures, drains, sewers, and other obstructions encountered in the progress of the work.
   2. Permanently support, relocate, remove, or reconstruct existing utility structures (such as conduits, ducts, and pipe branch connections to main sewers, main drains, or other structures).
      a. Deviations from the required line or grade not permitted.
   3. Contact the Sunshine State One Call Center and verify existing utility field locations at least 48 hours prior to beginning any excavation.
   4. Verify the size, locations, elevation, and materials of all existing utilities within the area of construction.

3.2 UNLOADING MATERIALS

A. Exercise care in unloading and handling pipe, valves, fittings, and all other material.
B. Follow manufacturer's requirements.
C. Inspect concrete pipe before installation in accordance with AASHTO R73 requirements.

3.3 EXCAVATION

A. Excavate pipe trenches to required depths.
B. In general, pipes shall have a minimum of 36" cover.
C. Excavate to a minimum of 6" below bottom of pipe, and backfill trench when encountering rock.
D. Excavation will be wide enough to allow workers to perform all operations incidental to constructing the pipeline.
E. Provide hand dug bell holes to permit proper joint making.
F. Pipe bearing on rock not permitted.
G. Provide trenching under provisions of Section Earthwork.
H. Pipe Trench Width
   1. Provide maximum clear width of trench measured at the spring line, without under-cutting the banks, in accordance with the following table.

Pipe Size Inches	**Trench Width (Reinforced Conc. Pipe)** (Inches) per AASHTO Section 27 (O.D. + 24”)	**Trench Width (Thermoplastic Pipe)** (Inches) per AASHTO Section 30 (1.5 x O.D. + 12”)
6	*	24
8	*	36
10	*	36
12	40	36
15	44	39
18	47	44
21	*	*

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Pipe Size Inches	**Trench Width (Reinforced Conc. Pipe)** (Inches) per AASHTO Section 27 (O.D. + 24")	**Trench Width (Thermoplastic Pipe)** (Inches) per AASHTO Section 30 (1.5 x O.D. + 12")
24	54	54
27	*	*
30	61	66
36	68	75
42	75	84
48	82	94
54	90	*
60	96	113
66	103	*
72	110	*
78	117	*

2. Minimum width of trench: Leave at least 6" clear space between the bell of pipe and the sheeting or the sides of the trench where no sheeting is used on each side of the bottom without under-cutting the banks.
3. For plastic pipe installed adjacent to poor soils (blow count <10), then trench width shall be three times pipe diameter per ASTM D2321 Sec. X1.10.

3.4 PREPARATION OF TRENCH BOTTOM

A. While preparing the trench bottom or installing pipe, keep water out of trenches.
B. Carefully prepare trench bottom to make a firm, unyielding base.
C. Then place bedding material and install pipe at true line and grade.
   1. Sand, crushed rock, gravel or pea rock used as bedding material to support the pipe.
      a. Loosely place un-compacted bedding materials in the trench bottom 4" minimum below the bottom of the pipe.

3.5 INSTALLATION

A. PVC Pipe Installation:
   1. In accordance with the Uni-Bell Plastic Pipe Association's "Recommended Practice for Installation of PVC Sewer Pipe."
   2. Grout PVC drainage pipe in place at catch basin walls.
B. Drain and Culvert Pipe:
   1. Comply with FDOT Standard Specifications for Road and Bridge Construction, Section 125 and 430, with exceptions as noted herein.
   2. Protect pipe during handling against impact shocks and free falls.
      a. Keep pipe clean at all times, and do not use pipe that does not conform to the specifications.
   3. Install RCP under paved areas per ASTM C1479 Type 1 Standard Installation using A-1, A-2, A-3, or A-4 materials. For RCP installed outside of paved areas, trench embedment shall be per ASTM C1479 Type 3 standard installation. Use insitu soils as embedment if soil classifications meet ASTM C1479 Type 3.
   4. Plastic pipe embedment shall consist of ASTM D2321 Class I or II soils compacted to 95% standard proctor density.
   5. Lay pipe with ends abutting and true to line and grade. Carefully center pipes and lay with a uniform invert.

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6. Accurately lay pipe to the line and grade required for fully functional system.
    a. Prior to making pipe joints, clean and dry all pipe surfaces being joined.
    b. Use lubricant, primers, adhesives, etc., as recommended by the pipe or joint manufacturer's specifications.
7. Place, fit, joint, and adjust jointing materials or factory-fabricated joints in such a manner as to obtain a watertight line.
    a. Provide sufficient backfill material along each side of the pipe to prevent movement of pipe off line and grade.
    b. Compact the backfill in accordance with the manufacturer's guidelines to ensure adequate structural support for the pipe. Refer to ASTM C1479 and D 2321.
8. Install all gravity flow pipes manufactured with bell and spigot joints so the spigot ends point in the direction of flow.

C. Exfiltration Trench: (Not allowed in well fields)
1. Excavate trench to depths required for drainage capacity.
2. Place filter fabric and ballast rock to the level of the proposed pipe.
3. After pipe is placed and accepted, place ballast rock carefully to avoid displacement of pipe and tamp carefully.
4. Fill trench to level indicated on drawings with ballast rock of size or sizes indicated.
5. Install filter fabric at top, bottom, and sides, overlapping two feet on top.
6. Backfill and compact in accordance with requirements of Section 31 20 00 Earthwork.

D. Catch basins: Install per manufacturer's recommendations.

E. Fill and Embankment:
1. Place roadway fill to within 1/10 (.1) foot of the required elevation.
2. If improperly, fill or settlement, remove fill, refill with new material, compact, smooth, and make to conform to grade.

F. Drainage and Culvert Pipe:
1. Install at elevation and line to provide working system.

3.6 FIELD QUALITY CONTROL

A. Temporary Drainage During Construction
1. Construct and maintain temporary drainage facilities that may be required to provide drainage relief for the new construction without causing abnormal or adverse flooding impacts to the existing or new facilities.
2. Temporary facilities may include swales, pipe, etc. as necessary.

B. Restoration of Surfaces and/or Structures:
1. Restore and/or replace paving, curbing, sidewalks, fences, sod, survey points, or other disturbed surfaces or structures to a condition equal to that before start of work.
2. Restoration of surfaces and/or structures outside the Owner's property line: comply with requirements of the applicable governing agencies.

C. Cleaning Up:
1. Remove surplus pipeline material, tools, temporary structures, etc.
2. Dispose of all dirt, rubbish, and excess earth shall be disposed of offsite.

D. Quality Assurance
1. Provide a visual inspection of the installed system via "lamping" or other method.
2. Provide mandrel test of all flexible piping systems using a mandrel with an effective outside diameter of at least 95% of the actual pipe inside diameter.
    a. Test will occur 30 days or more after the pipe trench is backfilled.
3. Repair all visible infiltration regardless of flow rate.

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4. Dig-up all pipes that fail the mandrel test, replace and relay the pipe and re-backfill then retest the pipe.
5. Provide a written summary of test results to the Architect and Owner per Section 1.3, above.

END OF SECTION

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SECTION 33 51 13
GAS PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pipe and fittings for site utility natural or propane gas distribution
B. Propane storage tanks

1.2 REFERENCES

A. AASHO T180 - Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in) Drop
B. ASME B16.3 - Malleable Iron Threaded Fittings
C. ASME B16.11 - Forged Fittings, Socket Welding and Threaded
D. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings
E. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
F. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes
G. ASME B31.8 - Gas Transmission and Distribution Piping Systems
H. ASME Boiler and Pressure Code
    1. ASME SEC. VIII - Pressure Vessels
    2. ASME SEC. IX - Welding and Brazing Qualifications
I. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
J. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
K. ASTM B32 - Standard Specification for Solder Metal
L. ASTM B75/B75M - Standard Specification for Seamless Copper Tube
M. ASTM B88 - Standard Specification for Seamless Copper Water Tube
N. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft3 (600 kN-m/m3))
O. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbs/ft3 (2,700 kN-m/m3))
P. ASTM D2513 - Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings
Q. ASTM D2517 - Standard Specification for Reinforced Epoxy Resin Gas Pressure Pipe and Fittings
R. ASTM D2683 - Standard Specification for Socket Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene Pipe and Tubing
S. ASTM D2837 - Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products
T. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
U. ASTM D3261 - Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
V. ASTM D3350 - Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
W. ASTM F1055 - Standard Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene Pipe and Crosslinked Polyethylene (PEX) Pipe and Tubing
X. AWS A5.8/A8.5M, Specification for Filler Metals for Brazing and Braze Welding
Y. AWWA C105 - Polyethylene Encasement for Ductile-Iron Pipe Systems
Z. NFPA 54 - National Fuel Gas Code

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AA. NFPA 58 - Liquefied Petroleum Gas Code
BB. FBCFG - Florida Building Code Fuel Gas

1.3 SUBMITTALS FOR REVIEW
A. Section 01 33 00 – Submittals Procedures, procedures for submittals
B. Product Data: Provide data on pipe materials, pipefittings, valves, and accessories.

1.4 SUBMITTALS FOR INFORMATION
A. Section 01 33 00 - Submittals Procedures, procedures for submittals.
B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.5 SUBMITTALS AT PROJECT CLOSEOUT
A. Section 01 77 00 - Contract Closeout, Procedures for submittals.
B. Record actual locations of pipe mains, valves, connections, and invert elevations.
C. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.6 QUALITY ASSURANCE
A. Perform Work in accordance with Owner, utility company, or municipality as required.
B. Welding Materials and Procedures: Conform to ASME Boiler and Pressure Vessel Code and applicable state regulations.
C. Welders Certification: In accordance with ASME Sec. IX
D. Conform to NFPA 58

1.7 DELIVERY, STORAGE, AND HANDLING
A. Deliver, store, protect, and handle products to site under provisions of Section 01 60 00.
B. Deliver and store valves in shipping containers with labeling in place.

PART 2 PRODUCTS

2.1 PIPE
A. Steel Pipe Below Ground: ASTM A53/A53M, Schedule 40 black:
1. Fittings: ASME B16.11, forged steel, or ASTM forged steel welding type.
2. Joints: Welded
3. Jackets: AWWA C105 polyethylene jacket, 10-mil polyethylene type,
4. See FBC-Fuel Gas for protective coating requirements.
B. Steel Pipe Above Ground: ASTM A53/A53M, Schedule 40 black:
1. Fittings: ASME B16.3, malleable iron, ASME B16.11, forged steel, or ASTM A234/A234M, forged steel welding type.
C. Plastic Tubing: ASTM D2513 Thermoplastic Gas Pressure Tubing
1. Fittings: ASTM 3350 Polyethylene
2. Joints: ASTM D2683, Specification for Socket-type Polyethylene (PE) Fittings for Outside Diameter Controlled Polyethylene Pipe; or ASTM D3261, Specification for Butt Heat Fusion Polyethylene (PE) Plastic Pipe and Tubing ; or ASTM F1055, Specification for Electrofusion Type Polyethylene Fittings

2.2 GAS COCKS
A. Up to 2": 150 psig WOG, bronze body, bronze tapered plug, non-lubricated, Teflon packing, threaded ends with cast iron curb box, cover, and key.
B. Over 2": 125 psig WOG, cast iron body and tapered plug, non-lubricated, Teflon packing, threaded ends, with cast iron curb box, cover, and key.
C. Gas Cock and Pressure Regulating Valves: Manufacturer's name and pressure rating marked on valve body.

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2.3 PRESSURE REGULATING VALVES
- A. Valves: Single stage, malleable iron body, corrosion-resistant, pressure regulator with atmospheric vent elevation compensator threaded ends for 2" and smaller, flanged ends larger than 2".
- B. Capacity: For inlet and outlet gas pressures, specific gravity, and flow rate indicated.

2.4 PROPANE STORAGE TANKS
- A. Construction: NFPA 58, closed, welded steel, tested and stamped in accordance with ASME Section 8D; minimum 250 psig rating; cleaned, prime coated with one coat of rust inhibitive paint and two coats of high gloss enamel; supplied with steel support saddles, pressure gage; tapping for installation of piping and accessories.

2.5 BEDDING AND COVER MATERIALS
- A. Bedding: Fill as specified in Section 02200.
- B. Cover: Fill as specified in Section 02200.

PART 3 EXECUTION

3.1 EXAMINATION
- A. Verify existing conditions under provisions of Section 01 31 00.
- B. Verify that building service connection and utility gas main size, location and invert are as indicated.

3.2 PREPARATION
- A. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, and remove burrs.
- B. Bevel plain end ferrous pipe over 2" diameter, thread ferrous pipe 2" diameter and under.
- C. Remove all scale and dirt from the inside and outside of the pipe before assembly.
- D. Prepare piping connections with threading and unions.

3.3 BEDDING
- A. Excavate pipe trench in accordance with Section 31 20 00 for work of this section, and if necessary hand trim excavation for accurate placement of pipe to elevations indicated.
- B. Place bedding material at trench bottom, level fill materials in one continuous layer not exceeding 8" compacted depth, compact to 98%.
- C. Backfill around sides and to top of pipe with cover fill tamped in place and compacted to 98%.
- D. Maintain optimum moisture content of bedding material to attain required compaction density.

3.4 INSTALLATION - PIPING
- A. Maintain separation of gas line from sewer and water piping in accordance with code.
- B. Route the piping in a straight line.
- C. Install piping to conserve space and not interfere with use of site space.
- D. Install piping to allow for expansion and contraction without stressing pipe or joints.
- E. Install cocks and other fittings.
- F. Establish elevations of buried piping to ensure not less than 36" of cover in non-traveled areas and 48" of cover in driveways and parking areas.
- G. Lay pipe on bedding.
- H. Install locator wire and warning markers along with all plastic pipe used to carry any type of fuel gas.
  1. Locator wire shall be single or multi-strand copper and insulated with a yellow high molecular weight jacket having a minimum thickness of 30 mils.
  2. Install a locator wire in the same trench as the pipe approximately 6" over the pipe crown.

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3. Locator wire shall be looped or terminated at all warning markers and be accessible for attachment of impressed radio signal locating devices by removing a cap or access port located near the warning marker.
4. Warning markers shall be provided at all points where the pipeline changes direction, at intervals not exceeding 1,000 feet, at all locations where the gas pipe enters School District Property, and at all locations where the gas pipe enters a building.
5. Warning markers shall be embedded at least 36" into the ground and terminate between 12" and 36" above the ground unless within the limits of a sport field.
   a. Other provisions will be made within sport field limits.
6. Warning markers shall be yellow and purchased from a company regularly engaged in the manufacture of utility line markers.

I. Wrap couplings and fittings of steel pipe with polyethylene tape and heat shrink over pipe.
J. Backfill the trench in accordance with Section31 20 00
K. Center and plumb valve box over valve, then set box cover flush with finished ground surface.
   1. Carefully install to prevent transmitting shock or stress through valve box to valve.
L. Wrap valve and valve box with polyethylene tape and heat shrink.
M. Paint all above ground and above ceiling piping yellow and labeled.

3.5 SERVICE CONNECTIONS

A. Provide sleeve in foundation wall for gas service main. Seal enlarged sleeve watertight.
B. Anchor service main to exterior surface of foundation wall.
C. Install service regulator adjacent to building wall in specified location.
D. Install service regulator and riser pipe to prevent undue stress upon service pipe.
E. Provide regulator vent with rain and insect proof opening, terminating away from building openings.
F. Provide bollards, fence, or other suitable protection for all above ground piping meters, and appurtenances.
   1. Contractor installing the piping, meter, or appurtenance shall install protection.

3.6 PROPANE TANK INSTALLATION

A. Install tank below grade in accordance with the plans and District guidelines / details. The more stringent condition shall govern in case of conflicting instructions.
B. Provide tank with relief valve, shutoff valve, pressure regulator, pressure gage, and removable protection cover. Install piping, shutoff valve, and pressure gage to underground piping.

3.7 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Control, field inspection and testing.
B. Perform compaction testing in accordance with ASTM D1557.
C. Gas lines will be pressure tested.
D. If tests indicate, work does not meet specified requirements, remove work, replace, and retest at no cost to Owner.

END OF SECTION

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SECTION 33 56 16
UNDERGROUND LP STORAGE AND DISTRIBUTION

PART 1 GENERAL

1.1 SECTION INCLUDES
- A. Pipe, fittings appurtenances for liquid-petroleum gas (LP gas) distribution at individual sites
- B. Underground LP gas storage tanks

1.2 REFERENCES
- A. NFPA 54-National Fuel Gas Code
- B. NFPA 58-Liquefied Petroleum Gas Code
- C. FBCFG - Florida Building Code Fuel Gas
- D. AASHO T180 - Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in) Drop
- E. ANSI, as referenced in A-C, above
- F. ASME - Boiler and Pressure Vessel (BPV) Code, Section VIII, Division 1, Unfired Pressure Vessels and Section IX, Welding
- G. ASTM, as referenced in A-C, above
- H. AWS, as referenced in A-C, above
- I. AWWA C105 –Polyethylene Encasement for Ductile Iron Pipe Systems

1.3 SUBMITTALS FOR REVIEW
- A. Section 01 33 00 – Submittals Procedures, procedures for submittals
- B. Product Data: Provide data on tanks, pipe materials, fittings, valves, and accessories.
- C. System Design: Provide an isometric drawing of the entire proposed system.
- D. Provide radiographic examination records for the tank welds.

1.4 SUBMITTALS AT PROJECT CLOSEOUT
- A. Section 01 77 00 - Contract Closeout, procedures for submittals.
- B. Record actual locations of tanks, pipes, valves, fittings, accessories, and invert elevations.
- C. Identify and describe unexpected variations in subsoil conditions and discovery of uncharted utilities.

1.5 QUALITY ASSURANCE
- A. Perform Work in accordance with referenced standards, gas supplier requirements, and the authority having jurisdiction.
- B. All welding will comply with AWS and ASME codes.
- C. Pipe and tank installation will comply with NFPA 54, 58, and the FBC-Fuel Gas.

1.6 DELIVERY, STORAGE, AND HANDLING
- A. Deliver, store, protect, and handle products to site under provisions of Section 01 60 00.
- B. Deliver and store valves and appurtenances in shipping containers with labeling in place.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS
- A. Design the LP Gas system to allow a maximum working pressure of 5-psig or less in the gas distribution pipe network. (The LP Gas distribution network commences immediately downstream of the pressure regulator at the LP Gas storage tank.)
  1. Design the LP Gas distribution network to convey only LP Gas.
     - a. Entry of liquefied LP Gas into the distribution network from the tank will be precluded by safety devices, including drips, and regulators.

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2. The design operating pressure for pipe, fittings, and appurtenances in the distribution network will be 125 psig.

B. Design the LP Gas delivery manifold (between delivery vehicle connection and storage tank), supply manifold (between tank and first stage regulator), attached appurtenances, and LP Gas storage tank for an operating pressure of 250 psig.
1. Smaller tanks may require higher pressures; refer to NFPA 58.
2. Rate the valve that separates the distribution system from the storage system for the higher operating pressure if the valve is a bulkhead during field pressure testing.

C. Design documents specify size, material, system configuration, and location for all tanks, piping, fittings, and appurtenant devices.
1. Gas demands determine the size of the gas distribution network, appurtenant items, and gas storage tank.

2.2 PIPE, FITTINGS, AND APPURTENANT DEVICES

A. Buried locations:
1. Buried shall mean in direct contact with soil on all or some surfaces.
2. Pipe shall be wrought iron, black or galvanized steel, brass, copper, or polyethylene and comply with applicable standards.
3. Tubing shall be steel, brass, copper, or polyethylene and comply with applicable standards.
4. Joints on pipe; provide welded, threaded, compression type using mechanical fittings, or fused, fittings and appurtenances matching the pipe material per applicable standards.
   a. Flanged joints require suitable asbestos, metal or other fire resistant material.
   b. Anode-less risers will transition between buried polyethylene pipe or tubing to an acceptable material at exposed locations.
5. Fittings for pipe and tubing shall be steel, brass, copper, malleable iron, ductile iron, or polyethylene and comply with applicable standards.
6. Prophylaxis for buried metal pipe will comply with AWWA C105, which requires a continuous polyethylene jacket using 10-mil polyethylene tubing.
   a. Provide Prophylaxis only where investigation of the soil type indicated that excess corrosion of the pipe and fittings will occur.
   b. District may accept other pipe and fitting materials depending on a life cycle cost evaluation.
7. Manufacture appurtenant items from materials that match the materials identified above or from proprietary materials specifically formulated for the intended service.
8. Do not use cast iron for pipe, fittings, or appurtenances.

B. Exposed locations:
1. Means in direct contact with atmosphere and on all surfaces in an open or enclosed location.
2. Pipe shall be wrought iron, black or galvanized steel, brass, or copper and comply with applicable standards.
3. Tubing shall be steel, brass, or copper and comply with applicable standards.
4. Provide a welded or threaded joint on pipe, fittings, and appurtenances, matching the pipe material per applicable standards.
5. Fittings for pipe and tubing shall be steel, brass, copper, malleable iron, ductile iron and comply with applicable standards.
6. Manufacture appurtenant items from materials matching the materials identified above or from proprietary materials specifically formulated for the intended service.
7. Do not use cast iron for pipe, fittings, or appurtenances.
8. Do not use polyethylene in exposed locations.

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2.3 UNDERGROUND PROPANE STORAGE TANKS
- A. Manufacture the tank will in accordance with ASME BPV Code, Section VIII Division 1.
- B. Code stamp and provide a partial radiography of tank to ensure soundness of welded joints.
- C. Fabricate tank with steel and weld all joints in accordance with procedures qualified under ASME BPV Code, Section IX.
- D. Openings in the tank will be sufficient to attach fill and draw piping, and all required vents and safety appurtenances.
- E. Properly label the tank in accordance with ASME Code requirements.
- F. Interior tank coating shall be a suitable multi-component system formulated for exposure to LP Gas in its liquid and gaseous forms.
- G. Exterior tank coating shall be a suitable multi-component system formulated for exposure to underground conditions in general and specific conditions at the site.

2.4 BEDDING AND COVER MATERIALS
- A. Bedding: Fill as specified in Section31 20 00.
- B. Cover: Fill as specified in Section31 20 00.

2.5 PUMPS, VAPORIZERS AND GAS-AIR MIXERS
- A. Avoid the use of gas-air mixers, transfer pumps, and vaporizers.

PART 3 EXECUTION

3.1 EXAMINATION
- A. Verify existing conditions under provisions of Section01 31 00.
- B. Verify that building service connection and utility gas main size, location and invert are as indicated.

3.2 PIPE PREPARATION
- A. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, and remove burrs.
- B. Bevel plain end ferrous pipe over 2" diameter, thread ferrous pipe 2" diameter and under.
- C. Remove scale and dirt from inside and outside of the pipe before assembly.
- D. Prepare piping connections with threading and unions.
- E. Install proper gaskets on flanged joints.
- F. Use pipe dope on threaded joints.

3.3 PIPE BEDDING
- A. Excavate pipe trench in accordance with Section 31 20 00 for work of this section.
  1. Hand trim excavation for accurate placement of pipe to elevations indicated.
- B. Place bedding material at trench bottom, level fill materials in one continuous layer not exceeding 8" compacted depth, compact to 98%.
- C. Backfill around sides and to top of pipe with cover fill tamped in place and compacted to 98%.
- D. Maintain optimum moisture content of bedding material to attain required compaction density.

3.4 PIPE INSTALLATION
- A. Maintain separation of gas line from sewer and water piping in accordance with code.
- B. Route piping in straight line, use fittings to change direction of the pipe run.
- C. Install piping to conserve space and not interfere with use of site space.
- D. Install piping to allow for expansion and contraction without stressing pipe or joints.
- E. Install fittings, valves, and appurtenances per plans.
- F. Establish elevations of buried piping to ensure not less than 36" of cover in non-traveled areas and 48" of cover in driveways and parking areas.
- G. Lay pipe on bedding.

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H. Wrap couplings and fittings of steel pipe with polyethylene tape and heat shrink over pipe when prophylaxis is required.
I. Install locator wire and warning markers along with all plastic pipe used to carry any type of fuel gas.
    1. Locator wire shall be single or multi-strand copper and insulated with a yellow high molecular weight jacket having a minimum thickness of 30 mils.
    2. Install locator wire in the same trench as the pipe approximately 6" over the pipe crown.
    3. Locator wire shall be looped or terminated at all warning markers and be accessible for attachment of impressed radio signal locating devices by removing a cap or access port located near the warning marker.
    4. Locator wire shall be terminated near the gas meter and near the tank access manhole and be accessible by removing a cap or access port.
    5. Warning markers shall be provided at all points where the pipeline changes direction, at intervals not exceeding 1,000 feet, at all locations where the gas pipe enters School District Property, and at all locations where the gas pipe enters a building.
    6. Warning markers shall be embedded at least 36" into the ground and terminate between 12" and 36" above the ground unless within the limits of a sport field.
        a. Other provisions will be made within sport field limits.
    7. Warning markers shall be yellow and purchased from a company regularly engaged in the manufacture of utility line markers.
J. Install warning tape 12" above crown of buried gas pipe.
    1. Tape shall be detectable with magnetic location devices.
K. Backfill trench in accordance with Section31 20 00
L. Center and plumb valve box over valve, then set box cover flush with finished ground surface.
    1. Prevent shock or stress from being transmitted through valve box to valve or pipe.

3.5 BUILDING SERVICE CONNECTIONS

A. Provide sleeve in foundation wall for gas service main.
    1. Seal sleeve annulus around carrier pipe with suitable material that is compatible with carrier pipe and will produce a watertight, durable seal.
B. Anchor service main to exterior surface of foundation wall using approved anchors and pipe supports or straps.
C. Install secondary service regulator adjacent to building wall in specified location.
D. Install secondary service regulator and riser pipe to prevent undue stress upon service pipe.
E. Provide regulator vent with rain and insect proof opening, terminating away from building openings.

3.6 UNDERGROUND PROPANE TANK LOCATION

A. Tank location shall provide required separation from property lines, buildings and ignition sources for the tank and all vents, safety devices, and fill location.
B. Protect tank location from vehicular traffic with fencing, bollards, landscaping, or other approved method.
C. Fill location shall be accessible by LP Gas delivery trucks.
D. Protect tank access manholes from vehicular traffic and protection shall meet District Standards.
E. Avoid multi-tank installations, but if multi-tank installations are necessary provide proper separation distances between the tanks per NFPA 54.
F. Coordinate tank location with location of fire protection system water delivery devices to ensure that adequate water will be available for fire suppression.

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3.7 UNDERGROUND PROPANE TANK INSTALLATION

A. Install tank with anchors that make the tank non-buoyant under conditions of high ground water.
B. Install tank with a minimum of 12" cover.
C. Over-excavate hole for tank installation. Set anchor system in excavation and backfill with suitable material to bottom elevation of tank.
D. Set tank in prepared excavation and attach required anchoring system, pipe, or accessories prior to backfilling.
E. Backfill around tank until only the crown of the tank is exposed.
F. Place access manholes at the fill and draw locations.
    1. Locate the connections to ASME containers installed underground within a substantial dome, housing, or manhole with a cover.
        a. Install underground containers so all connections for hoses and any opening through which there can be a flow from pressure relief devices or pressure regulator vents are located above the normal maximum water table.
        b. Provide proper venting for such manholes or housings.
        c. The area of ventilation openings shall equal or exceed the combined discharge areas of the pressure relief devices and other vent lines discharging into the manhole or housing.
    2. The ASME code label will be visible and legible from inside an access manhole.
G. Provide tank with all required vents, pressure relief devices, safety devices, and withdrawal and filling connections per applicable regulations.
    1. These devices and connections should include, but not necessary be limited to, relief valve, shut off valve on all pipe connections, pressure regulator, pressure gage, drip, and removable protection cover on access manholes.

3.8 PROTECTION

A. Provide bollards or chain link fence for protection around all above ground gas system components and buried tanks.
B. The Contractor shall install protective fence or bollards for all natural and LP gas components, even when others furnish those components.

3.9 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Control, field inspection and testing.
B. Perform compaction testing in accordance with ASTM D1557.
C. Pressure-test all gas lines
    1. Pipe joints shall be visible during the test.
    2. Test medium will be air or an inert gas; do not use oxygen as a test medium.
    3. Use the greater of; the system's design operating pressure or 1½ times the maximum working pressure, but not less than 3-psig.
    4. Test duration shall be not less than ½ hour for each 500 ft^3 of pipe volume or fraction thereof.
        a. When testing a system with a volume less than 10 ft^3, the test duration shall be a minimum of 10 minutes.
        b. Maximum duration of the test not to exceed 24 hours
    5. The piping system shall withstand the test pressure specified without showing any evidence of leakage or other defects.
D. All failing work shall be removed or repaired and be re-tested until passed with no additional cost.

END OF SECTION

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SECTION 33 71 19
ELECTRICAL UTILITY MANHOLES

PART 1 GENERAL

1.1 SECTION INCLUDES
- A. Prefabricated concrete manholes
- B. Manhole accessories

1.2 REFERENCES
- A. ASTM A48/A48M – Standard Specification for Gray Iron Castings
- B. ASTM A123/A123M – Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Product
- C. ASTM A153/A153M – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
- D. ASTM A659/A659M – Standard Specification for Commercial Steel (CS), Sheet and Strip, Carbon (0.16 Maximum to 0,25 Maximum Percent), Hot-Rolled

1.3 QUALITY ASSURANCE
- A. Manufacturer: Company specializing in precast concrete structures with three years documented experience.

1.4 SUBMITTALS
- A. Submit shop drawings and product data under provisions of Sec 01 33 00.
- B. Indicate material specifications, dimensions, capacities, size, and location of openings, reinforcing details, and accessory locations.
- C. Provide product data for manhole accessories.
- D. Submit manufacturer's installation instructions under provisions of Sec 01 33 00.

PART 2 PRODUCTS

2.1 PRECAST CONCRETE MANHOLES
- A. Precast Concrete: Air-entrained, 2000-psi compressive strength at 28 days.
- B. Reinforcing shall be per AASHTO H-20, bridge loading.

2.2 CAST-IN-PLACE MANHOLES
- A. Concrete: 3000-psi compressive strength at 28 days in conformance with requirements of Sec 03 30 00.
- B. Provide reinforcing under the provisions of Sec 03 20 00.

2.3 MANHOLE ACCESSORIES
- A. Manhole Frames and Covers: ASTM A48/A48M; Class 30B gray cast iron, machine finished with flat bearing surfaces.
- B. Sump Covers: ASTM A48/A48M Class 30B gray cast iron.
- C. Pulling Irons:
  1. 7/8-inch diameter steel bar forming a triangle of 9 inches per side when set.
  2. Galvanize to ASTM A153/A153M for irregular shaped articles.
- D. Cable Rack Inserts: Steel channel insert with minimum load rating of 800 pounds, length to match cable rack channel.
- E. Cable Rack Channel: 4" x 1½" x 3/16" steel channel wall bracket, 48" length, with cable rack arm mounting slots on 8" centers.
- F. Cable Racks: ASTM A659/A659M steel channel, 2 ½" x 14" with high-glazed wet-process porcelain insulators.

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PART 3 EXECUTION

3.1 PREPARATION

A. Excavate, install base material, and compact base material in accordance with manufacturer's instructions under provisions of Sec 31 20 00.

3.2 INSTALLATION - PRECAST CONCRETE MANHOLES

A. Install and seal precast sections in accordance with manufacturer's instructions.
B. Use precast neck and shaft sections to bring manhole entrance to proper elevation.
C. Install manholes plumb.
D. Set the top of each manhole to finished elevation or otherwise as indicated on the drawings.

3.3 INSTALLATION - CAST-IN-PLACE CONCRETE MANHOLES

A. Form cast-in-place manholes, inside and outside surfaces, in accordance with the provisions of Section 03 11 00.
B. Manhole Shape: As indicated.
C. Inside Dimensions: As indicated.
D. Wall Thickness: As indicated.
E. Form window for duct entry as indicated.
F. Include 12" drain opening and one-1" ground rod openings in base section.
G. Cast cable-pulling irons in place opposite each duct entry window as indicated.
H. Cast inserts for cable racks in place as indicated.

3.4 INSTALLATION - MANHOLE ACCESSORIES

A. Install drains in manholes, and connect to 4" pipe terminating in cu yd crushed gravel bed in accordance with provisions of Sec 22 20 00.
B. Install ground rod with top protruding 4" above manhole floor.
C. Waterproof exterior surfaces, joints, and interruptions of manholes after concrete has cured 28 days minimum, in accordance with provisions of Section 07 11 13.
D. Attach cable racks to inserts after manhole installation is complete.

END OF SECTION