CANYONS
SCHOOL DISTRICT

Project Manual
for
CCHS FIELDHOUSE & SOCCER FIELDS

12943 South 700 East
Draper, Utah 84020

Construction Documents

VOLUME 2

(DIVISIONS 21 – 33)

Prepared by:

CORE ARCHITECTURE

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CORE Project No. 24-013
September 12, 2024

THESE SPECIFICATIONS ARE COMPLEMENTARY TO THE CONSTRUCTION DRAWINGS AND THE SPECIFICATIONS AND CONSTRUCTION DRAWINGS CONSTITUTE THE CONSTRUCTION DOCUMENTS FOR THE PROJECT

TABLE OF CONTENTS

DIVISION 27– COMMUNICATIONS

DIVISION 28 – ELECTRONIC SAFETY AND SECURITY

DIVISION 29 - 30

NOT APPLICABLE

DIVISION 31 - EARTHWORK

DIVISION 32 – EXTERIOR IMPROVEMENTS

DIVISION 33 - UTILITIES

END OF TABLE OF CONTENTS

DIVISION 21 – FIRE SUPPRESSION

SECTION 21 0000 - FIRE PROTECTION

PART 1 – GENERAL

1.1 GENERAL CONDITIONS

A. The requirements of Section 220000, 230100, 230501, 230800 250900 and 251000 shall govern the work in Section 210000, where applicable, and where not in conflict with governing codes and ordinances. Division 1 is a part of this and all other sections of these specifications.

B. **Preferred contractors shall be Preferred Fire Protection, Kimco Fire Protection, Chaparral Fire Protection, Fire Engineering Co., Delta Fire Protection Systems, Paradise Fire Protection Inc. Intermountain Fire Protection and Firetrol Protection Systems.**

C. Contractors not listed on the approved list must submit for approval and review prior to bid as required by bid documents.

1.2 SCOPE

A. The work required includes the designing, hydraulically calculating pipe sizes, flows, and pressure, furnishing and installation of fire protection systems in accordance with the drawings, specifications, latest standards and codes for complete systems for the building.

B. The work specified in this section shall be installed by none other than a recognized fire sprinkler contractor. All fire protection system piping shall be hydraulically calculated. All systems shall be subject to the inspection and approval of the local fire authority or his representative for compliance of applicable standards.

C. All work shall be coordinated with other subcontractors.

D. The sprinkler system shall consist of the required number of sprinkler heads, piping, hangers, drains, test pipes, alarms, valves, gauges, fire department connections, and all other parts to assure a complete system to meet the requirements of the owner's insurance underwriter, local authority having jurisdiction, and in accordance with nationally recognized standards.

E. Codes & Standards:

1. Water Supply: NFPA #24 – 2021 International Building Code.
2. Wet Sprinkler System & Combined Systems: NFPA. #13 and #14 – latest I.F.C.
3. Alarm Equipment: NFPA #70 & 72A
4. Standpipe & Hose Systems: NFPA #14 – 2021 I.F.C.
5. Supervision: NFPA #13 and #14 – latest I.F.C.
6. Temporary Fire Protection: NFPA #14 – latest I.F.C.
7. Sprinkler Heads: NFPA. #13

8. Sleeves and Location: NFPA #13

9. Excavation and Backfill: 230900 of this specification

F. Work Included Elsewhere:

1. Fire Hydrants - by Site Utility Contractor

2. Underground Mains: NFPA #24

3. Concrete Work - by General Contractor

4. Access Doors - By Division 23 Contractor.

5. Painting of sprinkler piping - By Painting Contractor.

6. Color coding or pipe identification - By Mechanical Contractor.

7. Wiring of flow switches and gate valve supervisory switches - By Electrical Contractor.

1.3 WORK BY FIRE PROTECTION CONTRACTOR

A. This contractor shall furnish and install all labor, material, and equipment to make a complete and working fire protection system fully tested and approved in accordance with the drawings, standards of this specification for the new building.

B. Underground Water Supply:

1. See water flow analysis at the end of this section for hydraulic calculation design requirements.

2. Connect fire sprinkler mains to connections provided by the site utility contractor as shown on the drawings and install U.L. labeled pipes into building at locations shown. Coordinate testing and flushing of this portion of the main in accordance with NFPA #24 and furnish test certificates to the Owner's representative.

3. This contractor will be responsible for coordinating with the site utilities contractor to assure that the underground water supply has been flushed and tested in accordance with NFPA pamphlet #24 prior to the connection of the overhead sprinkler system.

4. Fire protection contractor shall perform a flow test at or near site prior to final calculations for system. Flow test to be performed in the presence of local fire marshal and Ogden School District representative.

5. Connect fire sprinkler mains to connections provided by others as shown on the drawings and install U.L. labeled pipes into building at locations shown. Coordinate testing and flushing of this portion of the main in accordance with N.F.C. #24 and furnish test certificates to the Owner's representative.

6. This contractor will be responsible for coordinating with the site utilities contractor to assure that the underground water supply has been flushed and tested in accordance with NFPA pamphlet #24 prior to the connection of the overhead sprinkler system.

7. Flow Test Information:

Test Location:	12943 South 700 East Draper, Utah
Test Date:	July 1, 2024
Residual Pressure:	48 PSI
Static Pressure	75 PSI
GPM at 20 PSI	3736 GPM
Water Flow:	2416 GPM

*Fire flows for design calculations shall be taken from test hydrant at front of school.

8. Sprinkler System:

   a. This system shall conform to the latest I.F.C., NFPA 13 & 14 and I.B.C. Riser may be calculated but shall not be smaller than 6". Sprinkler systems are to be light, ordinary, or extra hazard, as required by NFPA 13 and the Utah State Fire Marshall's office.

   b. System shall be hydraulically calculated. Sprinkler systems shall be light hazard, except for casual ordinary and extra hazard group 1 in storage and service areas. Density for light hazard areas shall be 0.10 gpm per sq. ft. over 1500 sq. ft. Remote area with a maximum head spacing of 225 sq.ft. Service area shall be density of 0.15 over 2000 sq. ft. with maximum spacing of 130 sq. ft.

1.4 QUALIFICATION OF DESIGNER

A. The designer shall be an engineering technician or Senior Engineering Technician (Level III or Level IV), NICET certification for fire sprinkler system design.

1.5 QUALIFICATION OF INSTALLER

A. It is intended that the system be designed and installed by a firm regularly engaged in the design and installation business of Fire Sprinkler contracting. The Owner's representative may require evidence to support the ability of the contractor to perform work in the scope and volume as specified. A contractor who cannot verify such experience may be found not suitable to perform the work.

PART 2 – PRODUCTS

2.1 HANGERS

A. All hangers to be in accordance with NFPA Pamphlet No. 13. All hangers shall be supported from the top or bottom chord of open web structure within 6” of panel points.

2.2 RISERS

A. Risers shall be at the locations shown and shall include a U.L. approved control valve, check valve, flow switch, pressure gauges, water motor gong, or electric bell, standard fire department connection, gate valve supervisory switch, test connections, and drains as required.

2.3 SPRINKLER HEADS

A. Sprinkler heads shall be U.L. approved. "K" factors shall be the same on each system and/or floor. See plans for head types.

B. Sprinklers shall be of the proper temperature rating. The location of sprinkler head wherever reasonably possible shall be symmetrical and coordinated with the ceiling pattern.

C. The number and location of sprinkler heads shown on the drawings are schematic. The exact number and location of heads shall be determined by the system design, and architectural coordination.

D. Provide dry pendent heads in areas subject to freezing, where wet piping can be run in heated space. Otherwise, provide antifreeze loops.

E. Provide spare head cabinets in accordance with NFPA No. 13 and equip same with at least ten (10) chrome heads, six (6) white heads, six (6) brass heads, and appropriate wrenches.

F. Provide head guards in sports field areas and all areas where heads are subject to physical abuse.

2.4 VALVES

A. All valves and fittings shall be listed by Underwriters Laboratories or approved by Factory Mutual for fire protection duty and shall be installed in accordance with their listing and/or approval. Control valve shall have alarm supervisory switches with two sets of contacts and normally open/normally closed.

B. All indicating valves will be of the listed and/or approved type with an electric tamper switch approved for use with that valve.

C. Water hammer arrestors shall be provided ahead of all automatic valves to eliminate water hammer and shall be installed vertically in an accessible location.

D. Hose valves off standpipes shall be U.L. approved. All valves shall be 2-1/2" with 2-1/2" X 1-1/2" reducer and cap with chains. Valves shall be polished brass and chrome plated.

2.5 PIPING

A. All piping above ground shall be Schedule 40 domestic steel pipe and fittings.

B. Schedule 40 equivalent, thin wall and foreign made pipe or fittings will not be permitted on this project.

2.6 EARTHQUAKE BRACING

A. Install earthquake bracing in accordance with NFPA #13 Standards and Utah State Fire Marshall's Office.

2.7 SLEEVES

A. Sleeves shall be furnished, together with their location and elevations to the construction manager, timely with required schedule or concrete pours. If sleeves are missed by this contractor, he shall be responsible for core drilling thru concrete at his own expense, and he shall be responsible for his cutting and patching. Sleeves shall be of the size, type, and length required by N.F.P.A. codes. See Section 230900 for Sleeves".

PART 3 – PART 3 - EXECUTION

3.1 TEMPORARY FIRE PROTECTION DURING COURSE OF CONSTRUCTION

A. This contractor shall provide fire protection as required by NFPA 241 and the 2021 I.F.C. Chapter 33 “FIRE SAFETY DURING CONSTRUCTION AND DEMOLITION” and shall be coordinated with the local fire department.

3.2 SHOP DRAWINGS

A. Shop drawings, submittals, and hydraulic calculations, as necessary and required, shall be submitted to the Owner's representative for approval prior to incorporating materials or equipment into the work. Shop drawings shall be complete and in accordance with I.F.C. #13, #14, #20, and all applicable standards, submittals, and equipment, valves, flow switches, controls, and other important items shall be complete, showing details, description, and characteristics; hydraulic calculations shall be based on the water system fire flow capacities shown on the drawings and shall show flows, pressures, velocities, pipe size, and equivalent lengths as required for the system.

B. Calculations shall be arranged in an orderly manner with sufficient reference points for the approving authority to review and approve.

C. Testing shall be accomplished by this contractor for all required systems, equipment, and appurtenances, as required by the various standards and codes. The Owner's representative shall witness and sign off each item required. This contractor shall furnish the required forms.

3.3 TESTS

A. Install all test pipes and valves as required by NFPA No. 13. Locate inspector's test valves and auxiliary drain valves above ceilings in areas approved by the Architect and provide hose bibb connections. Conduct all tests as required by NFPA Standards and Insurance Services Office and submit copies of completed test forms to the building owner.

B. All fire sprinkler related tests requiring witnessing by local authorities will be the responsibility of this contractor. If tests are not run or do not have the proper witness or documentation, then they will be run late and all damage caused by the system, or caused in uncovering the system for such tests, will be borne by this contractor.

C. The Utah State Fire Marshall and building owner shall be notified (in writing) at least three days in advance of the following:

1. Hydrostatic test and final inspection of the underground, prior to backfilling.

2. Flushing of underground prior to connection to overhead.

3. Hydrostatic test and final inspection of overhead, prior to the installation of the ceilings.

3.4 GENERAL REQUIREMENTS

A. This contractor shall submit complete drawings, hydraulic calculations, and proper documentation to the local authority having jurisdiction and receive their approval before submitting such material to the Owner's representative for final approval. The contractor will be required to show proof of submittal to the Owner's insurance underwriter and local building authorities before installation may begin.

B. All work of this contractor will be coordinated with other trades to insure minimal changes to the sprinkler system from the designs. Careful coordination of mechanical and electrical ducts, pipe and conduit shall be required. The ceiling cavity must be carefully reviewed and coordinated with all trades. In the event of conflict, the installation of the mechanical equipment and piping shall be in the following order: plumbing waste, rainwater, and soil lines' supply, return, and exhaust ductwork; water piping; fire protection piping; and pneumatic control piping.

C. Every effort shall be required to ensure that the heads form a symmetrical pattern in the ceiling with the ceiling grid, the lights, and diffusers and grilles and as shown on the Architect's reflected ceiling plan. Offsets shall be made in piping to accommodate ductwork in ceiling. Heads should be symmetrical, and all piping run parallel or perpendicular to building lines. Sprinkler heads be installed in pattern and locations listed on documents. In no case shall sprinkler heads be installed closer than 6" from ceiling grids or closer than approved distances from ceiling obstructions.

D. All sprinkler piping shall be concealed unless approved by the Owner's representative. All lines will be run as high as possible so as to not interfere with future changes to ceiling heights or other mechanical equipment. This contractor will be responsible for all sleeves, core drills, and sealing of penetrations in walls, floors, and structural members to facilitate the installation of the system, however, no holes in, or attachments to structural members will be allowed unless approved by the owner's representative.

E. All required drains and test pipes will be installed and finished in a workmanlike manner, terminating at a proper location to accommodate the required outflow without damaging the building or landscaping. Drain and test pipe locations shall be approved by the owner's representative.

F. All piping and heads located in un-heated spaces shall be installed with a glycol loop system. Coordinate location with the owner's representative. Indicating valves with tamper switches shall be installed and wired as required by code. Coordinate with electrical contractor.

G. No piping or valve assemblies shall be run exposed in a finished area without the prior approval of the owner's representative.

H. **All heads located in specialty ceiling systems shall be coordinated with Architect prior to any installation.**

4.1 JOB CLOSEOUT

A. This contractor shall assure that all placards, signs, and instruction manuals are in place, and all tests are run before any consideration for final payment will be considered. This includes maintenance manuals, hydraulic calculations placards, spare head cabinets and the proper number of spare heads, and instruction to on-site personnel.

B. This contractor shall, in addition to the above, furnish the owner one (1) set of reproducible prints of the sprinkler system "record drawings" for his project file.

4.2 WATER SUPPLY ANALYSIS

A. See attached report.

END OF SECTION 21 0000

Craig Blue, P.E. Inc.
Fire Suppression
Engineering & Testing

14489 S Majestic Oaks Lane
Herriman, UT 84096
801-886-3473
Craig@CBluePE.com

7/1/2024
Luke Butterfield
Canyons School District
12943 South 700 E
Draper, UT 84020

Luke.Butterfield@canyonsdistrict.org>

RE Water Supply Analysis

This report contains the assessment of the water supply available for fire protection at the following site/address:
Fieldhouse at Corner Canyon HS - Canyons SD
12943 South 700 E.,
Draper, UT 84020

Report was prepared at the direction of:
Luke Butterfield
Luke.Butterfield@canyonsdistrict.org>
Canyons School District
12943 South 700 E
Draper, UT 84020

Prepared by:
Craig Blue PE.

Background info:

The purpose of this report is to determine the amount of water supply available at the site noted above. The report shall assist authorities having jurisdiction, in determining fire suppression requirements & issuing of building permits. Comments included in report, that references 2021 International Building/Fire code are based on minimum recommended standards only. The authorities having jurisdiction may require more or less than the reference appendix.

Water & Private hydrants to site are supplied from Water Pro water system. Area is an established residential area. Private hydrants selected were highest, and farthest remote to site.

Flow Test:

The flow test was performed by Craig Blue P.E. and Connor Blue. Water flow and pressures available at hydrants nearest to site are as follows:

Static Pressure -	85	psi
Residual Pressure-	56	psi
Flowing 4.5" single outlet (34 psi-pitot):	2416	gpm
See flow data sheet for site plan, and hydrants reference elevation.		
Hydrants elev.	4469	ft. elev. Approx
Fire flow calculated for performance	3736	gpm at 20 psi

Fire Flow:

The builidng structure type is anticipated as Type IIB non combustible with an unknow area. With fire sprinklers provided throughout building the fire flow may be reduced to 25% of fire flow. The fire flow, sprinkler reduction demand (8000 x .25 =) 2000 gpm is then required. Fire flow meets and exceeds fire flow limits noted and allows for an unlimited fire area.

Fire Sprinkler System Designs

Fire Sprinkler design should use a 15% reduction in pressures to account for demand variations in area.

15% reduced- Static 72 psi, 48 psi flowing 2416 gpm

Summary & Recommendations:

It is our opinion, that fire flow performance near site is sufficient for structures anticipated.

If there are further questions, please contact me

Craig Blue PE
C.B.P.E. Inc
801-886-3473
Craig@CBluePE.com

CBPE# 2050-28

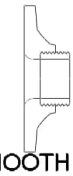
FLOW TEST DATA SHEET

Craig Blue P.E. Inc.
Fire Suppression Engineering & Testing
801-886-3473 Craig@CBluePE.com

CBPE: 2050-28

OUTLET TYPES:

PLAY PIPE
C=0.97



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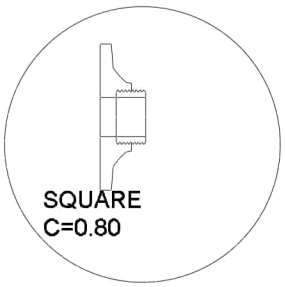

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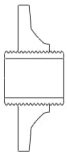


WATER SYSTEM: Corner Canyon High School Water System
NAME OF PROPERTY: Field-house at Corner Canyon High School
ADDRESS: 12943 South 700 East
South Jordan, UT 84020
DATE: 6/27/24 TIME: 11:00 am TEMPERATURE: +80 F
TYPE OF CITY SYSTEM:
TEST CONDUCTED BY: Craig Blue PE.
WITNESSED BY: Connor Blue
NOTES:

FORMULA Q=29.83 C D^2 P^.5

WHERE Q IS GALLONS PER MINUTE
C IS THE COEFFICIENT OF DISCHARGE
D IS I.D. IN INCHES OF OUTLET (2.469" typ.)
P IS PITOT GAUGE READING (PSI)

	SIZE (IN)	PITOT (PSI)	FLOW (GPM)
OUTLET 1	4.5	25	2416
OUTLET 2			
OUTLET 3			
OUTLET 4			

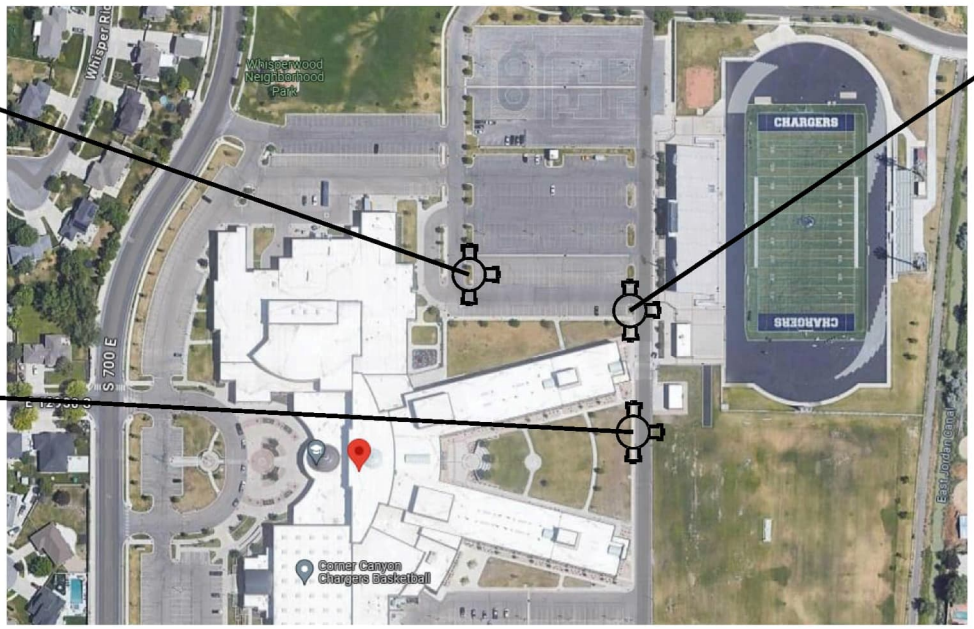
FIRE FLOW: 3736 gpm @ 20psi TOTAL FLOW: 2416 gpm

STATIC: 85 PSI RESIDUAL: 56 PSI ELEVATION: 4469 FT. hydrant elev.

SKETCH AREA MAP BELOW:

HYDRANT
Out of Service

HYDRANT
2416 gpm flow



85 psi Static
56 psi Residual
Elevation 4469 ft
approx.

NORTH

FLOW TEST DATA CHART

Craig Blue P.E. Inc.
Fire Suppression Engineering & Testing
801-886-3473 Craig@CBluePE.com

CBPE: 2050-28

WATER SYSTEM: Corner Canyon High School Water System

NAME OF PROPERTY: Field-house at Corner Canyon High School

ADDRESS: 12943 South 700 East
South Jordan, UT 84020

SUPPLY:	85 PSI	56 PSI	2416 GPM	3736 GPM	4469 ft.
	STATIC	RESIDUAL	FLOWING	FIRE FLOW at 20 psi	GRADE ELEV.

DATE OF TEST: 6/27/24

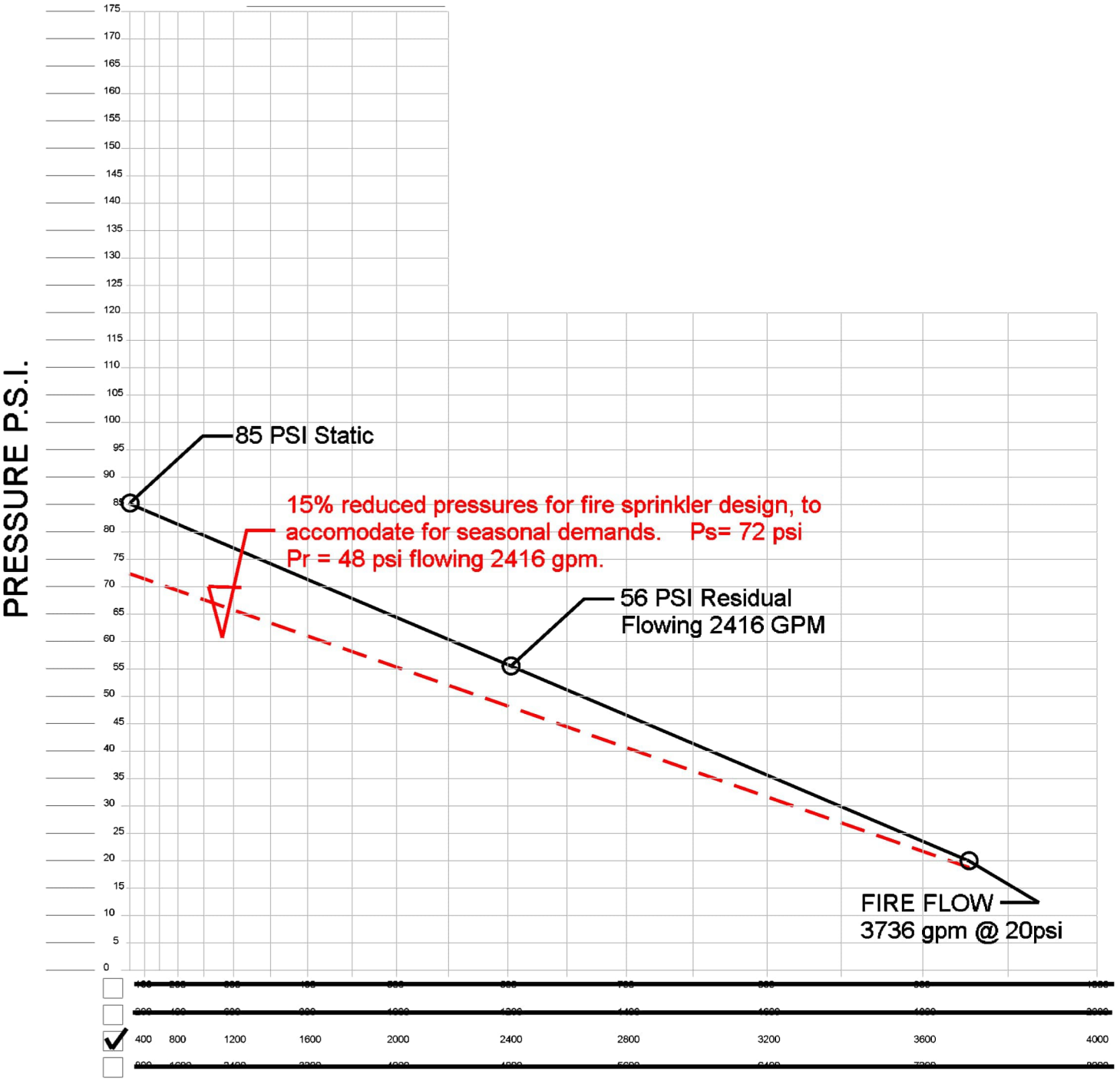


CHART #1

504.3 Stairway access to roof. New buildings four or more stories above grade plane, except those with a roof slope greater than four units vertical in 12 units horizontal (33.3-percent slope), shall be provided with a *stairway* to the roof. *Stairway* access to the roof shall be in accordance with Section 1011.12. Such *stairway* shall be marked at street and floor levels with a sign indicating that the *stairway* continues to the roof. Where roofs are used for landscaped roofs or for other purposes, stairways shall be provided as required for such occupancy classification.

SECTION 505
PREMISES IDENTIFICATION

505.1 Address identification. New and existing buildings shall be provided with *approved* address identification. The address identification shall be legible and placed in a position that is visible from the street or road fronting the property. Address identification characters shall contrast with their background. Address numbers shall be Arabic numbers or alphabetical letters. Numbers shall not be spelled out. Each character shall be not less than 4 inches (102 mm) high with a minimum stroke width of $^1/_2$ inch (12.7 mm). Where required by the *fire code official*, address identification shall be provided in additional *approved* locations to facilitate emergency response. Where access is by means of a private road and the building cannot be viewed from the *public way*, a monument, pole or other sign or means shall be used to identify the structure. Address identification shall be maintained.

505.2 Street or road signs. Streets and roads shall be identified with *approved* signs. Temporary signs shall be installed at each street intersection when construction of new roadways allows passage by vehicles. Signs shall be of an *approved* size, weather resistant and be maintained until replaced by permanent signs.

SECTION 506
KEY BOXES

506.1 Where required. Where access to or within a structure or an area is restricted because of secured openings or where immediate access is necessary for life-saving or fire-fighting purposes, the *fire code official* is authorized to require a key box to be installed in an *approved* location. The key box shall be of an *approved* type *listed* in accordance with UL 1037, and shall contain keys to gain necessary access as required by the *fire code official*.

506.1.1 Locks. An *approved* lock shall be installed on gates or similar barriers where required by the *fire code official*.

506.1.2 Key boxes for nonstandardized fire service elevator keys. Key boxes provided for nonstandardized fire service elevator keys shall comply with Section 506.1 and all of the following:

1. The key box shall be compatible with an existing rapid entry key box system in use in the jurisdiction and *approved* by the *fire code official*.
2. The front cover shall be permanently labeled with the words "FIRE DEPARTMENT USE ONLY—ELEVATOR KEYS."
3. The key box shall be mounted at each elevator bank at the lobby nearest to the lowest level of fire department access.
4. The key box shall be mounted 5 feet 6 inches (1676 mm) above the finished floor to the right side of the elevator bank.
5. Contents of the key box are limited to fire service elevator keys. Additional elevator access tools, keys and information pertinent to emergency planning or elevator access shall be permitted where authorized by the *fire code official*.
6. In buildings with two or more elevator banks, a single key box shall be permitted to be used where such elevator banks are separated by not more than 30 feet (9144 mm). Additional key boxes shall be provided for each individual elevator or elevator bank separated by more than 30 feet (9144 mm).

Exception: A single key box shall be permitted to be located adjacent to a *fire command center* or the nonstandard fire service elevator key shall be permitted to be secured in a key box used for other purposes and located in accordance with Section 506.1.

506.2 Key box maintenance. The operator of the building shall immediately notify the *fire code official* and provide the new key where a lock is changed or rekeyed. The key to such lock shall be secured in the key box.

SECTION 507
FIRE PROTECTION WATER SUPPLIES

507.1 Required water supply. An *approved* water supply capable of supplying the required fire flow for fire protection shall be provided to premises on which facilities, buildings or portions of buildings are hereafter constructed or moved into or within the jurisdiction.

507.2 Type of water supply. A water supply shall consist of reservoirs, pressure tanks, elevated tanks, water mains or other fixed systems capable of providing the required fire flow.

507.2.1 Private fire service mains. Private fire service mains and appurtenances shall be installed in accordance with NFPA 24.

507.2.2 Water tanks. Water tanks for private fire protection shall be installed in accordance with NFPA 22.

507.3 Fire flow. Fire-flow requirements for buildings or portions of buildings and facilities shall be determined by an *approved* method.

507.4 Water supply test. The *fire code official* shall be notified prior to the water supply test. Water supply tests shall be witnessed by the *fire code official* or *approved* documentation of the test shall be provided to the *fire code official* prior to final approval of the water supply system.

507.5 Fire hydrant systems. Fire hydrant systems shall comply with Sections 507.5.1 through 507.5.6.

507.5.1 Where required. Where a portion of the facility or building hereafter constructed or moved into or within the jurisdiction is more than 400 feet (122 m) from a hydrant on a fire apparatus access road, as measured by an *approved* route around the exterior of the facility or building, on-site fire hydrants and mains shall be provided where required by the *fire code official*.

Exceptions:

1. For Group R-3 and Group U occupancies, the distance requirement shall be 600 feet (183 m).
2. For buildings equipped throughout with an *approved automatic sprinkler system* installed in accordance with Section 903.3.1.1 or 903.3.1.2, the distance requirement shall be 600 feet (183 m).

507.5.1.1 Hydrant for standpipe systems. Buildings equipped with a standpipe system installed in accordance with Section 905 shall have a fire hydrant within 100 feet (30 480 mm) of the fire department connections.

Exception: The distance shall be permitted to exceed 100 feet (30 480 mm) where *approved* by the *fire code official*.

507.5.2 Inspection, testing and maintenance. Fire hydrant systems shall be subject to periodic tests as required by the *fire code official*. Fire hydrant systems shall be maintained in an operative condition at all times and shall be repaired where defective. Additions, repairs, alterations and servicing shall comply with *approved* standards. Records of tests and required maintenance shall be maintained.

507.5.3 Private fire service mains and water tanks. Private fire service mains and water tanks shall be periodically inspected, tested and maintained in accordance with NFPA 25 at the following intervals:

1. Private fire hydrants of all types: Inspection annually and after each operation; flow test and maintenance annually.
2. Fire service main piping: Inspection of exposed, annually; flow test every 5 years.
3. Fire service main piping strainers: Inspection and maintenance after each use.

Records of inspections, testing and maintenance shall be maintained.

507.5.4 Obstruction. Unobstructed access to fire hydrants shall be maintained at all times. The fire department shall not be deterred or hindered from gaining immediate access to fire protection equipment or fire hydrants.

507.5.5 Clear space around hydrants. A 3-foot (914 mm) clear space shall be maintained around the circumference of fire hydrants, except as otherwise required or *approved*.

507.5.6 Physical protection. Where fire hydrants are subject to impact by a motor vehicle, guard posts or other *approved* means shall comply with Section 312.

SECTION 508
FIRE COMMAND CENTER

508.1 General. Where required by other sections of this code and in all buildings classified as high-rise buildings by the *International Building Code* and in all F-1 and S-1 occupancies with a building footprint greater than 500,000 square feet (46 452 m^2), a *fire command center* for fire department operations shall be provided and shall comply with Sections 508.1.1 through 508.1.7.

508.1.1 Location and access. The location and access to the *fire command center* shall be *approved* by the *fire code official*.

508.1.2 Separation. The *fire command center* shall be separated from the remainder of the building by not less than a 1-hour *fire barrier* constructed in accordance with Section 707 of the *International Building Code* or *horizontal assembly* constructed in accordance with Section 711 of the *International Building Code*, or both.

508.1.3 Size. The *fire command center* shall be not less than 0.015 percent of the total building area of the facility served or 200 square feet (19 m^2) in area, whichever is greater, with a minimum dimension of 0.7 times the square root of the room area or 10 feet (3048 mm), whichever is greater.

Where a *fire command center* is required for Group F-1 and S-1 occupancies with a building footprint greater than 500,000 square feet (46 452 m^2), the *fire command center* shall have a minimum size of 96 square feet (9 m^2) with a minimum dimension of 8 feet (2438 mm) where *approved* by the *fire code official*.

508.1.4 Layout approval. A layout of the *fire command center* and all features required by this section to be contained therein shall be submitted for approval prior to installation.

508.1.5 Storage. Storage unrelated to operation of the *fire command center* shall be prohibited.

508.1.6 Required features. The *fire command center* shall comply with NFPA 72 and shall contain the following features:

1. The emergency voice/alarm communication system control unit.
2. The fire department communications system.
3. Fire detection and alarm system annunciator.
4. Annunciator unit visually indicating the location of the elevators and whether they are operational.
5. Status indicators and controls for air distribution systems.
6. The fire fighter's control panel required by Section 909.16 for smoke control systems installed in the building.

APPENDIX B

FIRE-FLOW REQUIREMENTS FOR BUILDINGS

The provisions contained in this appendix are not mandatory unless specifically referenced in the adopting ordinance or legislation of the jurisdiction.

User note:

About this appendix: *Appendix B provides a tool for the use of jurisdictions in establishing a policy for determining fire-flow requirements in accordance with Section 507.3. The determination of required fire flow is not an exact science, but having some level of information provides a consistent way of choosing the appropriate fire flow for buildings throughout a jurisdiction. The primary tool used in this appendix is a table that presents fire flow based on construction type and building area based on the correlation of the Insurance Services Office (ISO) method and the construction types used in the* International Building Code®.

SECTION B101
GENERAL

B101.1 Scope. The procedure for determining fire-flow requirements for buildings or portions of buildings hereafter constructed shall be in accordance with this appendix. This appendix does not apply to structures other than buildings.

SECTION B102
DEFINITIONS

B102.1 Definitions. For the purpose of this appendix, certain terms are defined as follows:

FIRE FLOW. The flow rate of a water supply, measured at 20 pounds per square inch (psi) (138 kPa) residual pressure, that is available for fire fighting.

FIRE-FLOW CALCULATION AREA. The floor area, in square feet (m^2), used to determine the required fire flow.

SECTION B103
MODIFICATIONS

B103.1 Decreases. The *fire code official* is authorized to reduce the *fire-flow* requirements for isolated buildings or a group of buildings in rural areas or small communities where the development of full *fire-flow* requirements is impractical.

B103.2 Increases. The *fire code official* is authorized to increase the *fire-flow* requirements where conditions indicate an unusual susceptibility to group fires or conflagrations. An increase shall be not more than twice that required for the building under consideration.

B103.3 Areas without water supply systems. For information regarding water supplies for fire-fighting purposes in rural and suburban areas in which adequate and reliable water supply systems do not exist, the *fire code official* is authorized to utilize NFPA 1142 or the *International Wildland-Urban Interface Code*.

SECTION B104
FIRE-FLOW CALCULATION AREA

B104.1 General. The *fire-flow calculation area* shall be the total floor area of all floor levels within the *exterior walls*, and under the horizontal projections of the roof of a building, except as modified in Section B104.3.

B104.2 Area separation. Portions of buildings that are separated by *fire walls* without openings, constructed in accordance with the *International Building Code*, are allowed to be considered as separate *fire-flow calculation areas*.

B104.3 Type IA and Type IB construction. The *fire-flow calculation area* of buildings constructed of Type IA and Type IB construction shall be the area of the three largest successive floors.

Exception: *Fire-flow calculation area* for open parking garages shall be determined by the area of the largest floor.

SECTION B105
FIRE-FLOW REQUIREMENTS FOR BUILDINGS

B105.1 One- and two-family dwellings, Group R-3 and R-4 buildings and townhouses. The minimum *fire-flow* and flow duration requirements for one- and two-family *dwellings*, Group R-3 and R-4 buildings and *townhouses* shall be as specified in Tables B105.1(1) and B105.1(2).

B105.2 Buildings other than one- and two-family dwellings, Group R-3 and R-4 buildings and townhouses. The minimum *fire-flow* and flow duration for buildings other than one- and two-family *dwellings*, Group R-3 and R-4 buildings and *townhouses* shall be as specified in Tables B105.1(2) and B105.2.

B105.3 Water supply for buildings equipped with an automatic sprinkler system. For buildings equipped with an *approved automatic sprinkler system*, the water supply shall be capable of providing the greater of:

1. The *automatic sprinkler system* demand, including hose stream allowance.
2. The required *fire flow*.

APPENDIX B—FIRE-FLOW REQUIREMENTS FOR BUILDINGS

TABLE B105.1(1)
REQUIRED FIRE FLOW FOR ONE- AND TWO-FAMILY DWELLINGS, GROUP R-3 AND R-4 BUILDINGS AND TOWNHOUSES

FIRE-FLOW CALCULATION AREA (square feet)	AUTOMATIC SPRINKLER SYSTEM (Design Standard)	MINIMUM FIRE FLOW (gallons per minute)	FLOW DURATION (hours)
0–3,600	No automatic sprinkler system	1,000	1
3,601 and greater	No automatic sprinkler system	Value in Table B105.1(2)	Duration in Table B105.1(2) at the required fire-flow rate
0–3,600	Section 903.3.1.3 of the *International Fire Code* or Section P2904 of the *International Residential Code*	500	$^1/_2$
3,601 and greater	Section 903.3.1.3 of the *International Fire Code* or Section P2904 of the *International Residential Code*	$^1/_2$ value in Table B105.1(2)	1

For SI: 1 square foot = 0.0929 m^2, 1 gallon per minute = 3.785 L/m.

TABLE B105.1(2)
REFERENCE TABLE FOR TABLES B105.1(1) AND B105.2

FIRE-FLOW CALCULATION AREA (square feet)					FIRE FLOW (gallons per minute)[b]	FLOW DURATION (hours)
Type IA and IB[a]	Type IIA and IIIA[a]	Type IV and V-A[a]	Type IIB and IIIB[a]	Type V-B[a]		
0–22,700	0–12,700	0–8,200	0–5,900	0–3,600	1,500	2
22,701–30,200	12,701–17,000	8,201–10,900	5,901–7,900	3,601–4,800	1,750	
30,201–38,700	17,001–21,800	10,901–12,900	7,901–9,800	4,801–6,200	2,000	
38,701–48,300	21,801–24,200	12,901–17,400	9,801–12,600	6,201–7,700	2,250	
48,301–59,000	24,201–33,200	17,401–21,300	12,601–15,400	7,701–9,400	2,500	
59,001–70,900	33,201–39,700	21,301–25,500	15,401–18,400	9,401–11,300	2,750	
70,901–83,700	39,701–47,100	25,501–30,100	18,401–21,800	11,301–13,400	3,000	3
83,701–97,700	47,101–54,900	30,101–35,200	21,801–25,900	13,401–15,600	3,250	
97,701–112,700	54,901–63,400	35,201–40,600	25,901–29,300	15,601–18,000	3,500	
112,701–128,700	63,401–72,400	40,601–46,400	29,301–33,500	18,001–20,600	3,750	
128,701–145,900	72,401–82,100	46,401–52,500	33,501–37,900	20,601–23,300	4,000	4
145,901–164,200	82,101–92,400	52,501–59,100	37,901–42,700	23,301–26,300	4,250	
164,201–183,400	92,401–103,100	59,101–66,000	42,701–47,700	26,301–29,300	4,500	
183,401–203,700	103,101–114,600	66,001–73,300	47,701–53,000	29,301–32,600	4,750	
203,701–225,200	114,601–126,700	73,301–81,100	53,001–58,600	32,601–36,000	5,000	
225,201–247,700	126,701–139,400	81,101–89,200	58,601–65,400	36,001–39,600	5,250	
247,701–271,200	139,401–152,600	89,201–97,700	65,401–70,600	39,601–43,400	5,500	
271,201–295,900	152,601–166,500	97,701–106,500	70,601–77,000	43,401–47,400	5,750	
295,901–Greater	166,501–Greater	106,501–115,800	77,001–83,700	47,401–51,500	6,000	
—	—	115,801–125,500	83,701–90,600	51,501–55,700	6,250	
—	—	125,501–135,500	90,601–97,900	55,701–60,200	6,500	
—	—	135,501–145,800	97,901–106,800	60,201–64,800	6,750	
—	—	145,801–156,700	106,801–113,200	64,801–69,600	7,000	
—	—	156,701–167,900	113,201–121,300	69,601–74,600	7,250	
—	—	167,901–179,400	121,301–129,600	74,601–79,800	7,500	
—	—	179,401–191,400	129,601–138,300	79,801–85,100	7,750	
—	—	191,401–Greater	138,301–Greater	85,101–Greater	8,000	

For SI: 1 square foot = 0.0929 m^2, 1 gallon per minute = 3.785 L/m, 1 pound per square inch = 6.895 kPa.

a. Types of construction are based on the *International Building Code*.

b. Measured at 20 psi residual pressure.

8000 x .25 = 2000 gpm with fire sprinkler reduction applied.

TABLE B105.2
REQUIRED FIRE FLOW FOR BUILDINGS OTHER THAN ONE- AND TWO-FAMILY DWELLINGS, GROUP R-3 AND R-4 BUILDINGS AND TOWNHOUSES

AUTOMATIC SPRINKLER SYSTEM (Design Standard)	MINIMUM FIRE FLOW (gallons per minute)	FLOW DURATION (hours)
No automatic sprinkler system	Value in Table B105.1(2)	Duration in Table B105.1(2)
Section 903.3.1.1 of the *International Fire Code*	25% of the value in Table B105.1(2)[a]	Duration in Table B105.1(2) at the reduced flow rate
Section 903.3.1.2 of the *International Fire Code*	25% of the value in Table B105.1(2)[b]	Duration in Table B105.1(2) at the reduced flow rate

For SI: 1 gallon per minute = 3.785 L/m.
a. The reduced fire flow shall be not less than 1,000 gallons per minute.
b. The reduced fire flow shall be not less than 1,500 gallons per minute.

SECTION B106
REFERENCED STANDARDS

B106.1 General. See Table B106.1 for standards that are referenced in various sections of this appendix. Standards are listed by the standard identification with the effective date, standard title, and the section or sections of this appendix that reference the standard.

TABLE B106.1
REFERENCED STANDARDS

STANDARD ACRONYM	STANDARD NAME	SECTIONS HEREIN REFERENCED
IBC—21	*International Building Code*	B104.2
IRC—21	*International Residential Code*	Table B105.1(1)
IWUIC—21	*International Wildland-Urban Interface Code*	B103.3
NFPA 1142—17	*Standard on Water Supplies for Suburban and Rural Fire Fighting*	B103.3

DIVISION 22 – PLUMBING

SECTION 22 0000 – PLUMBING

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Piping diagrams are schematic and indicate preferred pipe routing. It is the intent that the installation be complete. Where fixtures are not shown connected to any required services, they shall be connected properly and completely. Connect all fixtures to various services, i.e., hot water, cold water, waste, and vent, etc., as required.

B. The work shall include furnishing of all materials and labor required for the job as described, together with all accessories and trim implied or required to finish the work, and generally as follows:

1. Complete rain removal system, including piping and roof drains.
2. Plumbing fixtures and piping.
3. Water Heater.
4. Sanitary sewer systems.
5. Natural gas system.
6. Backflow prevention systems.
7. Condensate drain systems.
8. Final connection of building systems to site utilities.

1.2 STANDARDS

A. Plumbing installation shall be made in accordance with the 2021 International Plumbing Code, City Code, and all other governing codes.

B. In the event drawings violate the codes as being locally enforced, the contractor shall base his estimate on the enforced code requirements.

1.3 DISINFECTING

A. After flushing the mains, introduce a water and chlorine solution concentrated to 300 PPM to disinfect the system and oxidize piping contaminates. Retain treated water and chlorine for a period of not less than three hours or more than six hours before final flushing out of system.

B. All valves should be opened periodically during the process and the residual chlorine checked to ensure that at least 50 percent of the initial concentration is present to complete the disinfection. If there is less than 50 percent, the valves should be allowed to drain water until the 50 percent or greater level is obtained. A make-up chlorine solution of a concentration equal to the initial concentration must be added as needed during the withdrawal of the spent solution.

C. A warning sign shall be conspicuously posted at each water outlet and faucet during the disinfecting process to prevent occupants from drinking the water.

D. Flushing: Following disinfection, all treated water shall be flushed from the system through its extremities. Flushing shall continue until samples show that the quality of the water delivered is comparable with the quality of the public water supply and satisfactory to the public health authority having jurisdiction. Flushing shall be repeated if samples taken daily over a period of three days show the water quality is not being maintained. Samples shall be taken only from taps located and installed in such a manner that they will not contribute any contamination. Samples shall not be drawn from hydrants or through unsterilized hose. Test samples shall be certified by a recognized and approved testing laboratory, and a certificate of acceptability shall be submitted.

E. Written certification of the disinfecting process and purity of water samples shall be forwarded to the Owner's representative.

1.4 VERIFICATION OF GRADE

A. The contractor shall verify with the site utilities contractor the connection of water, storm water and waste piping systems to the mains, and shall verify the actual job site elevation and location prior to the installation of the building footings.

PART 2 - PRODUCTS

2.1 CLEANOUTS

A. Approved cleanouts shall be installed in the base of each vertical drainage line, and in the horizontal line at each change in direction. In addition, there shall be cleanouts spaced at a maximum of 50' in all horizontal lines. All cleanouts shall be extended to accessible surfaces. All cleanouts to grade shall be capable of cleaning in both directions

2.2 WATER HAMMER

A. Provide and install stainless steel bellows type shock absorbers in the ends of all multiple fixture water lines and in piping ahead of snap-acting automatic valves.

B. Absorbers shall be sized and located in compliance with manufacturer's recommendations for the specific application. Absorbers shall be Zurn, Wade, or Smith.

C. Absorbers shall not be installed in inaccessible areas. Extend piping to accessible locations.

2.3 FLASHINGS

A. All pipes passing through the roof shall be neatly flashed. Flashing shall be provided under Division 7.

2.4 FIXTURE STOPS

A. All stops for plumbing fixtures shall be McDonald loose key, 1/4 turn ball valves.

2.5 PLUMBING FIXTURES

A. This contractor shall furnish and install all fixtures shown on the architectural or mechanical drawings or specified hereinafter, clean and adjust all fixtures and replace any damaged fixtures at the contractor's expense.

B. The fixtures shall be all new and complete as shown and described in manufacturer's catalog, and as required for the work, including accessible loose key 1/4 turn ball valve stops above the floor in supplies to all fixtures, and cast brass P-traps, unless otherwise shown. Trim for all fixtures shall be chrome-plated, and all trim shall match in design. Supply faucets shall have renewable seats and barrels.

C. Approved Fixtures:

Water closets, urinal & lavatories:	Kohler, American Standard, Crane, or approved equal.
Flush valves:	Chicago, Zurn, Sloan, or approved equal.
Sinks:	Elkay, Just, or approved equal.
Faucets:	Chicago, Moen, American Standard, or approved equal.
Drinking fountains:	Elkay, Murdock, Acorn, or approved equal.
Hose bibbs:	Chicago, Watts, Zurn, JR Smith, Woodford, or approved equal.
Tempering valves:	Bradley, Symmons, Watts, or approved equal.
Floor drains, floor sinks, roof drains:	Zurn, JR Smith, Watts, Josam, or approved equal.

PLUMBING FIXTURES

WC-1	Water Closet:	Kohler K-4330 'Kingston' syphon jet, wall hung, elongated bowl, 1-1/2" top spud; Zurn ZER6000AV-W2 1.6 GPF chrome plated, battery powered sensor flush valve with vacuum breaker and battery; K-666C 'Bemis 1955C extra heavy solid plastic white open front seat with stainless steel check hinge; Wade W-311 (horizontal) or W-331 (vertical) series carrier, single or double right or left as required, with foot support.
WC-2	Water Closet (ADA):	Same as "WC-1" - Set at ADA height.
WC-3	Water Closet (ADA):	Kohler K-4368 "Highcliff" siphon jet, floor-mounted, extended lip bowl, 1-1/2" top spud, vitreous china, Zurn ZER6000AV-W2 1.6 GPF chrome plated, battery powered sensor flush valve with vacuum breaker and battery; K-4666-C Bemis 1955C extra heavy solid plastic white open front seat with stainless steel check hinge; 431310-100 bolt caps
U-1	Urinal:	Kohler K-4991-ET "Bardon" vitreous china, wall hung, siphon jet with flushing rim, 2" outlet connection, 3/4" top spud with Zurn ZR60003AV – WS1 1.0 gpf battery powered sensor operated chrome plated flush valve with vacuum breaker and battery, plate type carrier and bearing plate. Wade W-452, Zurn 1222, Smith 633. Provide spare battery for each urinal.
U-2	Urinal (ADA):	Same as “U-1. Set at ADA height.

L-1	Lavatory (ADA):	Kohler K-2032 "Greenwich" 20" x 18" - 4" center set vitreous china, front overflow, anti-splash rim, center basin, wall hanger, punched for concealed arm carrier, Moen CA8302 battery powered, touch free sensor faucet with laminar flow aerator. Provide grid strainer, tailpiece and flexible supplies w/stops and brass P-trap. Support lavatory with Zurn ZN1231 concealed arm carrier with foot support.
S-1	Sink:	Elkay LR2219 22" L x 19 1/2" W x 7 1/2" D, 18 ga., 304 stainless steel, single compartment, drilled for 4-hole center set faucet, self-rimming, sound dampening, cup strainer, with Moen 87403 faucet with swing spout, hose spray, ADA compliant handles, aerator, flexible supplies and brass P-trap.
SS-1	Service Sink: (Floor type)	Kohler K-6710 "Whitby" 28" x 28" service sink, floor mounted, drain channels; Chicago Faucet 897-CP polished chrome faucet with vacuum breaker, hose end with hose, bucket hook, wall brace, integral stops and rough chrome finish. Faucet to be mounted 30" above finish floor; K-8940 rim guard; K-9146 drain with strainer for 3" connection.
DF-1	Drinking Fountain:	Elkay LZSTL8WSSP bi-level, wheelchair access, double bowl, wall mounted, air cooled, refrigerated type with bottle filler to cool 8 gal/hr. from 80 deg. F. to 50 deg. F. with 90 deg. F. EAT. 1/5 HP hermetic compressor, 120/1/60. 304 stainless steel top w/Flexi-Guard bubbler and 'Light Touch' wrap around self-closing press bar operable from front of fountain. The cabinet color shall be stainless steel #4 satin finish. Note: Cut electrical cord at time of installation to suit electrical outlet provided.
SH-1	Shower Trim: (ADA)	Bradley built-in shower model 1C-EF-ST-D1-SB-DV-BP single lever Equa-Flow pressure balanced shower valve (ASSE1016) with volume control and adjustable temperature limit. Shower shall have shower head with ball joint, bent arm and back plate with wall flange. Head shall be deluxe type, vandal proof with 1.5 GPM flow regulator and adjustable spray with lock, set for handicapped height as detailed on plans. Handheld 60” flexible hose with spray head and quick disconnect, Bradley Model DV in-wall diverting valve and vacuum breaker. All items shall be set to handicapped heights and comply with standards of ADA.
HB-1	Hose Bibb:	Zurn Z-1310 3/4" "Ecolotrol" non-freeze, anti-syphon wall hydrant with bronze casing and plain bronze face, provide with loose key and set screw for each hydrant.
HB-2	Hose Bibb:	Zurn Z-1330 Encased Ecolotrol "anti-siphon" wall hydrant, for interior wall installation. Complete with integral backflow preventer, all bronze interior parts, non-turning operating coupling with hemispherical neoprene plunger and 3/4" solder inlet. Stainless steel box and hinged cover with operating key lock and "WATER" stamped on cover.
TV-1	Tempering Valve:	Watts series USG-8 (ASSE 1070) tempering valve, 3/8” inlets and 3/8” outlet, to mix cold water with 120 deg. F. hot water for 110 deg. F. tempered water supply. .50 GPM min. flow and 1 GPM at 10 psi pressure drop. Tempering valve shall be complete with check stops, bronze body, and adjustment cap with locking feature.

IMB-1	Ice Maker Box:	Guy Gray BIM-875 for in-the-wall installation with concealed piping, 1/2" ball valve. 18-gauge dipped galv. steel finish. Face plate with 20-gauge box. (Verify mounting height with conditions).
FD-1	Floor Drain:	Zurn Z-415 2" cast iron drain with nickel bronze top. Drain to have deep seal P-trap with ProVent "trap guard".
SD-1	Shower Drain:	Zurn #Z-415-4 2” cast iron drain with chrome-plated bronze square top. Drain to have deep seal P-trap. Provide Pro Vent systems Proset trap guard in all SD-1 shower drains.
FS-1	Floor Sink:	Zurn ZN-1900-2" sanitor floor sink with 12" x 12" square top, full removable grate with center opening. N.B. dome, sani-coated exterior, acid resistant enamel interior, and Z-100 deep seal trap. Sink shall be complete with full grate, 3/4 grate, 1/2 grate, etc. as necessary to match application. Sink to be installed flush with floor.
RD-1	Roof Drain:	Zurn ZC-100 roof drains shall be cast iron type with flashing collar, C.I. dome, gravel guard, adjustable extension, sump receiver, and underdeck clamp. See plans for sizes.
RD-2	Roof Drain: (Secondary)	ZC-100 with 2" water dam, duco cast iron body with combined flashing clamp and gravel stop with underdeck clamp, adjustable extension, sump receiver, and cast-iron dome. See plans for sizes.
DN-1	Downspout Nozzle:	Zurn Z-199 brass downspout nozzle. Provide 1/4" mesh aluminized, slip fit bird screen. See plans for sizes.

2.6 WATER HEATER: (WH-1)

A. Water heater shall be electric, heavy-duty use, ETL certified. 50-gallon glass lined ASME:"H" stamp vertical storage tank with pressure and temperature relief valve, magnesium anode rods in separate tank head couplings, 74 GPH at 100 deg. F. temperature rise, factory sediment reduction system, insulated jacket with baked enamel finish, complete with all controls for automatic operation. Water heater shall be designed for 120 deg. F. operation. 480/3/60 power.

Manufacturer:	Bradford White or equal of Rheem, AO Smith or approved equal
Model:	E32-50S-3
Electrical:	(2) 4500-watt elements, 28.1 KW FLA.
Nominal Size:	22” Dia. x 47-1/2” H.
Shipping Weight:	140 lbs.

2.7 LEAD PANS AND WATERPROOF MEMBRANES

A. Division 22 0000 shall furnish a 30" square 4# lead flashing with each vent and/or pipe penetration of roof. Coordinate with roofing contractor.

B. All floor drains shall be fitted with clamping collar and waterproof membrane.

C. Membrane and lead waterproofing pans for shower stalls and built-up type custodial floor sinks shall be installed by plumbers so they are 100% watertight. Drains shall have clamping device which clamps drain to pans. There shall be a mastic seal between floor drain bottom and lead or membrane so when clamping device is tightened, there is a complete watertight seal.

D. Care should be taken not to clog weep holes. All pans will be tested by placing test plug in drain and filling with water overnight.

2.8 CONDENSATE DRAIN

A. All refrigerated air conditioning and/or cold storage cases which have cooling coil condensate drip pans with pipe connections shall be piped to the nearest drain by this contractor.

B. Pipe location and routing shall be approved by the owner's representative.

C. Piping shall be the same size as the drain pan connection and shall be trapped to prevent forced air flow thru the pipe.

2.9 VACUUM BREAKERS, DOUBLE CHECK VALVE ASSEMBLIES, & BACKFLOW PREVENTERS

A. Vacuum breakers and backflow preventers shall comply with the requirements of the 2021 IPC and Utah State Plumbing Code for the actual installed duty.

B. Vacuum breakers and backflow preventers shall be of the type, style, and arrangement approved by the Code.

C. All vacuum breakers and backflow preventers shall be installed with the necessary isolation valves and test cocks.

D. Backflow preventers shall be located at a maximum of 4' - 0" A.F.F. and shall be accessible for service. Backflow preventers shall have a water filter with a replaceable cartridge.

2.10 SEISMIC GAS SHUT-OFF VALVE

A. Valve shall be seismically activated type with positive shut-off seal and automatic non-creeping mechanism with manual reset and visual open-close indicator.

B. Valve shall be U.L. listed for natural gas use and meet Standards for Earthquake Activated Automatic Gas Shut-off Systems, Standard No. 12-23-1, and ANSI Z21.70 1981.

C. Shut-off shall activate within five seconds when subjected to a horizontal sinusoidal oscillation having a peak acceleration of 0.3 G and a period of 0.4 seconds.

D. Positive seal shall be provided from -10 deg. F. to +150 deg. F. at 20 psi gas pressure.

E. Seismic shut-off valve shall be Koso Model 2" 3/4 HP or approved equal.

2.11 GAS PRESSURE REGULATORS

A. Furnish and install, as required, approved type gas pressure regulators in gas piping ahead of appliance and equipment. Regulators located outside of the building shall have weatherproof vent with bugproof screen. Regulators located inside of the building shall be vented to the outside with an approved cap screen. Approved manufacturers of gas regulators are Fisher and Reliance.

2.12 CIRCULATORS

A. Furnish and install the circulators shown and specified on the drawings. Circulators shall be of the in-line, pipe-mounted, motor driven, centrifugal type. All motors shall operate at 1750 RPM. Circulators shall operate at high efficiency and shall have a quiet, vibrationless operation. Provide steel support for motor. All circulators to be all bronze construction.

B. Mount pumps at **48" AFF** minimum & **60" AFF** maximum in a serviceable location.

C. Circulators shall be Bell & Gossett, Armstrong or Taco.

PART 3 - EXECUTION

3.1 PRODUCT HANDLING

A. Protection:

Use all means necessary to protect plumbing materials before, during, and after installation and to protect the installed work and materials of all other trades.

B. Replacements:

In the event of damage, immediately make all repairs and replacements necessary to the approval of the Owner and at no additional cost to the Owner.

3.2 TESTING

A. Furnish all required personnel and equipment and conduct all tests required to receive the approval of the Owner and all agencies having jurisdiction.

3.3 CLEAN UP

A. Prior to acceptance of the building, thoroughly clean all exposed portions of the plumbing installation, removing all labels and all traces of foreign substance, using only a cleaning solution approved by the manufacturer of the plumbing item and being careful to avoid all damage to finished surfaces.

3.4 WATER CLOSET INSTALLATION

A. General: Install water closets as shown on the drawing and as follows:

1. Supply pipe extending from wall shall be covered by chrome plated sleeve and wall flange.
2. Additional wall plates shall be provided where each pipe extends through finished wall.
3. Two rubber or plastic seat bumpers with metal holders shall be provided and secured to the wainscot behind the fixture.
4. The centerline of the flush valve shall be on the centerline of the fixture, 39 inches above the finished floor and a minimum of 2-1/4 inches from the wall.
5. Chrome plated pipe support shall be provided on the long flush pipe outlet and shall be secured rigidly to the wall with suitable anchors.
6. The backflow preventer for the flush valve shall be installed at the discharge of the valves.
7. The flush valve water piping concealed in the partition shall be rigidly supported; piping between flush valve and wall shall be provided with a factory fabricated chromium plated spacer sleeve and wall flange.

3.5 LAVATORY INSTALLATION

A. General: Install water closets as shown on the drawing and as follows:

1. Lavatories for use by wheelchair handicapped shall be installed with a minimum rim height of 34", a minimum vertical clearance of 29" from floor, and a minimum clear knee recess of 30" in width and 20" in depth.
2. Trap on lavatory for use by wheelchair handicapped shall be installed so as to provide maximum clearance under bowl. Exposed waste, trap and hot water supply under lavatory shall be insulated in accordance with the requirements for domestic hot water piping.
3. All lavatories shall be installed with a rim height of 34".

3.6 UNRINAL INSTALLATION

A. General: Install water closets as shown on the drawing and as follows:

1. Supply pipe extending from wall shall be covered by chrome plated sleeve and wall flange.
2. Additional wall plates shall be provided where each pipe extends through finished wall.
3. The centerline of the flush valve for wall hung urinals shall be on the centerline of the fixture, 45 inches above the finished floor and a minimum of 2-1/4 inches from the wall.
4. The centerline of the flush valve for handicap urinals shall be 40 inches or less above the finished floor.
5. The backflow preventer for flush valve shall be installed at the discharge of the valve.
6. The flush valve and the water piping concealed in the partition shall be rigidly supported; piping between flush valve and wall shall be provided with a factory fabricated chromium-plated spacer sleeve and wall flange.
7. **Provide Schedule 40 solid core PVC spool piece at urinal.**

3.7 FIXTURE CONNECTIONS

A. Floor Mounted Water Closets and Service Sinks: Provide connections between soil pipes and floor connected water closets and service sinks made with cast-iron floor flanges.

B. Connection sizes shall be 4-inch for water closets and 3-inch for service sinks.

C. Floor flanges shall be slipped over the ends of the pipes and caulked in position.

D. Special short-radius fittings shall be used where space does not permit the use of standard fittings below the flanges.

E. Setting Compounds and Gaskets: Provide watertight and gas tight seals between flanges and fixtures with plumbing-fixture-setting compound or manufacturer's standard non-asbestos gaskets.

F. Neither rubber gaskets nor putty shall be used in sealing connections.

3.8 FIXTURE SUPPORTS

A. Urinal Support: Provide urinal chair carriers consisting of a pair of cast-iron feet bolted to or imbedded into the floor together with 1.66-inch outside diameter (minimum), steel tubular upright members, steel hanger support plate, and steel bearing plate connected to cast iron or steel adjustment sleeves and furnished with necessary bolts, nuts, washers, and chrome plated trim. Provide chair carrier that is fully concealed in the building construction and that supports the fixture in such a manner that no part of the fixture will be supported by the wall or the partition.

B. Lavatory Support: Provide lavatory chair carriers consisting of a pair of cast-iron feet bolted to or imbedded into the floor together with 1.66- inch (minimum) steel tubular upright members, a horizontally adjustable alignment truss or tie rod at bottom and another at the top connected to cast-iron or steel adjustment sleeves and painted cast-iron or steel adjustment sleeves, and painted cast-iron concealed arms.

3.9 INSTALLATION OF PRESSURE REDUCING VALVES

A. General: Install one or more pressure reducing valves on the main water line supplying plumbing fixtures.

1. Provide each pressure reducing valve with a ball valve 3” and smaller or butterfly valve 4” and larger and union on both the inlet and outlet connections.
2. A bypass one pipe size smaller than the main water line provided with a globe valve and union, shall be installed between the inlet and outlet sides of the pressure reducing valve assembly.
3. Pressure gauges shall be installed at the inlet and outlet connections to the pressure reducing valve assembly. Gauges shall have T-handle stops in their connections.

3.10 STRAINER INSTALLATION

A. General: Place strainers ahead of pressure reducing valves, automatic control valves, pumps, and elsewhere as indicated on the drawings or specified.

3.11 BACKFLOW PROTECTION VALVE INSTALLATION

A. General: The entire water distribution system shall be protected against contamination due to backflow from non-potable sources. Each connection to a fixture or an item of equipment shall be protected in accordance with the requirements of the International Plumbing Code.

B. Reduced Pressure Zone Backflow Preventer: Install a reduced pressure zone backflow preventer in the building water supply main to expansion tanks, condenser water systems, and boilers as shown on the drawings and/or as required by the local codes.

3.12 INSTALLATION OF PIPE SLEEVES

A. Basic Requirements: Install pipe sleeves as follows:

1. Pipe sleeves shall be provided for all pipes passing through walls, slabs on grade and floors. Sleeves may be omitted where pipes pass through exterior walls above ground to wall hydrants and downspout nozzles.
2. Sleeves for pipes passing through exterior walls and slabs on grade which do not have membrane waterproofing shall be of cast-iron or galvanized steel pipe or black steel pipe, Schedule 40.
3. Sleeves for pipes passing through exterior walls, slabs on grade and floors which are provided with membrane waterproofing shall be of threaded galvanized steel pipe fitted with companion flanges and arranged to secure membrane. Companion flanges shall be drilled and tapped in such a manner that bolting is effected from the outer (or upper) face only.
4. Sleeves for pipes passing through potentially wet floors that do not have membrane waterproofing such as in toilet rooms, cafeteria kitchens, serving areas, dishwashing rooms, utility cores, mechanical equipment rooms, and areas that are provided with fire protection sprinkler systems, shall be galvanized steel pipe, shall project 2 inches above the finished floors, and shall be caulked watertight.

5. Sleeves for pipes passing through all other floors and walls shall be constructed of galvanized or black steel pipe, standard weight.

B. Sleeves on New Work: On new work, sleeves shall be built into the walls and floors as the work progresses.

3.13 INSTALLATION OF VENTS THRU ROOF

A. All vents thru roof shall be installed a minimum of 15’-0” form any outdoor air intake. In addition, vents shall be installed a minimum of 4’-0” from any fire rated walls. See plans for fire rated wall locations.

3.14 INSTALLATION OF CLEANOUTS AND FERRULES

A. Riser Connection to Sewer or Drain: Where soil, waste, or roof drainage risers connect to a sewer or drain extending from the building above the lowest floor, the fitting at the base of each stack or downspout shall be a sanitary tee or a combination Y and 1/8 bend with cleanout plug in the end of the run of the main.

B. Test Tees: Each vertical soil, waste, and vent pipe and each downspout and roof drainage pipe which connects to horizontal drain piping below ground shall be fitted with a test tee above the lowest floor or ground. Where accessible, test tee may be installed in the horizontal pipe at the base of the riser.

C. Cover Plates: Where cleanouts or test tees occur on concealed pipes in finished rooms, they shall be provided with a 1/8-inch thick, machine finished, brass cover plate of sufficient diameter to cover the opening in the finished wall or partition. The cleanout plug shall have a solid head, tapped for a 1/4-inch brass screw to secure the cover plate. Where cleanout plugs extend beyond the wall finish, the cover plates shall be of machine finished brass and shall be only of sufficient depth to fit against the wall to cover plug. Cleanout cover plates shall be painted to match adjacent wall finish.

D. Cleanouts Plugs For Threaded Fittings: Cleanout plugs for threaded fittings shall be in accordance with ANSI B16.12. Except for test openings, where size must be sufficient to admit test plug, bushings will be permitted on pipes 5-inches and larger to reduce plug size to 4 inches; cleanout plugs for piping 4 inches and smaller shall be the same size as the pipe.

E. Cleanout Plugs For Hub-and-Spigot Fittings: Cleanout plugs for hub-and-spigot fittings shall be screwed into ferrules caulked into the fitting. Ferrules and plugs shall be in accordance with ANSI B16.12, except that plugs required to be flush with the floor shall have square countersunk heads in lieu of raised heads.

F. Cleanout Plugs For Copper Drainage Lines: Cleanout plugs on copper drainage lines shall be installed in solder-joint fittings having threaded openings provided for the cleanout, or in solder-joint fittings with threaded adapters.

3.15 WATER PIPING INSTALLATION

A. General: Water piping shall be complete from service connection to all fixtures and equipment outlets. Sizes of pipes shall be as shown or specified.

B. Reaming: Ends of pipes and tubes shall be reamed before being made up.

C. Threaded Joints: Threaded joints shall be made up metal-to-metal, with a noncorrosive lubricant applied to the male thread only. Lampwick or other packing material shall not be used in making up threaded joints.

D. Chromium Plated Piping: Chromium plated piping shall be threaded and made up carefully, and not more than one full turn of thread shall be exposed beyond any fittings.

E. Long Screws and Bushings: Long screws and bushings (other than bushings cast in the sand) shall not be used on water piping.

F. Soldering: Ends of tubing and recesses of fittings to be soldered shall be thoroughly cleaned. Joints shall be assembled without binding. Solder shall penetrate fully and shall fill the joint completely. Joints shall be made using lead-free solder, as specified.

G. Joint Materials: All joint materials shall be free from oil, tar, and greasy substances, and shall be dry when placed in the joint. The material shall be handled with care to prevent contamination.

H. Copper Tubing: All copper tubing shall be free from cuts, dents or other surface damage at the time of final inspection. Damaged tubing shall be removed and replaced with new.

I. Copper Tube Anchoring: Horizontal runs of copper tubing over 50 feet in length shall be anchored to wall or floor construction. Anchors shall be located near the midpoints of the runs so as to force the expansion equally to the ends or in a direction where expansion can take place without excessive strain.

J. Swing Joints, Offsets, and Expansion Joints: Swing joints, offsets, and expansion joints shall be provided where necessary to accommodate expansion of piping, which will be approximately two inches in 100 feet of copper hot water piping.

K. Dielectric Couplings: Where non-ferrous metal piping and zinc-coated metal piping are joined, dielectric (insulating) couplings, fittings or unions shall be provided.

L. Reducing Fittings: Where pipe sizes shown or specified differ from the connection sizes of meters, pumps, fixtures, outlets, and the like, reducing fittings shall be installed close to them.

M. Pipe Branches: Branches from water supply mains shall be taken from the top, bottom or side, using crossover fittings where required by structural or operating conditions.

N. Upfeed Hot Water Return: On upfeed hot water distribution systems for which return circulation piping is shown, a 1/2" circulation connection shall be made at a point on each riser just below the highest outlet connection. Provide branch circulation lines with gate valves near the valves on corresponding supply lines.

O. Downfeed Hot Water Supply: Each downfeed main for a hot water supply system shall be graded upward to the first branch connection, which shall be taken from the top of the main. Beyond the first connection the main shall grade downward, and all branch connections shall be taken from the bottom of the main. Connect a 1/2-inch circulating line to the bottom of each downfeed riser. Provide branch circuiting lines with gate valves in locations corresponding to the supply branch valve locations.

P. Grading: Hot water supply and hot water circulating lines shall be accurately and uniformly graded to avoid traps which might impede or destroy circulation. All lines shall be graded so as to facilitate drainage.

Q. Unions: Unions shall be installed near points of connection to each piece of equipment, and elsewhere as required for installation of piping, removal and replacement of regulating and control equipment and the like. Right and left couplings or nipples are prohibited.

R. Water Hammer Arresters: Water hammer arresters shall be provided where indicated on the drawings. Water hammer arresters shall be approved and installed in accordance with the requirements of PDI-WH201 and shall bear the PDI seal of approval.

S. Roughing: Roughing shall be provided for equipment furnished under other sections of the specifications.

END OF SECTION 22 0000

SECTION 22 0700 – INSULATION

PART 1 - GENERAL

1.1 WORK INCLUDED

A. It is the intent of this section of the specifications that all hot (above 100 deg. F.) and cold (below 55 deg. F) surfaces of all piping and mechanical system components be insulated, unless specifically excluded herein.

B. Systems to be insulated:

1. Supply air ductwork
2. Culinary hot water recirculating and cold-water piping systems
3. Primary and secondary roof drain piping systems (vertical & horizontal)
4. Water pipe, tempering valve and waste lines below ADA sinks and lavatories
5. Refrigeration piping

C. The providing of all materials, supplies, equipment, tools, transportation, and facilities and performing all labor and service necessary to provide the work outlined above and as shown on the working drawings.

PART 2 - PRODUCTS

2.1 COMPLIANCE

A. All insulation shall (as a minimum) conform to the requirements of the building code and have a flame spread rating of less than 25 and smoke developed less than 50.

B. Insulation shall be as manufactured by Johns-Manville, Owens-Corning, Knauf, Armstrong, or Certainteed.

2.2 DOMESTIC HOT, COLD & HOT WATER RECIRCULATING WATER PIPING

A. All piping shall be insulated with 2-piece heavy density pipe insulation having an average thermal resistivity in the range of 4.0 to 4.6 Hr Deg. F. Ft^2/BTU per inch of thickness on a flat surface at a mean temperature of 75 deg. F. Thickness of insulation shall be as follows:

INSULATION THICKNESS IN INCHES FOR PIPE SIZES**

PIPING SYSTEM TYPES	FLUID TEMP. RANGE, F	RUN-OUTS 2"	LESS THAN 1”	1" TO 1-1/4”	1-1/2" TO 3"	4" TO 8”	8” +
DOMESTIC HOT WATER SYSTEMS							
Low Press/Temp.	141-200	1-1/2	1-1/2	1-1/2	2	2	2
Low Temp.	105-140	1	1	1	1-1/2	1-1/2”	1-1/2”
DOMESTIC COLD WATER SYSTEMS							
Cold Water	40-60	1-1/2	1-1/2	1-1/2	1-1/2	1-1/2	1-1/2

** For piping exposed to outdoor air, increase thickness by ½”.

Pipe insulation shall be covered with an all-service jacket.

Insulated piping run exposed in occupied areas shall have a white PVC cover.

2.3 ROOF DRAIN PIPING

A. Roof drain receivers, horizontal and vertical roof drain piping (both primary and secondary) except in masonry wall and where buried in the ground, shall be insulated as specified for domestic cold water. Insulation thickness shall be 1".

2.4 WATER & WASTE PIPING EXPOSED BELOW ADA PLUMBING FIXTURES

A. Insulate all exposed surfaces at all exposed lavatories and sink fixtures with an approved ADA style insulation kit as required by sink or lavatory manufacturer.

2.5 LOW PRESSURE ROUND DUCTS

A. All round metal ducts shall be wrapped with 1" thick fiberglass duct wrap with factory-applied vapor barrier. All joints shall be sealed with mastic and taped to form a neat and complete insulation system.

2.6 REFRIGERANT PIPING

A. Refrigerant piping shall be insulated with 1/2" thick closed cell flexible foam insulation. Finish insulation exposed to outdoors with two heavy coats of UV resistant gray sealer.

PART 3 - EXECUTION

3.1 GENERAL

A. The contractor shall provide a complete installation which is neat in appearance and functional.

B. Remove all excess materials and packaging from job site.

C. **All insulation shall be continuous thru wall and ceiling openings and thru sleeves.**

D. **Terminations of insulation on piping shall be tapered and coated with finish cement.**

E. Insulation on all cold surfaces where vapor barrier jackets are used will be applied with a continuous, unbroken vapor seal. Hangers, supports, anchors, etc., that are secured directly to cold surfaces must be adequately insulated and vapor-sealed to prevent condensation.

F. Valves and fittings inside the building shall be insulated as specified for the piping systems and covered with high temperature P.V.C. insulation fitting covers.

G. Fittings and valves for pipe size smaller than 4" shall be insulated and finished with Insulating and Finishing Cement to a thickness equal to the adjoining pipe insulation. Fittings and valves for pipe sizes 4" and larger shall be insulated with segments of the molded insulation secured with No. 20 gage galvanized annealed steel wire finished with a smoothing coat of finishing cement. Vapor seal with a layer of glass fabric embedded between two 1/16" coats of vapor seal adhesive. Lap seal outer jacket at least 1" on itself adjoining insulation.

H. In exposed areas, all fittings shall be additionally finished with FSK wrap smoothly adhered. Overlap the FSK wrap on itself and adjoining pipe insulation. Overlap to be at least 1" on pipe insulation below 4" and 2" on sizes 4" and above. Piping exposed in occupied areas shall have a white PVC cover installed.

I. Insulation inserts and shields for hot and cold surface piping such as roof drain lines heating hot water, chilled water and domestic water piping shall be installed at all pipe hangers. Inserts between the pipe and pipe hangers shall consist of calcium silicate block insulation of equal thickness to the adjoining insulation and shall be provided with vapor barrier where required. Insulation inserts shall not be less than the following lengths, unless otherwise approved on submittals:

1/2" to 2-1/2" pipe size	6" long
3" to 6" pipe size	9" long
8" to 10" pipe size	12" long

J. Rigid metal shields shall be applied between hangers or supports and the pipe insulation. Shields shall be formed to fit the insulation and shall extend up to the centerline of the pipe and length specified for the insulation hanger inserts.

K. **Vapor barrier wrap shall be sealed tight and not penetrated by the hanger or shield**.

L. Adhesives, mastics, and coatings shall be applied at the manufacturer's recommended minimum coverage per gallon.

M. Where insulation pipes pass thru sound or fire-rated walls, floors, or ceilings, the insulation sleeves shall be sound or fire-rated to match rating of surface penetrated.

N. All insulation which runs outside of the building, or inside of the building in areas where the insulation will be exposed to physical abuse, shall be jacketed with a minimum thickness of .016-inch aluminum. The insulation and aluminum shall be secured in place by a continuous friction type joint to provide a positive weatherproof seal along the entire length of the aluminum jacket. Then, an aluminum preformed strap containing a permanently plastic weatherproof sealant shall be centered over each circumferential joint, and secured by tightening on a clip, or by use of separate 1/2-inch-wide stainless-steel banding. All elbows, tube, turns, sweeps, and bends shall be insulated with mitered sections of aluminum-jacketed insulation. Joints shall be sealed with a sealing compound and preformed aluminum bands. Valves shall be covered by prefabricated sections of aluminum-jacketed insulation according to manufacturer's recommendation.

3.2 INSULATION WORKMANSHIP

A. All insulation shall be applied by specialists experienced in the field and shall be neat in appearance. Neatness in appearance shall be equated to proper insulation application procedures, and sloppy workmanship will not be tolerated. Work which is deemed unacceptable shall be condemned, removed, and replaced at the contractor's expense.

B. Protect floors, valve handle, accessories, etc., to keep paste off areas not being insulated.

C. Splitting of longitudinal sections on flexible foam pipe insulation will not be permitted.

D. Do not install insulation on pipes which require heat taping without coordinating with mechanical contractor.

3.3 CLEAN-UP

A. The piping shall be cleaned and tested prior to installation of insulation.

B. Fittings shall be cleaned after insulation is installed.

END OF SECTION 22 0700

DIVISION 23 – HEATING, VENTILATION AND AIR CONDITIONING (HVAC)

23 0100	GENERALPROVISIONS
23 0501	TESTING
23 0593	BALANCING
23 0800	SYSTEM COMMISSIONING
23 0900	BASIC MATERIALS & METHODS
23 3000	AIR DISTRIBUTION

SECTION 230100 - GENERAL PROVISIONS

PART 1 - GENERAL

1.1 GENERAL CONDITIONS

A. The contractor shall carefully read the General Conditions of the Contract and all information to bidders which, with the following specifications for heating, cooling, snowmelt, plumbing, exhaust ventilation, and temperature control are a part of the Contract.

1.2 BASIC BID

A. Base bid shall include all labor and materials specified in this division. The term "furnish" and/or "install" or similar implication shall mean "furnish and install complete."

1.3 SCOPE OF WORK

A. The work to be done under this section includes the furnishing of all labor, materials, equipment, controls and accessories required to complete all heating, air conditioning, ventilating, plumbing, drainage, heat recovery, and other mechanical systems as shown on plans and/or described in these specifications, including miscellaneous items required to provide a complete and functional facility.

B. Work shall include, but shall not be necessarily limited to, the following:

1. System commissioning
2. Testing
3. Balancing
4. Insulation systems
5. Fire suppression systems
6. Air distribution system
7. Exhaust systems
8. Automatic control systems
9. Air conditioning system
10. Plumbing systems
11. Special systems
12. **Equipment start-up by factory trained and authorized technician**

C. The mechanical contractor shall provide all miscellaneous electrical work and control wiring for special systems where the wiring requirements are provided by the equipment manufacturers and/or suppliers, unless all of the required wiring is clearly shown on the electrical drawings to be provided by the electrical contractor.

1.4 CODES AND ORDINANCES

A. All work shall be installed in accordance with the city, state, and local plumbing codes, and all other codes, ordinances, and regulations which govern the type of work covered by these specifications.

B. Should the drawings conflict with the code, the code shall govern the proper installation of the work, and no extra charge shall be made for such change.

C. Should the contractor perform any work that does not comply with the requirements of the applicable building codes, state laws, local ordinances, industry standards, or utility company regulations, he shall bear all costs arising in correcting the deficiencies.

D. Where the work required by the drawings and specifications exceeds the minimum code requirements, the work shall be done as shown or specified.

E. NOTE: Code compliance, or similar terminology, shall be interpreted to mean "the interpretation of the code as enforced by the local building authority".

1.5 DRAWINGS AND SPECIFICATIONS

A. These specifications are intended to cover all labor, material, and standards of mechanical workmanship to be employed in the work shown on the drawings, called for in these specifications, or reasonably implied by terms of same. The drawings and specifications are intended to supplement one another, and any part of the work that may be mentioned in one and not represented in the other shall be done the same as if it had been mentioned or represented in both.

B. Large scale drawings shall take precedence over layouts and small-scale details.

C. The mechanical drawings are schematic in nature, and show the general arrangement of all piping, ductwork, mechanical equipment, and appurtenances. They shall be followed as closely as the actual building construction, and the work of other trades will permit.

D. Due to tight structural conditions and space limitations in selected areas the contractor should anticipate structural and space conflicts and shall make allowances for them in his bid. Until the steel fabrication shop drawings are submitted for review, the mechanical coordination cannot be completed.

E. The architectural and structural drawings shall be considered part of the mechanical work insofar as these drawings furnish this Division with information relating to design and construction of the building. Architectural and structural drawings take precedence over the general building layouts and details shown on the mechanical drawings.

F. The structural engineer and architect shall approve all attachments to or modifications of any structural members in the building required for installation of the mechanical systems.

G. Because of the small scale of the mechanical drawings, it is not possible to indicate all offsets, fittings, and accessories which will actually be required. This contractor shall investigate the structural and finish conditions affecting the work and provide all necessary offsets, fittings, valves, trim, and accessories required to meet actual job-site conditions.

1. Dimensions -
   Verify dimensions governing mechanical work at the building. No extra compensation shall be claimed or allowed on account of differences between the actual job-site dimensions and those indicated on the drawings.

2. Adjoining work -
   Examine all adjoining work on which the mechanical work is dependent and report any work which must be corrected. No waiver of responsibility shall be claimed or allowed due to failure to report unfavorable conditions affecting the mechanical work.

1.6 INTERPRETATION OF DRAWINGS AND DOCUMENTS

A. If any person contemplating submitting a bid for the proposed contract is in doubt as to the true meaning of any part of the plans, specifications, or other proposed contract documents, or finds discrepancies in or omissions from the drawings or specifications, he may submit to the Owner's representative, a written request for an interpretation or correction thereof. The person submitting the request will be responsible for its prompt delivery. Any interpretation or correction of the proposed documents will be made only by addenda duly issued, and a copy of such addenda will be mailed or delivered to each person receiving a set of such documents. The Owner will not be responsible for any other explanations or interpretations of the proposed documents. All questions shall be submitted at least seven days in advance of bidding.

B. The Owner's representative will interpret the meaning of any part of the drawings and specifications about which any misunderstanding may arise, and his decisions will be final. Should there appear to be any error or discrepancy in or between the drawings and specifications, the contractor shall refer the matter to the Owner's representative for adjustment before proceeding with the work. Should the contractor proceed with the work without so referring to the matter, he does so on his own responsibility.

1.7 WORKMANSHIP

A. Workmanship shall be the best quality of its kind for the respective industries, trades, crafts, and practices, and shall be acceptable in every respect to the Owner's representative.

1.8 SUBSTITUTIONS

A. See Special Conditions pertaining to Substitutions.

B. Requests for prior approval must be submitted to the owner’s representative a minimum of five working days prior to bid date.

1.9 FEES AND PERMITS

A. This contractor shall obtain all necessary permits and pay all fees required in connection with the work.

B. Requirements of the local utility companies shall apply at the time of bidding. The contractor shall have checked with the local utility companies, and shall determine from them all valves, boxes, meter boxes, and meters which they will require to be installed, and shall figure cost of same in his bid. Utility connection fees will be paid by the Owner.

C. Division 22 & 23 contractor shall be responsible for fees, permits.

D. Site utility contractor shall provide water meter and meter box as required by local water department.

1.10 SITE INSPECTION AND EXAMINATION OF DRAWINGS

A. The contractor shall carefully study all drawings and specifications pertaining to the work. If any of the work as laid out, indicated, or specified is contrary to or conflicts with any governing ordinances or regulations, the same shall be reported to the Owner's representative before submitting a bid. The Owner's representative will then issue instructions as to the procedure.

B. The contractor shall carefully examine the building site and compare the drawings with existing conditions. By the act of submitting a bid, the contractor shall be deemed to have made such examination, to have accepted such conditions, and to have made allowance therefore in preparing his bid.

1.11 VERIFICATION OF DIMENSIONS

A. Before proceeding with any work, the contractor shall carefully check and verify all dimensions, sizes, etc., and shall assume full responsibility for the rigging and fitting-in of his ductwork, piping, and equipment. Where apparatus and equipment has been indicated on the drawings, dimensions have been taken from typical equipment of the class indicated. The contractor shall carefully check the drawings to see that the equipment he is required to install will fit into the spaces provided and will allow for proper maintenance and service of the equipment.

1.12 COORDINATION

A. This contractor shall coordinate his work with other specification divisions and shall provide all necessary specialty items, trim, and incidental 115 volt and 24-volt power and control wiring (which is not shown or specified under other divisions) required to provide a complete functional acceptable system.

B. The Division 22 & 23 contractor shall coordinate his work such that all slots and openings through floors, walls, ceilings, and roofs are properly located and shall do any cutting and patching caused by neglecting to do so.

1. Furnish sleeves, inserts, supports, and equipment that are to be installed by others in sufficient time to be incorporated into the construction as the work proceeds.

2. It is the responsibility of Division 22 & 23 to locate these items and see that they are properly installed.

C. The locations of all piping, ducts, apparatus, and equipment indicated on the drawings are approximate only, and shall be changed as required to meet the actual architectural and structural conditions at the job site. All changes shall be approved by the Owner's representative. Any change in work which has not been installed shall be made by the contractor without additional compensation, except changes which are caused by architectural and structural changes which substantially increase the size of any of the mains, or which substantially increase the number of fixtures or length of pipe runs. Any and all changes shall be made only upon approval of a written change order.

1. Right of way - Lines which pitch shall have the right of way over those which do not pitch. For example, plumbing drains shall normally have right of way. Lines whose elevations cannot be changed shall have right of way over lines whose elevations can be changed.

2. Offsets, transitions, and changes in direction in pipes and ducts shall be made as required to avoid conflicts with building footings and foundations or other buried ducts or utilities, and to maintain proper head room and pitch of sloping lines whether or not indicated on the drawings. Furnish and install all traps, air vents, sanitary vents, and devices as required to affect these offsets, transitions and changes in direction.

D. It shall be each contractor's responsibility to verify exact location, elevation, and/or route of the various mechanical system components with architectural details and with Owner's representative's personnel on job.

E. Where deviations from locations and/or arrangements described are necessary to meet actual job conditions, the changes shall be made without cost to the Owner.

F. The Owner's representative reserves the right to make any reasonable change in the location of any outlet, piping, or equipment, before installation, without additional cost.

1.13 LOCATION OF CEILING OUTLETS

A. This contractor shall assist the Owner's representative, General Contractor, Electrical Contractor and other interested parties in the establishment of room centerlines, axis of rooms and all walls.

B. All grilles, registers, ceiling diffusers, etc. shall be located with reference to these established data points.

C. These outlets shall be referenced to such features as room centerlines, walls and ceiling furrings, balanced border widths, etc.

D. Outlets in acoustical tiles, panels, etc. shall occur in joints or centers of whole pieces, etc.

E. The final determination of the exact location of all outlets shall be subject to the direction and approval of the Owner's representative.

1.14 PROVISIONS FOR REMOVAL & ADEQUATE CLEARANCE

A. Install Mechanical work to permit removal of heating and cooling coils, filters, belt guards, sheaves, drives, and other parts requiring periodic replacement or maintenance without damage to or interference with other parts of equipment or structure.

B. Arrange pipes, ducts, and equipment to permit ready access to filters, valves, cocks, traps, starters, motors, control components, and to clear the openings of swinging doors and access panels.

1.15 RECORD DRAWINGS

A. The contractor shall maintain one set of record drawings. These prints shall show the location, elevations and details of all items of work installed under this contract. Buried piping shall be located by dimensions from foundation walls and depths of bury shall be indicated. These shall be marked in red. The completed set of record drawings must be submitted to the Owner's representative before the contractor is eligible to receive the final payment. An up-to-date record set of drawings shall be maintained during the progress of the project and be available to the Owner's representative upon request.

1.16 COORDINATION DRAWINGS

A. The contractor shall provide coordination drawings, when requested by the Owner's representative, to ensure that the various mechanical system components are coordinated with each other, and with other building systems.

B. The coordination drawings shall be drawn to scale (usually 1/4" = 1'-0") and shall show all systems as they relate to each other, especially in areas of potential conflict.

C. Equipment room coordination drawings shall include, in addition to the information specified, the size and location of all piping, pipe fittings, valves, strainers, specialties, flexible connections, water treatment devices, control panels, etc., and their installed elevation.

D. Equipment room coordination drawings shall show the location of all pertinent electrical outlets, lights, panels, transformers and switch gear, and their required clearances from duct, piping, and equipment, and for maintenance access.

E. Footing and foundation coordination drawings shall be prepared showing the exact location, depth, and slope of all buried piping to be installed. These coordination drawings shall include all sand and grease interceptors, drains in depressed slab areas, and all necessary buried water piping.

F. This set of foundation coordination drawings shall be maintained in the construction trailer and shall be marked up daily to indicate exact location and elevation of all buried piping and conduit systems.

G. Coordination drawings shall be professionally drafted and shall be clear and concise in their presentation and clarity.

H. All coordination drawings shall be prepared in digital format in the latest version of Revit. Material shall be submitted in both printed and digital form.

I. All ductwork and piping attachments to the building structure shall be detailed and shall be coordinated with the Owner's representative.

1.17 COOPERATION WITH OTHERS

A. The contractor shall so organize the work that progress will harmonize with the work of all trades, so that all work may proceed as expeditiously as possible. The contractor shall be held responsible for any delays which might be caused by his negligence or failure to cooperate with other contractors or crafts.

1.18 FOREMAN

A. A full-time foreman shall be designated by the contractor to the Owner's representative and shall be available on site for consultation. This individual, when appointed, will not be replaced without prior approval from the Owner's representative. The foreman shall be responsible for the coordination and correct placing of the work.

1.19 GUARANTEE

A. By the acceptance of the contract award for the work herein described, the contractor assumes the full responsibility imposed by the guarantee as set forth herein and should protect himself through proper guarantee from equipment and specialty manufacturers and subcontractors as their interests may appear.

B. All materials and equipment provided and installed under this division of the specifications shall be guaranteed for a period of one (1) year from the date of substantial completion and acceptance by the Owner, unless specifically noted elsewhere in the specification. Should any trouble develop during this period due to defective materials or workmanship, the contractor agrees to correct the trouble without any cost to the Owner, any defect noticed at the time of installation and/or during the guarantee period shall be corrected immediately to the satisfaction of the Owner.

1.20 SCHEDULES, MATERIALS AND EQUIPMENT

A. Approved Manufactures:

Naming of a manufacturer or product does not mean the manufacturer or product automatically complies with the design documents. Submittals must meet all design criteria and shall be acceptable in all respects to the project design team.

B. As soon as practicable, and within 30 days after the date of award of contract, and before commencement of work, a complete schedule of equipment and materials proposed for installation shall be submitted to the Owner's representative. The schedule shall include catalogs, cuts, drawings, and such other descriptive data or samples that are requested by the Owner's representative. Schedules shall include all items of equipment used. No partial submittals will be accepted.

C. Provide corrected copies of each required shop drawing or similar submittal to the Owner's representative for review, approval, and return of one (1) copy. DO NOT SUBMIT without the general contractor's signed stamp, indicating the general contractor has reviewed the submittal for completeness and conformance to the Contract Documents.

D. Inform the Owner's representative by notation, or in the letter of transmittal, of any proposed deviation from the requirements of the Contract Documents.

E. Provide required shop drawings or other submittals within time stipulated on approved progress schedule.

F. Do not commence work requiring a shop drawing or other submittal until approval of the required submittal has been received. Such approval will be based upon a review only for conformance with the design concept of the project and with the information given in the Contract Documents, and does not relieve the contractor from responsibility for errors or omissions in the shop drawings.

G. Schedules shall be neatly bound in hard-backed loose-leaf binders. Schedules shall be completely indexed, and shall include the following items:

1. Flow meters
2. Water heater
3. Piping systems
4. Pipe supports & restraints
5. Unit heaters
6. Pressure gauges & thermometers
7. Plumbing fixtures
8. Dampers
9. Louvers
10. Exhaust air fan
11. Low pressure flexible ducts
12. Low pressure fittings
13. Roof hoods
14. Expansion tanks
15. Valves
16. Rooftop units
17. AC split systems
18. Air turnover unit
19. Make-up air units
20. Evaporative coolers

21. De-stratification fans
22. Grilles & registers
23. Diffusers
24. PRV stations
25. Tempering valves
26. Insulation systems
27. Vibration isolators
28. Seismic restraints
29. Automatic temperature controls
30. Air balance contractor qualifications
31. System commissioning contractor's qualifications
32. Fire safing system with installation diagrams
33. Fire suppression systems
34. Other schedule items

H. Submittals received which do not contain all of the above items will be returned unchecked.

I. Purpose and Contractor's Responsibility:

1. The purpose of the final submittal is to "assist the contractor in selecting the equipment." The contractor shall review the submittals prior to submission to the Owner's representative to make sure that the submittals are complete in all details including the following items:

    a. Manufacturers' names shall be mentioned in specifications as accepted by Owner at time of bidding.
    b. Equipment dimensions shall be verified to fit the spaces provided with sufficient clearances, as may be required by the equipment or indicated on the drawings.
    c. Equipment shall be reviewed with respect to schedules, specifications, plans and details.
    d. Equipment submittal sheets shall be clearly marked indicating equipment symbol and exact selection of proposed equipment.
    e. The supplier of each piece of equipment shall field verify that the equipment provided is installed per manufacturer's recommendations with adequate clearances for service and maintenance.
    f. The supplier of each piece of equipment shall furnish factory start-up services and shall certify that each piece of equipment is properly piped, wired, and controlled, that all joints and seams are leak-proof, that the unit is operating within the MCAs recommended by the manufacturer, and that it is operating within the normal noise parameters recommended by the manufacturer and as required by the contract documents.
    g. All equipment provided shall be represented and serviced locally. All start-up shall be performed by a local factory authorized agent.

J. Review:

1. Review and acceptance of submittal does not relieve the contractor of his responsibility to fulfill the contract requirements. Review and acceptance of the submittal will not be used as a means of changing the contract requirements. Items not covered in the accepted submittal, or items incorrectly covered but not recognized or identified, shall not be used when contrary to the requirements of the contract documents.

K. Acceptance of Substitute Equipment:

1. If the proposed installation is approved, this contractor shall make all incidental changes in piping, ductwork, supports, installation, wiring, heaters, panel boards, and as otherwise necessary. Provide any additional motors, valves, controllers, fittings, and other additional equipment required for the proper operation of the system resulting from the contractor's selection of alternate equipment, including all required changes in the effected trades.

L. Owner's Refusal Right:

1. In the event that items submitted are substitutions for specified items and are found to be not acceptable, the right shall be reserved to require the specified items.

1.21 OPERATING AND MAINTENANCE INSTRUCTIONS AND CATALOG INFORMATION

A. This contractor shall compile a reproducible set of every product used by him in the completion of the work. The reproducible shall also include copies of the test data (Section 230501), balancing reports (Section 230593), and system commissioning data (Section 230800). Before final acceptance by the Owner's representative, he shall turn over to the Owner this compilation of catalog data. The reproducible shall be bookmarked and indexed and easily navigable by bookmarks. Provide data for each item of equipment listed in SCHEDULES, MATERIALS & EQUIPMENT, as shown in Section 230100 and on the drawings. Provide copy of submittal data. A complete digital copy shall be delivered to the Owner's representative for his approval.

B. Provide warranty schedule and schedule of overload protection as required in Section 230800.

C. Provide maintenance schedules for each piece of equipment.

D. Manuals not in compliance will not be reviewed and will be rejected.

PART 2 - PRODUCTS

2.1 MATERIALS, EQUIPMENT AND ACCESSORIES

A. Unless otherwise specified, all equipment, accessories, and materials shall be new and undamaged, and the workmanship shall be of the best quality for the use intended and shall be acceptable to the Owner's Representative.

B. Equipment, accessories, and materials shall be essentially the standard products of the manufacturer, or as specified herein. Where two or more units of the same class of new equipment are required, these units shall be products of a single manufacturer.

C. Should mechanical equipment other than that used in the design be furnished, it shall be the responsibility of the mechanical subcontractor to provide large scale (1/2" = 1'-0") installation drawings, as required, showing service and maintenance points with proper clearance allowances for service.

D. All equipment shall be selected to deliver full rated capacity at the job site elevation.

PART 3 - EXECUTION

3.1 FUNCTIONING AND OPERATION OF EQUIPMENT

A. Contractor's Responsibility

1. Installation and startup shall be so made that its several component parts will function together as a workable system and shall be left with all equipment properly adjusted and in working order.

B. All Division 230000 equipment shall be started by a factory trained and authorized technician. Start up for all equipment shall be witnessed by the owner and commissioning agent.

3.2 CLEANING AND PATCHING BY MECHANICAL CONTRACTOR

A. The contractor shall remove all stains or grease marks on walls, floors, glass, hardware, fixtures, or elsewhere, caused by his workman or for which he is responsible. He shall remove all stickers on plumbing fixtures, do all required patching up and repair all work of others damaged by this division of the work, and leave the premises in a clean and orderly condition.

3.3 INSTRUCTIONS TO OWNER'S REPRESENTATIVES

A. The mechanical contractor shall provide, without expense to the Owner, competent instructors to train the Owner's representatives in the care, adjustment, maintenance, and operation of all parts on the heating, air conditioning, ventilating, plumbing, and automatic temperature control systems and equipment. Training shall be a minimum of **16 hours** with no less than **4 hours** for ATC training.

B. Instruction date shall be scheduled with the owner at the time of final inspection. A written report specifying times, dates, and the name of personnel instructed shall be forwarded to the Owner's representative.

C. All training sessions for all divisions shall be professionally videoed, with notations as required for owner reference as to specific equipment.

D. An additional **8 hours** shall be provided by all mechanical subcontractors to walk through the building with Canyons School District representative to verify operation of all Division 22, 23, & 25 items and control sequencing.

E. An additional **4 hours** of training shall be provided to the owner at the time of the 12-month warranty inspection.

F. All portions of training shall be documented on video (professional quality) and a CD Rom provided as a part of the O&M documentation.

G. No training shall begin until system commissioning is complete and accepted by the owner.

3.4 PROTECTION AGAINST THE ELEMENTS

A. The contractor shall, at all times, take reasonable and adequate precautions to protect his work and all stored materials and equipment from damage by the elements, including flooding, windstorms, etc., and shall not expose the work of any other contractor to such damage.

B. In addition to requirements specified in Division 01, stored material shall be readily accessible for inspection by the Owner's representative until installed.

C. All items subject to moisture damage, such as controls, shall be stored in dry, heated spaces.

D. Protect all bearings during installation, and thoroughly grease steel shafts to prevent corrosion.

3.5 REMOVAL OF DEBRIS, ETC.

A. Upon completion of this division of the work, remove all surplus material and rubbish resulting from the work, and leave the premises in a clean and orderly condition.

3.6 MOTORS & STARTERS

A. This contractor shall furnish all motors required and necessary to operate equipment furnished by him. The voltage, phase, and horsepower of each motor shall be coordinated with the electrical contractor prior.

3.7 OPENINGS FOR MECHANICAL SYSTEMS

A. All openings required for installation of mechanical systems shall be provided by the mechanical contractor. Any piece of equipment which is to be installed in any space of the building and which is too large to permit access through stairways, doorways or shafts shall be brought to the job by the Contractor involved and placed in the space before the enclosing structure is completed. Materials shall be delivered at such stages of the work as will expedite the work as a whole.

3.8 SAFETY REGULATION

A. The contractor shall comply with all local and OSHA safety requirements in performance with this work. (See General Conditions). This contractor shall be required to provide equipment, supervision, construction, procedures, and all other necessary items to assure safety to life and property.

3.9 OWNER FURNISHED EQUIPMENT

A. This contractor shall include in his bid the necessary labor and material to properly coordinate and install the required piping, trim, specialties, controls, ductwork, and other necessary utilities and services to equipment furnished by the Owner.

B. This contractor shall relocate (where noted), rough-in and make final connections to owner furnished equipment.

C. See bid documents for a list of owner furnished equipment which is not otherwise identified on the mechanical drawings or in the mechanical division of the specifications.

END OF SECTION 23 0100

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SECTION 230501 - TESTING

PART 1 - GENERAL

1.1 DESCRIPTION

A. The work outlined in this section shall be performed by the several trades involved.

B. The mechanical contractor shall provide all supervision, labor, materials, tools, scaffolding, and equipment required to complete all system testing.

C. The mechanical contractor shall remove and repair any defective component as indicated by the system tests and retest.

D. The mechanical contractor shall test the operation of all safety and high limit controls to insure proper installation and operation. Any defective devices shall be replaced.

1.2 TESTS AND ADJUSTMENTS

A. Before any piping is covered, tests shall be made in the presence of the Owner's Representative, and any leaks or defective work corrected. No caulking of threaded work will be permitted.

B. Before application of insulation covering, and as far as practical before concealing any piping, all piping shall be hydrostatically tested and proved tight.

C. Stubs shall be capped and all control valves shall be removed during the test.

D. System may be tested in sections, providing connections to last section tested are included in each succeeding test.

E. Following minimum pressures shall be used for testing:

1. Natural gas piping at 150 psig for six hours.
2. Domestic hot and cold-water piping at 150 psig for six hours.
3. Plumbing waste and vent piping at 10 ft. head for six hours.
4. Roof drain piping at 10 ft. head for six hours.
5. Refrigerant piping as required in 230900.
6. Fire suppression system in accordance with Section 210000.

F. All valves and equipment which may be damaged shall not be subjected to test pressure.

PART 2 - PRODUCTS

2.1 EQUIPMENT

A. The contractor shall furnish all necessary gauges, plugs, test fans, pumps, etc., as required to conduct the tests.

2.2 REPORTS

A. The contractor shall give the Owner's Representative **one** weeks' notice prior to performing the tests. All tests shall be recorded, and copies of reports bound in the O & M manuals and given to the Owner.

PART 3 - EXECUTION

3.1 PROCEDURE

A. The contractor shall be responsible for conducting all tests in a safe manner, protecting the work of other trades from water or physical damage.

B. The tests, as indicated, shall be in addition to any test, as required, by any governing agency. Submit all approved tests, as required, by any governing agency to the Owner's representative.

C. Each test and any necessary repairs and retest shall be performed by the contractor which installed the system.

D. Upon completion, a test shall demonstrate that the culinary hot water system is circulating, that all traps are properly vented, that there is an ample supply of hot and cold water to fixtures, that no fixture or equipment can be back-siphoned, and that there are no back-flow connections.

END OF SECTION 23 0501

SECTION 230593 - BALANCING

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. The mechanical contractor shall employ an independent technical firm to perform the checking, adjusting, and balancing (CAB) of the HVAC systems. This firm shall be one whose operations are limited to the field of professional CAB, and this firm shall meet the following qualifications:

1. The firm shall be a member of AABC and/or NEBB.
2. The firm shall be one which is organized to provide professional services of this specific type.
3. The firm shall have completed projects of similar scope within the past 12 months and shall be capable of performing the services specified at the location of the facility described within the time frame specified, and following up the basic work as may be required.
4. All personnel used on the job site shall be engineering technicians, who shall have been permanent, full-time employees of the firm for a minimum of six (6) months prior to the start of the work for this project.

B. **Preferred contractors shall be Certified Test & Balance, Diamond Test & Balance, BTC Services, Bonneville Test & Balance, and Independent Test & Balance.**

C. As a part of this contract, the CAB contractor shall make all changes in the sheaves, belts, and dampers, including the addition of dampers required for correct balance as required by the Owner's representative, at no additional cost to the Owner.

D. The CAB contractor shall provide, and coordinate services of qualified, responsible subcontractors, suppliers, and personnel as required to correct, repair, or replace any and all deficient items or conditions found during the testing, adjusting, and balancing period.

E. In order that all systems may be properly checked, balanced, and adjusted as required by these specifications, the mechanical contractor shall operate said systems at his expense for the length of the time necessary to properly verify their completion and readiness for the CAB and shall further pay all costs of operation during the CAB period.

F. The project completion schedule shall be coordinated with the CAB work to provide sufficient times to permit the completion of CAB services prior to Owner occupancy.

G. CAB contractor shall provide a minimum of **24 hours** to aid the owner's independent commissioning agent as required. See 230800.

1.2 DOCUMENTS

A. The Owner's representative will furnish, without charge to the CAB firm, one set of mechanical specifications, all pertinent change orders, and the following:

1. One complete set of plans less the structural sheets.
2. One set of mechanical floor plans of the conditioned spaces.

B. These sheets should be ozalid type (blue or black on light background) reproductions to facilitate marking.

C. Approved submittal data on equipment installed to accomplish the test procedures outlined in paragraph "Services of the CAB Firm" of this specification will be provided by the mechanical contractor.

D. The Owner's representative will transmit one copy of the following "Records for Owner" to the CAB firm for review and comments:

1. Record drawings
2. Approved fixture brochures, wiring diagrams, and control diagrams.
3. Shop drawings
4. Instructions
5. Motor and valve charts
6. Operating and Maintenance Manuals

1.3 SERVICES OF MECHANICAL CONTRACTOR

A. The mechanical contractor shall have all systems complete, calibrated, and in operational readiness prior to notifying the CAB firm that the project is ready for their services. The mechanical contractor shall coordinate system readiness with the system commissioning contractor and shall certify in writing to the Owner's representative that the system is complete and ready to balance.

1.4 SERVICES OF THE CAB FIRM

A. The technical CAB firm shall submit biographical data on the individual proposed to directly supervise the CAB work. It shall also submit their record of specialized experience in the field of air and hydronic system balancing.

B. Act as liaison between the Owner's representative, contractor, and Independent Commissioning Agent, and periodically inspect the installation of mechanical piping systems, sheet metal work, temperature controls and other component parts of the heating, air conditioning and ventilating systems as the installation progresses. The inspection will cover only those parts of the systems relating to the checking and balancing.

C. To check, adjust, and balance system components to obtain optimum conditions in each conditioned space in the building.

D. Prepare and submit to the Owner's representative, complete reports on the balance and operations of the systems.

E. The CAB firm shall be responsible but not limited to the inspecting, adjusting, balancing, and logging the data on the performance of the following general systems, including all components.

1. Air distribution system, including rooftop units, fans, filters, unit heaters, controls, etc.
2. Domestic hot water recirculating system including water heaters, pumps, circuit setters, controls, etc.
3. Temperature control system in its entirety, including the verification of all control sequences and safety devices.
4. Building exhaust and ventilation systems.
5. Make-up air systems.
6. Evaporative cooling systems

F. Before any adjustments are made, the air systems are to be checked for such items as dirty filter, duct leakage, damper leakage, equipment vibrations, correct damper operations, etc.

G. Before any adjustments are made to water systems, the strainers shall be cleaned, temperature control valve operation shall be checked, pump rotation shall be checked, pressure reducing valves shall be adjusted, etc.

H. It shall be the responsibility of the CAB personnel to check, adjust, and balance the components of the various systems as listed above using an applicable "proportionate balance procedure" in order that each of them will operate under optimum noise, temperature and air flow conditions in the conditioned spaces in the building "while simultaneously operating at the most energy efficient condition."

I. During the balancing process, if abnormalities or malfunctions of equipment or components are discovered by the CAB personnel, the owner's representative shall be advised promptly so that the condition may be corrected by the project contractor. Data from malfunctioning equipment or components shall not be recorded in the final CAB report.

PART 2 - PRODUCTS

2.1 EQUIPMENT AND INSTRUMENTS

A. This contractor shall provide all necessary labor, equipment, scaffolding, instruments, and materials required to adjust, balance, and check all systems.

PART 3 - EXECUTION

3.1 REPORT

A. The activities, as described hereinbefore, will culminate in a report to be provided to the Owner's representative. This report shall be furnished in six (6) copies. One copy shall be bound in each O & M manual. The intent of the final report is to provide a reference of actual operating conditions for the building operating personnel.

B. The CAB report shall include the following as a minimum:

1. Preface:

   a. A general discussion of the systems, any idiosyncrasies, any problems encountered, an outline of normal sequence of operation for the HVAC system cycles, any un-corrected noise problem.

2. Pitot Tube Traverses:

   a. For use in future trouble-shooting by maintenance personnel, all exhaust ducts, main supply ducts and return ducts will have air velocity and volume measured and recorded by the traverse method. The locations of these traverse test stations will be described on the sheet containing the data.

3. Temperature Tabulation:

   a. Of all conditioned spaces on a room-by-room basis, a total of at least three readings will be taken of each room on successive days. Record outside ambient temperature at two-hour intervals. The total variation in conditioned space temperatures shall not exceed 2 deg. variance from the thermostat settings.

4. Air Volumes and Velocities:

    a. As measured at each supply grille, return air grille, and exhaust air grille or air handling device. In all fan systems, the air quantities indicated on the plans may be varied as required to secure a maximum temperature variation of two degrees within each separately controlled space, but the total air quantity indicated for each zone must be obtained. It shall be the obligation of the contractor to furnish or revise fan drive and/or motors, if necessary, without cost to the Owner, to attain the specified air volumes.

5. Air Pressure:

    a. As measured across each supply fan, cooling coil, heating coil, air handling unit filter and exhaust fan. Relate these readings to the particular fan curve in terms of CFM handled at the various static pressures, and their relationship to fan power and fan instability.

6. Electrical Current/Voltage:

    a. Measurements to be taken at the drive motor on each piece of equipment.

7. Fan Speeds:

    a. To be measured in RPM.

8. Instrumentation List:

    a. A list of instruments by type and make used in gathering the CAB data.

9. Drawings:

    a. The CAB contractor's working drawings shall have the supply air openings numbered and/or lettered to correspond to the numbers and letters used on the report data sheets so that data in the report can be correlated with each specific supply air opening in the building. If room numbers actually used in the building differ from those on the plans, the building room numbers shall be marked on these plans. Only one such marked-up set of drawings need be provided with the six copies of the CAB report.

C. Before final acceptance of the CAB report, the report data, at the discretion of the Owner's representative, shall be verified one time on the job site, by selection of check points (not to exceed 10 percent of total) at random, in the presence of the Owner's representative. Representatives of the testing firm doing the work shall be present and provide the necessary equipment for test data verification.

D. The firm shall be responsible for inspecting, adjusting, balancing, and logging the data on the performance of fans, all dampers in the duct system, all air distribution devices, the flows of freon or water thru all coils, and the power consumption of all motors.

E. During the CAB work, the temperature regulation will be adjusted for proper relationship between controlling instruments. The Owner's representative will be advised of any instruments out of calibration so that the controls subcontractor may come in and recalibrate, using data supplied by the balancing firm.

F. CAB Contractor shall be available as necessary to aid the independent system commissioning contractor with verification and adjustment of systems as required by the commissioning contractor.

G. Make a total of three inspections within ninety (90) days after occupancy of the building to ensure that satisfactory conditions are being maintained throughout and to satisfy and unusual conditions.

H. An additional inspection in the building shall be made by the firm during the season opposite that in which the initial adjustments were made. At that time, any necessary modifications to the initial adjustment required to produce optimum operation of the system components shall be made to produce the proper seasonal conditions in each conditioned space.

I. At the time of opposite season checkout, the Owner's representative shall be given timely notification before any readings or adjustments are made so that they may participate in the checkout.

END OF SECTION 23 0593

SECTION 23 0800 - SYSTEM COMMISSIONING

PART 1 – GENERAL

1.1 DESCRIPTION

A. The work required under this section shall include, but not necessarily be limited to, the following:

B. The pre-startup inspection of all systems by installing contractor and coordinating of the subsequent correction of any incorrect items.

C. Repair, replacement, or adjustment of each item shall be performed by the installing contractor.

D. System operations inspection.

E. The contractor shall be required to provide a detailed report verifying proper operation of all equipment and devices, correct control sequences for all systems and proper air and water flow for systems throughout the building.

F. The installing contractor shall act as liaison between the Owner's representative and the commissioning contractor and periodically inspect the installation of mechanical piping systems, sheet metal work, temperature controls and other component parts of the heating, air conditioning and ventilating systems as the installation progresses.

G. Verification of proper systems start-up, installation and ATC sequence shall be demonstrated to CSD representative prior to request for final inspection of systems.

H. An additional 4 hours of commissioning shall be provided by the installing contractor to be used as required to owner at the time of the 12-month warranty inspection.

I. The intent of this section is to provide for proper installation, startup, service, and operation of the mechanical systems in preparation for system balancing. See Section 230593 for balancing.

1.2 PRE-STARTUP INSPECTION

A. The pre-start-up inspection of all systems shall provide for verifying that each piece of equipment is properly installed and prepared for startup.

B. All pertinent items shall be checked, including, but not necessarily limited to, the following:

1. Removal of shipping stops.
2. Vibration isolators and seismic snubbers properly aligned and adjusted.
3. Flexible connections are properly aligned.
4. Belts are properly adjusted.
5. Belt guards and safety shields are in place.
6. Safety controls, safety valves, and high or low limits are properly installed and functioning.
7. All systems are properly filled.
8. Filters are in place with a proper seal around their edges.
9. Fire dampers are properly installed, linked, and serviceable.
10. Pressure and temperature gauges of the proper size and range are installed.
11. All test stations and measuring devices are properly installed and functioning.
12. Initial lubrication of equipment is complete.
13. Filters and strainers are clean.

14. Motor rotations are correct.
15. Voltages match nameplates.
16. Control system is operating properly.
17. All interlocks are wired and verified.
18. All controls have been connected and verified.
19. All valves, dampers, and operators are properly installed and operating.
20. All ductwork is installed and connected.
21. All roof-mounted equipment is properly flashed.
22. All water piping is either heat taped or located in spaces which are heated to prevent freezing.
23. All other items necessary to provide for proper start-up.
24. All seismic restraints are in place and secured.
25. All condensate drain lines are piped to discharge in proper drains.

1.3 FIRST RUN INSPECTION

A. Recheck all items outlined in pre-startup inspection to insure proper operation.

B. Check the following items:

1. Excessive vibration or noise.
2. Loose components.
3. Initial control settings.
4. Motor amperages.
5. Heat buildup in motors, bearings, etc.
6. Control system is sequencing properly, calibrated and functioning as required.
7. Heat tapes are wired & functioning.

C. Correct all items which are not operating properly.

1.4 SYSTEM OPERATION INSPECTION

A. The mechanical systems shall be observed by the owner under operation conditions for sufficient time to insure proper operation under varying conditions, such as daylight and heating-cooling.

B. Periodically check the following items:

1. Strainers and filters.
2. Visual check of air flow for "best guess" setting for preparation for system air balancing under Section 230593.
3. Control operation of time clocks, on-off sequences, system cycling, etc.
4. Visual checks for water flow, seals, packings, safety valves, operating pressures and temperatures.
5. Cleaning of excessive oil or grease.
6. Dampers close tightly.
7. Valves close tightly.
8. System leaks.
9. All other items pertaining to the proper operation of the mechanical system, whether specifically listed or not.

1.5 WARRANTY SCHEDULE

A. Provide a list in each O & M Manual of all motors, fans, and equipment with manufacturer's names, models, serial numbers and date of startup approved by the Owner's representative, date of warranty, extent of warranty, and equipment supplier with address and phone numbers.

1.6 SCHEDULE OF OVERLOAD PROTECTION

A. Provide a list in each O & M Manual of all motors with size, voltage, amperage, and size and rating of overload protection.

1.7 REPORT

A. Prior to the start of system balancing the installing contractor is required to submit a detailed written report to the owner's representative outlining the results of the installation and start-up of all systems and piece of equipment which lists any un-corrected system abnormalities.

1.8 CERTIFICATION

A. Provide written certification of all tests, and start-up procedures. Bind a copy of this certification in the O & M manuals. Certification shall include an itemized list of systems serviced during the system commissioning process with dates, times, and a complete description of the work completed, and the name of the responsible system commissioning mechanic.

1.9 BUILDING OPERATION DEMONSTRATION

A. Contractor shall include as a part of their bid an additional 12 hours for all Division 22,23 & 25 sub-contractors to demonstrate to building owner, and/or owner’s representative that proper installation, operation, air and water balance, control, and system commissioning has been completed properly for all equipment, material or systems provided and/or installed by Division 22, 23 & 25 contractor.

B. All systems shall be verified in their entirety and all items resolved prior to this demonstration. This demonstration does not replace the owner training requirements.

END OF SECTION 23 0800

SECTION 23 0900 - BASIC MATERIALS AND METHODS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the basic materials and methods to be used in Division 21, 22, 23 & 25 work.

1.2 MATERIALS & EQUIPMENT

A. All materials shall be new and undamaged. Protect all stored materials and equipment from damage by the elements, including exposure to excessive heat, flooding and rain, windstorms, etc.

B. All materials and equipment shall be installed in strict compliance with the manufacturer's recommendations.

1.3 CUTTING AND PATCHING

A. Any cutting, patching, or filling necessary for the proper execution of this work, except as noted in the drawings, shall be done by this contractor.

B. No rough or unsightly work will be allowed. Cutting of structural members shall be done only on approval of the Owner's representative.

C. The attention of the contractor is directed to the requirements of running pipes thru concrete slabs, walls, and beams. These conditions are to be anticipated, and sleeves installed as provided for under "Sleeves".

1.4 INSERTS

A. Furnish and set, in all necessary locations, before or during construction, unistrut inserts for use in connection with the support and seismic restraint of piping, ductwork, and equipment furnished under this division of the work.

1.5 SLEEVES

A. Sleeves for Concrete or Masonry Surfaces:

1. For pipes passing thru masonry or concrete construction, provide sleeves at least two pipe sizes larger than the pipe passing thru and made from sections of steel pipe.

2. Provide galvanized iron sleeves with collar on each side of wall for all ducts passing thru masonry or concrete construction.

3. Sleeves shall be placed in structural members only where approved by the owner’s representative.

4. Sleeves through foundation walls below grade shall be mechanical seal type with watertight sealing grommets and pressure rings. Sealing grommets shall be non-melting at temperatures incurred. Foundation wall sleeves shall be "O.Z. Type WSK".

B. Sleeves thru Gypsum Surfaces:

1. Provide 22-gauge sheet metal collars on each side of wall for all ducts passing thru gypsum wall construction or similar construction.

C. Sleeves thru Finished Surfaces:

1. For pipes passing thru finished partitions or ceilings, provide galvanized sheet iron sleeves of suitable size. The sleeves shall be fastened to construction to prevent creep along pipe and the sleeve ends shall be flush with finished surfaces. Provide escutcheon plates at each side of finish wall or floor or ceiling for all pipes passing thru same.

D. Sleeves thru Fire-rated Surfaces:

1. All pipe sleeves and ductwork penetrating fire walls and surfaces shall be packed inside after pipes and/or ducts have been placed with a firestop system tested in accordance with ASTM E814 or UL 1479 and have and F rating of not less than the fire-resistance rating of the wall penetrated. The contractor shall submit to the Owner's representative for review and approval specific installation diagrams showing exact method(s) to be used.

E. Sleeves thru Sound Rated Surfaces:

1. Pipe or duct sleeves thru sound rated walls or surfaces shall be packed with dense fiberglass. Duct sleeves shall be sealed with duct sealer and fitted with metal cover flanges on both sides.

F. Sleeves thru Floors:

1. Sleeves thru floors above grade shall extend 1" above the floor and shall be sealed watertight with waterproof silicone caulking.

1.6 PIPING & DUCTWORK SUPPORT

A. Steel roof deck shall not be used to support loads from plumbing, HVAC ducts, light fixtures, architectural elements or equipment of any kind, unless specifically noted otherwise. Lightweight suspended acoustical ceilings with a total weight per wire not exceeding 50# may be hung from the steel roof deck. The hangers should be staggered to distribute the load over multiple deck flutes.

B. Bracing of miscellaneous items (mechanical, electrical, plumbing, etc.) to the bottom chord of joists or girders will not be allowed in any instance. All lateral braces must connect to the top flange/top chord of the framing member above unless noted otherwise on the structural drawing.

1.7 PIPE LOCATION AND ARRANGEMENT

A. No water supply piping inside the building shall be placed in direct contact with the earth. Buried water piping shall be placed in split tile or PVC pipe to keep pipe from direct contact with ground.

B. Unless otherwise noted on the drawings, all water piping shall be kept out of concrete floor slabs.

C. Under no circumstances shall plastic piping or ducting materials be run inside of supply or return air plenums.

D. All piping shall be properly racked and supported to run straight and true.

E. All changes in direction shall be made with approved fittings. Pipes shall not be bent to change direction.

F. All piping shall be racked and run to facilitate maintenance work. Under no circumstances shall valves, shock absorbers, drip traps, or piping specialties be installed in a "closed space" without proper access provided for future maintenance. See "Access Doors" section of specifications.

G. **NOTE: All piping shall be capped or plugged at the end of each work shift and when not being extended, to prevent the entry of rocks and debris.**

H. Any timelines are broken or disconnected, they shall be capped immediately after flushing to remove rock and debris from pipes. **If rocks or other foreign materials are found in the system after it has been closed, the contractor shall stand the expense of their removal.**

I. All valves, piping, and equipment to be installed so as to permit disassembly for maintenance purposes.

J. Provide drain valves at all low points in piping systems. Run to floor drain where possible, otherwise provide 3/4" hose connection with vacuum breaker.

1.8 VERIFICATION OF INSTALLATION

A. **At time of final inspection contractor shall provide a color video of all new buried sanitary sewer lines & storm water lines 3" and larger.**

B. **Video must be taken after installation is complete to ensure that line is installed Properly with no low spots, separations, etc. Video shall be performed with water in lines. All areas shall be identified and running linear feet shall be noted. Video shall also ensure that all connections have been made properly and that no debris remains in piping system. At any point that debris is noted, debris shall be removed by the contractor and line video re-done for that portion of the line. The building owner shall be notified to witness videotaping.**

C. **Piping video shall be performed by a source approved by Owner and project engineer.**

1.9 PIPE JOINING

A. All steel pipe 2" and under in size shall be joined by screwed connections.

B. All joining shall be made to maintain the full metal strength of the pipe, with neat and workmanlike appearance.

C. All piping must be perfectly clean before the system is filled.

D. Copper Piping in Domestic Water Service: Piping shall be cut (with a pipe cutter) so ends are square and will "bottom" in fittings. There must be no gaps left thru which solder can run into the line. If a hack saw must be used, it shall be guided with a miter box to insure a square, even cut. Tubing shall be reamed to remove burrs, being careful not to expand tubing while reaming.

E. The outside of the copper pipe and the inside of the fittings, where solder will be applied, shall be burnished with fine crocus cloth or fittings brushes until all dirt and oxide is removed.

F. A light coat of soldering flux shall be applied to both pipe and fittings. **Acid flux shall not be used.**

G. Joints in copper pipe shall be uniformly heated to proper soldering temperature to insure that solder will flow to **all parts** of the joint. The solder shall be fed to the joint until a uniform line of solder appears around the pipe at the end of the fittings.

H. Copper piping used in domestic water service shall be joined with 'Stay-Safe-50' or 'Silvabrite-100' no lead solder.

I. When valves are being installed in copper piping, the non-metallic parts shall be removed to prevent the heat of soldering from damaging the valves. No heat shall be applied near where an excessive temperature may cause damage.

1.10 SCREWED CONNECTIONS

A. All pipe shall be reamed at the ends and free of all inside scale or burrs. Threads shall be cut clean and sharp, and to a length equal to 1-l/8 the length of the female thread receiving the pipe. The pipe shall be screwed in the full length of the female thread.

B. Pipe shall be made tight with teflon thread tape or thread lubricant worked into male thread only. Surplus material shall be wiped off and the joint left neat and clean. Lubricant shall be powdered graphite and linseed oil, or plumbage and linseed oil.

1.11 PIPE GRADING

A. Piping shall be uniformly graded in direction of flow as noted below:

PIPING	FALL/RISE	DIRECTION	PER/RUN
Rainwater	1”	Down	4’
Water	1"	Up	40'
Waste - 4" & smaller	1"	Down	4'
Vent	1"	Up	4'
Condensate Drip	1"	Down	4'
Natural Gas	1"	Up	40'
Refrigerant	1"	Down	40'

1.12 THRUST BLOCKS

A. Plugs, caps, tees, and bends deflecting 22-1/2 degrees or more, either vertically or horizontally, on water lines 6 inches in diameter or larger, shall be provided with thrust blocking, or metal tie rods and clamps or lugs, as directed. Valves shall be securely anchored or shall be provided with thrust blocking to prevent movement. Thrust blocking shall be concrete of a mix not leaner than 1 cement: 2-1/2 sand: 5 gravel and having a compressive strength of not less than 2000 psi after 28 days. Blocking shall be placed between solid ground and the hydrant or fitting to be anchored. Unless otherwise indicated or directed, the base and thrust bearing sides of thrust blocks shall be poured directly against undisturbed earth. The sides of thrust blocks not subject to thrust may be poured against forms. The area of bearing shall be as directed. Blocking shall be placed so that the fitting joints will be accessible for repair. Steel rods and clamps shall be protected by galvanizing or by coating with bituminous paint.

1.13 EQUIPMENT BASES

A. Pumps, tanks and other equipment shown on the plans shall be set on 4" high concrete pads. The pads shall be furnished by the General Contractor. The mechanical contractor shall coordinate pad size and location with the general contractor.

B. Roof curbs shall provide a free height from the roof membrane to the top of the curb of at least 12". All roof curbs and platforms shall have a wood nailer strip around the top perimeter for securing the roof membrane and attaching roof flashings. All equipment mounted on roof curbs shall be installed level. Flashings by Division 7.

C. Roof curbs shall be attached to the building structure as required by the 2021 IMC and local cods.

1.14 VIBRATION ISOLATION

A. All mechanical equipment over 5 H.P. shall be isolated in accordance with Table 34, Chapter 42, in the 2021 ASHRAE Handbook.

B. Care shall be taken by this contractor to prevent the transmission of vibration from equipment to building structure. Flexible connectors shall be installed in all piping connecting to pumps, air handling units, cooling towers, and other flexibly mounted equipment.

C. Flexible connection shall be specifically designed to absorb noise and vibration and to prevent damage to equipment caused by piping stress. Unit construction shall consist of heavy bellows type neoprene rubber hose sections with stainless steel liners and attachments to match piping.

PART 2 - PRODUCTS

2.1 PIPING SYSTEMS

A. All piping shall be in accordance with the American Society for Testing and Materials, ASTM A-53. **No foreign made piping or connectors will be accepted in this construction.**

B. Water piping to the pressure reducing station shall be Class 52 ductile iron pipe with mechanical joints.

C. Culinary cold, hot, and recirculating hot water above grade shall be Type "L" copper with soldered wrought copper fittings. 'Pull-T' systems will not be allowed.

D. Waste & rainwater piping water below slabs shall be standard weight DWV schedule 40 solid core PVC with solvent welded joints ASTMF 1488 piping.

E. Waste, vent & rainwater piping above grade shall be standard weight cast iron pipe with no-hub, tyseal, M-G, or A.B.I. 'Best' gasketed fittings for sizes 2" and larger; and galvanized Schedule 40 with tarred Durham drainage fittings for 1-1/2”.

F. All cast iron pipe and fittings, above ground, shall bear the collective trademark of the Cast Iron Soil Pipe Institute, or have prior approval of the engineer.

G. Condensate lines shall be Type "M" copper with soldered wrought fittings.

H. Gas lines shall be Schedule 40 black steel pipe. Fittings shall be standard black malleable screwed, or standard welding fittings where welding is required. All gas lines shall be installed in strict compliance with the local fuel supply company requirements.

I. Gas lines located outside the building and below finished grade shall be ASTM D2513 polyethylene plastic pipe. Fittings shall be ASTM D2513 polyethylene, butt-fusion type; and ASTM D2683, polyethylene socket-fusion type. Installation and piping material shall be in strict compliance with the local fuel supply company requirements.

J. All exposed gas piping and fittings shall be painted with UV resistant paint.

K. Refrigeration piping shall be Type “L” copper with malleable copper fittings. Piping shall be specifically treated and sealed for refrigeration systems piping, similar to Mueller.

L. NOTE: Pre-charged line sets will be permitted on refrigeration systems with rated capacities below 65,000 BTUH.

M. NOTE: All exposed piping, fittings, valves, and trim in kitchen area shall be chrome plated.

2.2 PIPING SYSTEMS: (Waste and Storm Water Outside Building)

A. All piping and fittings shall be SDR 35 in accordance with the American Society for Testing and Materials, ASTM D-3034 for 4" thru 15" piping. Piping shall be colored green for in ground identification as sewer pipe. No foreign made piping will be accepted in this construction.

B. Waste & stormwater piping below grade shall be polyvinyl chloride (PVC) gravity sewer pipe with integral wall bell and spigot joints.

C. All plastic sewer pipe and fittings shall meet the requirements of ASTM D 3034 and UNI BELL UNI-B-4. The standard dimension ratio (SDR) of all pipe and fittings shall not exceed 35 unless otherwise specified.

D. All pipe shall be suitable for use as a gravity sewer. Sizes and dimensions shall be as designated in ASTM D 3034 and/or UNI BELL UNI-B-4. Standard lengths shall lay 13 ft. +/- 1 inch. At manufacturer's option, random lengths may be shipped not to exceed 10% of total footage.

E. All joints shall be of the bell and spigot type and conform to ASTM D 3212 and/or UNI BELL UNI-B-1. Gaskets shall be in accordance with ASTM F 477. All bells shall be formed integrally with the pipe and shall contain a factory installed elastomeric gasket which is positively retained. No solvent cement joints will be permitted in field construction except as specifically authorized by the engineer.

F. All fittings shall be furnished by the pipe supplier. All fittings shall have a push-on joint which is compatible with the pipe and conform to ASTM D 3034.

G. Assembly Instruction:

1. Clean: Before starting assembly, make certain that the factory-installed gasket, bell recess and beveled spigot end are free of all dirt.

2. Lubricate: Apply lubricant to the exposed surface of the gasket; then also to the surface of the spigot up to the stop mark, including the tapered end of the spigot. (Note: DO NOT TOUCH lubricated spigot on trench wall or bottom to avoid dirt or other material from sticking.)

3. Assemble: Align the spigot to the bell and insert. Push spigot into the bell as far as the stop mark either by hand or with a bar and block.

2.3 HANGERS AND SUPPORTS

A. Vertical Piping:

1. Attachment - Vertical piping shall be secured at sufficiently close intervals to keep the pipe in alignment and to carry the weight of the pipe and contents.
2. Stacks shall be supported at their bases, and if over two (2) stories in height at each floor by approved metal floor clamps.
3. Cast iron soil pipe shall be supported at not less than each story height and at its base.
4. Screwed pipe (IPS) shall be supported at not less than every other story height.
5. Copper tubing shall be supported at each story for piping one and one-half (1-1/2) inches in diameter and at not more than six (6) foot intervals for piping one and one-quarter (1-1/4) inches in diameter and smaller. Piping shall be wrapped with three wraps of vinyl tape to isolate pipe from ferrous pipe supports.

B. Horizontal Piping:

1. **Under no circumstances shall piping be supported from the metal roof deck.**
2. It is essential that all piping be supported from roof structure at joist within 6” of panel point location and from top or bottom chord of floor or roof joist.
3. Supports - Horizontal piping shall be supported at sufficiently close intervals to keep it in alignment and prevent sagging.
4. Cast Iron Soil Pipe - Where joints occur, soil pipe shall be supported at not more than 5-foot intervals, except that where 10-foot pipe lengths are used, supports at 10-foot intervals are acceptable. Supports shall be placed within eighteen (18) inches of the hub or joint. No-hub joints and fittings shall be restrained with rods and clamps per manufacturer's recommendations.
5. Screwed pipe (IPS) shall be supported at approximately 12-foot intervals.
6. Copper tubing shall be supported at approximately 6-foot intervals for piping one and one-half inches and smaller in diameter and at 10-foot intervals for piping two inches and larger in diameter.
7. Piping placed underground shall be laid on a firm bed for its entire length. Hangers shall be Grinnell Figure 260 for both bare and insulated pipe.
8. Where roller type supports are used, they shall be chair type or suspension type, as required. (Provide carbon steel pipe saddles on insulated pipes).
9. Where piping is run adjacent to walls or steel columns, it shall be supported from steel brackets or vertical channel hangers. Brackets shall be Grinnell Figure PS 732 or PS 3282 as directed, or approved substitute. Channel systems shall be approved for each condition on an individual basis.
10. Furnish all hangers, inserts, brackets, anchors, guides, sliding supports, etc., and all auxiliary steel necessary for the installation. All supports shall be designed in accordance with the AISC Steel Handbook and painted with one shop coat of primer paint.
11. Insulation inserts and shields for hot and cold surface piping will be provided under Section 22 0700 of these specifications.
12. Pipe covering protection saddles shall be installed at all pipe hangers which support insulated "hot surface" piping. Saddles shall be tack welded to the piping and shall match the insulation thickness applied.

13. All copper, fiberglass, or plastic piping shall be securely supported from the building structure at intervals specified and/or as recommended by the pipe manufacturer. Hanger shields for suspended piping shall be functionally similar to isolators with Grinnell Fib. 97. Non-ferrous piping shall be isolated from contact with ferrous supports with three wraps of vinyl tape.
14. All piping in mechanical equipment rooms shall be supported with vibration control hangers.
15. Plumbers' tape, chain, or wire will not be permitted for pipe support.

2.4 VALVES AND STRAINERS

A. All valves and strainers shall be by one manufacturer. Approved valve manufacturers are Crane, Stockham, W. C. Norris, Grinnell, or Powell. Crane numbers are used for convenience.

B. Heating, Cooling, and Domestic Hot and Cold Water:

1. Gate Valves:
   a. Valves 2" and smaller shall be Crane No. 428, bronze, screwed, 200# WOG gate valve with solid wedge disc and rising stem.

   NOTE: If unable to use a rising stem valve because of insufficient clearance, use a Crane No. 438 nonrising stem valve.

2. Globe Valves:
   a. Valves 1-1/2" and smaller shall be Crane No. 37, bronze, screwed, 200# WOG globe valve with a replaceable teflon disc and teflon packing. The disc shall be suitable for hot water up to 360 deg. F. at 150 psi.

3. Check Valves:
   a. Valves 1-1/2" and smaller shall be Crane No. 37, bronze, screwed, Y-pattern 200# WOG swing check valve. Valves 2" and larger shall be Crane No. 373.

4. Butterfly Valves:
   a. Valves 2-1/2" and larger shall be Crane No. 23N-BRB iron body and disc, lug type, stainless steel stem, 200# WOG EPT Nordel seat rated for 275 deg. F butterfly valve.
   b. NOTE: Valves 4" and smaller shall be equipped with the proper size 10 position Multi-lock hand lever. Valves 5" and larger shall be equipped with the proper size Extra Power Manual weatherproof gear operator.

5. Ball Valves:
   a. For hot and cold domestic water service: Valves 2" and smaller shall be Crane No. 2190H bronze, screwed, 200# WOG, Gem ball valve with Buna-N rubber capsule. Watts B6000 or Apollo 70-100.

6. Strainers:
   a. Strainers 1-1/2" and smaller shall be Crane No. 988-1/2, iron body, screwed Y-pattern, 200# WOG, sediment separators with a 20-mesh Monel screen. All strainers shall be installed with fine mesh supplementary "construction screens" which shall remain in place while the system is flushed and chemically cleaned. The "construction strainer" basket shall be removed just prior to balancing the water systems.
   b. Provide blow-down ball valve with cap on all strainers same size as strainer tapping.

C. Gas Service:

1. Ball Valves:
   a. Valves 2" and smaller shall be Crane No. 2330-TF, bronze, screwed, 400# WOG Accesso ball valve with teflon seats, and shall have Underwriters' approval for LP gases up to the pressure limit of 250 psi set by that agency.

2. Gate Valves:
   a. Valves 3" and smaller shall be Crane No. 424, bronze, screwed, 400# WOG gate valve with Exelloy seats and shall have Underwriters' approval for LP gases up to the pressure limit of 250 psi set by that agency.

3. Globe Valves:
   a. Valves 2" and smaller shall be Crane No. 130, bronze, screwed, 400# WOG globe valve with a No. 6 replaceable composition disc and shall have Underwriters' approval for LP gases up to the pressure limit of 250 psi set by that agency.

4. Check Valves:
   a. Valves 2" and smaller shall be Crane No. 132, bronze, screwed, 400# WOG horizontal lift check valve with a No. 6 replaceable composition disc and shall have Underwriters' approval for LP gases up to 250 psi set by that agency.

5. Pressure Regulators:
   a. Furnish and install approval type gas pressure regulators in gas piping ahead of each appliance and piece of equipment, to which is connected. Regulators located outside the building shall have weatherproof vent with bugproof screen. Regulators located inside of building shall be vented to the outside thru the roof with weatherproof vent and thread-on bugproof screen.

2.5 NON-SLAMMING OR SPRING-LOADED CHECK VALVES

A. Types: Provide valves of the fully guided or cone-and-diaphragm types.

B. Bodies: Provide flanged or wafer type bodies constructed of cast iron ASTM A 126, Class B; cast steel ASTM A 216/A 216M, Class WCB; stainless steel, Type 304 or cast bronze ASTM B 61.

C. Trim: Seats, discs and springs shall be constructed of 18-8 stainless steel or bronze complying with ASTM B 62. Seats may be of elastomers suitable for 250 degrees F. minimum continuous working temperature or not less than 50 degrees F. above the operating temperature of the system, whichever is higher.

D. Mating Surfaces: Mating surfaces of closure faces shall be bronze or Type 316 or 17-4PH stainless steel or elastomer approved for the particular service and materials must be compatible to prevent electrolytic action.

E. Pressure Loss: Pressure loss through the valves, measured in feet of water, shall not exceed 6/10 of the water velocity in feet per second.

F. Bubble-Tight: Non-slamming and spring-loaded check valves shall provide bubble-tight shut-off when handling water up to 250 degrees F. and 125 pounds per square inch differential pressure. Design shall prevent rubbing of seat materials when opening and closing. Poppet valves shall have conical springs.

2.6 GENERAL DUTY VALVES & SPECIALTY COCKS

A. Cocks:

1. Balancing cocks 1-1/2" and smaller shall be Crane No. 80E, bronze, screwed, 200# WOG.
2. Balancing cocks 2" and larger shall be Crane No. 325, all iron, flanged 125# WOG.
3. Gas cocks 2" and smaller shall be Crane No. 270, flat head, bronze screwed.
4. Gage cocks shall be Crane No. 744, 1/4", bronze, screwed.
5. Pet cocks shall be Crane No. 702, 1/4", bronze, screwed with lever handle.
6. Try cocks shall be Crane No. 734, 3/8", bronze, screwed, 250# rated with stuffing box.
7. Provide two complete sets of wrenches for all cocks and stops.

2.7 BACKFLOW PREVENTERS

A. Backflow preventers shall comply with requirements of the 2021 International Plumbing Code as to type, style, size, location, and arrangement for the actual installed duty.

B. Where backflow preventers are installed which release water thru the valve to the atmosphere, these units shall be provided with drip pans which collect the free water. The drip pans shall be piped to the nearest drain.

C. All backflow preventers shall be installed with all necessary isolation valves and test cocks.

2.8 AUTOMATIC VALVES AND WELLS

A. The mechanical subcontractor shall install the automatic temperature control valves, temperature sensing wells, and flow switches, as directed by the automatic temperature control subcontractor.

2.9 UNIONS

A. Ground joint unions shall be installed on pipe 2-1/2" and under where indicated on drawings. Whenever piping is connected to a major piece of apparatus, unions shall be provided as near as practical on each side of the apparatus.

2.10 ISOLATION FITTINGS

A. Approved isolation fittings shall be installed at the junction of all copper and steel piping to prevent electrolytic action. **Fittings shall be dezincification resistant brass DZR corrosion resistant brass nipples and a minimum of 6” long or NZR brass nipples**. Fittings shall be submitted for approval.

2.11 THERMOMETERS

A. General: Provide liquid-in-glass type thermometers or Vari-angle digital thermometers as manufactured by Weiss unless bimetal dial type is required due to space limitations or other conditions.

B. Scale and Dial: Provide liquid-in-glass thermometers of the organic liquid type having a nominal scale length of not less than 7 inches. Provide bimetal dial thermometers with a nominal 5-inch dial size graduated through a minimum arc of 270 degrees. Provide a recessed dial so that graduated portion and pointer are in the same plane.

C. Range: Temperature range shall be as shown on the drawings or as specified. Chilled water system 20 degrees F. to 120 degrees F. Hot water system 30 degrees F. to 240 degrees F. Condenser water system 30 degrees F. to 240 degrees F.

D. Case: Provide liquid-in-glass type thermometer with an aluminum alloy or steel case. Provide bimetal dial thermometers with all exposed metal parts, including the case and stem made of 300 Series stainless steel, all welded construction.

E. Accuracy and Calibration: Bimetal dial thermometers shall have zero adjustment for recalibration and shall have an accuracy of plus or minus one percent of span through the complete range. Liquid-in-glass thermometers used for indicating shall have an accuracy of plus or minus 0.5-degree F. Unless otherwise required in other sections of the specifications, thermometers for commissioning tests shall have an accuracy of plus or minus 0.25-degree F.

F. Thermometers measuring temperature for energy calculations shall have an accuracy of plus or minus 0.1-degree F.

G. Thermometer Wells: Provide pipeline liquid-in-glass thermometers with a union connection, tapered bulb chamber and matching taper on well. Provide bimetal dial thermometers with a well to match bulb chamber. Provide wells for insulated pipe of the extension neck type suitable for insulation thickness. Provide wells fabricated of bronze, brass or 316 stainless steel suitable for the fluid or gas in the pipe.

H. Stem: Provide stems with a minimum length of 2-1/2 inches immersion which shall be increased in length as necessary to reach the center lines of the pipes in which they are installed.

I. Adjustment: Provide straight or angle pattern adjustable type thermometers as required to facilitate readings.

J. Thermometers shall be Palmer, Trerice, Marsh or Weiss. Install all thermometers so as to be easily readable from the floor.

2.12 PRESSURE GAUGES

A. General: Provide pressure gauges which comply with ANSI B40.1.

B. Dials: Provide dials not less than 4-1/2 inches in diameter, except that packaged equipment may be provided with manufacturer's standard gauges of equal accuracy.

C. Ranges: Select operating ranges so that during normal service the gauge pointer will be at the approximate midpoint of the gauge scale.

D. Refrigerant Gauges: Provide refrigerant pressure gauges with corresponding temperature scales for the particular refrigerant sensed.

E. Accuracy: Pressure gauges used for commissioning of other equipment shall have a minimum accuracy of 3 percent of span.

F. Gage Cocks: All gages shall be furnished with gage cocks and pressure snubbers.

G. Gauges shall be Ashcroft, Trerice, or U.S. Gage.

2.13 PRESSURE & TEMPERATURE TEST PLUGS

A. Plugs shall be brass body type with Neoprene, Nordel, or Vitron self-closing valve (to suit temperatures of fluid in pipe). Test plugs shall be Pete's Plug or approved substitute. Furnish six pressure and six temperature instruments to Owner to permit reading pressures and temperatures.

2.14 FLOW MEASURING AND BALANCING SYSTEMS

A. Furnish and install complete the Venturi and calibrated orifice Flow Metering Systems as shown on the drawings.

B. This shall be a coordinated system with individual Venturi Flow Stations supplied by one manufacturer and each individual calibrated orifice supplied by one manufacturer.

C. On pipe sizes 3/4-inch diameter and smaller, provide calibrated balancing valves on runouts to fan coil units, fin tube radiation, convectors and reheat coils.

D. Fittings shall be of the combination balancing and shut-off type with the balancing device positioned by an Allen set screw or other approved method which permits closing of the valves without disturbing its balanced position.

E. Bodies may be of the globe or "Y" type with contour flow plug or approved equivalent.

F. Provide a graduated dial or other device to indicate the valve setting.

G. Gland shall permit packing under pressure.

H. Materials and construction shall be as specified for water valves sizes 1-1/2-inch and smaller.

I. On sizes 3/4-inch and smaller ends may be sweat or compression type.

J. Each station shall be complete with quick disconnect valves and safety shut-off valves, metal identification tag on chain giving pipe size, meter series, station identification, and meter reading at specified flow rate. Metering stations shall be selected so that design flow rate shall be between 10 and 40 inches of water pressure differential with permanent pressure loss of not more than 25% of indicated flow rate differential pressure.

K. The calibrated flow metering valves shall be selected to deliver the rated flows at the mid-point of their set-point range.

L. A master meter shall be furnished to the owner for maintenance purposes.

M. Venturi Flow Metering System shall be by Barco Engineering Company or Robertson. Calibrated orifice system shall be Bell & Gossett, Armstrong, or Taco.

2.15 V-BELT DRIVES

A. Capacity of V-belt drives at rated RPM shall be not less than 150 percent of motor nameplate horsepower rating.

B. V-belt drive combinations shall be limited to A, B, C, and fractional horsepower belts. 3V, 5V, and 8V belts and sheaves shall not be used.

C. Drives requiring single belt application shall be of the adjustable pitch type. Multiple belt drives shall be of the non-adjustable type. All fixed pitch sheaves, including single groove fan sheaves, shall be of the bused type. Fixed bore sheaves will not be acceptable for non-adjustable pitch sheaves.

2.16 MAGNETIC STARTERS

A. Contractor furnishing "packaged equipment" with 1/2 HP and larger motors shall furnish factory-mounted magnetic starters. Magnetic starters shall provide both overload and under voltage protection and shall have integral hand-off-auto switch, auxiliary contacts, and pilot. All motors installed under this contract shall have a disconnect switch in the immediate vicinity of the motor. Starters on three phase motors shall protect all three legs of the circuit. Starters to be Square "D". (No substitutions).

B. Starters for all motors on other than "packaged equipment" which are furnished under the mechanical section of the work will be installed by the electrical contractor.

C. Starters shall be two-speed type or explosion-proof type where required.

D. Provide a heater index bound in the O & M manual and listed in digital format for all starters furnished on the project.

2.17 MISCELLANEOUS ITEMS

A. Motors:

1. Motors shall be furnished and installed under the applicable Mechanical Sections of the Specifications.
2. Each motor shall be provided with a nameplate for the electrical characteristics shown on the Drawings or as otherwise noted.
3. Motors shall be constructed and rated to deliver full nameplate capacity at the project altitude.
4. Horsepower shall be at least equal to that shown on the drawings. Where equipment is submitted and approved for the installation which requires larger motor sizes than shown, the wire and starter sizes shall be increased and means provided for operation and control suitable for the larger motors with no increase in cost to the Owner.
5. Unless otherwise specified, or required for controller sequencing, all motors over 5 HP shall be high efficiency type, and all fractional HP single phase motors 1/2 HP & under shall be permanent split capacitor (PSC) type.
6. Premium efficiency motors shall be based on CEE premium efficiency criteria for OPD motors at 1800 RPM.

HORSEPOWER	NEMA PREMIUM EFFICIENCY
5	89.5%
7.5	91.0%
10	91.7%
15	93.0%
20	93.0%
25	93.6%
30	94.1%
40	94.1%
50	94.5%

7. Motors for V-belt drives shall be provided with cast iron or steel base, with slide rail and adjustable screw device and shall be isolated by rubber-in-shear devices.
8. Motors shall have sufficient capacity to start and operate the machine it drives without exceeding the motor nameplate rating at the speed specified or at any speed and load which may be obtained by the drive actually furnished.
9. Motors provided with automatic control shall be capable of making as frequent starts as the control device may demand. Motors not provided with automatic control shall be capable of making not less than 4 starts per hour.
10. All belt-connected motors, regardless of size, shall be equipped with shafts and bearings that will withstand both the normal belt pull of the drive furnished and the momentary or continuous overloads due to acceleration of incorrect belt tension.
11. Motors shall be air cooled and shall be guaranteed to operate continuously at 115% of full load with temperature rise in any part not to exceed 40 degrees C above the ambient air temperature.
12. Motors shall be open drip-proof or totally enclosed fan cooled type as required and shall be commercially dynamically balanced and tested at the factory before shipment.
13. Motors shall be selected for quiet operation. Sound power levels shall be within NEMA MGI-12.49.
14. Motors shall comply with the requirements of ANSI C 50, NEMA MG-1, and all NEMA standards.
15. Motors controlled by variable frequency drives shall have characteristics which are fully compatible with the drives to which they are connected. Provide written confirmation of coordination with VFD supplier.
16. Approved Manufacturers: Allis-Chalmers, Century, Gould, Lincoln, Reliance, Westinghouse, U.S.

2.18 SEISMIC RESTRAINTS

A. All Division 21, 22 & 23 equipment, piping, and ductwork shall be anchored and seismically restrained as required by the IBC for site Seismic Zone requirements and per NFPA 90A (current edition), UL Standard 181, Tri-services Manual Fagel Et Al 1973, and the SMACNA Guidelines for seismic restraints of mechanical systems.

B. The Division 21, 22 & 23 contractor shall be responsible for supplying and installing equipment, vibration isolators, flexible connections, rigid steel frames, anchors, inserts, hangers and attachments, supports, seismic snubbers and bracing to comply with the site Seismic Zone and per of the 2021 International Building Code.

C. All supports, hangers, bases, anchorage and bracing for all isolated equipment shall be designed by a professional engineer employed by the restraint manufacturer, qualified with seismic experience in bracing for mechanical equipment.

D. Shop drawings submitted for earthquake bracing and anchors shall bear the Engineer's signed professional seal.

E. The above qualified seismic engineer shall determine specific requirements on equipment anchorage and restraints, locations and sizes based on shop drawings for the mechanical equipment which have been submitted, reviewed and accepted by the Owner's representative for this project.

F. The Division 21, 22 & 23 contractor shall require all equipment suppliers to furnish equipment that meets the seismic code, with bases designed to receive seismic bracing and/or anchorage. All isolated mechanical equipment bracing to be used in the project shall be designed for the equipment shop drawings and certified correct by the equipment manufacturer for Seismic Zone D with direct anchorage capability.

G. Submit shop drawings, calculations, and printed data for the following items under provisions of the General Conditions of the Contract:

1. Complete engineering calculations and shop drawings for all vibration and seismic requirements for all equipment to be isolated and restrained.
2. The professional seal of the engineer who is responsible for the design of the Vibration and Seismic restraint System for isolated equipment.
3. Details for all the isolators and seismic bracing with snubbers proposed for items in this specification and on the drawings.
4. Details for steel frames, concrete inertia bases, and anchors to be used in conjunction with the isolation of the items in this specification and drawings.
5. Clearly outlined procedures for installing and adjusting the isolators, seismic bracing anchors and snubbers.
6. The location of all restraints of pipes and ducts with the locations shown on a floor plan noting the size and type of anchorage and restraint to be used.

H. Snubbers:

1. Snubbers shall be double acting and consist of interlocking steel members restrained by replaceable shock absorbent elastomeric materials a minimum of 3/4 inch thick.
2. Snubbers shall be manufactured with an air gap between hard and resilient material of not less than 1/8 inch nor more than 1/4 inch.
3. A one "g" minimum vertical and lateral level shall be used in the design of all snubbers restraining isolated equipment.

I. Design and Installation:

1. General: All mechanical equipment, piping and ductwork shall be braced, anchored, snubbed or supported to withstand seismic disturbances and remain operational. Provide all engineering, labor, materials and equipment for protection against seismic disturbances as specified herein.
2. All equipment not anchored directly to the floors shall be restrained by cables as designed and furnished by the Restraint Manufacturer.
3. Isolated Equipment: All vibration isolated equipment shall be mounted on rigid steel frames or concrete bases as described in the vibration control specifications unless the equipment manufacturer certified direct attachment capability. Each spring mounted base shall have a minimum of four all-directional seismic snubbers that are double acting and located as close to the vibration isolators as possible to facilitate attachment both to the base and the structure. Snubbers shall be installed with factory set clearances.
4. Piping: All isolated and non-isolated piping 2-1/2" I.D. and larger shall be protected in all planes by restraints to accommodate thermal movement as well as restrain seismic motion. Where necessary the piping restraints shall be resiliently attached to the piping with vibration dampening inserts to prevent the transmission of vibration to the building structure.
Locations shall be as scheduled and shall include but not be limited to:

a. At all drops to equipment and at flexible connections. At all 45 deg. or greater changes in direction of pipe.
b. At horizontal runs of pipe, not to exceed 30 ft. O.C. spacing.
a. Piping shall be restrained by a cable restraining system using a minimum of two cables at all restraint points.

5. Piping in mechanical rooms shall have additional restraints as scheduled.
6. Non-Isolated Equipment: The restraint systems for all non-isolated equipment are to be installed to resist stresses produced by lateral forces according to Sec. 2312 of the International Building Code with an Occupancy Importance Factor of 1.5, a Seismic Zone Factor of Z = 0.75 for Zone 3 and a Horizontal Force Factor for Elements of Structures and Nonstructural Components of Cp = 0.3. In addition, the vertical forces restraint requirement shall be half the value of the horizontal forces. All equipment not anchored directly to floors shall be restrained by cables as designed and furnished by the Restraint Manufacturer.

7. Acceptable Manufacturers and Suppliers for Non-Isolated Systems:

a. Mason Industries, Inc.
b. Korfund
c. Amber/Booth Company
d. Vibration Mountings and Control Company

8. Manufacture and design of restraints and anchors for internally isolated equipment shall be the responsibility of the manufacturer of the vibration isolators furnished with the equipment.
9. Piping, ductwork, and equipment without moving parts shall be restrained as shown and noted on the drawings. Locations shown are approximate and shall be coordinated with other trades and with the structural engineer at the job site.

J. Field Services:

1. **The seismic restraint manufacturer's engineer shall inspect the final installation and shall certify that all seismic restraints have been installed per manufacturer's instructions and applicable codes and standards. A letter of certification shall be provided in O&M manuals.**

2.19 GREASING AND OILING

A. Prior to placing the equipment in operation, the bearings on all motors, fans, pumps, etc., shall be properly lubricated with a lubricant suitable for the service.

B. Lubrication instruction tags are to be left on "all" bearings and equipment for the Owner's future use. Only lubricants recommended by the equipment manufacturers shall be used.

C. It shall be incumbent on the contractor to operate the building equipment used for temporary heat, etc., in a prudent manner to ensure that when the building is turned over to the Owner all equipment is in a "first-class" condition.

D. Equipment shall not be operated unless:

1. All safety devices are installed and functioning properly.
2. Filters are in place on fan systems. Filters to be new and clean.
3. Equipment is properly greased and oiled.
4. Belts and drives are properly aligned and adjusted.

E. The contractor shall maintain a current "equipment maintenance" chart in the construction shack at all times. This chart shall be posted in a conspicuous place and shall include all items of maintenance necessary for proper operation of the equipment.

F. Equipment used for temporary heat and cooling shall, if requested by the Contracting officer, have tube bundles pulled by contractor for Owner inspection prior to acceptance.

2.20 VALVE TAGGING

A. All valves shall be designated by distinguishing numbers and letters on required charts and diagrams. The contractor shall furnish and install approved engraved plastic tags for all designated items, which numbers and letters on the tags corresponding to those on the charts and diagrams.

B. Tags shall be not less than 1-1/2" diameter with depressed black filled numbers not less than 1/2" high and black filled letters not less than 1/4" high. Tags shall be securely fastened to valves with approved brass "S" hooks, or brass jack chain, in a manner to permit easy reading. Zip ties are not acceptable. Do not attach to valve wheel. Brass tags shall be as manufactured by Seton Name Plate Company, New Haven, Connecticut, or approved equal.

C. Each valve shall have an identifying number identifying the unit. Standard identifications may be used for identifying type of service or fluid in pipe. The contractor shall submit his system of identification to the Owner's representative for approval prior to ordering. Any work done without this approval is done at the contractor's risk.

D. Charts of all valves shall be furnished to the Owner's representative by the contractor.

E. A chart to be mounted in a frame with clear glass front, and secured on the wall in the main Mechanical Equipment Room.

F. Second chart shall be prepared for use outside of the equipment room, and to be provided with an approved heavy transparent plastic closure for permanent protection. Two (2) holes to be punched at top of plastic closure to allow for affixing approximately an 8" length of nickel plated bead chain. Each hole to be reinforced by means of a small brass or nickel grommet. Plastic closure shall be manufactured by Seton Name Plate Company, New Haven, Conn., or approved equal.

G. Identify all valves. A sample identification shall be as follows:

VALVE IDENTIFICAION CHART

NUMBER	DESCRIPTION	LOCATION	NORMAL POSITION
1.	Cold Water Supply to Water Heater	Mech. Room #121	Open
2.	Cold Water Supply to Hose	Room #13	Open
3.	Cold Water Supply to Equip. in Room #12	Room #18	Open
4.	Hot Water Supply to Toilet Room #212	Chase #210	Open
5.	Air Vents - Cooling Coil #12 (2 required)	Fan Room 3122	Closed
6.	Heating Hot Water Balancing Valve (Southwest Zone)	Above Ceiling Room #412	Marked On Valve

The above chart shall refer to the room numbers actually used for the project.

H. Mechanical Equipment & Ductwork:

1. All mechanical and plumbing equipment, including meters, fans, pumps, water heaters, and other devices shall be identified with signs made of laminated plastic 1/8" or larger engraved letters. Signs shall be securely attached by rustproof screws or some other permanent means (no adhesives).
2. Information on sign shall include name of equipment, rating, maintenance instructions, and any other important data not included on factory attached nameplate.
3. Signs shall be attached to equipment so they can be easily read.
4. Identify all ducts exposed in mechanical equipment rooms and in ducts and pipe chases. Sample duct identification shall be as follows:

   "Cold Duct - High Pressure - To Second Floor System"
   "Exhaust Duct - Toilet Room - To EF-3"
   "Ventilation Air Duct - To Utility Room #228"

5. Ducts shall be labeled at all wall penetrations and at connections to equipment.

2.21 PAINTING

A. Mechanical Contractor: All equipment which is to be furnished in factory prefinished conditions by the mechanical contractor shall be left without mark, scratch, or impairment to finish upon completion of job. Any necessary refinishing to match the original shall be done. Do not paint over nameplates, serial numbers, or other identifying marks.

B. Mechanical Contractor: Spot painting for application of pipe and equipment identification markers.

C. All piping exposed to weather. All insulated piping and all piping in equipment rooms of finished areas shall be painted, as required by the painting specifications.

D. Coding, Pipe Identification & Painting:

All pipes are to be labeled and color coded with contents clearly identified and arrows indicating direction of flow. Pipes shall be identified at the following locations:

1. Adjacent to each valve.
2. At every point of entry and exit where piping passes thru wall or floor.
3. Every 50 feet on long continuous lines.
4. On each riser and junction.
5. Adjacent to all special fittings or devices (regulating valves, etc.)
6. Connection to equipment.

Apply markers to they can be read from floor.

E. Labels and markers shall be of the self-sticking, all temperature permanent type.

F. Pipe color coding shall be uniform throughout.

G. Background colors shall be as follows:

Yellow:	Dangerous Materials (natural gas condensate, etc.)
Bright Blue:	Protective Materials (filtered water)
Green:	Safe Materials (chilled water, cold water, instrument air, sanitary sewer, etc.)

H. Letters of identification legend shall be 2" high for pipes 3" and larger, and 1" high for pipes 2-1/2" and under.

I. Markers shall be installed in strict accordance with the manufacturer's instructions.

J. On chalky and loose insulation, soft, porous, fiber-filled or fiberglass coverings, a spiral wrap of pipe banding tape shall be made around the circumference of the pipe.

K. Sufficient spiral wraps shall be made to accommodate the horizontal dimension of the pipe marker.

L. On bare pipes, painted pipes, and pipes insulated with a firm covering, pipe banding tape matching the background color of the marker shall be used for 360 deg. color coding. After applying pipe markers, wrap pipe banding tape around pipe at each end of marker. Tape should cover 1/4" to 1/2" of each end of marker, and should overlap approximately 1/2" to 1" on itself. Be sure pipe surface is dry and free of dirt or grease before applying markers or banding tape.

M. Stenciling may be used in lieu of the above labels and markers if finished application gives the same overall appearance that is that stenciling is applied over a background color. If stenciling is used, letter heights, background colors, banding, and arrow shall be as specified above. Submit sample to Owner's representative before proceeding with work.

2.22 PLASTIC MARKING TAPE

A. Provide and install continuous plastic tape over the top of all underground utilities. Tape shall be placed 1/2 way between finished grade and top of utility line.

B. Plastic marking tape for underground utilities shall be acid and alkali-resistant Polyethylene film, 6 inches wide with minimum thickness of 0.004 inch. Tape shall have a minimum strength of 1750 psi lengthwise and 1500 psi crosswise. The tape shall be manufactured with integral wires, foil backing or other means to enable detection by a metal detector when the tape is buried up to 3 feet deep. The tape shall be of a type specifically manufactured for marking and locating underground utilities. The metallic core of the tape shall be encased in a protective jacket or provided with other means to protect it from corrosion. Tape color shall be as specified in Table 1 and shall bear a continuous printed inscription describing the specific utility.

TABLE 1 - TAPE COLOR

Yellow	Gas, Oil, Dangerous Materials
Blue	Water systems
Green	Sewer Systems

2.23 CEILING MARKERS

A. Use round color coded stickers on all accessible ceiling tile grid to indicate location of VAV boxes, valves and dampers.

B. Color code as follows:

Yellow	HVAC
Green	Plumbing
Blue	Air
White	Duct valves
Orange	Electrical devices
Red	Fire

PART 3 - EXECUTION

3.1 COORDINATION

A. All equipment and piping shall be arranged to allow for easy maintenance and access to service valves.

B. Provide valves and unions or flanges at all pieces of equipment to allow maintenance.

C. Install all automatic valves, sensor well, flow switches, etc., as directed by the control contractor.

3.2 TESTING

A. All piping shall be tested in accordance with Section 230501 prior to applying insulation or concealing in partitions, wall, etc.

3.3 ACCESS

A. All valves and equipment shall be located to allow easy access for inspection, service and maintenance, test and balance, and operation. If valves are installed in inaccessible locations, it shall be this contractor's responsibility to furnish and install access doors of a type approved by the owner's representative.

B. Locate piping, valves, etc., to allow easy access to and maintenance of equipment. Do not block walkways, filter access, maintenance access, or tube-pull space in equipment rooms.

3.4 CEILING ACCESS DOORS

A. Furnish and install complete ceiling access doors for each fire damper or VAV reheat box located above inaccessible ceilings as shown or mentioned on the drawings. All access doors are to be 24" X 24" in size. Refer to Architectural Ceiling Plans. Wherever a fire rated classification is indicated provide access door assembly with panel door, frame, hinge, and latch from manufacturer listed Underwriters Laboratories, Inc.; "Classified Building Materials Index" for rating shown. Provide UL label on each fire rated access door.

B. In addition to the access panels mentioned above, provide thirty (30) non-fire rated access doors for location in gypsum board ceilings, as directed by Architect.

C. Units shall be fabricated of continuous welded steel construction. Grind welds smooth and flush with adjacent surfaces. Frames shall be fabricated from 16-gauge steel. Flush panel doors shall be fabricated from 14-gauge sheet steel, with concealed spring hinges or concealed piano hinge set to open 175 degrees. Finish with manufacturer's factory applied prime paint.

D. Locking devices shall be screwdriver operated cam lock of number required to hold door flush, smooth plane when closed. Ceiling access doors shall be Karp, Meadowcraft, Milcor or Nystrom.

3.5 LOCATIONS & ARRANGEMENTS

A. All pressure gages shall be so installed as to be easily readable from eye level 5' -6" above the floor.

B. Test plugs on flow measuring stations shall be unobstructed and shall be arranged in the piping per manufacturer's recommendations.

C. All equipment and accessories shall be installed to facilitate proper service and maintenance in compliance with the manufacturer's recommendations.

3.6 WIRING BY THE ELECTRICAL CONTRACTOR

A. It is the intent of these specifications that all line voltage electrical power wiring and power connections to equipment be furnished and installed by the electrical contractor, unless otherwise specified or shown on the drawings.

B. The mechanical contractor shall coordinate actual job-site power requirements with the electrical contractor prior to installation of power wiring and electrical equipment. The electrical contractor shall provide necessary wiring to electric heat tape as required and shall coordinate with the mechanical contractor the location and capacity of required circuits.

C. When mechanical system components are furnished with remote mounted control panels, alarm bells, alternators, etc. the electrical contractor shall run all required line voltage power wiring as directed by the mechanical contractor. It shall be the mechanical contractor's responsibility to coordinate the work and provide the necessary wiring diagrams.

D. When exhaust fans are provided which are not controlled by the ATC contractor, they shall be wired to local line voltage wall switches. The wall switch locations shall be coordinated with the owner's representative.

E. Line and low voltage control wiring will be furnished and installed by the ATC contractor in accordance with IEC and Division 26. Minimum 3/4" conduit.

3.7 STORAGE AND INSTALLATION OF MOTORS

A. Handle motors carefully to prevent damage, denting and scoring. Do not install damaged motors or components; replace with new.

B. Store motors and components in a clean, dry place. Protect from weather, dirt, water, construction debris, and physical damage.

C. Install motors where indicated on the drawings and in accordance with manufacturer's drawings and in accordance with manufacturer's published installation instructions.

D. Install each direct-connected motor such that it is securely mounted in accurate alignment. The drive must be free from both angular and parallel misalignment when both motor and driven machine are operating at normal temperatures. Provide each belt-connected motor with a securely mounted adjustable base to permit installation and adjustment of belts.

3.8 INSTALLATION OF ABOVE GROUND PIPING

A. Provide piping systems of sizes indicated on the drawings. Systems shall be installed complete.

B. Install piping systems in conformance with ANSI B31.

C. Install piping to allow for expansion and contraction of the piping systems. Provide offsets and swing joint connections at coils, pumps and other equipment to eliminate undue strain to the equipment connections.

1. Springing of piping at equipment connections will not be permitted.
2. The use of "cold-spring" is not permitted.

D. Branch connections to up feed systems shall be made at the top or at a 45-degree angle above the centerline. Branch connections for down feed systems shall be made at the bottom or at a 45 degree angle below the centerline.

E. Install water piping with a pitch or slope of not less than 1-inch in 40 feet.

1. Provide 3/4-inch diameter plugged drain valves at each low point in mechanical rooms.

F. High Points: At each high point of the piping system provide a 3/8-inch diameter plugged globe valve.

1. Where high points are located in an inaccessible position, provide a 3/8-inch diameter bleed line from the high point of the piping system and extend to an approved location, with access. Anchor bleed piping and provide 3/8-inch diameter globe valve.

G. Support, anchor, and guide piping systems to preserve piping flexibility and the isolation effects of sound and vibration isolation hangers.

H. All installed pipelines shall be straight, free from dents, scars and burrs, with ends reamed smooth and shall remain straight against strains tending to cause distortion during system operation. The Contractor shall make proper allowance for pipeline expansion and contraction so that no unsightly distortion, noise, damage or improper operation will occur.

I. Piping shall be run in a neat and efficient manner and shall be neatly organized. Piping shall be run parallel or at right angles to the building walls or construction. The Contractor shall study the general, electrical, and other drawings to eliminate conflict of piping with structure, sheet metal, lighting, or other services. Unless specified otherwise, no piping shall be exposed in a finished room, all changes in direction shall be made with fittings.

J. All piping shall be clean and free from acids and loose dirt when installed.

K. Temporary pipe plugs of rags, wool, cottons, waste or similar materials shall not be used.

L. All piping shall be so arranged to not interfere with removal of other equipment or devices and shall not block access openings, etc.

M. Piping shall be arranged to facilitate equipment maintenance.

N. Flanges or unions shall be provided in the piping at connections to all items of equipment.

O. All piping shall be installed to insure noiseless circulation.

P. All valves and specialties shall be so placed to permit easy operation and access, and all valves shall be regulated and adjusted at the completion of the work.

3.9 VALVE INSTALLATION

A. After piping system has been tested and put into service, but before final testing, adjusting and balance, inspect each valve for possible leak. Open and close each valve to verify proper operation.

3.10 INSTALLATION OF UNDERGROUND PIPING

A. Coordinate the routing and location of all underground piping with building footings. See structural drawings.

B. Outside pipe placed underground shall be buried deep enough to protect against freezing.

C. Depth of bury of services shall be:

	Minimum	Preferred
Sewer	48"	48"
Rainwater	48”	48”
Water	48”	60”
Gas	36”	42”
Fire	48”	48”

D. Services shall be buried at the "preferred" depth unless site conditions require the "minimum" depth as listed above.

E. Handling: Pipe and accessories shall be handled so as to insure delivery to the trench in sound, undamaged condition. Particular care shall be taken not to injure the pipe coating. If the coating or lining of any pipe or fitting is damaged, the repair shall be made by the Contractor at his expense in a satisfactory manner. No other pipe or material of any kind shall be placed inside a pipe or fitting after the coating has been applied. Pipe shall be carried into position and not dragged. Use of pinch bars and tongs for aligning or turning pipe will be permitted only on the bare ends of the pipe. The interior of pipe and accessories shall be thoroughly cleaned of foreign matter before being lowered into the trench and shall be kept clean during laying operations by plugging or other approved method. Before installation, the pipe shall be inspected for defects. Material found to be defective before or after laying shall be replaced with sound material without additional expense to the owner. Rubber gaskets that are not to be installed immediately shall be stored in a cool dark place.

F. Coated and wrapped steel pipe shall be handled in conformance with AWWA Standard C203.

G. Cutting of pipe shall be done in a neat and workmanlike manner without damage to the pipe. Unless otherwise recommended by the manufacturer and authorized by the Contractor Officer, cutting shall be done with an approved type mechanical cutter. Wheel cutters shall be used when practicable.

H. Copper tubing shall be cut square, and all burrs shall be removed.

I. Locating: Where the location of the water pipe is not clearly defined by dimensions on the drawings, the water pipe shall not be laid closer horizontally than 10 feet from a sewer except where the bottom of the water pipe will be at least 12 inches above the top of the sewer pipe, in which case the water pipe shall not be laid closer horizontally than 6 feet from the sewer. Where water lines cross under gravity-flow sewer lines, the sewer pipe for a distance of at least 10 feet each side of the crossing shall be fully encased in concrete or shall be made of pressure pipe with no joint located within 3 feet horizontally of the crossing. Water lines shall, in all cases, cross above sewage force mains or inverted siphons and shall be not less than 2 feet above the sewer main. Joints in the sewer main, closer horizontally than 3 feet to the crossing, shall be encased in concrete.

J. Water lines shall not be laid in the same trench with sewer lines, gas lines, fuel lines, or electric wiring.

K. Copper tubing shall not be installed in the same trench with ferrous piping materials.

L. Nonferrous metallic pipe: Where nonferrous metallic pipe, e.g., copper tubing, crosses any ferrous piping material, a minimum vertical separation of 12 inches must be maintained between pipes.

M. Plastic pipe shall be insulated against heat from steam lines, water lines, or other heat sources.

N. Placing and Laying: Pipe and accessories shall be carefully lowered into the trench. Under no circumstances shall any of the materials be dropped or dumped into the trench. Care shall be taken to avoid abrasion of the pipe coating. Pipe shall be laid with the bells facing in the direction of laying. The full length of each section of pipe shall rest solidly upon a compacted sand bed, with recessed excavated to accommodate bells, couplings, and joints. Pipe that has the grade or joint disturbed after laying shall be taken up and re-laid. Pipe shall not be laid in water or when trench conditions are unsuitable for the work. Water shall be kept out of the trench until jointing is completed. When work is not in progress, open ends of pipe, fittings, and valves shall be securely closed so that no trench water, earth, or other substance will enter the pipes or fittings. Where any part of the coating or lining is damaged, the repair shall be made by the Contractor at his expense in a satisfactory manner. Pipe ends left for future connections shall be valved, plugged, or capped, and anchored, as required.

O. Where prescribed by the manufacturer of the pipe, gaskets shall be placed in the groove on the end of the pipe before the pipe is placed in the trench. After the pipe has been forced together, the position of the rubber gasket shall be checked with a feeler gage in accordance with the pipe manufacturer's recommendations. Pipe shall be protected during handling against impact shocks and free fall and the pipe interior shall be free of extraneous material.

P. Laying of gravity drain shall proceed upgrade with the spigot ends of bell-and-spigot pipe and tongue-and-groove pipe pointing in the direction of the flow. Each pipe shall be laid accurately to the line and grade shown on the drawings. Pipe shall be laid and centered so that the pipe has a uniform invert. As the work progresses, the interior of the pipe shall be cleared of all superfluous materials.

Q. Before making pipe joints, all surfaces of the portions of the pipe to be joined shall be clean and dry. Lubricants, primers, and adhesives shall be used as recommended by the pipe manufacturer. The joints in gravity drain lines shall then be placed, fitted, joined, and adjusted so as to obtain the degree of water tightness required.

3.11 EXCAVATION

A. Excavation of every description and of whatever substances encountered shall be performed to the lines and grades indicated. During excavation, material satisfactory for backfilling shall be stockpiled in an orderly manner at a distance from the banks of the trench sufficient to avoid overloading and to prevent slides or cave-ins. Adequate drainage shall be provided for the stockpiles and surrounding areas by means of ditches, dikes, or other approved methods. The stockpiles shall also be protected from contamination with unsatisfactory excavated material or other material that may destroy the quality and fitness of the suitable stockpiled material. If the Contractor fails to protect the stockpiles and any material becomes unsatisfactory as a result, such material, if directed, shall be removed and replaced with satisfactory on-site or imported material from approved sources at no additional cost to the owner.

B. Excavated material not required or not satisfactory for backfill shall be removed from the site. Grading shall be done as may be necessary to prevent surface water from flowing into the excavation, and any water accumulating therein shall be removed so that the stability of the bottom and sides of the excavation is maintained. Sheeting and shoring for the work and for the safety of personnel shall be in compliance with applicable safety standards.

C. Trench Excavation: The trench shall be excavated as recommended by the manufacturer of the pipe to be installed. Trench walls below and above the top of the pipe shall be sloped, or made vertical, as recommended in the manufacturer's installation manual. The trench width below the top of the pipe shall not exceed that recommended in the installation manual. Where no manufacturer's installation manuals are available, trench walls below the top of the pipe shall be vertical, and trench walls above the top of the pipe shall be sloped as required to properly complete the work. Trench width below the top of the pipe shall not exceed 24 inches plus pipe outside diameter (O.D.). Where recommended trench widths are exceeded, redesign shall be performed by the Contractor using stronger pipe or special installation procedures. The cost of this redesign and the increased cost of the pipe or installation procedures shall be borne by the Contractor without additional cost to the Owner.

D. Bottom Preparation: The bottoms of trenches shall be accurately graded to provide uniform bearing and support for the bottom quadrant of each section of the pipe. Bell holes shall be excavated to the necessary size at each joint or coupling to eliminate point bearing. Stones of 3 inches or greater in any dimension, or as recommended by the pipe manufacturer, whichever is smaller, shall be removed to avoid point bearing.

E. Removal of Unyielding Material: Where overdepth is not indicated and unyielding material is encountered in the bottom of the trench, such material shall be removed 4 inches below the required grade and replaced with suitable materials.

F. Removal of Unstable Material: Where unstable material is encountered in the bottom of the trench, such material shall be removed to the depth directed and replaced to the proper grade with select granular material. When removal of unstable material is required due to the fault or neglect of the Contractor in his performance of the work, the resulting material shall be excavated and replaced by the Contractor without additional cost to the Owner.

G. Excavation for Appurtenances: Excavation for manholes, catch basins, inlets, or similar structures shall be of sufficient size to permit the placement and removal of forms for the full length and width of structural footings and foundations as shown. Removal of unstable material shall be as specified above. When concrete or masonry is to be placed in an excavated area, special care shall be taken not to disturb the bottom of the excavation. Excavation to the final grade level shall not be made until just before the concrete or masonry is to be placed.

3.12 BACKFILLING

A. Backfill material shall consist of satisfactory material. Backfill shall be placed in layers not exceeding 4 inches loose thickness for compaction by hand operated machine compactors, and 8 inches loose thickness for other than hand operated machines, unless otherwise specified. Each layer shall be compacted to at least 95 percent maximum density unless otherwise specified.

B. Trenches shall be backfilled to the grade shown. The trench shall be backfilled to 2 feet above the top of the pipe prior to performing the required pressure tests. The joints and couplings shall be left uncovered during the pressure test.

C. Replacement of Material: Material removed from the bottom of the trench shall be replaced with 6" sand base prior to the installation of the piping. Piping shall be encased in sand with a 6" top layer over the top of the piping.

D. Initial backfill material shall be placed in layers of a maximum of 4 inches loose thickness and compacted with approved tampers to the density of the adjacent soil and to a height of at least 1 foot above the utility pipe or conduit. The backfill shall be brought up evenly on both sides of pipe for full length of the pipe. Care shall be taken to ensure thorough compaction of the fill under the haunches of the pipe. Backfill material in this portion of the trench shall consist of satisfactory material at a moisture content that will facilitate compaction free from stones of such size as recommended by the pipe manufacturer, or larger than 2 inches in any dimension, whichever is smaller, except that where the pipe is coated or wrapped for protection against corrosion, the backfill material shall be free of stones larger than 1 inch in any dimension, or as recommended by the pipe manufacturer, whichever is smaller.

E. The remainder of the trench, except for special materials for roadways, shall be backfilled with satisfactory material.

F. Degree of Compaction: Degree of compaction required is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557, Method B or D.

3.13 INSTALLATION OF VALVES

A. Gas Cocks: Provide and install gas cocks at connection to gas train for each gas-fired equipment item; and on risers and branches where indicated on the drawings. Locate gas cocks where easily accessible and where they will be protected from possible injury.

B. Pressure Regulating Valves: Install pressure regulating valves in accordance with local utility company's requirements and manufacturer's installation instructions. Install gas shutoff valve upstream of each pressure regulating valve. Each pressure regulating valve shall have an independent vent piped to the outside of the building. Vents shall be terminated with an approved bug screen fitting.

3.14 INSTALLATION OF NATURAL GAS PIPING

A. General: Install natural gas piping as shown on the drawings in accordance with NFPA 54 and as follows.

B. Caulk spaces watertight between pipes and sleeves passing through exterior walls, slabs on grade and over crawl spaces, and waterproofed floors. Pack and seal spaces between pipes and sleeves passing through floors, walls, and ceilings of machine spaces, such as mechanical equipment, refrigeration, boiler, pump, fan, and machinery rooms at both ends of sleeve to provide an airtight acoustical barrier.

C. Unless otherwise indicated, gas piping shall be run exposed. Where concealed piping is indicated, it shall be installed inside of a welded steel casing which is vented on both ends and in a location to permit access to the piping casing with a minimum amount of damage to the building.

D. The gas supply pipe shall be of the size indicated on the drawings.

E. A stop cock or tee handled gate valve, with cast-iron extension box and cover, shall be installed in the gas supply pipe near the curb. A brass gas cock shall be installed in the gas supply pipe just inside the building wall. If the gas supply pipe is larger than 2-inch size, a bronze mounted iron body gate valve may be provided in lieu of the brass cock.

F. Joints shall be welded from the seismic shut-off valves to the gas train connections at the boilers. Other non-welded joints shall be made with graphite and oil or an approved graphite compound applied to the male thread only. After cutting, and before threading, pipe shall be reamed and all burrs shall be removed. Threads shall be accurately cut, and not more than three threads shall remain exposed outside each fitting after the joint has been made up. Each length of pipe shall be hammered and all scale shall be blown out before assembling. Threaded joints shall not be caulked to prevent or stop leaks.

G. An approved type gas cock shall be installed in the branch connection to each riser and near each appliance. Plugged or capped outlets for future extensions or connections shall be provided where noted on drawings.

H. Piping shall be graded not less than 1-inch in 40 feet of length to prevent trapping. The gas supply pipe from the main in the street to the meter shall grade up toward the meter. Horizontal lines from the meter to the risers shall grade down toward the risers and branches from risers to appliances shall grade up toward the risers and branches from risers to appliances shall grade up toward the appliances.
A full-size tee fitting and a 6-inch long capped drip pocket shall be installed at the bottom of each riser or drop and at each low point in a horizontal gas line.

I. Uncovered, exposed pipes shall be provided with plates at the point where they pass through floors, finished walls, and finished ceilings. Where necessary to cover beads of fittings, special deep escutcheons shall be provided in lieu of plates. Plates shall be not less than 0.018-inch thick. Wall and ceiling plates shall be secured with round head set screws, not with spring clips. Unless otherwise specified, plates shall be of the one-piece types. Wall and ceiling plates may be flat, hinged pattern.

J. Unions shall be installed in the gas piping between the gas burning appliance and the gas shut-off valve serving the appliance.

K. All gas piping and hanger/supports exposed to weather shall be painted by Division 23000 contractor.

3.15 REFRIGERATION PIPING INSTALLATION

A. Refrigeration tubing shall be cut (with a pipe cutter) so ends are perfectly square and will "bottom" in fittings. There must be no gaps left thru which solder can run into the line. If a hack saw must be used, it shall always be guided with a miter box to insure a square, even cut. Tubing shall be reamed to remove burrs, being careful not to expand tubing while reaming.

B. The outside of the copper pipe and the inside of the fittings, where solder will be applied, shall be burnished. Fine crocus cloth or fitting brushes especially made for this type of work should be used. Surfaces shall be burnished until all dirt and oxide is removed. Cleaned surface should not be touched with hands or gloves.

C. A light coat of brazing flux shall be applied to both pipe and fittings. Acid flux (such as muriatic or hydrochloric acid) shall not be used. The resulting corrosion would seriously affect the pipe and composition for brazing.

D. Joint shall be heated to proper brazing temperature, being sure that it is uniformly hot so brazing material will flow to all parts of the joint. The brazing material shall be fed to the joint until a uniform line of brazing material appears around the pipe at the end of the fittings.

E. Refrigerant piping shall be joined with "sil-fos" soldered joints. "Easy-Flow" solder may be used for connections at valves and specialties only.

F. An oxy-acetylene torch shall be used for heating the joint for brazing. During brazing, the pipe and fittings must be kept full of an inert gas, N or CO2 to prevent formation of scale.

G. **NOTE**: Should the contractor be observed by the job superintendent or any authorized inspector soldering or brazing any part of a refrigeration piping system without proper circulation of inert gas thru the lines being worked on, it shall be assumed that the entire system was fabricated in such a manner, and all of the piping installed on that system shall be condemned and promptly removed from the job site at the expense of the contractor.

H. When solenoid stop valves are being installed, the coil shall be removed to prevent the heat of soldering from ruining the insulation. When sight glasses are being installed, the glass should be removed to prevent cracking. No heat shall be applied near the bulb of the expansion valve or any other place where an excessive temperature may cause damage.

I. All of the foregoing piping shall be examined, and if found to leak, shall be made tight and test repeated until the system is proved tight. All tests shall be verified by the Owner's representative.

J. After all refrigeration piping and connections are completed, make a leak test by filling the system with freon and test for leaks with an electronic leak detector. Evacuate all piping to 500 microns and hold for 24 hours prior to final charging.

K. Charge the system with clean, dry refrigerant until a proper operating charge has been added as determined by proper operation with a clean refrigerant stream at the sight of glass.

L. Pipe covering shall not be installed, nor the piping anchored until testing is completed and all leaks have been properly eliminated.

3.16 INSTALLATION OF THERMOMETERS AND THERMOMETER WELLS

A. General: Install thermometers and thermometer wells at locations shown on the drawings and where specified. Install thermometers so that they can be read by a person standing on the floor and with normal illumination.

B. Locations: Install thermometers and thermometer wells at the following locations, and elsewhere as indicated:

1. Thermometer Wells: Drill and tap pipes 5-inch and larger for installation of wells. Provide tees or reinforced welding fittings on pipes smaller than 5-inch for installation of wells. Provide oversize tees or enlarge pipe smaller than 3-inch at points where wells are installed to avoid restriction of flow.

END OF SECTION 23 0900

SECTION 233000 - AIR DISTRIBUTION

PART 1 – GENERAL

1.1 SCOPE

A. Work shall include the air distribution, ventilation, and exhaust duct systems, and all materials, equipment, and labor required to complete the systems shown on plans and specified herein.

PART 2 – PRODUCTS

2.1 GENERAL

A. Construct all ducts, plenums, etc., of the gauges specified in the latest editions of the applicable SMACNA manuals, unless otherwise shown. Sheets shall be free from blisters, slivers, pits, and imperfectly galvanized spots.

B. Duct construction and installation details shall comply with the latest edition of the SMACNA Duct Construction Standards.

C. All supply air ducts shall be designed to meet the requirements for +2-inch pressurized ducts. All exhaust ducts shall be -2-inch suction ducts.

2.2 ACCESS DOORS AND PANELS

A. Location: Provide access doors in casings, plenums, and ducts where shown on the drawings and where specified for ready access to operating parts including fire dampers, smoke dampers, valves, and concealed coils.

B. Pressure Clarification: Construct and install access doors in accordance with SMACNA Standards to suit the static pressure classifications and the locations where installed.

C. Access Doors in Ducts: Provide and size doors as follows:

1. Minimum 24-inch by 24-inch clear opening.

2. When field conditions require an access opening smaller than 16-inch by 12-inch, provide a 24-inch long removable section of casing or duct, secured with quick acting locking devices, 6 inches on centers, to permit ready access without dismantling other equipment.

D. Door Requirements: Provide doors in casings and duct as follows:

1. Arrange doors so that system air pressure will assist closure and prevent opening when the system is in operation.

2. Coordinate doors and equipment to provide unrestricted passage through clear door opening, without removal of any equipment.

3. When pressure regulating dampers are installed in ducts or plenums, provide access doors with a clear wire glass observation port, 6-inch by 6-inch minimum size. Anchor port with structural metal frame, resilient gaskets and stainless-steel bolts.

4. Hinges for doors in zinc coated or aluminum construction shall be steel or iron, zinc coated with brass pins.

5. Hinges for doors in copper, copper nickel alloy construction shall all be brass.

2.3 CLOSURE COLLARS

A. A duct ending at a wall or partition shall have the edge turned back to form a closure collar and flanged tight to the wall or partition so that no sharp or ragged edge appears.

2.4 EXPOSED ROUND +2" PRESSURE CLASS

A. All joints and fittings shall be sealed with thermo-fit duct band by Raychem or approved equal. Contractor shall take care to ensure that all joints and fittings are neat in appearance.

2.5 FLASHING

A. Where ducts pierce roof construction, the flashing shall be provided as part of Division 7.

B. The equipment bases and duct opening bases on the roof shall be constructed by this Contractor as shown on the drawings. The base shall be constructed to fit the equipment approved for construction. This Contractor shall construct and install a weatherproof inverted pan over the wood bases to act as a counterflashing and weatherproof hood for the base. All openings through the pan for equipment mounting shall be sealed weathertight with lead washers.

2.6 TEST HOLES IN DUCTWORK

A. Test holes for testing air quantities in ducts shall be installed at locations to be specified by the Balancing Contractor. Rubber stoppers shall be provided for closing the test holes. Where these holes are installed in insulated ductwork, a removable plug of approved insulation material shall be provided. An instrument port shall be provided in the following locations for each fan system.

1. Return air shaft and/or duct upstream of sound traps

2. Return air fan plenum

3. Main return air duct upstream of fresh air dampers

4. Mixed air plenum

5. Supply fan plenum

B. Additional ports are to be installed in locations determined by the Owner's representative.

C. Instrument ports shall be die cast with screwed cover for the insulation thickness specified. Ports shall be located outside of the plenum with 20-gauge sheet metal sleeve of the same size as the port opening, passing through insulation where ducts have interior insulation.

2.7 ELBOWS

A. Elbows with radius to the center of the elbow at least 1.5 times the duct width shall be installed parallel to the radius or turning vanes. Square elbows may be used if they are provided with Duct turns. Single blade duct turns with trailing edge shall be used in all square elbows. No short radius elbows shall be allowed in high-velocity ductwork.

2.8 CLEANOUT OPENINGS

A. Duct systems shall have cleanout openings equipped with tight fitting sheet metal doors. Doors shall be tightly latched without the use of tools.

2.9 FIRE-RESISTIVE ACCESS OPENING

A. When cleanout openings are located in ducts within a fire-resistive shaft or enclosure, access openings shall be provided in the shaft or enclosure at each cleanout point.

B. These access openings shall be equipped with tight-fitting sliding or hinged doors which are equal in fire-resistive protection to that of the shaft or enclosure.

2.10 CLEARANCES

A. Duct systems shall have a clearance from combustible construction of not less than 18 inches. This clearance may be reduced to not less than three inches, provided the combustible material is protected with materials approved for one-hour fire-resistive construction on the duct side.

2.11 EXHAUST OUTLETS

A. Exhaust outlets shall extend thru the roof, unless otherwise noted. Such extension shall be a minimum of 24” above the roof surface, at least 10 feet from any adjacent building, property line, or air intake opening into any building, and shall be located at least 10 feet above the adjoining grade level.

B. Duct shall terminate in a Breidert type vent cap with birdscreen.

2.12 BRANCH TAKEOFFS

A. Branch takeoffs shall be high efficiency type as shown on the drawings, and shall be fitted with adjustable lock balancing dampers, complete with extended locking quadrants. Where dampers are not accessible for adjustment from above, concealed ceiling regulators with adjustable chrome-plated covers shall be provided.

B. H.E.T. duct branch fittings shall be fabricated from 26 ga. G.I. for fittings 8" dia. and smaller, and from 28 ga. G.I. for fittings larger than 8" dia. Fittings shall have attachment flange, and duct collar with **locking quadrant balancing damper.** Fittings shall be Precision Air, Genflex or Metals Mfg.

2.13 WALL PENETRATIONS

A. All ducts penetrating structural or architectural walls shall be sealed air and sound tight.

2.14 FIRE RATED SURFACE PENETRATIONS

A. All ducts penetrating fire rated surfaces shall be sealed as directed in 230900.

2.15 DUCTWORK

A. All ductwork shall be fabricated and installed in compliance with the latest SMACNA duct manuals.

B. Sheet metal ducts shall be properly braced and reinforced with and, where they protrude above roof, they shall be properly flashed.

2.16 DUCT JOINTS

A. All duct joints must be sealed airtight as required by Table 1-2 "SEAL CLASSIFICATION" of the "HVAC Duct Construction Manual". The term "seal" or "sealed" means use of mastic or mastic plus tape or gasketing as appropriate.

2.17 DIMENSIONS

A. Ducts, unless otherwise approved, shall conform accurately to the dimensions indicated on the drawings, and shall be straight and smooth on the inside with joints neatly finished. All duct sizes shown on the drawings are free area inside dimensions. Acoustically-lined ducts shall have outside dimensions increased as required to accommodate the acoustic lining specified and still maintain the free area inside dimensions shown on the drawings.

B. Under no circumstances shall the cross section of any duct be decreased by dents, pipes, or hanger rods running through it unless otherwise indicated on the drawings. Neither shall the shape be changed without approval. No abrupt transitions that restrict the area shall be used. Where necessary to gain clearance, the duct seams may be turned inside. Structural and Architectural drawings shall be consulted for areas with restrictive clearances.

2.18 FIELD VERIFICATION

A. No ductwork shall be fabricated without first field verifying that the available space (under actual job conditions) will permit installation of the ductwork without structural or other conflicts.

2.19 FLEXIBLE CONNECTION

A. This contractor shall provide flexible connections not less than 4 inches wide, constructed of heavy, waterproof, woven plastic-coated glass fabric at the inlet and outlet connections of each fan unit, securely fastened to the unit and to the ductwork by a galvanized iron band, and provided with tightening screws. Corners shall be sewn tight shut.

2.20 VOLUME DAMPERS

A. Opposed-blade balancing dampers (OBD) to 12 inches by 36 inches: Dampers used in low-velocity branch ducts to control the volume of air flow shall be Young No. 820 or Air Devices volume control dampers. An operating head shall be locked in position by a set key where the damper is accessible. Where the damper is not accessible, a volume control damper, consisting of a coupling, 3/8 inch square shaft, and regulator for operating the unit from suspended ceiling shall be provided.

B. Opposed-blade balancing dampers (OBD) larger than 12 inches by 36 inches: Airolite type 902 opposed-blade damper of 16-gauge galvanized steel with locking quadrant shall be used or equal of Airolite, Ruskin, Louvers and Dampers, American Warming, or Dowco.

2.21 DAMPER REGULATORS

A. All volume dampers and splitter dampers in exposed ductwork shall be provided with Ventlock No. 640 or Young No. 443 damper regulators. Each volume damper and splitter damper concealed above an inaccessible ceiling, etc., shall be provided with a shaft extended thru the ceiling, to which shall be attached a chrome-plated Ventlock No. 666 concealed damper regulator. No. 680 Ventlock miter gears shall be used where necessary.

2.22 AIR FLOW MEASURING DEVICES

A. The sheet metal contractor shall install the air flow measuring devices as specified in Section 251000. The devices will be furnished by the control contractor.

2.23 BELT GUARDS

A. Belt guards shall be fabricated and installed. Guards shall be constructed of 10-gauge wire, 1-inch mesh in 1-1/2-inch angle-iron welded frames. All guards shall be provided with an opening for a tachometer and shall be either the split type or easily removable for belt repair. The guards shall be anchored securely to the floor or walls to prevent any vibration.

2.24 PRE-MANUFACTURED DUCTS

A. Runouts above ceiling from primary supply air ducts to diffusers may be rigid conduit or pre-manufactured high pressure flex duct or a combination of the two.

B. Runouts shall be similar to "Genflex - Type IL". The maximum allowance length is 5'-0" in any given duct run. Duct to be factory fabricated with spring steel wire helix and 1" thick glass fiber insulation covered with external vapor barrier and lined with continuous non-perforated inner sleeve.

C. Material shall comply with the 2021 IMC Standard 10-1.

2.25 RECTANGULAR DUCT LINING

A. The interior surface of all rectangular supply, return, fresh, relief, and exhaust air ducts (except where noted otherwise), shall be lined with 1" thick fiberglass dual density duct liner, having an average "K" factor of .24 BTU at 75 deg. F mean. The liner shall meet standards NFPA No. 90A and No. 90B and shall have the Underwriters' Laboratories, Inc., label.

B. Duct liner shall be applied to the flat sheet with a 100% coverage of duct adhesive. The duct liner shall be cut to assure snug corner joints. The black surface of the liner shall face the air stream. On horizontal runs, tops of ducts over 12" in width and sides over 16" in height shall be additionally secured with welded pins and speed clips on a maximum of 15" centers. On vertical runs, gripnails or welded pins and speed clips shall be spaced on a maximum of 15" centers on all width dimensions over 12". Pins shall start within 2" of all cross joints within the duct section.

C. Welded pins shall be cut virtually flush with the liner surface. Clips should be drawn down flush only and not so as to compress the liner and cause the leading edge of raise. All exposed edges and the leading edge of all cross joints of the liner shall be coated with adhesive.

D. Material shall comply with 2021 IMC Standard 10-1.

2.26 GAS VENTS

A. Flues for gas-fired equipment shall be of the sizes shown on the drawings. Flues shall be type ‘B’ vent or as required for condensing water heaters.

B. Top flues with Metalbestos Type "S-CT" vent cap especially designed for non-backdraft application. Flash and counterflash around flue at point of roof penetration to make watertight. Vertical and horizontal flues shall be double wall stainless steel construction.

2.27 INSULATED LOW PRESSURE FLEXIBLE DUCT

A. Low pressure flexible duct shall be fully insulated high density, factory installed, fiberglass insulation with a minimum R-value of 6.0. The inner core shall be constructed with multiple layers of aluminum foil/polyester laminate and metalized polyester film that encapsulates a steel wire helix. The outer portion of the duct shall be sheathed in multiples of metalized polyester film with fiberglass spiral reinforcing strands to form a continuous vapor barrier. The duct shall be constructed to withstand 6" w.g. positive pressure thru 20" dia. and 3/4" w.g. negative. Duct shall be U.L. listed. Duct to be Casco or approved equal.

2.28 REGISTERS, GRILLES AND DIFFUSERS

A. Supply Air Grilles:

1. Furnish and install all supply air grilles shown and specified on the drawings. All units to have opposed blade balancing dampers. Grilles to have 4-way air deflection. All grille cores shall be removable, or plaster frames shall be furnished with units. Grilles shall be of steel, or anodized aluminum construction. Finish shall be bright white unless otherwise noted.

2. Units shall be Titus, Tuttle & Bailey, Carnes, Metalaire, Nailor or Price.

B. Return, Exhaust & Transfer Air Grilles and Registers:

1. Furnish and install all ceiling and sidewall return, exhaust, and transfer air grilles or registers shown and specified on the drawings. All units to be painted steel, or aluminum construction (where permitted by fire code) with bright white finish and opposed blade balancing dampers. All cores shall be removable or plaster frames shall be furnished with units. Grilles located near the floor shall be heavy duty gymnasium type. Registers shall be Titus, Tuttle & Bailey, Metalaire, Nailor, Carnes or Price.

C. Ceiling Diffusers:

1. All ceiling diffusers shall be of the round, square, or rectangular type with louvered face and 1, 2, 3, or 4 way air pattern as indicated on the drawings. Units shall be painted steel, or aluminum construction (where permitted by fire code) with bright white finish and inner assembly shall be easily removable from outer frame without special tools. Louvers shall be spaced on 1-1/2" centers maximum.

2. All diffusers shall be furnished with round or square opposed blade volume control and air extractor. Diffusers shall be Titus, Tuttle & Bailey, Price, Metalaire, Nailor, or Carnes.

D. General:

1. All visible surfaces through the louvers of grilles and registers shall be painted flat black.

2. Color and finish of all grilles, registers, and diffusers shall match ceiling grid. Coordinate with the Owner's representative.

2.29 LOUVERS

A. At all air system openings in outside wall, install storm louvers.

B. Construct louvers of aluminum with kynar custom color finish. Color shall be selected by Architect. Provide color samples.

C. Slats shall be inclined at least 45 degrees from the horizontal and overlap a minimum of 1". Slats over 40" long shall have a 2" wide intermediate support. The exterior face of the louver shall be neatly fitted to the building wall, flashed at top, and caulked at sides and bottom. New open area for air passage shall be at least 50% of the nominal size. On the inside face of the louver, install a removable screen, consisting of 1/2" mesh galvanized wire screen in a galvanized channel frame. The louver shall have a sub-frame and shall be removable. See plans for custom louvers required.

D. Caulk around louver frames with clear G.E. silicone sealer after installation. Caulk color shall match color of surrounding material.

E. Louvers shall be drainable type with recessed mounting frames.

F. Louvers shall be Airolite, Air Balance, Air Guide, American Warming, Dowco or Air-Rite.

2.30 FUSIBLE LINK FIRE DAMPERS

A. Furnish and install complete the 1 1/2 hr fusible line fire dampers shown on the plans and specified herein. Dampers shall be provided and installed in accordance with NFPA-90A and bear the UL 555 Label of Approval. Fire dampers shall be curtain-type with fusible link located in the air stream. Submit installation drawings.

B. Spring catches shall hold the dampers in a closed position when F.L. is broken. The weight of the mounting frames shall comply with the National Board of Fire Underwriters and approved installation drawings. Sleeves with angles are required at all locations.

C. Fusible line dampers shall be Pottorff, Ruskin, or Nailor.

2.31 PACKAGED ROOFTOP HEATING AND AIR CONDITIONING UNITS

A. Furnish and install complete the roof-mounted packaged type Gas/DX cooling unit, as shown and specified on the plans. Unit to be factory-wired and tested and of capacities as listed. the unit shall be shipped completely assembled, pre-charged, piped, and wired internally, ready for field connections. In addition, the manufacturer shall provide field start-up and test for each unit and shall forward a copy of the start-up report to the Architect.

B. The unit shall be complete with integrated economizer capable of simultaneous economizer and compressor operation. Economizer shall include all hardware and controls for cooling with outside air, low leakage dampers not to exceed 3% leakage at 1.0 in. wg pressure differential, capable of introducing up to 100% outside air and equipped with gravity relief air damper. Provide 0-10 VAC control points as required for ATC contractor.

C. Gas-fired heat exchanger shall be constructed of aluminized steel. Power burner shall have electric direct spark ignition, 100% safety shut-off electronic flame sensing controls, pre-purging and combustion air adjustment. All controls shall be listed for operation at low outdoor air temperatures. System shall be equipped with dual limit safety controls, shall be AGA design certified for outdoor installation for natural gas firing, shall be rated and tested according to D.O.E. and F.T.C.

D. Roof curb shall be of steel construction and shall extend 24" minimum above the roof deck. The mounting shall made to the bottom perimeter of equipment and distribute the unit weight uniformly to the structure.

E. High- and low-pressure switches shall be factory-installed and wired. These switches shall protect the system against abnormal operating conditions. Low pressure switch shall be automatically reset, high pressure switch shall be manual reset.

F. The unit shall be furnished complete with a field installed starting kit to aid the compressor when the compressor is starting under a condition of low voltage.

G. All components, wiring, and inspection areas shall be completely accessible thru removable panels which have locking door handles.

H. Provide a factory mounted weather-proof 120 volt GFI outlet. Outlet to be powered independently from unit.

I. Unit shall be provided with a Bacnet card, or as required by BMS for project.

J. The compressor section shall carry a 5-year guarantee.

K. Units shall be Carrier or equal of Trane.

2.32 SPLIT SYSTEM AIR CONDITIONER

A. Furnish and install complete the air-to-air split system packaged air conditioner shown and specified on the drawings.

B. Evaporator section shall be ceiling mounted type with pre-charged refrigerant system, packaged controls, swing flow outlet air louvers, and packaged, integral, concealed drain pump. Unit shall be complete with filter section, hard wired, wall mounted thermostat, and all controls for automatic operation.

C. Condensing unit section shall be complete with high performance hermetic compressor with high and low pressure safety controls, air cooled condenser with modulating fan controls for operation at outdoor air temperatures as cold as 0 deg. F.

D. Unit shall be LG, Carrier, Mitsubishi or approved equal.

2.33 EXHAUST FANS

A. Roof-Mounted Type:

1. Furnish and install complete the low-profile roof-mounted exhaust fans of the size and capacity shown on the drawings.

2. Roof-mounted fans shall be of the centrifugal type with spun aluminum hood. All parts exposed to weather and all fastenings shall be either aluminum or stainless steel. All fans to be equipped with permanently lubricated two-speed (where specified) ball bearing motors located in separate compartment out of the air stream. Fan shall have adjustable V-belt drive, self-flashing insulated curb, backdraft dampers, birdscreen, disconnect switch, and shall be complete with all necessary fittings and transition pieces for a complete installation. All units shall bear the AMCA certified performance seal.

3. Fans shall be Twin City, Cook, Penn, Ammerman or Jenn-Air.

B. Ceiling Type:

1. Furnish and install complete the ceiling-mounted exhaust fans shown and specified on the drawings.

2. Fan shall have acoustically insulated housing for quiet operation. Air deliveries shall be as indicated on the drawings and shall be certified by AMCA performance tests.

3. Fan shall have centrifugal wheel direct connected to motor. Ceiling grille shall be all aluminum construction with satin finish. Entire fan, motor, and wheel assembly shall be removable without disturbing the housing. Fan speeds shall not exceed 1100 RPM. Unit shall be complete with backdraft damper.

4. Fan shall be Twin City, Cook, Penn, Broan or Breidert.

2.34 DE-STRACTIFCATION FANS

A. Mixed air type for exposed mounting.

B. Multi-vane stator, venturi nozzle, inlet grille, 6'-0" steel seismic safety leash, high/low temperature sensors, factory thermostat, BACnet/IP MSTP fan control package, factory smart controller, & all controls for automatic operation.

C. Warranty to be 3-year parts & labor.

D. Color to be "Off-White" Submit color chart with submittal for Architect approval.

E. Manufacture/Model: Airius Fans/Air Pear or approved equal.

2.35 UNIT HEATERS (Gas Fired)

A. Furnish and install in the locations shown on the plans the sealed combustion gas-fired unit heater shown and specified. Each unit to have capacity, air delivery, fan type, and motor characteristics as shown on the plans.

B. Heat exchangers shall be either open or sealed type as shown on drawings and shall be aluminized steel designed to accommodate thermal stresses without internal damage. Burners shall be AGA approved with 24-volt control circuit and automatic safety pilot.

C. Unit casings shall be of not less than 16-gauge steel. All casings to be phosphatized for rust resistance and finished with a baked enamel. All hardware shall be plated for rust resistance.

D. Motors and fans shall be designed for unit heater service and shall be tested for continuous duty as applied on each size to eliminate vibration and minimize sound.

E. Horizontal delivery units shall be equipped with formed louvers, 4-way individually adjustable.

F. Units shall be furnished with 2-stage room thermostat (fan only and fan & heat) and all controls for automatic operation.

G. Provide factory vent and intake kit.

H. heaters shall be Reznor, Hastings or Lennox.

2.36 UNIT HEATERS (Electric)

A. Furnish and install in the locations shown on the plans the electric unit heater shown and specified. Each unit to have capacity, air delivery, fan type, and motor characteristics as shown on the plans.

B. Unit casings shall be of not less than 16-gauge steel. All casings to be phosphatized for rust resistance and finished with a baked enamel. All hardware shall be plated for rust resistance.

C. Motors and fans shall be designed for unit heater service and shall be tested for continuous duty as applied on each size to eliminate vibration and minimize sound.

D. Horizontal delivery units shall be equipped with formed louvers, 4-way individually adjustable.

E. Units shall be furnished with factory disconnect, 2-stage room thermostat (fan only and fan & heat) and all controls for automatic operation.
F. Unit heaters shall be Markel, Chromalox, Intertek or approved equal.

2.37 WALL HEATERS (Electric)

A. Furnish and install in the locations shown on the plans the electric wall heater shown and specified. Each unit to have capacity, air delivery, fan type, and motor characteristics as shown on the plans.

B. Unit casings shall be for recessed mounting and shall be of not less than 18 gauge steel. Face shall be heavy duty. All casings to be phosphatized for rust resistance and finished with a baked enamel. All hardware shall be plated for rust resistance.

C. Motors and fans shall be designed for wall heater service and shall be tested for continuous duty as applied on each size to eliminate vibration and minimize sound.

D. Units shall be furnished with disconnect, fan purge circuit, 2-stage room thermostat (fan only and fan & heat) and all controls for automatic operation.

E. Unit heaters shall be Markel, Chromalox, Intertek, or approved equal.

2.38 AIR TURNOVER UNIT

A. Furnish and install complete the exterior-mounted packaged type direct fired gas heating/ventilating unit, as shown and specified on the plans. Unit to be factory-wired and tested and of capacities as listed. The unit shall be shipped completely assembled, wired internally, ready for field connections. In addition, the manufacturer shall provide field start-up and test for each unit and shall forward a copy of the start-up report to the Architect.

B. The unit shall be complete with integrated economizer capable of simultaneous economizer and compressor operation. The economizer shall include all hardware and controls for cooling with outside air, low leakage dampers not to exceed 3% leakage at 1.0 in. wg pressure differential, capable of introducing up to 100% outside air and equipped with gravity relief air damper.

C. Provide a factory stand with service platform, safety rails and ladder. Stand height shall be as required for building heights.

D. Non-fused disconnect intercept at ignition.

E. Provide a factory remote control panel to allow operation and monitoring of the unit from the occupied space.

F. The unit shall come complete with a wall-mounted unit control panel and thermostat for field installation.

G. Provide LON or Bacnet card for BMS interface.

H. 2' 80/20 pleated filter section.

I. Heavy duty discharge diffuser and return grille.

J. All components, wiring, and inspection areas shall be completely accessible thru removable panels.

K. Discharge damper and actuator.

L. Units shall be Titan Air or approved equal.

M. Heat exchanger shall have a 10-year warranty.

2.39 DIRECT EVAPORATIVE COOLERS:

A. Evaporative coolers shall be of heavy-duty construction and be designed for industrial application. Evaporative media shall be 12” cellular media in a cross-fluted design. Cooler shall be of a self-Cleaning design. Media shall meet or exceed the required capacity and be 12” thick.

B. Cooler housing shall be constructed of 16-gauge 304 stainless steel. Sump shall be constructed from 10-gauge 304 stainless steel welded watertight at the comers.

C. The distribution header shall be fabricated from PVC pipe. The distribution supply piping and flush out line piping shall be PVC. Make-up line and level controls shall consist of a brass float valve, copper float, steel drain and overflow connections. Automatic water make-up, and fast fill connection. The copper bleed line shall be furnished with an adjustable ball valve. Coolers shall be furnished with a stainless-steel submersible pump. All connections shall be piped to the exterior. Provide output for fill and drain system tie into the stop & waste system.

2.40 AIR FILTER BANKS

A. Furnish and install the filtering bank systems shown and specified on the drawings. Filter banks shall be suitable for the space available. Filter banks shall be constructed and installed so as to prevent the passage of unfiltered air. Felt, rubber, or neoprene gaskets shall be provided between filter frames and unit casing, etc. Steel filter parts shall be protected against corrosion.

B. Filter bank shall consist of 2” thick MERV 9 (ASHRAE 52-76 test standard) replaceable media type air filters. The supporting front grid of each filter section shall be hinged to facilitate easy replacement of filter media. Filter frames shall be of 18 gauge galvanized steel construction with 11 gauge galvanized steel wire grids to support the media.

C. At the time of acceptance of the work, new filter media shall be furnished and installed by the contractor.

D. Provide one complete set of spare filter media (in addition to the new filters installed at time of acceptance) for each filter bank and store on site as directed by the owner's representative.

E. Air filter banks shall be Cambridge, AAF, or Camfil Farr.

2.41 AIR FILTERS

A. Provide one complete set of spare MERV 9 filter media (in addition to the new filters installed at time of acceptance) for each unit filter bank and store on site as directed by Architect.

B. Air filter banks shall be Cambridge, AAF or Camfil Farr

2.42 HVAC SMOKE DETECTORS

A. All units above 2000 CFM shall be provided with smoke detectors located in the return air intake and supply air discharge as per IMC. Detectors to be provided and wired to fire alarm under Section 26. The sheet metal contractor shall install all detectors. ATC contractor shall wire fan shutdown.

B. Duct smoke detectors shall not be installed until just prior to final inspection to prevent dust and debris from contaminating the detector.

2.43 DAMPERS - GENERAL

A. Damper frames shall be of not less than 14-gauge galvanized steel, formed for extra strength, with mounting holes for enclosed duct mounting.

B. All damper blades shall be of not less than 16-gauge galvanized steel formed for strength and high velocity performance. Blades on all dampers must be of not over 6" in width. Blades shall be secured to 1/2" diameter zinc-plated axles by zinc-plated bolts and nuts. All blade bearings shall be nylon. Blade side edges shall seal off against spring stainless steel seals. Teflon-coated thrust bearings shall be provided at each end of every blade to minimize torque requirements and ensure smooth operation. All blades linkage hardware shall be constructed of corrosion-resistant, zinc-plated steel and brass.

2.44 AUTOMATIC DAMPERS

A. The ATC contractor shall furnish all automatic control dampers. The sheet metal contractor shall install all dampers and transition all ductwork to the dampers.

PART 3 – EXECUTION

3.1 JOB SITE CONDITIONS

A. Inspection:

1. Prior to all the work of this section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.

2. Verify that the work of this section may be installed in accordance with all pertinent codes and regulations in the approved shop drawings.

B. Discrepancies:

1. In the event of discrepancy, immediately notify the Owner.

2. Do not proceed with installation in areas of discrepancy, until all such discrepancies have been fully resolved.

3.2 INSTALLATION OF EQUIPMENT

A. Install all equipment with adequate space for service and maintenance. **Minimum of 24" clearance for all service and control access.**

B. Equipment which requires periodic service and maintenance shall be installed in plenum space within 2 ft. of finished ceilings, or within 2 ft. of the bottom chord of the structure.

C. All visible surfaces behind grilles and registers shall be painted flat black.

D. Care shall be taken to avoid interference with structure and the work of other trades. Do not cut into load carrying members without the approval of the Owner's representative.

E. All roof penetrations for the installation of rooftop equipment shall be located a minimum of 4'-0" from fire-rated walls. See plans for fire-rated wall locations.

3.3 INSTALLATION OF DUCTS

A. All ducts shall be installed in compliance with the latest editions of the SMACNA manuals.

B. All necessary allowance and provisions shall be made in the installation of sheet metal ducts for the structural conditions of the building, and ducts shall be transformed or divided as may be required. Whenever this is necessary, the required area shall be maintained. All changes, however, must be approved and installed as directed.

C. Pre-manufactured ducts shall be connected to rigid ducts and equipment with solid wraps of fabric duct tape and tyton bands drawn tight to form an airtight joint.

D. During the installation, the open ends of all ducts shall be protected by covering with plastic sheet tied in place to prevent debris and dirt from entering.

E. Install this work in cooperation with other trades so that there will be no delay in the progress of construction work. It is extremely important that the duct system be clean before final connections are made.

F. The contractor shall take special care when running exposed ductwork to ensure that the final installation is neat in appearance.

G. Spiral ducts running exposed in occupied areas shall be hung with an aircraft cable type hanger.

H. Under no circumstances shall ductwork be supported from the metal roof deck.

I. Ceiling outlets shall be rigidly supported from the overhead structure with G.I. wires or straps, or from rigid galvanized iron ductwork. Outlets shall not be supported from T-bar ceilings or metal roof deck.

J. Hanger and Supports:

1. Hangers for ducts up to 18" in width shall be placed on not more than 8'-0" centers. Ducts 19" and over in width shall be supported on not more than 4'-0" centers. Hangers shall be placed plumb and present a near appearance. Construct hangers from galvanized band iron 1" x 1/8" for duct up to 36" wide. Hangers shall extend down the sides of the ducts not less than 9". On ducts less than 9" in depth, hangers shall extend the full depth of the ducts. Attach hangers to ducts using not less than three rivets or parker screws of appropriate sizes. It is essential that all ducts be rigidly supported. Where vertical ducts pass thru floors or roofs, supporting angles shall be rigidly attached to ducts and to the structure. Angles shall be galvanized and of sufficient size to support the ductwork rigidly. Place supporting angles on at least two sides of the duct. For round ducts, strap hangers shall extend completely around ducts.

2. Ceiling outlets shall be rigidly supported from the overhead structure with G.I. wires on straps, or from rigid galvanized iron ductwork. Outlets shall not be supported from T-bar ceilings unless approved by the owner's representative.

K. Ducts at Masonry:

1. Where ducts are shown connecting to masonry openings and along edges of all plenums at floors and walls, provide a continuous 2" x 2" x 3/8" galvanized angle iron which shall be bolted to the construction and made airtight to the same by applying caulking compound. Sheet metal at these locations shall be bolted to the angle irons.

3.4 STORAGE OF DUCTS

A. Ductwork shall be stored in a protected area to prevent physical damage to the duct liner, and to ensure that the duct liner is not exposed to excessive heat or moisture which would deteriorate the air side surface.

B. Ductwork which has been improperly stored and/or sustained physical damage will be rejected and shall be removed from the job site as directed by the Owner's representative.

3.5 CLEANING OF DUCTS

A. Before ducts are insulated and before the ceiling is installed and final connections made to the terminal boxes, the fans shall be operated at full capacity to blow out any dirt and debris from ducts. If it is not practical to use the main supply blower for this cleaning, the ducts may be blown out in sections by a portable fan. After the ducts have been cleaned and initially pressure tested, the final connection shall be made to the terminal boxes.

3.6 TESTING OF DUCTS

A. Supply, return, and exhaust ducts, plenums, and casings operating at duct pressures from +2" to -2" shall be tested and made substantially airtight at static pressure indicated for the system before covering with insulation or concealing in masonry. Substantially airtight shall be construed to mean a leakage rate less than 5% of the rated airflow.

B. Supply air ducts operating at pressures above +2" shall be tested and made substantially airtight. Leakage shall be less than 1% of the rated air flow.

C. Ducts including all flexible runouts shall be tested in accordance with SMACNA Duct Construction Standards.

D. After the vertical duct risers or branch ducts have all been tested and tied into the mains, and after the central station air handling apparatus has been installed, the mains shall be tested in accordance with SMACNA Duct Construction Standards.

END OF SECTION 23 3000

DIVISION 26 – ELECTRICAL

26 0500	ELECTRICAL GENERAL PROVISIONS
26 0501	MECHANICAL & ELECTRICAL COORDINATION
26 0502	ELECTRICAL SUBMITTALS O & M MANUALS AND SPARE PARTS
26 0507	ELECTRICAL CONNECTIONS FOR EQUIPMENT
26 0510	ELEVATOR ELECTRICAL REQUIREMENTS
26 0519	CONDUCTORS AND CABLES (600V AND BELOW)
26 0526	GROUNDING
26 0529	SUPPORTING DEVICES
26 0532	CONDUIT RACEWAY
26 0533	ELECTRICAL BOXES AND FITTINGS
26 0548	ELECTRICAL SEISMIC CONTROL
26 0553	ELECTRICAL IDENTIFICATION
26 0573	PROTECTIVE DEVICE STUDY
26 0923	OCCUPANCY SENSORS
26 0943	LIGHTING CONTROL EQUIPMENT
26 2200	TRANSFORMERS
26 2416	PANELBOARDS
26 2713	SERVICE ENTRANCE
26 2726	WIRING DEVICES
26 2815	OVERCURRENT PROTECTIVE DEVICES
26 2816	MOTOR AND CIRCUIT DISCONNECTS
26 2819	SCOREBOARDS & ATHLETIC EQUIPMENT
26 2913	MOTOR STARTERS
26 3213	EMERGENCY ELECTRICAL SYSTEMS
26 4314	SURGE PROTECTIVE DEVICES (SPD)
26 5100	INTERIOR AND EXTERIOR BUILDING LIGHTING
26 9000	SYSTEM COMMISSIONING

26 0500 - ELECTRICAL GENERAL PROVISIONS

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. Architectural, Structural, Mechanical and other applicable documents are considered a part of the electrical documents insofar as they apply as if referred to in full. Contractor must review the entire set of plans and specifications. Reviewing only the electrical set is not acceptable.

1.2 MANDATORY PROJECT TIMELINES AND MILESTONES:

A. Coordinate all additional phasing, schedules, and requirements with general contractor.

1.3 SCHEDULE OF ALTERNATES:

A. Alternate No. 1 – Second Level improvements

1. Walls and wall finishes.
2. Doors and Frames.
3. Ceilings.
4. Floor Finishes.
5. Cabinets and Counters.
6. Display Cases.
7. Projection Screens
8. Restroom Finishes and accessories.
9. Stairs and Railings.
10. Hydraulic Elevator.
11. Mechanical work.
12. Plumbing work.
13. Electrical work.

1.4 DESCRIPTION OF WORK:

A. The extent of electrical work is indicated on drawings and/or specified in Divisions 26, 27 and 28 sections of the specification. Provide all labor, materials, equipment, supervision and service necessary for a complete electrical system. Work includes, but is not necessarily limited to, the following items.

	ITEM	SECTION
1.	Electrical General Provisions	26 0500
2.	Mechanical and Electrical Coordination	26 0501
3.	Electrical Submittals and Spare Parts	26 0502
4.	Electrical Connections for Equipment	26 0507
5.	Elevator Electrical Requirements	26 0510
6.	Conductors and Cables (600V and Below)	26 0519
7.	Grounding	26 0526
8.	Supporting Devices	26 0529
9.	Conduit Raceway	26 0532
10.	Electrical Boxes and Fittings	26 0533

11.	Electrical Seismic Control	26 0548
12.	Electrical Identification	26 0553
13.	Protective Device Study	26 0573
14.	Occupancy Sensors	26 0923
15.	Lighting Control Equipment	26 0943
16.	Transformers	26 2200
17.	Panelboards	26 2416
18.	Service Entrance	26 2713
19.	Wiring Devices	26 2726
20.	Overcurrent Protective Devices	26 2815
21.	Motor and Circuit Disconnects	26 2816
22.	Scoreboards & Athletic Equipment	26 2819
23.	Motor Starters	26 2913
24.	Emergency Electrical Systems	26 3213
25.	Surge Protective Devices (SPD)	26 4313
26.	Interior and Exterior Building Lighting	26 5100
27.	System Commissioning	26 9000
28.	Telephone & Data Systems CSD	27 1500
29.	Audiovisual Systems	27 4100
30.	Audiovisual System Checklists	27 4101
31.	Intercommunication Systems	27 5123
32.	Common Requirements for Security Systems	28 0501
33.	Intrusion Detection System	28 1600
34.	Access Control System	28 2205
35.	IP Video Surveillance System	28 2300
36.	Fire Alarm and Detection System	28 3111

B. Use of standard industry symbols together with the special symbols, notes, and instructions indicated on the drawings describe the work, materials, apparatus and systems required as a portion of this work.

C. Visit the site during the bidding period to determine existing conditions affecting electrical and other work. All costs arising from site conditions and/or preparation shall be included in the base bid. No additional charges will be allowed due to inadequate site inspection.

1.5 DEFINITION OF TERMS

A. The following terms used in Divisions 26, 27 and 28 documents are defined as follows:

1. "Provide": Means furnish, install and connect, unless otherwise indicated.
2. "Furnish": Means purchase and deliver to project site.
3. "Install": Means to physically install the items in-place.
4. "Connect": Means make final electrical connections for a complete operating piece of equipment.

1.6 RELATED SECTIONS:

A. Consult all other sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

B. General and Supplementary Conditions: Drawings and general provisions of contract and Division 1 of the Specifications, apply to all Division 26, 27 and 28 sections.

C. Earthwork:

1. Provide trenching, backfilling, boring and soil compaction as required for the installation of underground conduit, buried cable, in-grade pull boxes, manholes, lighting pole foundations, etc. See Division 31, Sitework, and other portions of Divisions 26, 27 and 28, for material and installation requirements.

D. Concrete Work:

1. Provide forming, steel bar reinforcing, cast-in-place concrete, finishing and grouting as required for underground conduit encasement, light pole foundations, pull box slabs, vaults, equipment pads, etc. See Division 3, Concrete for material and installation requirements.

E. Miscellaneous Metal Work:

1. Provide fittings, brackets, backing, supports, rods, welding and pipe as required for support and bracing of raceways, lighting fixtures, panelboards, distribution boards, switchboards, motor controls centers, etc. See Division 5, Metals for material and installation requirements.

F. Miscellaneous Lumber and Framing Work:

1. Provide wood grounds, nailers, blocking, fasteners, and anchorage for support of electrical materials and equipment. See Division 6, Rough Carpentry for material and installation requirements.

G. Moisture Protection:

1. Provide membrane clamps, sheet metal flashing, counter flashing, caulking and sealants as required for waterproofing of conduit penetrations and sealing penetrations in or through fire walls, floors and ceiling slabs and foundation walls. All penetrations through vapor barriers at slabs on grade shall be taped and made vapor tight. See Division 7, Thermal and Moisture Protection for material and installation requirements.

H. Access panels and doors:

1. Provide in walls, ceiling, and floors for access to electrical devices and equipment. See Division 8, Doors and Windows for material and installation requirements.

I. Painting:

1. Provide surface preparation, priming and finish coating as required for electrical cabinets, exposed conduit, pull and junction boxes, poles, surface metal raceways, etc. See Division 9, Finishes for material and installation requirements.

1.7 WORK FURNISHED AND INSTALLED UNDER ANOTHER SECTION REQUIRING CONNECTIONS UNDER THIS SECTION:

A. Provide electrical service, make requisite connections and perform operational test. Items furnished and installed under other sections and connected under this section, include but are not limited to the following:

1. Electric motors.
2. Package mechanical equipment: fans, fan coil units, pumps, boilers, duplex compressors, etc.
3. Flow switches and valve monitors.
4. Motorized dampers.
5. Fire and smoke dampers
6. Duct mounted smoke detectors.
7. Elevator/Escalator Controllers.
8. Irrigation controllers.
9. Door hold-open/release devices.
10. Motorized projection screens.
11. Wheel chair lifts.

12. Roll down doors.
13. Electric hardware.
14. Laboratory equipment including hoods, cold rooms, autoclaves, drying ovens, glassware washers and dryers, refrigerators, freezers, etc.
15. Shop equipment including saw dust collectors, saws, lathes, grinders, welders, planers, presses, etc.
16. Temperature control panels.
17. Variable frequency controllers.
18. Chiller starters.
19. Motorized Chalkboards/Markerboards/Whiteboards.
20. Display cases.
21. Water coolers.
22. Kitchen equipment including ovens, fryers, mixers, disposers, dishwashers, etc.
23. Paint spray booths.
24. Fire sprinkler alarm bells.
25. Electric heat trace cable for domestic and industrial hot water piping systems.
26. Electric heat trace cable for guttering, drain lines, etc.
27. Anti-sweat heaters, fan coils, etc. for walk-in coolers and freezers.
28. Hand dryers, hair dryers.
29. Dock levelers.
30. Systems/Open Office Furniture

1.8 ITEMS FURNISHED UNDER ANOTHER DIVISION, BUT INSTALLED AND CONNECTED UNDER THIS DIVISION:

A. Items furnished under other Divisions, but turned over to Division 26 for installation and final connection include, but are not necessarily limited to, the following:

1. Wall mounted control stations for motorized roll-up doors/grills.
2. Wall mounted control stations for motorized projection screens.
3. Wall mounted control stations for handicap lift.
4. Lighting fixtures for paint spray booths.
5. Lighting fixtures, receptacles, and switches for fume hoods.
6. Lighting fixtures for kitchen hoods.
7. Lighting fixtures for walk-in freezers and coolers.

1.9 INTERPRETATION OF DRAWINGS AND SPECIFICATIONS:

A. Before bidding, Contractor shall familiarize himself with the drawings, specifications and project site. Submit requests for clarification to Architect/Engineer in writing prior to issuance of final addendum. After signing the contract, the Contractor shall meet the intent, purpose, and function of the Contract Documents. Any costs of materials, labor and equipment arising therefrom, to make each system complete and operable, is the responsibility of the Contractor.

1.10 REQUESTS FOR INFORMATION (RFIs):

A. Contractor shall review all Contract Documents thoroughly before submitting an RFI to avoid unnecessary questions and ensure the question has not already been addressed within the existing Contract Documents.

B. RFIs should be used to seek clarification on issues or areas of confusion that cannot be

resolved through a review of the Contract Documents.

C. Each RFI shall contain the following:

1. Description of the Issue/Question: Clearly detail the issue or confusion, referencing the related Contract Document drawings and/or specifications.
2. Relevant Documents: Attach any necessary supporting documents that could aid in understanding the RFI.
3. Proposed Solution: Suggest a possible resolution to the problem or confusion.

D. Non-Compliant RFIs

1. Frivolous or incomplete RFIs will not be accepted. RFIs that do not follow the guidelines set forth in this section, or are deemed unnecessary, may be returned without response at the discretion of the Engineer.

1.11 QUALITY ASSURANCE:

A. Reference to codes, standards, specifications and recommendations of technical societies, trade organizations and governmental agencies refers to the latest edition of such publications adopted and published prior to submittal of the bid proposed, unless noted otherwise herein. Such codes or standards are considered a part of this specification as though fully repeated herein.

B. When codes, standards, regulations, etc. allow work of lesser quality or extent than is specified under this Division, nothing in said codes shall be construed or inferred as reducing the quality, requirements or extent of the Drawings and Specifications. Perform work in accordance with applicable requirements of all governing codes, rules and regulations including the following minimum standards, whether statutory or not:

1. National Electric Code (NEC).
2. International Building Code (IBC).
3. International Fire Code (IFC).
4. International Mechanical Code (IMC).

C. Standards: Comply with the following standards where applicable for equipment and materials specified under this Division.

1.	UL	Underwriters' Laboratories
2.	ASTM	American Society for Testing Materials
3.	CBN	Certified Ballast Manufacturers
4.	IPCEA	Insulated Power Cable Engineers Association
5.	NEMA	National Electrical Manufacturer's Association
6.	ANSI	American National Standards Institute
7.	ETL	Electrical Testing Laboratories

D. All electrical apparatus furnished under this Section shall conform to (NEMA) standards and the NEC and bear the Underwriters' Laboratories (UL) label where such label is applicable.

E. Comply with requirements of State and Local Ordinances. If a conflict occurs between these requirements and the Contract Documents, the most stringent requirements shall govern. The Contractor accepts this responsibility upon submitting his bid, and no extra charge will be allowed after the contract is awarded. This shall not be construed as relieving the Contractor from complying with any requirements of the Contract Documents that may be in excess of the aforementioned requirements, and not contrary to same.

F. Obtain all permits, inspections, etc. required by authority having jurisdiction. Include all fees in bid. Furnish a certificate of approval to the Owner's Representative from the Inspection Authority at completion of the work.

G. Employ only qualified craftsmen with at least three years of experience. Workmanship shall be neat, have a good mechanical appearance and conform to best electrical construction practices. Provide a competent superintendent to direct the work at all times. Any person found incompetent shall be discharged from the project and replaced by satisfactory personnel.

H. Contractor shall have a current state contracting license applicable to type of work to be performed under this contract.

I. Required Pre-Electrical Construction Meeting with Electrical Engineer: Electrical contractor/representative will be required to attend a pre-electrical construction meeting (approximately 30-60 minutes) with engineering representative in the electrical engineers office prior to electrical construction commencement. This meeting will address any questions on the part of the contractor and the expectations of the Engineer with regard to specifications, plans and site visits for both rough and finish electrical work.

1.12 CONSTRUCTION CHANGE ORDER PROPOSALS

A. In the event that a submission of a change order is issued by the contractor, the following information will be required to be submitted by the contractor, prior to any consideration by the owner/architect.
   a. Where project manager or project engineer work is required, the labor cost shall not exceed 2% of the electrical portion of the change order.
   b. All equipment, including conduit and wire, shall be itemized, identifying unit costs and quantities of equipment. Distributor quotes shall accompany all change order requests. The distributor quotes shall include costs for all equipment including conduit and wire. Lot pricing for equipment is not acceptable.
   c. The general contractor shall review and confirm that the quantity and costs of materials submitted appear reasonable for the scope proposed.
   d. Labor units shall not exceed base NECA #1 standards. No adjustment factors shall be approved.
   e. Any research and labeling time, shall be the responsibility of the electrical contractor and shall not be included in the change order request.
   f. Any costs associated with the purchase of tools or transportation shall be fully itemized for review by architect/owner.
   g. Overtime rates shall only be approved where additional manpower cannot achieve the same result.
   h. Change order form shall follow the following format:
      i. PCO number
      ii. Detailed description of work being performed
      iii. Location on project where work is performed
      iv. Chosen NECA column
      v. Identified material:
         1. QTY
         2. Unit cost
         3. Mark up
         4. Material total
      vi. Identified labor:
         1. QTY
         2. Unit cost
         3. Composite labor rate
         4. Labor total

1.13 RECORD DRAWINGS:

A. Contractor shall provide as-built drawings and a record model of the completed project, reflecting all deviations from the original design including but not limited to field conditions, RFIs, ASIs, and other modifications. The as-built drawings shall be provided in both

Autodesk Revit and PDF formats.

B. Maintain, on a daily basis, a complete set of “Record Drawings”, reflecting an accurate record of work in accordance with the following:

1. Show the complete routing and location of all feeders rated 100 amps and larger. Contractor shall clearly indicate dimensions on the drawings for work that is hidden beneath the ground or under slabs, concealed above ceiling structures, and within concealed spaces. These dimensions shall be measured from fixed structural elements, rather than from partition walls or other non-structural elements.
2. Show the complete routing and location of all telecommunications conduits, systems raceways, and empty raceways, 1-1/4" and larger. Contractor shall clearly indicate dimensions on the drawings for work that is hidden beneath the ground or under slabs, concealed above ceiling structures, and within concealed spaces. These dimensions shall be measured from fixed structural elements, rather than from partition walls or other non-structural elements.
3. Show all changes, deviations, addendum items, change orders, job instructions, etc., that change the work from that shown on the contract documents, including wall relocations, fixtures and device changes, branch circuiting changes, etc. Where locations of boxes, raceways, equipment, etc. are adjusted in the field to fit conditions, but such new locations may not be obvious by referring to the contract document, show new locations on the record drawings.
4. Provide a copy of the raceway as-builts within the equipment rack for the system indicated below. Provide 11x17 size laminated prints that are legible.
    a. Telecommunications
    b. Audiovisual

C. At the discretion of the Architect/Engineer, the drawings will be reviewed on a periodic basis and used as a pre-requisite for progress payments. This requirement shall not be construed as authorization for the Contractor to make changes in the layout, or work without written authorization for such changes.

D. The Architect/Engineer shall review the drawings and the Contractor shall incorporate the resulting comments into the final record drawings.

E. Certify the “Record Drawings” for correctness by placing and signing the following certifications of the first sheet of the drawings:

"CERTIFIED CORRECT (3/8" high letters)

(Name of General Contractor)

By: _____ Date: _____

(Name of Electrical Contractor)

By: _____ Date: _____

1.14 GUARANTEE:

A. Ensure that electrical system installed under this contract is in proper working order and in compliance with drawings, specifications, and/or authorized changes. Without additional charge, replace any work or materials that develop defect, except from ordinary wear and tear, within one year from the date of substantial completion. Exception: Incandescent and fluorescent lamps shall be guaranteed for a period of two months from the date of substantial completion.

1.15 OTHER:

A. Right to Hire. “Client” agrees that during the project and for a period of twenty four (24) months following substantial completion that it will not, directly or indirectly, employ or solicit to employ BNA Personnel.

PART 2 – PRODUCTS

2.1 GENERAL:

A. Products are specified by manufacturer name, description, and/or catalog number. Discrepancies between equipment specified and the intended function of equipment shall be brought to the attention of the Architect/Engineer in writing prior to bidding. Failure to report any conflict, including catalog numbers, discontinued products, etc., does not relieve the Contractor from meeting the intent of the contract documents nor shall it change the contract cost. If the Contractor is unable to interpret any part of the plans and/or specifications, or should he find discrepancies therein, he shall bring this to the attention of the Architect/Engineer who will issue interpretation and/or additional instructions to Bidders before the project is bid.

2.2 MANUFACTURERS:

A. Provide products of manufacturers specified. Manufacturers catalog numbers and descriptions establish the quality of product required. Substitutions will be considered if a duplicate written application (2-copies) is at the office of the Architect/Engineer eight (8) working days prior to the day of the bidding. The application shall include the following: 1) A statement certifying that the equipment proposed is equal to that specified; that it has the same electrical and physical characteristics, compatible dimensions, and meets the functional intent of the contract documents; 2) The specified and submittal catalog numbers of the equipment under consideration; 3) A pictorial and specification brochure.

B. Any conflict arising from the use of substituted equipment shall be the responsibility of the Contractor, who shall bear all costs required to make the equipment comply with the intent of the contract documents.

C. Samples may be required for non-standard or substituted items before installation during construction. Provide all samples as required.

D. No materials or apparatus may be substituted after the bid opening except where the equipment specified has been discontinued.

E. Provide only equipment specified in the Contract Documents or approved by addendum.

2.3 SPARE PARTS:

A. Provide spare parts (fuses, diffusers, lamps, etc.) as specified. Transmit all spare parts to Owner's Representative prior to substantial completion.

PART 3 – EXECUTION

3.1 INSTALLATION:

A. Layout electrical work in advance of construction to eliminate unnecessary cutting, drilling, channeling, etc. Where such cutting, drilling, or channeling becomes necessary for proper installation; perform with care. Use skilled mechanics of the trades involved. Repair damage to building and equipment at no additional cost to the contract. Cutting work of other Contractors shall be done only with the consent of that Contractor. Cutting structural members shall not be permitted.

B. Provide equipment enclosures appropriate to the environment to which they are installed. For example, provide NEMA 3R for exterior enclosures and NEMA 1 for interior enclosures unless otherwise noted.

C. Since the drawings of floor, wall, and ceiling installation are made at small scale; outlets, devices, equipment, etc., are indicated only in their approximate location unless dimensioned. Locate outlets and apparatus symmetrically on floors, walls and ceilings where not dimensioned, and coordinate such locations with work of other trades to prevent interferences. Verify all dimensions on the job. Do not scale the electrical drawings, but refer to the architectural and mechanical shop drawings and project drawings for dimensions as applicable.

D. Perform for other trades, the electrical wiring and connection for all devices, equipment or apparatus. Consult Architectural, Mechanical, and other applicable drawings, and all applicable shop drawings to avoid switches, outlets, and other equipment from being hidden behind doors, cabinets, counters, heating equipment, etc., or from being located in chalkboards, tackboards, glass panels, etc. Relocate buried electrical devices and/or connections as directed at no additional cost.

E. Coordinate the location of outlets, devices, connections, and equipment with the supplier of the systems furniture prior to rough-in.

F. Where conduit, outlets or apparatus are to be encased in concrete, it must be located and secured by a journeyman or foreman present at the point of installation. Check locations of the electrical items before and after concrete and/or masonry installation and relocate displaced items.

G. Provide block-outs, sleeves, demolition work, etc., required for installation of work specified in this division.

3.2 CLEAN:

A. Clean up all equipment, conduit, fittings, packing cartons and other debris that is a direct result of the installation of the work of this Division.

B. Clean fixtures, interiors and exteriors of all equipment, and raceways. Replace all filters in electrical equipment upon request for Substantial Completion.

3.3 POWER OUTAGES:

A. All power outages required for execution of this work shall occur during non-standard working hours and at the convenience of the Owner. Include all costs for overtime work in bid.

B. Submit written request at least 7 days in advance of scheduled outage and proceed with outage only after receiving authorization from the Owner's Representative.

C. Keep all outages to an absolute minimum.

3.4 STORAGE AND PROTECTION OF MATERIALS:

A. Provide storage space for storage of materials and apparatus and assume complete responsibility for all losses due to any cause whatsoever. In no case shall storage interfere with traffic conditions in any public thoroughfare or constitute a hazard to persons in the vicinity. Protect completed work, work underway, and apparatus against loss or damage.

3.5 EXCAVATING FOR ELECTRICAL WORK:

A. General: Locate and protect existing utilities and other underground work in manner that will ensure that no damage or service interruption will result from excavating and backfilling. Perform excavation in a manner that protects walls, footings, and other structural members from being disturbed or damaged in any way. Burial depths must comply with NEC Section 300-5 (or State of Utah requirement, whichever is more stringent), unless noted otherwise on drawings.

B. Protect persons from injury at excavations, by barricades, warnings and illumination.

C. Coordinate excavations with weather conditions, to minimize possibility of washouts, settlements and other damages and hazards.

D. Provide temporary covering or enclosure and temporary heat as necessary to protect bottoms of excavations from freezing and frost action. Do not install electrical work on frozen excavation bases or sub-bases.

E. Do not excavate for electrical work until the work is ready to proceed without delay, so that total time lapse from excavation to completion of backfilling will be minimum. See other sections of specification for additional requirements for excavating.

F. Store excavated material (temporarily) near excavation, in a manner that will not interfere with or damage excavation or other work. Do not store under trees (within drip line).

G. Retain excavated material that complies with requirements for backfill material. Dispose of excavated material that is either in excess of quantity needed for backfilling or does not comply with requirements for backfill material. Remove unused material from project site, and dispose of in lawful manner.

3.6 BACKFILL MATERIALS:

A. For buried conduit or cable (other than below slab-on-grade, or concrete encased) - 2" thickness of well graded sand on all side of conduit or cable.

B. For trench backfill to within 6" of final grade - soil material suitable for compacting to required densities.

C. For top 6" of excavation - Top soil.

D. Backfill excavations in 8" high courses of backfill material, uniformly compacted to the following densities (percent of maximum density, ASTM D 1557), using power-driven hand-operated compaction equipment.

1. Lawn/Landscaped Areas: 85 percent for cohesive soils, 95 percent for cohesionless soils.
2. Paved Areas, Other than Roadways (90 percent for cohesive soils, 95 percent for cohesionless soils).

E. Subsidence: Where subsidence is measurable or observable at electrical work excavations during general project warranty period, remove surface (pavement, lawn or other finish), add backfill material, compact, and replace surface treatment. Restore appearance, quality and condition of the surface or finish to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.7 UTILITY COORDINATION:

A. Coordinate closely with Rocky Mountain Power (RMP) to finalize the conduit routing shown on the site plan. Verify all equipment dimensions and locations before beginning rough in. Consult all applicable contract drawings and latest RMP ESR to insure RMP code clearances required around all electrical equipment, trenching and burial depths, and identification requirements are met. Adjust locations of electrical work, boxes, outlets etc. As necessary to avoid obstructing electrical equipment or building appurtenances. Where job conditions require changes from the contract documents that do not change the scope of installation or nature of work required, the contractor will make such changes without additional cost to the owner. No other changes may be made without written permission of the owner.

B. Contractor responsible for renovating/updating the existing utility service as per plans. In general the existing RMP transformer is to be replaced with new along with upgraded service entrance and supporting disconnects and panelboards. Provide a complete and working system.

C. Submit metering, main breaker, switchgear for approval prior to preconstruction.

3.8 CONCRETE BASES:

A. Unless otherwise noted, provide 4" high reinforced concrete bases for all floor mounted or floor standing electrical equipment, including generators, transformers, switchgear, battery racks, motor control centers, etc. Extend bases 6" beyond equipment or mounting rails on all sides or as shown on the drawings. Notwithstanding this requirement, coordinate with equipment manufacturer, shop drawings, and height of base to ensure compliance with NEC 404.8.

B. Concrete bases shall be provided under Divisions 26, 27 and 28. Coordinate size and location of all bases and furnish all required anchor bolts, sleeves, reinforcing and templates as required to obtain a proper installation.

C. Provide and locate properly sized concrete pads for power company furnished pad mounted transformers in accordance with power company clearance requirements. Where the serving utility is Rocky Mountain Power, the electrical contractor shall conform to the requirements of Electrical Service Requirements, Section 6.4.

3.9 ROOF PENETRATIONS:

A. Where raceways penetrate roofing or similar structural area, provide appropriate roof jack coordinate with the roofing contractor and the Architect in order to match the vent with the roof construction. The jack shall be sized to fit tightly to raceway for weather-tight seal, and with flange extending a minimum of 9" under roofing in all sides or as required by the roof type of construction. Completely seal opening between inside diameter of roof flashing and outside diameter of penetrating raceways. Coordinate all work with work required under roofing section of specifications.

3.10 FIRE PENETRATION SEALS:

A. Seal all penetrations for work of this section through fire rated floors, walls and ceilings to prevent the spread of smoke, fire, toxic gas or water through the penetration either before, during or after fire. The fire rating of the penetration seal shall be at least that of the floor, wall or ceiling that it is installed, so that the original fire rating of the floor or wall is maintained as required by Article 300-21 of the National Electrical Code. Where applicable, provide OZ Type CFSF/I and CAFSF/I fire seal fittings for conduit and cable penetrations through concrete and masonry walls, floors, slabs, and similar structures. Where applicable, provide 3M CID cast-in device for floor slabs. Where applicable, provide 3M fire barrier sealing penetration system, and/or IPC Flame Safe Fire Stop System, and/or Chase Foam fire stop system, including wall wrap, partitions, caps, and other accessories as required. All materials to comply with UL 1479 (ASTM E-814). Comply with manufacturer's instructions and recommendations for installation of sealing fittings and barrier sealing systems.

3.11 PROJECT FINALIZATION AND START-UP:

A. Upon completion of equipment and system installation, assemble all equipment Factory Representatives and Subcontractors for system start-up.

B. Each Representative and Subcontractor shall assist in start-up and check out their respective system and remain at the site until the total system operation is accepted by the Owner's representative.

C. The Factory Representative and/or System Subcontractor shall give personal instruction on operating and maintenance of their equipment to the Owner's maintenance and/or operation personnel. To certify acceptance of operation and instruction by the Owner's Representative, the contractor shall prepare a written statement as follows:

1. This is to certify that the Factory Representative and System Subcontractor for each of the systems listed below have performed start-up and final check out of their respective systems.

2. The Owner's Representative has received complete and thorough instruction in the operation and maintenance of each system.

SYSTEM	FACTORY REPRESENTATIVE
(List systems included)	(List name and address of Factory Representative)

Owner's Representative	Contractor

D. Send copy of acceptance to Architect/Engineer.

3.12 FINAL REVIEW:

A. At the time of final review, the project foreman shall accompany the reviewing party, and remove coverplates, panel covers and other access panels as requested, to allow review of the entire electrical system.

END OF SECTION 26 0500

SECTION 26 0501 - MECHANICAL / ELECTRICAL & OWNER PROVIDED EQUIPMENT COORDINATION

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. Architectural, Structural, Vertical Transportation, Mechanical and other applicable documents are considered a part of the electrical documents insofar as they apply as if referred to in full. Contractor must review the entire set of plans and specifications. Reviewing only the electrical set is not acceptable.

1.2 CONTRACTOR RESPONSIBILITIES

A. Electrical Contractor shall verify electrical service provided prior to ordering any electrical equipment serving owner-provided equipment / mechanical equipment, and Electrical Contractor shall have the final responsibility for properly coordinating the electrical work, including the exact location, quantity and sizes of the electrical connection(s).

1. Circuit breakers, disconnects, starters, fuses, conduit sizes, wire sizes, VFDs, etc. have been coordinated by Engineers and sized according to the mechanical systems “Basis of Design”. Coordinate with Division 23 Contractor for any changes arising from substituted equipment or changes to the basis of design in any way. Coordinate all requirements of multi-motor VFD control (including fanwall units) and ensure all provisions accordingly. Prepare documentation showing changes in the electrical characteristics of each piece of equipment that has changed and submit for acceptance. All costs arising from said changes shall be the responsibility of Division 23.

B. Obtain submittals of all mechanical equipment from Division 21 through 23 contractor(s) as they are submitted to the design team.

1. Notify engineer of any modifications between contract documents and submittals. It shall be the contractor’s responsibility to ensure compliance with the documents.

C. Obtain submittals of all owner-provided equipment from Owner Representative prior to rough-in. It is not acceptable to proceed with the rough-in phase of work until this has been completed—if contractor elects to proceed they do at their own risk.

1. Notify engineer of any modifications between contract documents and submittals. It shall be the contractor’s responsibility to ensure compliance with the documents.

D. Electrical contractor shall be responsible for coordinating all their own blockouts and coordinating their space of a shared blockout.

E. Coordinate all interfaces between Mechanical and Electrical/Communications/Security Divisions before submitting any equipment for review or beginning installation.

1.3 ABBREVIATIONS

A. MC: Mechanical Contractor = Divisions 21 through 23 Contractor who provides equipment and motor.

B. TC: Temperature Controls = Division 25 1000 Contractor who provides control.

C. EC: Electrical Contractor = Divisions 26 through 28 Contractor who provides power/data.

D. FA: Fire Alarm Contractor = Division 28 Contractor who furnishes Fire Alarm System.

1.4 RESPONSIBILITY SCHEDULE

A. Responsibility: Unless otherwise indicated, all equipment, motors, and controls for Divisions 21 through 23 equipment shall be furnished, set in place and wired in accordance with the following schedule:

ITEM -	Furnished Under	Set In Place Under	Power Wiring Under	Control Wiring Under
AHU Interior Lights (Note 8)	MC	MC	MC	MC
AHU Light Switch	EC	EC	EC	EC
RTU Light Switch	MC	MC	EC	EC
Equipment Motors	MC	MC	EC	TC
Automatically or Manually Controlled Starters/Contactors: (Note 4)				
-Separate	EC	EC	EC	TC
-Factory Mounted and Wired	MC	MC	EC	TC
Variable Frequency Drives				
-Separate	MC	EC	EC	TC
-Factory Mounted and Wired	MC	MC	EC	TC
In Motor Control Centers (Note 4)	EC	EC	EC	TC
Motor Speed Controllers: (Note 4)				
-Separate	MC	EC	EC	TC
-Factory Mounted and Wired	MC	MC	EC	TC
Disconnect Switches (Note 1)	EC	EC	EC	--
Thermal Overload Switches (Note 1)	EC	EC	EC	--
Switches (Manual or Automatic other than disconnect) (Note 2)	MC or TC	MC or TC	EC or TC	TC or MC
Control Relays (Note 2)	MC or TC	MC or TC	--	TC
Control Transformers	TC	MC or TC	EC (120V)	TC
Thermostat and Controls: Integral with Equipment or Directly Attached to Ducts, Pipes, etc. (Note 2)	TC	MC or TC	TC	TC
Equipment in Temperature Control Panels	TC	TC	EC	TC
Standalone Control Panels (BAS) (Note 6)	TC	TC	EC (120V)	TC
Valve Motors, Damper Motors, Solenoid Valves, etc.	MC & TC	MC & TC	TC	TC
EP Valves or Switches, P.E. Switches, etc.	TC	TC	--	TC
Fire Alarm System (Note 3)	FA	FA	EC	FA
Fire Sprinkler Alarm (Note 3)	FA	FA	EC	FA
Duct System Smoke Detectors (Note 5)	FA	MC	EC	TC/FA

ITEM -	Furnished Under	Set In Place Under	Power Wiring Under	Control Wiring Under
Relays for Fan Control via duct detectors (Note 5)	MC	EC	EC	FA
Room Smoke Detectors Including Relays for Fan Control (Note 3)	FA	EC	EC	EC
Smoke Management Curtain and Shutters (Note 6)			EC	EC/FA
CO Sensors	FA	FA	EC	FA
Equipment Interlocks	TC	TC	--	TC
Fire/Smoke and Smoke Dampers (Note 7)	MC	MC	EC	FA
Positive Indication Devices (i.e., current sensors, end switches, airflow sensors)	TC	TC	--	FA/TC
Freezer and Refrigerator Temperature Controls (Intrusion)	MC	MC	EC	EC
Domestic Water Flow Switch (Intrusion) Located downstream past the cooling tower. Provide 120V power.	MC	MC	EC	EC
Low Building Temperature Sensor (Intrusion)	MC	MC	EC	EC

B. Responsibility Schedule Notes:

1. If furnished as part of factory wired equipment furnished and set in place by MC, wiring and connections by EC.

2. If float switches, line thermostats, P.E. switches, time switches, or other controls carry the FULL LOAD CURRENT to any motor, they shall be furnished by MC, but they shall be set in place and connected by EC, except that where such items are an integral part of the mechanical equipment, or directly attached to ducts, piping, or other mechanical equipment, they shall be furnished and set in place by MC and connected by EC. If they do not carry the FULL LOAD CURRENT to any motor, they shall be furnished, set in place and wired by TC contractor.

3. Electrical contractor is responsible for wiring from starter to motor, unless factory wired.

4. Temperature control contractor shall provide conduit and wire from auxiliary contact in motor starter to the detector so that the unit shuts down in all operating modes. Fire Alarm Contractor to wire from detector to fire alarm panel.

5. Each division shall be fully responsible for any control panels as called for on the drawings or specifications.

   a. Division 26 and 28 shall provide all power and control wiring to fire/smoke and/or smoke dampers. Division 23 shall provide parallel control wiring (with 28 fire alarm having priority signal) to dampers and equipment utilized in both normal and smoke control modes. Refer to Smoke Control and Fire Alarm Drawings and the Fire Alarm Matrix.

   b. Fire alarm system shall override automated building control system during smoke exhaust mode.

   c. TC wiring required only when damper also serves HVAC system.

6. FA wires from the fire alarm control panel necessary for the initiation and monitoring of the Smoke Management System Control Panel. TC wires to components and smoke control fans and dampers utilized in the control and

monitoring of the Automated Building Control System.

a. Provide 120V emergency circuit and fire alarm connections to each curtain and shutter. Coordinate exact locations with curtain and shutter contractor.

7. Division 26 shall provide power to junction box on the exterior of the AHU.

8. Exhaust Fans - Division 26 shall provide power and connection to all exhaust fans:

a. Exhaust fans utilized for restrooms shall be operate on/off with the local lighting occupancy sensor. Provide pre-wired relay to accept contact from occupancy sensor to exhaust fan operating voltage.

C. Power Wiring by Divisions 21 through 23: The electrical power for certain equipment provided under Divisions 21 through 23 has not been specifically indicated on the electrical drawings and must be provided by and field coordinated by the Divisions 21 through 23 trades requiring such power. Electrical contractor shall review Division 21 through 23 drawings and coordinate with said contractors to confirm power needs.

1. Sufficient power for this purpose shall be furnished as “spare” dedicated circuit capacity in Division 26’s panelboards. All wiring, conduit and electrical devices downstream of the panelboards are the responsibility of the Divisions 21 through 23 trades requiring the power.

a. Such equipment is hereby defined as:

2. Electrical heat trace. Required heat trace locations, capacities and specification are shown on the plumbing drawings (Division 22 work).

3. Dry-pipe control panels and valves. Required connections are included in the Division 21 work, and will be shown by that contractor’s engineered system design drawings.

a. Such equipment is hereby defined as:

b. Electrical heat trace. Required heat trace locations, capacities and specification are shown on the plumbing drawings (Division 22 work).

c. Fire protection air compressors, dry-pipe control panels and valves. Required connections are included in the Division 21 work, and will be shown by that contractor’s engineered system design drawings.

d. Pre-action system alarm and trouble initiation signals (such as smoke detectors or general alarm conditions in a pre-action zone) shall be provided under Division 28 fire alarm work.

e. Division 21 shall provide pre-action control panel and interconnection between pre-action panel and location of pre-action valve(s). See Specification 21-5000 for FM 200.

f. Division 28 shall provide interconnection between fire command center alarm panel (provided under Division 28) and remote communication fire alarm panel (provided under Division 28).

4. Infrared plumbing fixtures. Fixtures requiring power are shown on the plumbing drawings and schedules. Provide junction box and or receptacle as required by manufacturer.

5. Temperature control panels, control air compressors and line voltage power for 24v control transformers. Required connections are included in Division 23 09 00 and will be shown by that contractor’s control submittal drawings.

6. Condensate pumps. Provide power from associated unit or from nearby panelboard.
7. BAS or Control System Gateways. Provide power from nearest panelboard and single data cable from nearest telecommunications room.

1.5 GENERAL REQUIREMENTS

A. Special Requirements:

1. Motors, starters and other electrical equipment installed in moist areas or areas of special conditions, such as explosion proof, shall be designed and approved for installation in such areas with appropriate enclosure.

B. Building Management System Controls:

1. Provide 120V circuit and single data cable to each building management control panel. Coordinate exact locations with controls contractor. See Specification 27-1500
2. Low voltage wiring from J-boxes to distributed control components, all low voltage connections, all control panels and all control transformers (not part of unitary equipment) shall be provided under Division 23.
3. Any additional power requirements shall be the responsibility of the Division 23 Contractor requiring same, and shall be provided at no additional cost to the owner.

1.6 CEILING AND CHASE CAVITY PRECEDENCE

A. Coordinate ceiling cavity space carefully with all trades. In the event of conflict, install mechanical and electric systems within the cavity space allocation in the following order of precedence. A system with higher precedence may direct that systems of lower precedence be relocated from space, which is required for expedient routing of the precedent system.

1. Plumbing waste, cooling coil drain piping, and roof drain mains and leaders.
2. Condensate piping.
3. Hydronic main piping (8” and larger).
4. Plumbing vent piping.
5. Supply, return and exhaust ductwork.
6. Cable tray systems.
7. Electrical conduit 4” diameter or greater.
8. Hydronic branch and mains (greater than 2”, but less than 8”).
9. Domestic water piping.
10. Fire sprinkler mains and leaders.
11. Hydronic branch piping (2” and less).
12. Domestic hot and cold-water branches.
13. Electrical branch conduits.
14. Pneumatic control piping.
15. Fire sprinkler branch piping and sprinkler runouts.

B. Light fixtures have precedence in a zone, which is the same height above the ceiling as the depth of the fixture (plus 2”).

C. Examine the contract documents of all trades (e.g. all Divisions 21 through 23 and 26 through 28 drawings, the architectural floor plans, reflected ceiling plans, elevations and sections, structural plans and sections, etc.).

D. Coordinate necessary equipment, ductwork and piping locations so that the final installation is compatible with the materials and equipment of the other trades.

E. Prepare shop drawings for installation of all new work before installation to verify coordination of work between trades.

F. Provide access doors for all electrical and communications equipment which require access for adjustment or servicing and which are in otherwise inaccessible locations. All access door locations must be approved by the architect prior to installation and be in as inconspicuous location as possible.

1. For equipment located in “accessible locations” such as lay-in ceilings: Locate equipment to provide adequate service clearance for normal maintenance without removing architectural, mechanical, electrical or structural elements such as the ceiling support system, electrical fixtures, etc. “Normal maintenance” includes, but is not limited to: replacement of drivers, fuses, etc.

1.7 BLOCKOUT USAGE

A. Electrical and Mechanical Contractors shall review the contract documents and advise if additional blockouts are necessary for the execution of work. Electrical and Mechanical Contractors shall coordinate and hold meetings with other contractors who will occupy the blockouts to ensure sufficient space is allocated for their scope of work. It is not acceptable to delay this meeting until conduit/piping/tray is being installed. Change orders are not acceptable due to a lack of contractor coordination prior to commencing rough in.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 26 0501

SECTION 260502 - ELECTRICAL SUBMITTALS AND O & M MANUALS

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 all Division 26, 27 and 28 sections.

B. Architectural, Structural, Mechanical and other applicable documents are considered a part of the electrical documents insofar as they apply as if referred to in full. Contractor must review the entire set of plans and specifications. Reviewing only the electrical set is not acceptable.

C. Consult all other sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

1.2 SUBMITTAL REQUIREMENTS:

A. GENERAL:

1. After the Contract is awarded but prior to ordering, manufacture, or installation of any equipment, prepare complete Submittals including shop drawings, product data, brochures, etc. for materials and equipment as required by each section of the specification.
2. Review of Submittals shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from the Contract Document's requirements. It shall be clearly understood that the noting of some errors but overlooking others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Document's shall govern and are not waived, or superseded in any way by the review of the Shop Drawings and Brochures.
3. Submittals are reviewed, not approved. Comments made within submittals do not alter the contract documents in any way. The contractor is still responsible, regardless of comments (if any) made within submittals, for complying with drawings and specifications.
4. Notify engineer in writing if any of the comments noted in the submittals alter the contract cost. A comment within the submittal process which increases/decreases cost of product is not an authorization to the contractor under any circumstances to proceed.
5. Notify engineer of any modifications between contract documents and submittals. It is the responsibility of the contractor to ensure compliance.
6. ELECTRONIC SUBMITTAL REQUIREMENTS:
    a. Provide submittals in Portable Document Format (PDF).
    b. Documents must be electronically bookmarked and keyword searchable using Adobe Acrobat (http://www.adobe.com/acrobat) or Bluebeam Revu (http://www.bluebeam.com) for each relevant section. For example, include electronic bookmarks separating “Light Fixtures” from “Panelboards”.

c. Electronically highlight all options for light fixtures, electrical equipment, etc. Manual highlighting and scanning of the documents is NOT acceptable and will NOT be reviewed.

d. Provide only completed cutsheets for all fixture and equipment types. Blank cutsheets submitted with a schedule are NOT acceptable and will NOT be reviewed.

e. At the time of submission, the electrical contractor shall provide a complete and comprehensive submission of all required specification sections/shop drawings at the same time. Exceptions may be given, with prior approval, for time-sensitive equipment.

f. A maximum of one submittal per specification section is allowed. It is NOT acceptable to provide a product by product submittal. Single product by product submittals will NOT be reviewed.

B. SCHEDULING

1. GENERAL

a. A minimum period of two weeks, exclusive of transmittal time, will be required each time Submittals are submitted or resubmitted for review. This time period shall be considered by the Contractor when scheduling submittal data.

b. If the shop drawings are rejected twice, the contractor shall reimburse the engineer the sum of $1,200.00 for the third review and any additional reviews required prior to commencement of the third review.

C. QUALITY ASSURANCE

1. PRE-SUBMITTAL PREPARATION

a. Prior to submission of the Shop Drawings and Project Data, review and certify that they are in compliance with the Contract Documents. Verify all dimensional information to ensure proper clearance for installation of equipment.

b. Shop drawings requiring the use of electronic documents (floor plans, Lighting plans, fire alarm plans, etc.) shall be requested via a request for information (RFI) through the general contractor. Electronic documents will be provided to the Architect for distribution. No direct vendor requests will be accepted.

c. Contractor is completely responsible for the content of the submittal

2. SUBMITTAL REQUIREMENTS

a. Certifications shall be written or in the form of rubber stamp impressions as follows:

i. I hereby certify that this Shop Drawing and/or Brochure has been checked prior to submittal and that it complies in all respects with the requirements of the Contract Drawings and Specifications for this Project.

(Name of Electrical Subcontractor)

Name_____.

Position_____Date_____.

b. Brochures to be submitted shall be published by the Manufacturers and shall contain complete and detailed engineering and dimensional information. Brochures submitted shall contain only information relevant to

the particular equipment or materials to be furnished. The Contractor shall not submit catalogs that describe several different items in addition to those items to be used, unless all irrelevant information is marked out, or unless relevant information is clearly marked. Brochures from each manufacturer shall be identified and submitted separately.

c. Shop Drawings shall be done in an easily legible scale and shall contain sufficient plans, elevations, sections, and isometrics to clearly describe the equipment or apparatus, and its location. Drawings shall be prepared by an Engineer/Draftsmen skilled in this type of work. Shop Drawings shall be drawn to at least 1/4" = 1'0" scale.

d. Observe the following rules when submitting the Shop Drawings and Brochures.

i. Each Shop Drawing shall indicate in the lower right hand corner, and each Brochure shall indicate on the front cover the following: Title of the sheet or brochure, name and location of the building; names of the Architect and Electrical Engineer, Contractor, Subcontractors, Manufacturer, Supplier/Vendor, etc., date of submittal, and the date of correction and revision. Unless the above information is included the submittal will be returned for resubmittal.

1. Submittal Identification shall include the following:

a. A unique number, sequentially assigned, shall be noted on the transmittal form accompanying each item submitted.

b. Original submittal numbers shall have the following format: “XXX-Y;” where “XXX” is the originally assigned submittal number and “Y” is a sequential letter assigned for resubmittals (for example, A, B, or C being the first, second, and third resubmittals, respectively). Submittal 25B, for example, is the second resubmittal of Submittal 25.

e. SPECIFICATION section and paragraph to which submittal applies.

D. POST-SUBMITTAL

1. Check all materials and equipment after arrival on the job site and verify compliance with the Contract Documents.

1.3 PROVIDE SUBMITTALS AS REQUESTED FOR EACH OF THE SECTIONS LISTED BELOW:

A. 26 0519 Conductors and Cables

1. (600V and Below)

a. Submit megohmmeter test data for circuits under 600 volts.

2. Conductors and Cables (Medium and Low Voltage)

a. Submit manufacturer's data on electrical cable and connectors for use above 600 volts. Upon request of Architect/Engineer, submit certificate of

compliance indicating that cable has been tested in accordance with ICEA S-68-516, AE16 #6 and UL Standard 1072, and meets or exceeds minimum requirements.

b. Submit test data in accordance with IEEE Standard 400-2001 showing ambient conditions, voltage levels, level durations, and conduction current for each step. Include effective insulation resistance in submittal.

c. Submit medium voltage cable Splicer/Terminator certification of competency and experience 20 days before splices or terminations are made in medium voltage cables. Splicer/Terminator experience during the immediate past 3 years shall include performance in splicing and terminating cables of the type and classification being provided under this contract.

B. 26 0526 Grounding

1. Submit the name of test agency to be used for testing specified in this section. Submit results of tests specified in this section. Also include test results in Operation and Maintenance Manuals as specified.

C. 26 0532 Conduit Raceway

1. Submit manufacturer's data on Power & Control/Signal Cable.

D. 26 0533 Electrical Boxes and Fittings

1. Submit manufacturer's data including specifications, installation instruction and general recommendations for each type of floor box used on project.

E. 26 0548 Electrical Seismic Control

1. A single submittal shall be provided for all seismic anchorage and restraints for all Division 26 equipment and systems provided as part of this project. Individual submittals for specific systems will not be accepted.

2. Submit shop drawings, calculations, and printed data for the following items under provisions of the General Conditions of the Contract:

a. Complete engineering calculations and shop drawings for all seismic requirements for all equipment to be restrained as outlined in Section 26 0548 Specification, and as detailed on drawings.

b. The professional seal of the engineer who is responsible for the design of the Seismic Restraint System.

c. Details for all seismic bracing.

d. Details for steel frames, concrete inertia bases, and housekeeping pads. Include dimensions, embed depths, dowelling details, and concrete reinforcing requirements.

e. Clearly outlined procedures for installing and adjusting the isolators, seismic bracing anchors, snubbers, cables, and bolt connections.

f. Floor plan noting the locations, size, and type of anchorage and restraint to be used.

g. Include confirmation that all calculations are based on the design criteria listed in appropriate Section.

h. Certificate of Compliance.

i. Where equipment is exempt per this specification provide a written certificate of compliance for each of the systems noted with the

professional seal of engineer who has reviewed the electrical system.

F. 26 0553 Electrical Identification

1. Submit manufacturer's data on each type of electrical identification products

   a. Submit one sample of each component of the electrical identification system as follows: Wire/cable tape marker, Tags, Engraved, plastic laminate labels, Arc-flash hazard labels

G. 26 0573 Protective Device Study

1. Submit partial study that includes the calculated values for short circuit current availability and arc flash levels for each switchgear bus, medium voltage controller, switchboard, low voltage motor control center, distribution panelboard, automatic transfer switch, and branch circuit panelboard. This data shall be submitted prior to, or at the same time as, submitting the entire electrical gear package. Contractor shall utilize construction drawings to estimate approximate feeder lengths for this preliminary submittal. Submitted data shall include equipment/panel designations, feeder conductor sizes, feeder lengths, and calculated short circuit values and arc flash levels. Include the utility transformer ratings and transformer impedances used for the preparation of the short circuit calculations.

2. Construction Period Submittal: During the construction period but prior to application of utility power to the electrical distribution system, submit an indexed copy of the complete protective device study based on actual field values. Include the following:

   a. Introductory section with basic formulas, pertinent data, and rationale employed in the study.

   b. One-line diagram for that portion of the system included in the study.

   c. Calculations section showing tabulated calculations.

   d. Results, recommendations, settings, etc.

3. Provide one revision to study based on engineering review comments for the completed study to allow for minor modifications to adjustable circuit breakers to minimize arc flash levels.

H. 26 0923 Occupancy Sensors

1. Submit manufacturer's data on occupancy sensors, control modules, wiring diagrams, interconnection diagrams and any related accessories.

2. Submit scaled drawings with lighting fixtures shown clearly marked by manufacturer showing proper product, location and orientation of each sensor.

I. 26 0943 Lighting Control Equipment

1. Submit manufacturer's data on lighting control equipment including, but not limited to published catalog data sheets, rough-in diagrams and instructions for installation, operating and maintenance, suitable for inclusion in maintenance manuals.

2. Meet with the electrical engineer at their office prior to preparation of shop drawings to discuss and verify specific programming and zoning requirements of system(s).

3. Meet with the lighting representative/manufacturer of the approved and accepted lighting control equipment to verify and understand specific installation requirements associated with that system.

4. Submit detailed drawings and documentation of lighting control components and interconnection including, but not necessarily limited to:
    a. Electronic controllers
    b. Control stations
    c. Photo sensors
    d. Occupancy sensors
    e. Network wiring details
    f. Input and output wiring details
    g. Lighting control panel load schedules
    h. Provide a complete sequencing and programming schedules for all devices, zones and scenes.
    i. Wallstations layouts
    j. Accurately scaled equipment layouts, wire/cable routing and connections to control wiring and electrical power feeders.

J. 26 2200 Transformers

1. Submit manufacturer's data on transformers, including certification of transformer performance efficiency, percentage regulation at 100 percent and 80 percent power factor, no-load and full load losses in watts, percent impedance at 75 degrees C, hot-spot and average temperature rise above 40 degrees C ambient, sound level in decibels, and standard published data. Before submitting product data, verify that dimensions of units to be supplied allow proper code required clearances adjacent to unit.
2. Submit dimensioned drawings of transformer installations, showing layout, mountings and supports, and spatial relationship to proximate walls and equipment.
3. For types and ratings required, furnish additional fuses, amounting to one unit for every five installed units, but not less than three units of each (including ELSP fuses when specified).

K. 26 2416 Panelboards

1. Submit dimensioned drawings of panelboards and enclosures showing accurately scaled layouts of enclosures and required individual panelboard devices, including but not necessarily limited to, circuit breakers, fusible switches, fuses, ground-fault circuit interrupters, and accessories.
2. Submit manufacturer data including specifications, installation instructions and general recommendations, for each type of panelboard required.
3. Submit manufacturer’s data and shop drawings only after completion of the preliminary protective device study (see Section 26 0573 as applicable). Any Section 26 2416 submittals received prior to submission of the preliminary protective device study will be REJECTED.

L. 26 2713 Service Entrance

1. Submit manufacturer's data on service-entrance equipment and accessories.
2. Submit dimensioned layouts of service-entrance equipment and spatial relationships to proximate equipment. Failure to submit said layouts shall not relieve contractor of responsibility to verify required clearances before release of equipment to fabrication.

3. Submit manufacturer's data and shop drawings only after completion of the preliminary protective device study (see Section 26 0573 as applicable). Any Section 26 2713 submittals received prior to submission of the preliminary protective device study will be REJECTED.

4. For types and ratings required, furnish additional fuses, amounting to one unit for every 2 installed units, but not less than one unit of each.

M. 26 2726 Wiring Devices

1. Submit manufacturer's data on electrical wiring devices.

N. 26 2815 Overcurrent Protective Devices

1. Submit manufacturer's data on overcurrent protective devices, including catalog cuts, time-current trip characteristic curves, and mounting requirements.

2. Submit layout drawings of overcurrent protective devices, with layouts of circuit breakers, including spatial relationships to proximate equipment. Failure to submit said spatial layouts does not relieve contractor of responsibility to verify all required clearances before release of equipment for fabrication.

3. Submit manufacturer's data and shop drawings only after completion of the preliminary protective device study (see Section 26 0573 as applicable). Any Section 26 2815 submittals received prior to submission of the preliminary protective device study will be REJECTED.

4. For types and ratings required, furnish additional fuses, amounting to one unit for every 5 installed units, but not less than two units of each size and type, unless specified otherwise in another section of these specifications.

5. Submit time-current trip curves (in log-log format) and trip setting parameter/range information (for each trip function) for all solid-state circuit breakers.

6. Manufacturer shall also provide recommended trip settings with the shop drawing submittal (including ground fault settings) for coordination with downstream overcurrent devices. Manufacturer shall base recommendations on the AIC rating of the electrical equipment.

7. Where the Protective Device Study specification section 260573 is included in the project, the time-current curves and recommended trip settings for all solid-state circuit breakers shall be submitted as part of the protective device study.

O. 26 2816 Motor and Circuit Disconnects

1. Submit manufacturer's data including specifications, installation and general recommendations, for each type of motor and circuit disconnect switch required.

2. Submit dimensioned drawings of electrical motor and circuit disconnect switches that have rating of 100 amperes and larger.

P. 26 2913 Motor Starters

1. Submit manufacturer's data on motor starters.

2. Submit dimensioned drawings of motor starters showing accurately scaled equipment layouts.

3. After installation is complete, including water and air balancing, measure voltage (L-L and L-N) and full load current of each phase of each motor. Submit report showing field readings of voltage, amperage, service factor, and thermal heater size installed for each motor.

Q. 26 3213 Emergency Electrical Systems

1. Dimensioned drawings of emergency electrical system components and accessories including, but not necessarily limited to generator sets, isolation/by-pass switches, day tanks, transfer switches, instruments and accessories, (and) annunciator panels, (and fuel line and exhaust piping). Show accurately scaled layouts of system components; indicate their spatial relationship to associated equipment; show connections to normal and emergency power feeders. Failure to submit said scaled lay-outs does not relieve contractor of responsibility to verify all required clearances before release of equipment for fabrication.
2. Manufacturer's standard catalog data describing and depicting each engine-generator set, batteries, charger, tanks, and all ancillary equipment in sufficient detail to demonstrate complete specification compliance.
3. Drawings depicting each of the following:
    a. Base mounted equipment, with base and all attachments including anchor bolt template and recommended clearances for maintenance and operation.
    b. Complete starting system, fuel system, cooling system, and exhaust system.
    c. Electric wiring of relays, breakers, and switches with applicable single line and wiring diagrams and written description of operation and the instrumentation provided.
    d. Enclosure (if applicable).
4. Manufacturer's standard catalog data describing and depicting each transfer and by-pass isolation switch along with all ancillary equipment in sufficient detail to demonstrate complete specification compliance. In addition provide the following:
    a. One-line diagram of each switch assembly and wiring diagram of each unit.
    b. A complete list of equipment and material to be provided, containing an adequate description of each separate item of equipment.
5. Submit four complete sets of operating manuals for each item of equipment and/or component outlining the step-by-step procedure required for system start up, operation, and shutdown. Include the manufacturer's name, model number, and a description of all equipment, complete with basic operating features. Describe in detail all maintenance procedures and a troubleshooting guide listing possible breakdowns and repairs for each piece of equipment. Include all factory service manuals, complete parts lists, simplified schematic diagrams of each system as installed, and the original. Include complete rest reports specified in Part 3-Execution herein.

R. 26 4313 Surge Protective Devices (SPD)

1. Submit manufacturer's data on SPD's listing all performance ratings specified or required herein.
2. Submit dimensioned drawings of SPD's including, but not necessarily limited to, the following.
    a. Complete data sheet.
    b. Set of outline drawings giving complete mounting information, conduit entry and exit locations and dimensions, overall unit dimensions, weights, physical characteristics, etc.
    c. Set of complete electrical drawings for power and control wiring.

d. Manufacturer's literature giving detailed information of equipment including parts numbers, model numbers and ratings.

e. UL 1449 suppressed voltage rating documentation.

S. 26 5100 Interior and Exterior Building Lighting

1. Submit manufacturer's data on interior and exterior building lighting fixtures.

2. Submit dimensioned drawings of lighting fixtures. Submit fixture shop drawings in PDF format with separate sheet for each fixture, assembled in luminaire "type" alphabetical order, with proposed fixture catalog number and accessories clearly indicated on each sheet.

3. When applicable submit standard color samples with the shop drawings. If standard colors are not acceptable, a color sample will be provided to the fixture manufacturer. Return of the shop drawings will be delayed until color samples are provided.

4. Submit driver manufacturer cut sheets.

5. Submit a list of all lamps used on projects.

a. Stock of all spare items shall be delivered as directed to Owner’s storage space. All components shall be labeled to match construction document nomenclature,

T. 27 1500 Structured Cabling Systems

1. See District Specification for more information regarding submittal requirements.

2. Provide electronic submittals in Adobe PDF format within one file. Organize pages within submittal to be in the same order as the specification items (for example, racks prior to cabling). Where multiple submittals are provided due to submittal. If three or more reviews are required of the 27-1500 submittals, Contractor shall reimburse the Engineer for $1,200 before the Engineer will commence the third review. rejections/corrections, upon completing the submittal process with “No Exceptions Taken”, provide a consolidated single PDF submittal showing all products on the project.

3. Provide proof of RDIGITAL COPYD certification and connectivity manufacturer certification.

4. Provide submittals for all racks/cabinets; patch panels, devices, cabling, firestopping solutions, tray, non-continuous cable support devices, grounding equipment, and miscellaneous equipment to be used on project. Where multiple part numbers are listed on a datasheet/cutsheet, highlight or circle applicable part.

5. Provide submittals showing complete racking layout in plan and elevation view to scale. Coordinate exact rack layout with Owner Information Technology Representative prior to submittal.

6. Provide color samples of all available standard color faceplates to architect.

7. Provide proposed labeling scheme for approval by owner/engineer.

8. Provide catalog cutsheets of all test equipment that will be used.

9. Provide results of all copper and fiber optic cable tests.

U. 27 4100 Audiovisual Systems

1. The following items shall be included in the shop drawings submittal:

a. Project manager's written proof, with signature and date, that shop drawings and/or brochure has been checked for accuracy prior to submittal. Shop drawings to comply in all respects with the requirements of the contract drawings and specifications for this project.

b. A complete bill of materials, broken out per system type, for all components, accessories and hardware to be provided in order to assemble a complete and working system as described within the contract documents.

i. The bill of material is intended to be used to verify equipment within each system. Only one cut sheet per unique product type is required.

ii. Example several systems may require the same flat panel display mount, that mount should be listed in each system type with only one (1) cut sheet provided for that product.

c. Manufacturer's data sheets and installation details for all devices, plates, cables and similar equipment. Product data showing multiple options, products and/or models shall be clearly marked identifying the specific options, products and/or models being provided.

d. Signal flow drawings showing all audio, video, control, network and power connections required between all pieces of equipment within each system.

i. Unique cable/wire identifier for each connection that correspond to field cabling labelling scheme.

ii. All connections require connector type and sex to be identified. Type shall correspond to a connector legend or shall be clearly identified per instance.

iii. Wiring pinouts for all multipin connectors used

iv. Detailed panel drawings showing wall, floor, rack, etc. input/output panel dimensions, connector types and text labeling for each connection shown

v. Physical location information for each device.

vi. Upon request AV Consult's signal flow drawings may be utilized for signal flow documentation within the shop drawings, provided, the items above are included. Contractor shall make request for electronic files as indicated in section 1.2.C.

e. Equipment rack elevations.

f. Matrix routing and preset configuration tables, and digital signal processing configuration details.

g. Wireless microphone transmission frequencies.

h. Submit all manufacturer training, 3rd party and/or organization certificates for each equipment and/or systems required for the implementation of this specification.

i. Provide current equivalent if specified model has been discontinued.

2. All touch panel layouts, page logic functions and control system functionality, shall be submitted and approved by the Owner and AV Consultant prior to installation and programming of the control systems. Contractor shall submit the following

information at the following stages during the construction of the GUI.

a. Draft Stage: Draft drawings and/or sketches of; basic layouts, button details, text details and page flip progression. Include control schemes for all applicable devices in system.

b. Intermediate Stage: Intermediate Touch Panel Menus designed with manufacturer's software. Submit printouts and/or software files for review. Include detailed layouts, extensive control schemes for all controlled components, comprehensive button and text configurations, page flips and pop-up progression. Incorporate any changes or comments from previous stage mentioned above.

c. Demo Stage: Provide an active Touch Panel and controller to extensively demonstrate the operation of the control system. Demo of system shall be subject for review and considered as a deliverable. Include all revised detailed layouts, extensive control schemes for all controlled components, comprehensive button and text configurations, page flips and pop-up progression. Incorporate any changes or comments from the previous stage mentioned above.

d. Final Stage: Submit Final Touch Panel Menus designed with manufacturer's software. Submit printouts and software files for review. Include all detailed layouts, all revised control schemes for all controlled components, revised button and text configurations, page flips and pop-up progression. Include final page configurations for control of system from the touch panel. Incorporate any and all changes or comments from the previous stage mentioned above.

V. 27 5123 Intercommunication Systems

1. Provide a complete bill of materials for all components, accessories and hardware to be provided in order to assemble a complete and working system as described within the contract documents.

2. Provide wiring layouts for Audio, Video, Control, and power.

W. 28 1600 Intrusion Detection System

1. Submit manufacturer's data sheets including specifications, installation instructions, and general recommendation for each type of equipment specified.

2. Submit dimensioned drawings and wiring layout for any changes in wiring from the layout on the drawings. Submit actual riser diagrams of complete system and elevations of required equipment. Typical risers are not acceptable.

3. Contractor to provide a list of IP addresses of network devises with location and model #s.

X. 28 2205 Access Control System

1. Submit manufacturer's data sheets including specifications, installation instructions, and general recommendation for each type of equipment specified.

2. Submit dimensioned drawings and wiring layout for any changes in wiring from the layout on the drawings. Submit actual riser diagrams of complete system and elevations of required equipment. Typical risers are not acceptable.

3. Submit network switch port count and power requirements. Port count and POE switch requirements should be broken out per IDF/MDF closet.

4. Submit manufacturer certifications for all systems provided. Certifications must be

from local office providing the install.

5. Provide the Owner the following upon project completion:
   a. A complete set of shop drawings indicating: Locations of all panels, power supplies and controllers; point-to-point wiring diagrams for all devices.
   b. A complete equipment list identifying: Type; model; manufacturer; manufacturer's data sheets.
   c. A list of IP and MAC addresses, username and passwords for network devices coordinated with door name and/or location.
   d. Serial and model numbers for all major components.
   e. Installation manuals and user manuals for all systems listed in these specifications.

Y. 28 2300 IP Video Surveillance System

1. Submit dimensioned drawings and wiring layout for any changes in wiring from the layout on the drawings. Submit actual riser diagrams of complete system and elevations of required equipment. Typical risers are not acceptable.
2. Submit network switch port count and power requirements. Port count and POE switch requirements should be broken out per IDF/MDF closet.
3. Submit manufacturer certifications for all systems provided. Certifications must be from local office providing the install.
4. Mid-span power budget calculations showing power requirements for all cameras.
5. Provide the Owner the following upon project completion:
   a. A complete set of shop drawings indicating: Locations of all cameras, power supplies and controllers; point-to-point wiring diagrams for all devices.
   b. Locations of all cameras with custom painted enclosures due to wood ceilings.
   c. Contractor to provide a list of IP address for cameras coordinated with camera name and/or location.

Z. 28 3111 Fire Alarm and Detection System

1. Submit manufacturer's data on fire alarm and detection systems including, but not limited to, roughing-in diagrams and instructions for installation, operating and maintenance, suitable for inclusion in maintenance manuals.
2. Provide shop drawings showing equipment/device locations and connecting wiring of entire fire alarm and detection system. Include wiring diagrams and riser diagrams of panel. Provide dimensioned drawing of Fire Alarm Control Panel and Building Graphic. Shop drawings shall be prepared by an individual with a minimum NICET Level IV (Fire Protection Engineering/Fire Alarm Systems) certification. The individuals name and certification number shall be indicated on submittal design drawings.
3. Submit a written statement to the Architect and the state and local Fire Marshal's Office that each device of the fire alarm system will be installed, inspected and tested in accordance with applicable requirements of NFPA Standard 72.
4. Submit a complete set of documents to the Office of the State Fire Marshal

containing the following information:

a. A complete set of shop drawings indicating:

i. Location of all alarm-initiating and alarm-signaling devices.

ii. Point-to-point wiring diagrams for all alarm-initiating and alarm-signaling devices.

b. Wiring diagrams for:

i. Alarm control panels.

ii. Auxiliary function relays and solenoids.

iii. Remote signaling equipment.

iv. Standby battery calculations, including voltage drop calculation.

c. A complete equipment list identifying:

i. Type

ii. Model

iii. Manufacturer

iv. Manufacturer catalog data sheets

v. UL Listing and/or FM approval showing compatibility of device with Fire Alarm Control Panel (FACP)

d. A complete zone list identifying all:

i. Alarm-initiating and alarm-signaling devices.

ii. Remote signaling and auxiliary function zones.

iii. Specific devices associated with each zone.

e. Sample “System Record Document”.

f. Fire Alarm Key Plan Drawing showing the location of all device addresses and/or zones.

5. Address all comments from the Fire Marshal and instigate changes to the systems as applicable. Re-submit documents indicating changes instigated for final approval.

1.4 OPERATION & MAINTENANCE MANUALS

A. Provide operating instruction and maintenance data books for all equipment and materials furnished under this Division.

B. Submit four copies of operating and maintenance data books for review at least four weeks before final review of the project. Assemble all data in a completely indexed volume or volumes and identify the size, model, and features indicated for each item. The binder (sized to the material) shall be a 2" slide lock unit (Wilson-Jones WLJ36544B). The cover shall be engraved with the job title in 1/2" high letters and the name and address of the Contractor in 1/4" high letters. Provide the same information in 1/8" letters on the spine.

C. Include complete cleaning and servicing data compiled in clearly and easily understandable form. Show serial numbers of each piece of equipment, complete lists of replacement parts, motor ratings, etc. Each unit shall have its own individual sheet.

(Example: If two items of equipment A and D appear on the same sheet, an individual sheet shall be provided for each unit specified).

D. Include the following information where applicable.

1. Identifying name and mark number.
2. Certified outline Drawings and Shop Drawings.
3. Parts lists.
4. Performance curves and data.
5. Wiring diagrams.
6. Light fixture schedule with the lamps and ballast data used on the project for all fixtures
7. Manufacturer's recommended operating and maintenance instructions.
8. Vendor's name and address for each item.

E. The engineer will review the manuals and when approved, will forward the manuals on to the architect. If the manuals are rejected twice, the contractor shall reimburse the engineer the sum of $1,200.00 for each review afterwards.

F. Provide high quality video and audio recording for all training sessions. All trainings shall be recorded by utilizing a pro-grade digital camera system. Utilize camera tripod and record audio directly at the presenter. Smartphone recordings are not allowed.

G. Provide Operation and Maintenance Manual information for each section listed below in addition to the general requirements listed above.

1. 26 0526 Grounding
   a. Test Results of measured resistance values
2. 26 0548 Electrical Seismic Control
   a. Certificate of Compliance from Final Inspection
3. 26 0923 Occupancy Sensors
   a. Record Drawings
      i. A complete set of ‘as-builts’ drawings showing installed wiring, specific interconnections between all equipment, and internal wiring of this equipment shall be included in the operating and maintenance manuals upon complete of the system.
      ii. Provide a DIGITAL COPY to the owner containing the information specified below. The DIGITAL COPY shall include all information required to allow the Owner to change the schedules themselves. The DIGITAL COPY shall contain a minimum of following:
         1. CAD drawing files of ‘as-built’ lighting control components and point to point connections.
         2. General configuration programming.
         3. Job specific configuration programming to include schedule.
         4. Tutorial file on complete programming of lighting control system.
4. 26 0943 Lighting Control Equipment

a. Record Drawings

i. A complete set of ‘as-builts’ drawings showing installed wiring, specific interconnections between all equipment, and internal wiring of this equipment shall be included in the operating and maintenance manuals upon complete of the system.

ii. Provide a DIGITAL COPY to the owner containing the information specified below. The DIGITAL COPY shall include all information required to allow the Owner to change the schedules themselves. The DIGITAL COPY shall contain a minimum of following:

1. CAD drawing files of ‘as-built’ lighting control components and point to point connections.
2. General configuration programming.
3. Job specific configuration programming to include schedule.
4. Tutorial file on complete programming of lighting control system.

5. 26 2913 Motor Starters

a. After installation is complete, including water and air balancing, measure voltage (L-L and L-N) and full load current of each phase of each motor. Submit report showing field readings of voltage, amperage, service factor, and thermal heater size installed for each motor.

6. 26 3213 Emergency Electrical System

a. Manual Requirements

i. Submit four complete sets of operating manuals for each item of equipment and/or component outlining the step-by-step procedure required for system start up, operation, and shutdown. Include the manufacturer’s name, model number, and a description of all equipment, complete with basic operating features. Describe in detail all maintenance procedures and a troubleshooting guide listing possible breakdowns and repairs for each piece of equipment. Include all factory service manuals, complete parts lists, simplified schematic diagrams of each system as installed, and the original. Include complete rest reports specified in Section 26 3213.

b. Test Results as outlines in Section 26 3213

7. 26 0943 Lighting Control Equipment

a. Record Drawings

i. A complete set of ‘as-builts’ drawings showing installed wiring, specific interconnections between all equipment, and internal wiring of this equipment shall be included in the operating and maintenance manuals upon complete of the system.

ii. Provide a DIGITAL COPY to the owner containing the

information specified below. The DIGITAL COPY shall include all information required to allow the Owner to change the schedules themselves. The DIGITAL COPY shall contain a minimum of following:

1. CAD drawing files of 'as-built' lighting control components and point to point connections.
2. General configuration programming.
3. Job specific configuration programming to include schedule.
4. Tutorial file on complete programming of lighting control system.

8. 26 5100 Interior and Exterior Building Lighting

   a. The supply two complete manuals consisting of, as a minimum, general system arrangement, lighting cutsheets, schematic of System components and options, factory test reports, trouble-shooting data, parts lists, preventative maintenance information, and warranty contact information.

9. 27 1500 Structured Cabling Systems

   a. Test Results and requirements as outlined in Section 27 1500

   b. Manual shall include all service, installation, programming and warranty, including test results for each cable.

   c. Provide laminated plans (minimum size 11 x 17) of all telecommunications record drawings (including riser diagrams) in each and every EF, ER and TR.

   d. Record Drawings

      i. The Owner shall provide electronic (DWG) format of telephone/data system drawings that as-built construction information can be added. These documents will be modified accordingly by the telecommunications contractor to denote as-built information as defined above and returned to the Owner.

      ii. Provide a complete set of "as built" drawings in paper and electronic (DWG and PDF) formats showing cabinets, racks, patch panels, wiring, specific interconnections between all equipment and internal wiring of equipment within 30 working days of completion. Drawings are to include all labeling information used in denoting equipment used in the installation. Labeling, icons, and drawing conventions used shall be consistent throughout all documentation provided.

10. 275123 Intercommunications Systems

    a. Manual Requirements

       i. Operating and maintenance manuals shall be submitted prior to testing of system. Manuals shall include all model numbers, service, installation, and programming information.

ii. Include all the following information:

1. Warranty
2. Network settings
3. Riser diagrams from Shop drawings
4. Training videos
5. Flash drive with programing source code and software editing programs

b. Record Drawings

i. The Owner shall provide electronic (DWG) format of intercom System system drawings that as-built construction information can be added to. These documents will be modified by the intercom contractor to denote as-built information as defined above and returned to the Owner.

ii. Provide a complete set of "as built" drawings in paper and electronic (DWG and PDF) formats showing cabinets, racks, patch panels, wiring, specific interconnections between all equipment and internal wiring of equipment. Drawings are to include all labeling information used in denoting equipment used in the installation. Labeling, icons, and drawing conventions used shall be consistent throughout all documentation provided.

11. 27 4110 Audiovisual Systems

a. Manual Requirements

i. Operating and maintenance manuals shall be submitted prior to testing of system. Manuals shall include all model numbers, service, installation, and programming information.

ii. Include all the following information:

1. Warranty
2. Network settings
3. Riser diagrams from Shop drawings
4. Training videos
5. Flash drive with programing source code and software editing programs

b. Record Drawings

i. The Owner shall provide electronic (DWG) format of AV System system drawings that as-built construction information can be added to. These documents will be modified by the AV contractor to denote as-built information as defined above and returned to the Owner.

ii. Provide a complete set of "as built" drawings in paper and electronic (DWG and PDF) formats showing cabinets, racks, patch panels, wiring, specific interconnections between all equipment and internal wiring of equipment.

Drawings are to include all labeling information used in denoting equipment used in the installation. Labeling, icons, and drawing conventions used shall be consistent throughout all documentation provided.

12. 28 1600 Intrusion Detection System

    a. Record Drawings

        i. A complete set of CAD “AS-BUILT” Drawings showing installed wiring, color coding, specific interconnections between all equipment, and internal wiring of the equipment shall be delivered to the owner upon completion of the system.

        ii. A building map (2 copies) shall be supplied to the owner indicating the exact location of all devices along with the addresses of the individual devices. Install building security map adjacent to the security control panel. Provide high quality plastic sign (map holder) with two layers. The back layer shall be painted black. The front layer shall be a clear center for viewing the CAD security drawing. Edges of the sign shall be colored to match the building interior. The building map shall indicate the various by the use of different colors (minimum of five colors).

        iii. The USB flash drive containing the files shall be supplied to the owner. These shall include all information required to allow the district to change the security program themselves. The flash drive shall contain a minimum of the following:

            1. CAD drawing files of building security map.
            2. CAD drawing files of AS BUILT security components and point to point connections.
            3. General configuration programming.
            4. Job specific configuration programming.
            5. Tutorial file on complete programming of security system.

13. 28 2205 Access Control Systems

    a. Manual Requirements

        i. Manuals shall include all service, installation and programming information.

    b. Record Drawings

        i. A complete set of CAD “AS-BUILT” Drawings showing installed wiring, color coding, specific interconnections between all equipment, and internal wiring of the equipment shall be delivered to the owner upon completion of the system.

        ii. A building map (2 copies) shall be supplied to the owner indicating the exact location of all devices along with the addresses of the individual devices. Install building

security map adjacent to the security control panel. Provide high quality plastic sign (map holder) with two layers. The back layer shall be painted black. The front layer shall be a clear center for viewing the CAD security drawing. Edges of the sign shall be colored to match the building interior.

iii. The USB flash drive containing the files shall be supplied to the owner. The flash drive shall include all information required to allow the district to change the security program themselves. The flash drive shall contain a minimum of the following:

1. CAD drawing files of building security map.
2. CAD drawing files of AS BUILT security components and point to point connections.
3. General configuration programming.
4. Job specific configuration programming.
5. Tutorial file on complete programming of security system.

14. 28 2300 IP Video Surveillance System

a. Record Drawings

i. A complete set of CAD “AS-BUILT” Drawings showing installed wiring, color coding, specific interconnections between all equipment, and internal wiring of the equipment shall be delivered to the owner upon completion of the system.

ii. A building map (2 copies) shall be supplied to the owner indicating the exact location of all devices along with the addresses of the individual devices. Install building security map adjacent to the security control panel. Provide high quality plastic sign (map holder) with two layers. The back layer shall be painted black. The front layer shall be a clear center for viewing the CAD security drawing. Edges of the sign shall be colored to match the building interior.

iii. The USB flash drive containing the files shall be supplied to the owner. The flash drive shall include all information required to allow the district to change the security program themselves. The flash drive shall contain a minimum of the following:

1. CAD drawing files of building security map.
2. CAD drawing files of AS BUILT components and point to point connections.
3. General configuration programming.
4. Job specific configuration programming.
5. Tutorial file on complete programming of security system.

15. 28 3113 Fire Alarm and Detection System

    a. Manual Requirements

        i. Operating and maintenance manuals shall be submitted prior to testing of the system. Manuals shall include all service, installation, and programming information.

    b. Record Drawings

        i. A complete set of CAD "as-built" drawings showing installed wiring, color coding, specific interconnections between all equipment, and internal wiring of the equipment shall be delivered to the owner upon completion of the system. Vendor shall not request drawings from the Engineer. Vendor shall request current architectural drawings from the Architect and include all cost with bid.

        ii. A building map shall be supplied to the owner indicating the exact location of all devices along with the addresses of the individual devices. Install building fire alarm map adjacent to the fire alarm panel and all remote operating panels. Provide high quality plastic sign (map holder) with two layers. The back layer shall be painted black. The front layer shall be a clear center for viewing the CAD fire alarm drawing. Edges of the sign shall be colored to match the building interior. The building map shall indicate the various devices and wiring by the use of different colors (minimum of five colors).

        iii. Provide a DIGITAL COPY to the Owner containing the information specified below. The DIGITAL COPY shall include all information required to allow the Owner to change the fire alarm program themselves. The DIGITAL COPY shall contain a minimum of the following:

            1. CAD drawing files of building fire alarm map.
            2. CAD drawing files of as-built fire alarm components and point to point connections.
            3. General configuration programming.
            4. Job specific configuration programming.

    c. Final Submittal to the Office of the Fire Marshal

        i. Record of Completion: Provide a completed System Record of Completion (NFPA 72-Figure 4.5.2.1) in accordance with Section 4.5.3.

        ii. Operation Instructions and A-Built Drawings: Provide one set of instructions on operation of the Fire Alarm System and one set of As-Built drawings. Demonstrate compliance of installation of the System Record Documents at or near the fire alarm control unit.

        iii. Fire Alarm Key Plan Drawing: Demonstrate compliance of installation of the fire alarm key plan drawing at the FACP.

b. TUTORIAL FILE ON COMPLETE PROGRAMMING OF FIRE ALARM SYSTEM

1.5 SPARE PARTS:

A. Provide spare parts (fuses, diffusers, lamps, etc.) as specified. Transmit all spare parts to Owner's Representative prior to substantial completion. Any unused material/labor not utilized during construction shall be a credit back to the owner. Utilize Project Tracking Document to keep record of the following items.

Section	Section Name	Description	Qty. Rqrd.	Qty Rcvd	Fulfilled?
26 0532	Conduit Raceway	Provide 750 feet of 3/4" conduit with 4 #12 conductors, 750 feet of 3/4" conduit with 4 #10 conductors, and 750 feet of 1" conduit with 4 #10 conductor in PVC Provide all supports, fittings, boxes, terminations, etc. as required for installation. Install only as directed by engineer.	Per description		
26 0923/26 0943	Lighting Controls/Occupancy Sensors	Spare sensors for each type used on project.	5		
		Spare wallstations for each type used on project.	2		
26 2200	Transformers	Maintenance Stock Fuses: For types and ratings required, furnish additional fuses, amounting to one unit for every five installed units, but not less that three units of each (including ELSP fuses when specified).	Per description		
26 2726	Wiring Devices	Provide (2) switches, and (4) duplex receptacles as directed by the Engineer. Include 25' of 3/4" EMT conduit with 4 #12 THHN for each device. Provide a total of (1) spare floor boxes covers for each box type used (Attic Stock).			
26 2816	Motor and Circuit Disconnects	Spare fuses amounting to one spare fuse for each 10 installed but not less than three of any one type and size. (Attic Stock)	Per description		
26 2913	Motor Starters	Maintenance Stock Fuses: For types and ratings required, furnish additional fuses, amounting to one unit for every 10 installed, but not less than 5 units of each, for both power and control circuit fuses. (Attic Stock)	Per description		
26 5100	Interior and Exterior Building Lighting	Provide the following attic Stock Fixtures: A4H: 5 A4M: 5 B4H: 4 SL2C: 4			
		Provide (2) extra type X1 and (2) X2 exit signs for discretionary placement by fire marshal or code official. Include 150' of 3/4" EMT conduit with 3 #12 THHN for each exit sign. Provide all supports, fittings, boxes, terminations, etc. as required for installation. Install only as directed by engineer.	Per description		
27 1500	Structured Cabling System	Provide (4) type 2 drop data outlets, (2) WAPs, Include 30 meters of 1" EMT. Provide all supports, fittings, boxes, terminations, etc. as required for installation. Install only as directed by engineer. Credit back all unused material and labor to the Owner.	Per description		

28 3111	Fire Alarm and Detection	Thermal detectors with base	1		
		Smoke detectors with base	5		
		Strobe/horns	5		
		Manual pull stations with addressable modules	0		
		Duct smoke detectors	4		
		Carbon Monoxide Detector and Monitor Module	2		
		150 feet of conduit with wiring (completely installed and wired) for each spare device	Per description		

END OF SECTION 260502

SECTION 26 0507 - ELECTRICAL CONNECTIONS FOR EQUIPMENT

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. This section is a Division-26 Basic Materials and Methods section, and is part of each Division-23 section making reference to electrical connections.

1.2 DESCRIPTION OF WORK:

A. Extent of electrical connection for equipment includes final electrical connection of all equipment having electrical requirements. Make final connections for all owner furnished equipment. See other applicable portions of specification for building temperature control wiring requirements.

B. Refer to Division-23 sections for motor starters and controls furnished integrally with equipment; not work of this section.

C. Refer to Division-23 section for control system wiring; not work of this section.

D. Refer to Division-23 section for Snow/ice melting, Gutter and downspout snow/ice melting system wiring; not work of this section.

E. Refer to sections of other Divisions for specific individual equipment power requirements.

1.3 QUALITY ASSURANCE:

A. NEC COMPLIANCE: Comply with applicable portions of NEC as to type products used and installation of electrical power connections.

B. UL LABELS: Provide electrical connection products and materials that have been UL-listed and labeled.

PART 2 - PRODUCTS

2.1 GENERAL:

A. For each electrical connection indicated, provide complete assembly of materials, including but not necessarily limited to, raceways, conductors, cords, cord caps, wiring devices, pressure connectors, terminals (lugs), electrical insulating tape, heat-shrinkable insulating tubing, cable ties, solderless wire nuts, and other items and accessories as needed to complete splices, terminations, and connections as required. Crimp on or slip-on type splicing materials (insulation displacement type) designed to be used without wire stripping are not acceptable. See Section 26 0532, Conduit Raceways; Section 26 2726 Wiring Devices: and Section 26 0519 Conductors and Cables for additional requirements. Provide final connections for equipment consistent with the following:

1. Permanently installed fixed equipment - flexible seal-tite conduit from branch circuit terminal equipment, or raceway; to equipment, control cabinet, terminal junction box or wiring terminals. Totally enclose all wiring in raceway.

2. Movable and/or portable equipment - wiring device, cord cap, and multi-conductor cord suitable for the equipment and in accordance with NEC requirements (Article 400).

3. Other methods as required by the National Electrical Code and/or as required by special equipment or field conditions.

PART 3 - EXECUTION

3.1 INSTALLATION OF ELECTRICAL CONNECTIONS:

A. Make electrical connections in accordance with connector manufacturer's written instructions and with recognized industry practices, and complying with requirements of NEC and NECA's "Standard of Installation" to ensure that products fulfill requirements.

B. Connect electrical power supply conductors to equipment conductors in accordance with equipment manufacturer's written instructions and wiring diagrams.

C. Coordinate installation of electrical connections for equipment with equipment installation work.

D. Verify all electrical loads (voltage, phase, horse power, full load amperes, number and point of connections, minimum circuit ampacity, etc.) for equipment furnished under other Divisions of this specification, by reviewing respective shop drawings furnished under each division. Meet with each subcontractor furnishing equipment requiring electrical service and review equipment electrical characteristics. Report any variances from electrical characteristics noted on the electrical drawings to Architect before proceeding with rough-work. In summary, it is not in the Electrical Engineers scope to review the shop drawings from other trades/divisions.

E. Obtain and review the equipment shop drawings to determine particular final connection requirements before rough-in begins for each equipment item.

F. Refer to basic materials and methods Section 26 0553 Electrical Identification, Conductors, for identification of electrical power supply conductor terminations.

END OF SECTION 26 0507

SECTION 26 0510 - ELEVATOR ELECTRICAL REQUIREMENTS

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. Architectural, Structural, Vertical Transportation, Mechanical and other applicable documents are considered a part of the electrical documents insofar as they apply as if referred to in full. Contractor must review the entire set of plans and specifications. Reviewing only the electrical set is not acceptable.

C. Elevator Shop Drawings.

1.2 DESCRIPTION OF WORK:

A. The extent of electrical work is indicated on drawings and/or specified in Divisions 26, 27 and 28 sections of the specification. Provide all labor, materials, equipment, supervision and service necessary for a complete/operating/code compliant electrical system.

B. Carefully review elevator shop drawings prior to ordering elevator disconnects. Confirm physical dimensions of disconnect fit within enclosure (if provided) from elevator manufacturer. Review elevator shop drawings prior to ordering disconnect. Notify engineer in writing immediately, should any discrepancy occur. Confirm voltage and phase of equipment and compare with electrical drawings.

C. Coordinate the installation with the elevator manufacturer, including the sequencing of the electrical installation.

D. Anticipated 30-HP 480/277V/3P/60hz Electrical Specifications:

1. Hydraulic Machine Room-Less Elevator

2. No generator backup power connection. Manufacturer to provide Battery lower system as required.

3. Coordinate the exact location of the disconnect and extend power accordingly.

1.3 QUALITY ASSURANCE:

A. Coordination: All electrical equipment placement and installation shall be coordinated with the elevator contractor and shall not be located until elevator equipment is installed or coordination has been arranged with elevator contractor’s equipment placement.

B. Regardless of whether shown on drawings:

1. All electrical equipment, located less than 1225 mm (48 in.) above the pit floor, shall be weatherproof (NEMA 4X) and have wiring identified for use in wet locations in accordance with the requirements in NFPA 70.

2. Receptacles:

a. Provide one 120V/20A dedicated GFCI receptacle in <u>each</u> elevator machine rooms, machinery spaces and elevator pit areas. Provide an additional 120V/20A dedicated receptacle in the pit for a sump pump. Any receptacle installed in pits, machinery spaces, or elevator car tops shall be GFCI. Exception: Sump pump shall not require GFCI protection.

b. Provide one GFCI receptacle located at the top of the hoistway and machine room.

3. Clearances around all electrical equipment in the elevator machine room shall comply with NEC 110-26 electrical clearances requirements. The electrical contractor's work and equipment placement shall be coordinated with the elevator contractor's equipment placement.

4. All electrical piping runs provided by the electrical contractor and elevator contractor to the elevator equipment shall be run overhead or in a manner which does not restrict access to and around any equipment.

5. Lighting:

    a. Elevator Pits:

        i. Provide light fixture and light switch at the pit.

        ii. The location shall be determined after coordination with the elevator contractor so that the light fixture is located out of the way of all elevator equipment.

        iii. Sub-Pit Light fixture and Light Switches (when present): If there is more than one level of an elevator pit, a three-way switch shall be provided in both the pit areas to operate a light fixture located in both locations. A light fixture shall be installed in each pit level. Both light fixtures shall be wired so that they both operate at the same time by light switches at both pit levels.

        iv. The switch shall be a minimum of 18 inches above the elevator lowest landing doorsill and adjacent to (not behind) the pit access ladder.

        v. The elevator pit shall have a separate branch circuit supplying pit lighting and receptacle(s) and another for the pit sump pump.

    b. Elevator Cars:

        i. Provide a separate branch circuit to supply the car lights, receptacle(s), auxiliary lighting power source, and ventilation on each elevator car. It shall be lockable and shall be supplied in all elevator machine rooms. One disconnect required for each elevator. A label stating the location of the supply side overcurrent protection device is required on the disconnect.

    c. Hoistway:

        i. Provide light fixture every 1.5 stories within the hoistway and at the top of the hoistway if elevator disconnect is mounted on the elevator cab.

6. Fire Alarm:

    a. Provide a smoke detector and heat detector within each elevator hoistway.

    b. Provide a smoke detector and heat detector in machine room.

    c. Provide a heat detector within the space that houses the elevator controller. Heat detector to activate shunt trip and be located within 24" of the sprinkler head.

    d. For each group of elevators, provide a normally closed contact representing the smoke detector at the designated return landing.

e. For each group of elevators, provide a normally closed contact representing all smoke detectors located in lobbies, hoistways, or machine rooms / machine space, but not the smoke detector at the designated return landing or the smoke detectors as described in i. and ii. below:

i. If a smoke detector is located in the hoistway at or below the lower of the two recall landings, it shall be wired to activate the same normally closed contact as the smoke detector located in the lobby at the lower of the two recall landings.

ii. If machine rooms / machine space is located at the designated return landing, the smoke detectors located therein shall be wired to activate the same normally closed contact as the smoke detector at the designated landing.

f. Requirements for intermittently illuminating the fire hat visual signal in the car operating panel, either i. or ii. apply.

i. For a single unit or for a group of elevators having one common machine room / machine space and one common hoistway, provide one additional normally closed contact representing the machine room / machine space and hoistway smoke detectors.

ii. If the group contains more than one hoistway and hoistway smoke detectors are installed, or if the group has more than one machine room / machine space, provide one normally closed contact for each elevator. The contact is to represent the smoke detector in the machine room / machine space for that particular elevator, and any smoke detectors in the hoistway containing that particular elevator.

g. If sprinklers are installed in the hoistway or machine room / machine space(s), a means to automatically disconnect the mainline power supply to the affected elevator and any other power supplies used to move the elevator, upon or prior to the application of water is required and shall be provided (unless prohibited by local code). Smoke detectors shall not be used to activate sprinklers in hoistways or machine rooms / machine spaces or to disconnect the mainline power supply.

h. Heat sensors used to automatically disconnect the mainline power supply prior to the application of water from sprinklers shall be provided with a normally closed contact with wiring from the sensing device to a controller designated by Elevator Manufacturer / Elevator Equipment Installer. The normally closed contact shall be closed when the heat sensor is not activated and shall be open when the heat sensor is activated.

7. Sump Pumps:

a. Provide (1) 120V receptacle on a dedicated 20A circuit in each elevator pit for the elevator sump pump.

8. Elevator Main Disconnect:

a. Provide in all elevator machine rooms in sight of elevator motor and controller and adjacent to machine room entry door, one disconnect

required for each elevator. Provide a label on the disconnect stating location of overcurrent protection device.

b. Hydraulic Elevator Only: Main Line Disconnect Auxiliary Contact for Emergency Battery Lowering Operation: This item is provided by the electrical contractor within the main line disconnect: If an emergency lowering system is utilized on a hydraulic elevator, there shall be an auxiliary contact associated with the main line disconnect.

c. Shunt Trip Required When Sprinklers are Present: Electrical contractor shall provide a shunt trip for the elevator main line power in order to remove power from elevator controls before any sprinkler is activated in the elevator machine room and hoistway overhead. The shunt trip shall be installed in the elevator machine room.

9. Emergency Power Requirements:

a. Provide the emergency (standby) power unit and means for starting it, and deliver to the elevator via disconnect switches in the machine room / machine space, sufficient power to operate one or more elevators at a time at full rated speed and rated load.

b. Provide an Automatic Power Transfer Switch for each power feeder to monitor both Normal and Emergency (Standby) Power conditions and to perform the transfer from one to the other. Switch shall have two sets of normally closed dry contacts, one to be open when the switch is in the Emergency (Standby) Power position, the other to open upon initiation of power transfer and to close when transfer is complete. Switch shall have an inhibit function which will delay transfer to Normal and / or Emergency (Standby) Power by an adjustable period of 0 -300 seconds. Switch shall have a Phase Monitor feature, which prohibits the transfer of power between "live" sources unless the sources are in phase with each other. If a Shunt Trip device is provided, an additional Normally Closed contact is required from the Emergency (Standby) Power source.

10. Emergency Phone and Data Line: Provide (2) ¾" conduits from the communications utility to each elevator machine room / elevator controller. Electrical contractor shall provide electrical conduit for both the emergency elevator phone and required data line to the elevator machine room, to the elevator controller, and terminated on the elevator controller with coordination from the elevator contractor.

11. Provide copper elevator feeder conductors and grounding conductors.

1.4 SUBMITTALS

A. Refer to Section 26 0502 for requirements.

PART 2 - PRODUCTS

2.1 ELEVATOR DISCONNECTS:

A. GENERAL:

1. Provide Power Module Switch in a single NEMA enclosure with all necessary relay(s), control transformer and other options (as listed below), and as shown on drawings. The Power Module Switch shall have an ampere rating as required in the elevator shop drawings, and shall include a horsepower rated fusible switch with shunt trip capabilities.

2. The amp rating of the switch shall be based upon elevator manufacturer requirements and utilize Class J Fuses. It shall include a 100VA control power

transformer with primary and secondary fuses. Unit shall also contain an isolation relay (3PDT, 10 amp, 120V). A normally open dry contact shall be provided by the Fire Alarm Safety System to energize the isolation relay and activate the shunt trip solenoid.

3. Provide the following additional features:
   a. Key to Test Switch
   b. “ON” Green Pilot Light
   c. If elevator is hydraulic, provide 1P NC Mechanically Interlocked Auxiliary Contact.
   d. Fire Alarm Voltage Monitoring Relay (Needed to comply with NFPA 72)
   e. NEMA enclosure appropriate for the environment installed.
   f. All switches shall have shunt trip capabilities at 120Vac from remote fire safety signal.

B. ACCEPTABLE MANUFACTURER:
   1. Manufacturer: Subject to compliance with requirements. Provide elevator-disconnect of one of the following:
      a. Bussman Quick-Spec Power Module Switch Elevator Disconnect.
      b. Littlefuse LPS Series Elevator Disconnect.

PART 3 - EXECUTION

A. Install disconnect switches where indicated, complying with manufacturer's written instructions, applicable requirements of NEC, NEMA, and NECA's "Standard of Installation" and in accordance with recognized industry practices to ensure that products fulfill requirements.

B. Coordinate motor and circuit disconnect switch installation work with electrical raceway and cable work, as necessary for proper interface.

C. Install disconnect switches used with motor driven appliances, and motors and controllers within sight of controller position.

D. Grounding: Grounding shall be supplied from the elevator main line disconnect and controller to the upstream panel and building ground. Ground wire shall be the same size as phase wires to minimize electrical noise interference.

E. Non-elevator related piping and equipment is prohibited in the machine room or hoistway.

END OF SECTION 26 0510

SECTION 26 0519 - CONDUCTORS AND CABLES (600V AND BELOW)

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. This section is a Division-26 Basic Materials and Methods section, and is part of each Division-26 section making reference to conductors and cables specified herein.

1.2 DESCRIPTION OF WORK:

A. Extent of electrical conductor and electrical cable work is indicated by drawings and schedules.

B. Types of conductors and cables in this section include the following:

1. Copper Conductors (600V)
2. Aluminum Conductor (600V)
3. 0-10V Class 1 Circuits

C. Applications for conductors and cables required for project include:

1. Power Distribution
2. Feeders
3. Branch Circuits
4. 0-10V Class 1 Circuits

1.3 RECORDS SUBMITTAL:

A. Submit record in triplicate of megohmmeter readings to Architect/Engineer. Please see paragraphs 3.2A AFTER INSTALLATION TEST FOR CABLE 600 VOLTS AND BELOW for testing requirements.

1.4 QUALITY ASSURANCE:

A. Comply with NEC as applicable to construction and installation of electrical conductors and cable. Comply with UL standards and provide electrical conductors and cables that have been UL-listed and labeled.

B. Comply with applicable portions of NEMA/Insulated Cable Engineers Association standards pertaining to materials, construction and testing of conductors and cable.

C. Comply with applicable portions of ANSI/ASTM and IEEE standards pertaining to construction of conductors and cable.

1.5 SUBMITTALS:

A. Refer to Section 26 0502 for electrical submittal requirements.

PART 2 - PRODUCTS

2.1 COPPER AND ALUMINUM CONDUCTORS (600V):

A. Provide factory-fabricated conductors of sizes, ratings, materials, and types indicated for each service. Where not indicated provide proper selection to comply with project's installation requirements and NEC standards. Provide conductors in accordance with the

following:

1. Service Entrance Conductors – Copper/Aluminum conductor; see drawings for insulation type.
2. Distribution and Panelboard Feeders; and Other Conductors, #2 AWG and Larger – Copper/Aluminum conductor; see drawings for insulation type. SER conductor is acceptable where applicable by code.
3. Branch Circuit Conductors and All Conductors #3 AWG and Smaller - Copper conductor, with THHN/THWN insulation. Size all conductors in accordance with NEC; minimum size to be #12 AWG. NM/MC cable is acceptable where applicable by code.
4. Aluminum Conductors. Where aluminum conductors are specified for use, provide compact stranded Aluminum Association 8000- series alloy conductor material.
    a. Stabiloy - Alcan Cable
    b. Triple E - Southwire

B. Provide connectors and terminations for aluminum-alloy conductors of hydraulic compression type only, listed under UL 486-B, and marked "AL 7CU" for 75o rated circuits, and "AL9CU" for 90o rated circuits.

C. Provide a maximum of three phase conductors in any one conduit or as approved by electrical engineer. Where phase conductors share a common neutral they must have a means to simultaneously disconnect all ungrounded conductors at the point where the branch circuits originate. The ungrounded and neutral conductors of a multi-wire branch circuit must be grouped together by wire ties at the point of origination.

D. Provide neutral and ground wire as specified elsewhere in documents.

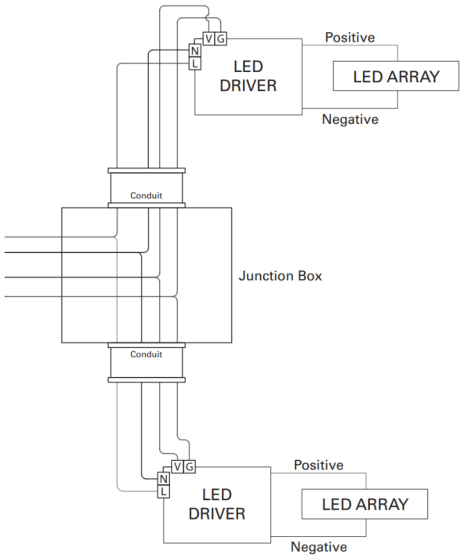
E. Provide separate neutral conductor for all single phase branch circuits installed. No shared neutrals are allowed. Neutral conductor shall be the same size as the phase conductor.

2.2 COPPER LOW VOLTAGE CONDUCTORS (0-10V CIRCUITS):

A. 0-10V Class 1 Circuits:

1. General:
    a. Provide Class 1 circuits for all 0-10V dimming installations. Class 1 circuits shall be permitted to be installed with other circuits as specified in NEC 725.48 (A) and (B):
        i. Class 1 circuits shall be permitted to occupy the same cable, cable tray, enclosure, or raceway without regard to whether the individual circuits are alternating or direct current, provided all conductors are insulated for the maximum voltage of any conductors in the cable, cable tray, enclosure or raceway.
        ii. Class 1 circuits shall be permitted to be installed with power supply conductors as specified:
            1. Class 1 and power supply circuits shall be permitted to occupy the same cable, enclosure, or raceway only when functionally associated.
        iii. Utilize VIOLET and PINK copper conductors, with

THHN/THWN insulation.



PART 3 - EXECUTION

3.1 INSTALLATION:

A. General: Install electric conductors and cables as indicated, in compliance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standards of Installation", and in accordance with recognized industry practices.

B. Coordinate installation work with electrical raceway and equipment installation work, as necessary for proper interface.

C. Cables may be pulled by direct attachment to conductors or by use of basket weave pulling grip applied over cables. Attachment to pulling device shall be made through approved swivel connection. Nonmetallic jacketed cables of small size may be pulled directly by conductors by forming them into a loop that pull wires can be attached; remove insulation from conductors before forming the loop. Larger sizes of cable may be pulled by using basket weave pulling grip, provided the pulling force does not exceed limits recommended by manufacturer; if pulling more than one cable, bind them together with friction tape before applying the grip. For long pulls requiring heavy pulling force, use pulling eyes attached to conductors.

D. Do not exceed manufacturer's recommendations for maximum allowable pulling tension, side wall pressure, and minimum allowable bending radius. In all cases, pulling tension applied to the conductors shall be limited to 0.008 lbs. per circular mil of conductor cross-section area.

E. Pull in cable from the end having the sharpest bend; i.e. bend shall be closest to reel. Keep pulling tension to minimum by liberal use of lubricant, and turning of reel, and slack feeding of cable into duct entrance. Employ not less than one man at reel and one in pullhole during this operation.

F. For training of cables, minimum bend radius to inner surface of cable shall be 12 times cable diameter.

G. Where cable is pulled under tension over sheaves, conduit bends, or other curved surfaces, make minimum bend radius 50% greater than specified above for training.

H. Use only wire and cable pulling compound recommended by the specific cable manufacturer, and that is listed by UL.

I. Seal all cable ends unless splicing is to be done immediately. Conduit bodies shall not contain splices.

J. Support all cables in pullholes, concrete trenches, and similar locations by cable racks and secure to rack insulators with nylon cord or self-locking nylon cable ties. Place each cable on separate insulator. In manholes, pullholes, concrete trenches, and similar locations, wrap strips of fire-proofing tape (approx. 1/16 inch thick by 3 inches wide) tightly around each cable spirally in half-lapped wrapping or in two butt-joined wrappings with the second wrapping covering the joints in the first. Apply tape with the coated side toward the cable, and extend tape one inch into the ducts. To prevent unraveling, random wrap the fireproofing tape the entire length of the fireproofing with pressure sensitive glass cloth tape. Provide fireproofing tape of a flexible, conformable fabric having one side coated with flame retardant, flexible, polymeric coating and/or a chlorinated elastomer not less than 0.050 inch thick weighing not less than 2.5 pounds per square yard. Provide tape that is noncorrosive to cable sheath, self-extinguishing, and that will not support combustion. Construct tape of materials that do not deteriorate when subjected to oil, water, gases, salt water, sewage and fungus.

K. Follow manufacturer's instructions for splicing and cable terminations.

L. Fire Protected Circuits:

1. Provide protected circuits for emergency feeders as required:

a. Educational occupancies with more than 300 occupants.

2. Feeders shall be protected by one of the following:

a. Fully protected by an approved automatic fire suppression system.

b. Feeder is protected by a listed assembly with a minimum 2 hour fire rating.

c. Feeder is listed a fire-resistive cable assembly.

d. Feeder is encased in a minimum of 2” concrete.

M.

3.2 AFTER INSTALLATION TEST FOR CABLE 600 VOLTS AND BELOW:

A. Prior to energization, test cable and wire for continuity of circuitry, and for short circuits, Megger all circuits of 100 amp and greater rating. Correct malfunctions. Record all test data and provide written test report.

B. Subsequent to wire and cable connections, energize circuitry and demonstrate functioning in accordance with requirements.

3.3 IDENTIFICATION OF FEEDERS: Refer to Section 26 0553 for requirements.

END OF SECTION 26 0519

SECTION 26 0526 - GROUNDING

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-26 Basic Materials and Methods sections apply to work specified in this section.

1.2 DESCRIPTION OF WORK:

A. Provide grounding as specified herein, and as indicated on drawings.

B. Provide grounding and bonding of all electrical and communication apparatus, machinery, appliances, building components, and items required by the NEC to provide a permanent, continuous, low impedance, grounding system.

C. Unless otherwise indicated, ground the complete electrical installation including the system neutral, metallic conduits and raceways, boxes, fittings, devices, cabinets, and equipment in accordance with all code requirements.

D. Ground each separately derived system, as described in NEC Section 250-30, unless otherwise indicated.

E. Types of grounding in this section include the following:

1. Underground Metal Water Piping
2. Metal Building Frames
3. Grounding Electrodes
4. Grounding Rods
5. Separately Derived Systems
6. Service Equipment
7. Enclosures
8. Systems
9. Equipment
10. Other items indicated on drawings

F. Requirements of this section apply to electrical grounding work specified elsewhere in these specifications.

1.3 QUALITY ASSURANCE:

A. Comply with NEC as applicable to electrical grounding and ground fault protection systems. Comply with applicable ANSI and IEEE requirements. Provide products that have been UL listed and labeled.

B. Resistance from the service entrance ground bus, through the grounding electrode to earth, shall not exceed 5 ohms.

1.4 SUBMITTALS: Refer to Section 26 0502 for requirements.

PART 2 – PRODUCTS

2.1 MATERIALS AND COMPONENTS:

A. GENERAL: Except as otherwise indicated, provide each electrical grounding system as

specified herein, and as shown on drawings, including but not necessarily limited to, cables/wires, connectors, terminals (solderless lugs), grounding rods/electrodes and plate electrodes, bonding jumper braid, and other items and accessories needed for complete installation. Where materials or components are not otherwise indicated, comply with NEC, NEMA and established industry standards for applications indicated.

B. ELECTRICAL GROUNDING CONDUCTORS: Unless otherwise indicated, provide electrical grounding conductors for grounding connections matching power supply wiring materials and sized according to NEC. Provide with green insulation.

C. GROUND RODS: Steel with copper welded exterior, 3/4" dia. x 10' long. Weaver or Cadweld.

D. GROUND WELL BOXES FOR GROUND RODS: Precast concrete box 9-1/2" W. x 16" L. X 18" D. with light duty concrete cover for non-traffic areas or rated steel plate for traffic areas. Provide covers with lifting holes. Engrave cover with "GROUND ROD".

E. CONCRETE ENCASED GROUNDING ELECTRODE (UFER GROUND): #2/0 AWG bare copper conductor.

F. INSULATED GROUNDING BUSHINGS: Plated malleable iron body with 150 degree Centigrade molded plastic insulating throat, lay-in grounding lug with hardened stainless steel fasteners, OZ-Gedney BLG, or Thomas & Betts #TIGB series.

G. CONNECTIONS TO PIPE: For cable to pipe, OZ-Gedney G-100B series or Thomas & Betts #390X series, or Burndy type GAR.

H. CONNECTIONS TO STRUCTURAL STEEL, GROUND RODS, OR SPLICES: For splicing and/or connecting conductors, use exothermic welds or high pressure compression type connectors. Provide exothermic weld kits manufactured by Cadweld or Thermoweld. If high compression type connectors are used for cable-to-cable, or cable-to-steel, or cable-to-ground rod connections, provide Thomas & Betts #53000 series, or Burndy Hyground series.

I. BONDING JUMPERS: OZ-Gedney Type BJ, or Thomas & Betts #3840 series, or Burndy type GG and type B braid.

J. MAIN BUILDING REFERENCE GROUND BUS: Provide one 18" L. X 2" H X 1/4" thick copper bus bar (or size noted on drawings). Mount on walls in locations shown, on insulating stand offs, 18" AFF. Furnish complete with lugs for connecting grounding system cables. All holes shall be drilled and tapped for single hole lugs. Provide 6 spare lugs and 6 lug spaces.

K. INTERSYSTEM BONDING TERMINAL: Provide one 12” L. x 2” H x ¼” thick copper bus bar. Mount on wall adjacent to Main Electrical Service Equipment on insulating standoffs, 18” A.F.F. Furnish complete with lugs for connecting systems grounding cables. All holes shall be drilled for 2 hole compression lugs. Provide 6 spare lugs. Connect to equipment grounding bus in Main Electrical Service Equipment with No. 4 AWG copper conductor.

PART 3 - EXECUTION

3.1 INSTALLATION OF GROUNDING SYSTEMS:

A. Install electrical grounding systems in accordance with manufacturer's written instructions and with recognized industry practices to ensure grounding devices comply with requirements.

B. Install clamp-on connectors only on thoroughly cleaned and metal contact surfaces, to ensure electrical conductivity and circuit integrity.

C. Provide grounding for the entire raceway, enclosure, equipment and device system in accordance with NEC. All non-metallic raceways shall include copper grounding conductor

sized in accordance with NEC. Include copper grounding conductor in all raceway installed in suspended slabs.

D. Provide service entrance grounding by means of ground rods (quantity of two, driven exterior to building), by means of bonding to water main, and by means of bonding to building structural steel. In addition, provide a grounding electrode for not less than 30 lineal feet in concrete footing or foundation that is in direct contract with earth. Size electrode following NEC, but in no case, smaller than No. 4 AWG bare copper. Support electrode so as to be below finished grade near the bottom of the trench, and approximately three inches from the bottom or sides of the concrete. Locate a point of connection for inspection.

E. Provide grounding conductors for dimming systems in accordance with manufacturer's requirement.

F. Remove existing building grounding and bonding system. Rework and provide new (UFER Ground), and bonding connections as required to make one unified grounding system.

3.2 GROUNDING ELECTRODES:

A. Concrete Encased Grounding Electrode (UFER Ground): Provide a #2/0 AWG minimum bare copper conductor encased along the bottom of concrete foundation or footings that are in direct contact with the earth and where there is no impervious water-proofing membrane between the footing and the soil. Extend electrode through a horizontal length of 30 feet minimum and encase with not less than 2 nor more than 5 inches of concrete separating it from surrounding soils. At point of emergence from concrete, run electrode through a protective non-metallic sleeve and extend to the main building reference ground bus.

B. Supplementary Grounding Electrode (Ground Ring, Grid, and Driven Rods): Provide driven ground rod(s) installed in listed ground well box(s) and filled with gravel after connection is made. Interconnect ground rod(s) with structural steel and adjacent rods with minimum #4 AWG bare copper conductor. Locate ground rod a minimum of 10 feet from any electrode of another electrical system or from adjacent ground rod(s).

C. Separately Derived Electrical System Grounding Electrode: Ground each separately derived system per requirements in NEC Section 250-26 unless indicated otherwise.

D. GROUNDING ELECTRODE CONDUCTOR: Provide grounding electrode conductor sized per NEC table 250-94 or as indicated.

E. POWER SYSTEM GROUNDING: Connect the following items using NEC sized copper grounding conductors to lugs on the Main Building Ground Bus Service Ground Bus.

1. Grounding electrode conductor from concrete encased electrode, and from ground rods, and from service entrance ground bus.
2. Conductor from main incoming cold water piping system.
3. Conductor from building structural steel.
4. Ground for separately derived systems.

F. Run main grounding conductors exposed or in metallic conduit if protection or concealment is required.

G. EQUIPMENT BONDING/GROUNDING: Provide a NEC sized conductor, whether indicated or not on the drawings, in raceways as follows:

1. Non-metallic conduits and ducts.
2. Distribution feeders.
3. Motor and equipment branch circuits.
4. Device and lighting branch circuits.

5. Provide grounding bushings and bonding jumpers for all conduit terminating in reducing washers, concentric, eccentric or oversized knockouts at panelboards, cabinets and gutters.

H. Provide bonding jumpers across expansion and deflection couplings in conduit runs, across pipe connections at water meters, and across dielectric couplings in metallic cold water piping system.

I. Provide bonding wire in all flexible conduit.

3.3 TESTING:

A. Obtain and record ground resistance measurements both from service entrance ground bus to the ground electrode and from the ground electrode to earth. Install additional bonding and grounding electrodes as required to comply with resistance limits specified under this Section.

B. Include typewritten records of measured resistance values in the Operation and Maintenance Manual.

C. Use independent testing agency for all testing.

D. Use test equipment expressly designed for the purpose intended. Submit name of testing agency for review and approval, in writing, to the Engineer prior to the performance of any testing.

END OF SECTION 26 0526

SECTION 26 0529 - SUPPORTING DEVICES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

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

B. This section is a Division-26 Basic Materials and Methods section, and is a part of each Division-26, 27 and 28 section making reference to supports, anchors, sleeves, and seals, specified herein.

1.2 DESCRIPTION OF WORK:

A. Extent of supports, anchors, and sleeves is indicated by drawings and schedules and/or specified in other Division-26 sections. See Section 260532, Raceways, for additional requirements.

B. Work of this section includes supports, anchors, sleeves and seals required for a complete raceway support system, including but not limited to: clevis hangers, riser clamps, C-clamps, beam clamps, one and two hole conduit straps, offset conduit clamps, expansion anchors, toggle bolts, threaded rods, U-channel strut systems, threaded rods and all associated accessories.

1.3 QUALITY ASSURANCE:

A. Comply with NEC as applicable to construction and installation of electrical supporting devices. Comply with applicable requirements of ANSI/NEMA Std. Pub No. FB 1, "Fittings and Supports for Conduit and Cable Assemblies". Provide electrical components that are UL-listed and labeled.

PART 2 - PRODUCTS

2.1 MANUFACTURED SUPPORTING DEVICES:

A. GENERAL:

1. Provide supporting devices; complying with manufacturer's standard materials, design and construction in accordance with published product information, and as required for a complete installation; and as herein specified. See drawings for additional requirements.

PART 3 - EXECUTION

3.1 INSTALLATION OF SUPPORTING DEVICES:

A. Install hangers, anchors, sleeves, and seals as required, in accordance with manufacturer's written instructions and with recognized industry practices to ensure supporting devices comply with requirements. Comply with requirements of NECA, NEC and ANSI/NEMA for installation of supporting devices.

B. Coordinate with other electrical work, including raceway and wiring work, as necessary to interface installation of supporting devices with other work.

C. Install hangers, supports, clamps and attachments to support piping properly from building structures. Arrange for grouping of parallel runs of horizontal conduits to be supported together on trapeze type hangers where possible. For pre-and post tensioned construction, use pre-set inserts for support of all electrical work. Do not use toggle bolts,

moly bolts, wood plugs or screws in sheetrock or plaster as support for any equipment or raceway.

D. Independent support wires are not allowed as indicated as per NEC 300.11(B).

E. RACEWAYS:

1. Support raceways that are rigidly attached to structure at intervals not to exceed 8 feet on center, minimum of two straps per 10 foot length of raceway, and within 12" of each junction box, coupling, outlet or fitting. Support raceway at each 90° degree bend. Support raceway (as it is installed) in accordance with the following:

NUMBER OF RUNS	3/4" TO 1-1/4" 0	1-1/2" & LARGER 0
1	Full straps, clamps or hangers.	Hanger
2	Full straps, clamps or hangers.	Mounting Channel
3 or more	Mounting Channel	Mounting Channel

2. Support suspended raceways on trapeze hanger systems; or individually by means of threaded rod and straps, clamps, or hangers suitable for the application. Do not use "tie wire" as a portion of any raceway support system; do not support raceway from ceiling support wires.

F. FLOOR MOUNTED EQUIPMENT:

1. Provide rigid attachment of all floor mounted equipment to the floor slab or structural system. Provide 5/8" bolts or expansion anchors at each 90 degree corner and at intervals not to exceed 48" on center along entire perimeter of the equipment. Provide rigid attachment for all floor mounted switchboards, panelboards, power and control equipment, motor control centers, dimmer cabinets, transformers (provide neoprene vibrations isolators at anchor points), oil switches, battery packs and racks, and similar equipment furnished under Division 26, 27 and 28.

G. WIREWAYS, BUS DUCTS AND CABLE TRAYS:

1. Provide vertical and lateral support systems for all wireways, busway, and cable trays that are supported from overhead structure. See Sections 260536 and 262500 for additional requirements.

END OF SECTION 26 0529

SECTION 26 0532 - CONDUIT RACEWAY

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. This section is a Division-26 Basic Materials and Methods section, and is part of each Division-26 section making reference to electrical raceways and specified herein.

1.2 DESCRIPTION OF WORK:

A. Extent of raceways is indicated by drawings and schedules.

B. Types of raceways in this section include the following:

1. Electrical Metallic Tubing
2. Flexible Metal Conduit
3. Intermediate Metal Conduit
4. Liquid-tight Flexible Metal Conduit
5. Rigid Metal Conduit
6. Rigid Non-metallic Conduit

1.3 QUALITY ASSURANCE:

A. MANUFACTURERS: Firms regularly engaged in manufacture of raceway systems of types and sizes required, whose products have been in satisfactory use in similar service for not less than three (3) years.

B. STANDARDS: Comply with applicable portions of NEMA standards pertaining to raceways. Comply with applicable portions of UL safety standards pertaining to electrical raceway systems; and provide products and components that have been UL-listed and labeled. Comply with NEC requirements as applicable to construction and installation of raceway systems.

1.4 SUBMITTALS:

A. Not Required.

PART 2 – PRODUCTS

2.1 METAL CONDUIT AND TUBING:

A. GENERAL:

1. Provide metal conduit, tubing and fittings of types, grades, sizes and weights (wall thicknesses) as indicated; with minimum trade size of 3/4".

B. RIGID METAL CONDUIT (RMC): FS WW-C-0581 and ANSI C80.1.

C. INTERMEDIATE STEEL CONDUIT (IMC): FS WW-C-581.

D. PVC EXTERNALLY COATED RIGID STEEL CONDUIT: ANSI C80.1 and NEMA Std. Pub. No. RN 1.

E. ALUMINUM CONDUIT: Not acceptable.

F. ELECTRICAL NON-METALLIC TUBING (ENT) SYSTEM: Not acceptable.

G. MC CABLE: Only acceptable as indicated below.

1. MC Cable is acceptable for all branch circuits installed in gypsum wallboard walls from the home run device box to the last device box on the branch circuit and all boxes in between, from the home run device box to the branch panel, the circuit shall be installed in an approved raceway. All MC Cable shall be provided with anti-short fittings.

2. MC Cable is acceptable for all light fixture whips not longer than six feet in length. Located in removable grid ceilings. MC Cable is unacceptable to be installed from light fixture to light fixture. All MC Cable shall be provided with anti-short fittings.

   a. The use of MC-PCS cable is acceptable for light fixture whips utilizing 0-10v control schemes, not longer than 72” in length, located above removable grid ceilings. All MC cable shall be provided with anti-short fittings.

      i. Acceptable Manufacturers

         1. AFC – MC Luminary Cable
         2. Encore – MC-LED Lighting Cable
         3. Southwire – MC-PCS Duo

3. Before any rough-in of MC cable, the contractor shall conduct a on-site meeting with owner and engineer to review standards and overall rough-in requirements. Contractor shall conform to all owner and engineer requirements.

4. Contractor mock-up one classroom for review of electrical installation prior to continuing installation of MC cabling.

H. RIGID AND INTERMEDIATE STEEL CONDUIT FITTINGS:

1. Provide fully threaded malleable steel couplings; raintight and concrete tight where required by application. Provide double locknuts and metal bushings at all conduit terminations. Install OZ Type B bushings on conduits 1-1/4" and larger.

I. ELECTRICAL METALLIC TUBING (EMT): FS WW-C-563 and ANSI C80.3.

J. EMT FITTINGS:

1. Provide insulated throat nylon bushings with non-indenter type malleable steel fittings at all conduit terminations. Install OZ Type B bushings on conduits 1" larger. Cast or indenter type fittings are not acceptable.

K. FLEXIBLE METAL CONDUIT: FS WW-C-566, of the following type;

1. Zinc-coated steel.

L. FLEXIBLE METAL CONDUIT FITTINGS: FS W-F-406, Type 1, Class 1, and Style A.

M. LIQUID TIGHT FLEXIBLE METAL CONDUIT:

1. Provide liquid-tight, flexible metal conduit; constructed of single strip, flexible continuous, interlocked, and double-wrapped steel; galvanized inside and outside; coated with liquid-tight jacket of flexible polyvinyl chloride (PVC).

N. LIQUID-TIGHT FLEXIBLE METAL CONDUIT FITTINGS: FS W-F-406, Type 1, Class 3, Style G.

O. EXPANSION FITTINGS: OZ Type AX, or equivalent to suit application.

2.2 NON-METALLIC CONDUIT AND DUCTS:

A. GENERAL:

1. Provide non-metallic conduit, ducts and fittings of types, sizes and weights as indicated; with minimum trade size of 3/4".

B. UNDERGROUND PVC PLASTIC UTILITIES DUCT:

1. Minimum requirements shall be schedule 40 for encased burial in concrete and for Type II for direct burial.

C. PVC AND ABS PLASTIC UTILITIES DUCT FITTINGS:

D. ANSI/NEMA TC 9, match to duct type and material.

E. HDPE CONDUIT: Not acceptable.

2.3 CONDUIT; TUBING; AND DUCT ACCESSORIES:

A. Provide conduit, tubing and duct accessories of types and sizes, and materials, complying with manufacturer's published product information, that mate and match conduit and tubing. Provide manufactured spacers in all duct bank runs.

2.4 SEALING BUSHINGS:

A. Provide OZ Type FSK, WSK, or CSMI as required by application. Provide OZ type CSB internal sealing bushings.

2.5 CABLE SUPPORTS:

A. Provide OZ cable supports for vertical risers, type as required by application.

PART 3 - EXECUTION

3.1 INSTALLATION OF ELECTRICAL RACEWAYS:

A. Install electrical raceways where indicated; in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA "Standard of Installation", and in accordance with the following:

1. FEEDERS UNDER 600 VOLTS:

a. Install in electric metallic tubing (EMT). Below concrete slab-on-grade or in earth fill, install in non-metallic plastic conduit. In areas exposed to weather, moisture, or physical damage, install in RMC or IMC. In suspended slabs, install in EMT (NOT APPROVED).

2. BRANCH CIRCUITS, SIGNAL AND CONTROL CIRCUITS, AND INDIVIDUAL EQUIPMENT CIRCUITS RATED LESS THAN 100 AMPS:

a. Install in electric metallic tubing (EMT). Below concrete slab-on-grade or in earth fill, install in non-metallic plastic duct. In areas exposed to weather, moisture, or physical damage, install in RMC or IMC. In suspended slabs, install in EMT (NOT APPROVED).

B. Coordinate with other work including metal and concrete deck work, as necessary to interface installation of electrical raceways and components.

C. Install raceway in accordance with the following:

1. Provide a minimum of 12" clearance measured from outside of insulation from flues, steam and hot water piping, etc. Avoid installing raceways in immediate

vicinity of boilers and similar heat emitting equipment. Conceal raceways in finished walls, ceilings and floor (other than slab-on-grade), except in mechanical, electrical and/or communication rooms, conceal all conduit and connections to motors, equipment, and surface mounted cabinets unless exposed work is indicated on the drawings. Run concealed conduits in as direct a line as possible with gradual bends. Where conduit is exposed in mechanical spaces, etc., install parallel with or at right angles to building or room structural lines. Do not install lighting raceway until piping and duct work locations have been determined in order to avoid fixtures being obstructed by overhead equipment.

2. PVC conduit not allowed within CMU and block type walls.
3. The required raceway size, for any given installation, shall remain the same throughout the entire length of the run. At no point shall any conduit be reduced in size.
4. Where cutting raceway is necessary, remove all inside and outside burrs; make cuts smooth and square with raceway. Paint all field threads (or portions of raceway where corrosion protection has been damaged) with primer and enamel finish coat to match adjacent raceway surface.
5. Provide a minimum of 1 ½" from nearest surface of the roof decking to raceway.
6. In open gymnasiums, auditoriums, etc; all conduit shall be installed in straight lines parallel to, or at right angles to, the structure or adjacent building elements. Separations between conduits and fastenings of conduits shall be neat and consistent. Conduit shall be installed as tight to the bottom of structural elements when parallel to joists as code will allow. Overall installation shall be accomplished in an aesthetic and workmanlike manner. No conduits shall be allowed to run perpendicular to the bottom chord and at the bottom of the joists.
7. Provide conduit from device to device in open and/or exposed ceilings. Ceilings with clouds are considered open/exposed ceiling. No exposed cables shall be seen from below.
8. Provide a maximum of three phase conductors in any one conduit or as approved by electrical engineer. Where phase conductors share a common neutral they must have a means to simultaneously disconnect all ungrounded conductors at the point where the branch circuits originate. The ungrounded and neutral conductors of a multi-wire branch circuit must be grouped together by wire ties at the point of origination.
9. Provide neutral and ground wire as specified elsewhere in documents.
10. Provide separate neutral conductor for all single phase branch circuits installed. No shared neutrals are allowed. Neutral conductor shall be the same size as the phase conductor.

D. Comply with NEC for requirements for installation of pull boxes in long runs.

E. Cap open ends of conduits and protect other raceways as required against accumulation of dirt and debris. Pull a mandrel and swab through all conduit before installing conductors. Install a 200 lb. nylon pull cord in each empty conduit run.

F. Replace all crushed, wrinkled or deformed raceway before installing conductors.

G. Do not use flame type devices as a heat application to bend PVC conduit. Use a heating device that supplies uniform heat over the entire area without scorching the conduit.

H. Provide rigid metal conduit (RMC) for all bends greater than 22 degrees in buried conduit. Provide protective coating for RMC bend as specified herein.

I. Where raceways penetrate building, area ways, manholes or vault walls and floors below grade, install rigid metal conduit (RMC) for a minimum distance of 10 feet on the exterior

side of the floor or wall measured from interior face. Provide OZ, Type FSK, WSK or CSMI sealing bushings (with external membrane clamps as applicable) for all conduit penetrations entering walls or slabs below grade. Provide segmented type CSB internal sealing bushings in all raceways penetrating building walls and slabs below grade, and in all above grade raceway penetrations susceptible to moisture migration into building through raceway.

J. Install liquid-tight flexible conduit for connection of motors, transformers, and other electrical equipment where subject to movement and vibration.

K. Install spare 3/4" conduits (capped) from each branch panelboard into the ceiling and floor space. Run five into the ceiling space and five into the floor space. Where the floor is not accessible run six conduits into the ceiling space. Run conduits the required distance necessary to reach accessible ceiling space.

L. Provide OZ expansion fittings on all conduits crossing building expansion joints, both in slab and suspended.

M. Provide OZ cable supports in all vertical risers in accordance with NEC 300-19; type as required by application.

N. Complete installation of electrical raceways before starting installation of cables/conductors within raceways.

O. Raceway installation below grade:

1. Apply protective coating to metallic raceways in direct contact with earth or fill of any type; consisting of spirally wrapped PVC tape (1/2" minimum overlap of scotch wrap tape or equal); or factory applied vinyl cladding (minimum thickness .020 inches). Completely wrap and tape all field joints.
2. Burial depths must comply with NEC Section 300-5 but in no case be less than 24", unless noted otherwise on drawings.
3. Utility burial depths must comply with RMP requirements or AHJ, but in no case be less than 48" minimum, unless noted otherwise on drawings, diagrams etc.

P. Raceway installation below slab-on-grade, or below grade:

1. For slab-on-grade construction, install runs of rigid plastic conduit (PVC) below slab. All raceway shall be located a at top of sub-grade and a minimum of 6” below bottom of slab. Stake down conduits as required to keep conduits from floating or moving. Coordinate strictly with other trades at grade level structural members for correct installation. Install RMC (with protective coating) for raceways passing vertically through slab-on-grade. Slope raceways as required to drain away from electrical enclosures and to avoid collection of moisture in raceway low points.
2. Apply protective coating to metallic raceways in direct contact with earth or fill of any type; consisting of spirally wrapped PVC tape (1/2" minimum overlap of scotch wrap tape or equal); or factory applied vinyl cladding (minimum thickness .020 inches). Completely wrap and tape all field joints.
3. Mark all buried conduits that do not require concrete encasement by placing yellow plastic marker tape (minimum 6" wide) along entire length of run 12" below final grade. Where multiple small lines are buried in a common trench and do not exceed an overall width of 16", install a single line marker.
4. Burial depths must comply with NEC Section 300-5 but in no case be less than 24", unless noted otherwise on drawings.
5. Do not locate utility feeds under any structure. Verify all utility power paths with RMP prior to any rough-in. Utility burial depths must comply with RMP

requirements or AHJ, but in no case be less than 48" minimum, unless noted otherwise on drawings, diagrams etc.

Q. Raceway installation in suspended slabs:

1. No conduit can be installed in suspended slabs.

R. Raceway installation in hazardous locations:

1. Install RMC in all hazardous locations as defined by NEC. Provide suitable fittings, seal-offs, boxes, etc. to comply with requirements.
2. Engage at least five full threads on all fittings. Provide inspection fittings with explosion proof drains to prevent water accumulation in conduit runs. Install seal-offs for arcing or high temperature equipment, at housing with splices or taps and where conduits enter or leave the hazardous area. Provide seal-offs of the appropriate type for vertical or horizontal installation. Ground all metallic parts.

S. Electrical Identification: Refer to Section 260553 for requirements.

END OF SECTION 26 0532

SECTION 26 0533 - ELECTRICAL BOXES AND FITTINGS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

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

B. This section is a Division-26 Basic Materials and Methods section, and is a part of each Division-26, 27 and 28 section making reference to electrical wiring boxes and fittings specified herein. See Section 260532, Raceways, for additional requirements.

1.2 DESCRIPTION OF WORK:

A. The extent of electrical box and electrical fitting work is indicated by drawings and schedules.

B. Types of electrical boxes and fittings in this section include the following:

1. Outlet Boxes
2. Junction Boxes
3. Pull Boxes
4. Floor Boxes
5. Conduit Bodies
6. Bushings
7. Locknuts
8. Knockout Closures
9. Miscellaneous Boxes and Fittings

1.3 QUALITY ASSURANCE:

A. Comply with NEC as applicable to construction and installation of electrical boxes and fittings. Comply with ANSI C 134,1 (NEMA Standards Pub No. OS 1) as applicable to sheet-steel outlet boxes, device boxes, covers and box supports. Provide electrical boxes and fittings that have been UL-listed and labeled.

1.4 SUBMITTALS:

A. Submit manufacturer’s data including specifications, installation instruction and general recommendations for each type of floor box used on project.

PART 2 - PRODUCTS

2.1 FABRICATED MATERIALS:

A. INTERIOR OUTLET BOXES:

1. Provide one piece, galvanized flat rolled sheet steel interior outlet wiring boxes with accessory rings, of types, shapes and sizes, including box depths, to suit each respective location and installation, construct with stamped knockouts in back and sides, and with threaded screw holes with corrosion-resistant screws for securing box and covers and wiring devices; minimum size 4"x4"x2-1/8".

2. Provide an 'FS' box, with no knockouts when surface mounted in a finished, non-utility space. Surface mounting is only acceptable when approved by the Architect.

B. INTERIOR OUTLET BOX ACCESSORIES:

1. Provide outlet box accessories as required for each installation, including mounting brackets, hangers, extension rings, fixture studs, cable clamps and metal straps for supporting outlet boxes, that are compatible with outlet boxes being used and fulfilling requirements of individual wiring applications.

C. WEATHERPROOF OUTLET BOXES:

1. Provide corrosion-resistant cast-metal weatherproof outlet wiring boxes, of types, shapes and sizes (including depth) required, with threaded conduit ends, cast-metal face plates with spring-hinged waterproof caps suitably configured for each application, with face plate gaskets and corrosion-resistant fasteners.

D. JUNCTION AND PULL BOXES:

1. Provide code-gage sheet steel junction and pull boxes, with screw-on covers; of types, shapes and sizes to suit each respective location and installation; with welded seams and equipped with stainless steel nuts, bolts, screws and washers.

E. FLOOR BOXES:

1. Single Service Floor Box: Provide leveling and fully adjustable floor service receptacle outlets and fittings of types and ratings indicated; and with finish as selected by Architect. Equip with wiring devices as specified in Section 262726. Provide boxes compatible with floor system; provide epoxy-coated stamped steel boxes or cast iron boxes for slab-on-grade construction; provide stamped steel boxes for suspended slabs. Equip with tile and/or carpet flanges to accommodate floor finish material. Boxes shall be available in one, two or three gang configurations. Boxes shall comply with UL Standard UL514A.

2. Multi-Service Floor Box: Provide leveling and fully adjustable multi compartment floor box; there shall be multiple independent wiring compartments; the floor box shall permit tunneling from end power compartment to end power compartment. Floor box shall accommodate a minimum of two duplex receptacles and two mounting plates for telecommunication devices. Equip with wiring devices as specified in Section 262726. Provide boxes compatible with floor system; with finish as selected by Architect. Provide epoxy-coated stamped steel boxes or cast-iron boxes for slab-on-grade construction; provide stamped steel boxes for suspended slabs. Equip with tile and/or carpet flanges to accommodate floor finish material. Boxes shall comply with UL Standards UL514A and/or UL514C.

3. Manufacturer: subject to compliance with requirements, provide floor boxes of one of the following:

   a. Bell Electric/Square D Co.

   b. Crouse-Hinds Co.

   c. Harvey Hubbell, Inc.

   d. Thomas & Betts.

   e. Wiremold

F. CONDUIT BODIES:

1. Provide galvanized cast-metal conduit bodies, of types, shapes and sizes to suit respective locations and installation, construct with threaded-conduit-entrance ends, removable covers, and corrosion-resistant screws.

G. BUSHINGS, KNOCKOUT CLOSURES AND LOCKNUTS:

1. Provide corrosion-resistant punched-steel box knockout closures, conduit locknuts and malleable steel conduit bushings and offset connectors, of types and sizes to suit respective uses and installation.

PART 3 - EXECUTION

3.1 INSTALLATION OF ELECTRICAL BOXES AND FITTINGS:

A. GENERAL:

1. Install electrical boxes and fittings where indicated, complying with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.
2. Coordinate installation of electrical boxes and fittings with wire/cable and raceway installation work.
3. Provide coverplates for all boxes. See Section 262726, Wiring Devices.
4. Provide weatherproof outlets for interior and exterior locations exposed to weather or moisture.
5. Provide knockout closures to cap unused knockout holes where blanks have been removed.
6. Install boxes and conduit bodies to ensure ready accessibility of electrical wiring. Do not install boxes above ducts or behind equipment. Install recessed boxes with face of box or ring flush with adjacent surface. Seal between switch, receptacle and other outlet box openings and adjacent surfaces with plaster, grout, or similar suitable material.
7. Fasten boxes rigidly to substrates or structural surfaces, or solidly embed electrical boxes in concrete or masonry. Use bar hangers for stud construction. Use of nails for securing boxes is prohibited. Set boxes on opposite sides of common wall with minimum 10" of conduit between them. Set boxes on opposite sides of fire resistant walls with minimum of 24” separation.
8. Provide a minimum of 1 ½” from the nearest surface of the roof decking to the installed boxes.
9. Provide electrical connections for installed boxes.

END OF SECTION 26 0533

SECTION 26 0548 - ELECTRICAL SEISMIC CONTROL

PART 1 – GENERAL

1.1 WORK INCLUDED:

A. Anchorage and seismic restraint systems for all Division 26 isolated and non-isolated equipment, cable tray, and conduit systems.

B. Equipment/cable tray/conduit to isolated and/or seismically supported shall include but not be limited to the following:

1. Pad Mounted Equipment
2. Conduit
3. Light Fixtures

1.2 RELATED WORK:

A. Requirements: Provide Electrical Seismic Control in accordance with the Contract Documents.

B. Section 26 0500 – Electrical General Provisions

1.3 REFERENCES:

A. International Building Code, Current Edition in use by Jurisdictional Authority.

B. NFPA Bulletin 90A, Current Edition.

C. UL Standard 181.

1.4 SYSTEM DESCRIPTION

A. The Division 26 Contractor shall be responsible for supplying and installing equipment, vibration isolators, flexible connections, rigid steel frames, anchors, inserts, hangers and attachments, supports, seismic snubbers and bracing to comply with the following:

1. Short period design spectral response acceleration coefficient SDS=0.70.
2. One second period design spectral response acceleration coefficient SD1=0.28.
3. Site Class B.
4. Seismic Design Category D.

1.5 QUALITY ASSURANCE:

A. All supports, hangers, bases, anchorage and bracing for all isolated equipment and non-isolated equipment shall be designed by a professional engineer licensed in the state where the project is located, employed by the restraint manufacturer, qualified with seismic experience in bracing for electrical equipment. Shop drawings submitted for earthquake bracing and anchors shall bear the Engineer's signed professional seal. All calculations/design work required for the seismic anchorage and restraint of all Division 26 equipment and systems shall be provided by a single firm.

B. The above qualified seismic engineer shall determine specific requirements for equipment anchorage and restraints, locations and sizes based on shop drawings for the electrical equipment that have been submitted, reviewed and accepted by the Architect/Engineer for this project.

C. Seismic Engineer or the Engineer's Representative shall field inspect final installation and certify that bracing and anchorage are in conformance with the Seismic Engineer's design. A certificate of compliance bearing the Seismic Engineer's signed Professional Engineer's seal shall be submitted and shall be included in each copy of the Operation and Maintenance Manuals.

D. The Division 26 Contractor shall require all equipment suppliers furnish equipment that meets the seismic code, with bases/skids/curb designed to receive seismic bracing and/or anchorage. All isolated and non-isolated electrical equipment bracing to be used in the project shall be designed from the Equipment Shop Drawings and certified correct by the equipment manufacturer for seismic description listed in Paragraph 1.4 above, with direct anchorage capability.

1.6 SUBMITTALS:

1. Refer to Section 26 0502 for electrical submittal requirements.

PART 2 – PRODUCTS:

2.1 RESTRAINT EQUIPMENT AND SYSTEMS:

A. Acceptable Manufacturers and Suppliers for Non-Isolated Systems:

1. Mason Industries, Inc.
2. Korfund
3. Amber/Booth Company
4. Vibration Mountings and Control Company
5. Kinetics
6. International Seismic Application Technology
7. Tolco

B. Manufacture and design of restraints and anchors for isolated equipment shall be by the manufacturer of the vibration isolators furnished for the equipment.

2.2 SNUBBERS:

A. Snubbers shall be all-directional and consist of interlocking steel members restrained by replaceable shock absorbent elastomeric materials a minimum of 3/4 inch thick.

B. Snubbers shall be manufactured with an air gap between hard and resilient material of not less than 1/8 inch or more than 1/4 inch.

C. Snubbers shall be Mason Industries Z -1011 or accepted equivalent.

PART 3 – EXECUTION

3.1 DESIGN AND INSTALLATION:

A. General:

1. All electrical equipment cable tray and conduit shall be braced, anchored, snubbed or supported to withstand seismic disturbances in accordance with the criteria of this specification. Provide all engineering, labor, materials, and equipment for protection against seismic disturbances as specified herein. The following electrical components are exempt from seismic restraint requirements.

a. Components in Seismic Design Categories A and B (see 1.4 above).

b. Components in Seismic Design Category C (see 1.4 above) that have an important factor IP of 1.0 (see 1.4 above).

c. Components that have an importance factor IP of 1.0 (see 1.4 above), that are mounted less than four feet above the floor, that weigh less than 400 pounds, and that have flexible ductwork, piping, and conduit connections.

d. Components that have an importance factor IP of 1.0 (see 1.4 above), that weigh 20 pounds or less, and that have flexible ductwork, piping, and conduit connections.

e. Electrical components in Seismic Design Categories D, E, or F where all of the following apply:

i. The component importance factor, I_p, is equal to 1.0;

ii. The component is positively attached to the structure;

iii. Flexible connections are provided between the component and associated ductwork, piping, and conduit; and either

1. The component weighs 400 lb (1,780 N) or less and has a center of mass located 4 ft (1.22 m) or less above the adjacent floor level; or

2. The component weighs 20 lb (89 N) or less or, in the case of a distributed system, 5 lb/ft (73 N/m) or less.

2. Powder-actuated fasteners (shot pins) shall not be used for component anchorage in tension applications in Seismic Design Category D, E, or F.

3. Attachments and supports for electrical equipment shall meet the following provisions:

a. Attachments and supports transferring seismic loads shall be constructed of materials suitable for the application and designed and constructed in accordance with a nationally recognized structural code such as, when constructed of steel, AISC, Manual of Steel Construction (Ref. 9.8-1 or 9.8-2).

b. Friction clips shall not be used for anchorage attachment.

c. Expansion anchors shall not be used for electrical equipment rated over 10 hp (7.45 kW). Exception: Undercut expansion anchors.

d. Drilled and grouted-in-place anchors for tensile load applications shall use either expansive cement or expansive epoxy grout.

e. Supports shall be specifically evaluated if weak-axis bending of light-gauge support steel is relied on for the seismic load path.

f. Components mounted on vibration isolation systems shall have a bumper restraint or snubber in each horizontal direction. The design force shall be taken as 2Fp. The intent is to prevent excessive movement and to avoid fracture of support springs and any non- ductile components of the isolators.

g. Seismic supports shall be constructed so that support engagement is maintained.

B. Pad Mounted Equipment

1. Spring Isolated Equipment:

a. All vibration isolated equipment shall be mounted on rigid steel frames or concrete bases as described in the vibration control specifications unless the equipment manufacturer certified direct attachment capability. Each spring mounted base shall have a minimum of four all-directional seismic snubbers that are double acting and located as close to the vibration isolators as possible to facilitate attachment both to the base and the structure. Snubbers shall be installed with factory set clearances.

2. Non-Isolated Equipment:

a. The section 260548 (Electrical Seismic Control) Contractor shall be responsible for thoroughly reviewing all drawings and specifications to determine all equipment i.e. switchboards, transformers, generators, etc. to be restrained. This Contractor shall be responsible for certifying that this equipment is mounted and braced such that it adheres to the system description criteria in part 1.4 of this specification section.

C. Conduit, Conduit Racks/Trapeze Assemblies, Cable Tray and Bus Duct:

1. Seismic braces for be omitted when the distance from the supporting structure to the raceway support point is 12” or less. Where rod hangers are used, they shall be equipped with swivels to prevent inelastic bending in the rod.
2. Seismic braces may be omitted where the total weight of the assembly is less than 10 lb/ft.
3. Seismic braces for individual conduit may be omitted for conduit less than 2.5 inch trade size.
4. A rigid conduit system shall not be braced to dissimilar parts of a building or two dissimilar building systems that may respond in a different mode during an earthquake. Examples: Wall and a roof; solid concrete wall and a metal deck with lightweight concrete fill.
5. Unbraced conduit attached to in-line equipment shall be provided with adequate flexibility to accommodate differential displacements.
6. At the interface of adjacent structures or portions of the same structure that may move independently, utility lines shall be provided with adequate flexibility to accommodate the anticipated differential movement between the ground and the structure.
7. Provide large enough pipe sleeves through wall or floors to allow for anticipated differential movements.
8. For spaces, where the Importance Factor (Ip) is equal to 1.5, all electrical components that are attached to structures that could displace relative to one another and for isolated structures where components cross the isolation interface, the components shall be designed to accommodate the eismic relative dispalcements.

D. Light Fixtures

1. Light fixtures, lighted signs, and ceiling fans not connected to ducts or piping, which are supported by chains or otherwise suspended from the structure, are not required to satisfy the seismic force and relative displacement requirements provided they meet all of the following criteria:
   a. The design load for such items shall be equal to 1.4 times the operating weight acting down with a simultaneous horizontal load equal to 1.4 times the operating weight. The horizontal load shall be

applied in the direction that results in the most critical loading for the design.

b. Seismic interaction effects shall not cause an effect so that the failure of the non-essential component causes a failure of an essential component.

c. The connection to the structure shall allow a 360° range of motion in the horizontal plane.

d. The component is less than 20 lbs and has flexible connections and an importance factor (Ip) equal to 0.

END OF SECTION 26 0548

SECTION 26 0553 - ELECTRICAL IDENTIFICATION

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. Requirements of the following Division 26 Sections apply to this section:

1. “Basic Electrical Requirements”.
2. “Basic Electrical Materials and Methods”.

1.2 SUMMARY

A. This section includes identification of electrical materials, equipment and installations. It includes requirements for electrical identification components including but not limited to the following:

1. Buried electrical line warnings.
2. Identification labels for raceways, cables and conductors.
3. Operational instruction signs.
4. Warning and caution signs.
5. Equipment labels and signs.
6. Arc-flash hazard labels

B. Related Sections: The following sections contain requirements that relate to this section:

C. Division 9 Section “Painting” for related identification requirements.

D. Refer to other Division 26 sections for additional specific electrical identification associated with specific items.

1.3 QUALITY ASSURANCE

A. Electrical Component Standard: Components and installation shall comply with NFPA 70 “National Electrical Code”

1.4 SUBMITTALS: Refer to Section 26 0503 for requirements.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. American Labelmark Co.
2. Calpico, Inc.
3. Cole-Flex Corp.
4. Emed Co., Inc.
5. George-Ingraham Corp.
6. Ideal Industries, Inc.
7. Kraftbilt
8. LEM Products, Inc.

9. Markal Corp
10. National Band and Tag Co.
11. Panduit Corp.
12. Radar Engineers Div., EPIC Corp.
13. Seton Name Plate Co.
14. Standard Signs, Inc.
15. W.H Brady, Co.

2.2 ELECTRICAL IDENTIFICATION PRODUCTS

A. Colored Conduit Systems for raceway identification:

1. Factory-painted conduit and/or factory-painted couplings and fittings

B. Colored paint for raceway identification:

1. Use Kwal Paint colors as specified in Part 3 – Execution.

C. Color Adhesive Marking Tape for Raceways, Wires and Cables:

1. Self-adhesive vinyl tape not less than 3 mills thick by 1” to 2” in width.

D. Underground Line Detectable Marking Tape:

1. Permanent, bright colored, continuous-printed, acid- and alkali-resistant plastic tape specifically compounded for direct-burial service. Not less than 6” wide by 4 mills thick.
2. With metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep.
3. Printed legend indicative of general type of underground line below.

E. Wire/Cable Designation Tape Markers:

1. Vinyl or vinyl-cloth, self-adhesive, wraparound, cable/conductor markers with pre-printed numbers and letters.

F. Brass or Aluminum Tags:

1. Metal tags with stamped legend, punched for fastener.
2. Dimensions: 2” X 2” 19 gage.

G. Engraved, Plastic Laminated Labels, Signs and Instruction Plates:

1. Engraving stock plastic laminate, 1/16” minimum thickness for signs up to 20 sq. in. or 8” in length; 1/8 “ thick for larger sizes. Engraved legend in 1/4” high white letters on black face and punched for mechanical fasteners.

H. Arc-flash Hazard Labels:

1. ANSI Z535.4 Safety Label.
2. Adhesive backed polyester with self-laminating flap. Chemical, abrasion and heat resistant.
3. Dimensions: 5” x 3.5”
4. Information contained: Arc-flash boundary; Voltage; Flash Hazard Category; Incident Energy (arc rating); checkboxes for the required Personal Protective Equipment (PPE) and the date that the calculations were performed.

I. Equipment Labels:

1. Adhesive backed polyester with self-laminating flap. Chemical, abrasion and heat resistant.

2. Dimensions: minimum 5” x 2”
3. Conductor-Identification-Means Labels:
    a. Information contained: the method utilized for identifying ungrounded conductors within switchboards, distribution panels and branch circuit panels.
4. Available-Fault-Current Labels:
    a. Information contained: maximum available fault current at the respective piece of equipment, and date of calculation of fault current.
5. Source-of-Supply Labels:
    a. Information contained: indicate the device or equipment where the power supply originates.

J. Baked Enamel Warning and Caution Signs for Interior Use:
1. Preprinted aluminum signs, punched for fasteners, with colors legend and size appropriate to location.

K. Fasteners for Plastic-Laminated and Metal Signs:
1. Self-tapping stainless steel screws or # 10/32 stainless steel machine screws with nuts, flat and lock washers.

L. Cable Ties:
1. Fungus-inert, self-extinguishing, one-piece, self-locking nylon cable ties, 0.18” minimum width, 50-lb. Minimum tensile strength, and suitable for a temperature range from minus 40° F. to 185° F. Provide ties for specified colors when used for color coding.

M. Colored Support Wires:
1. When electrical equipment/wiring is supported by wires within the ceiling cavity, these wires shall be independent of the ceiling support assembly and shall be distinguishable by painting entire length in bright yellow.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Lettering and Graphics:
1. Coordinate names, abbreviations, colors and other designations used in electrical identification work with corresponding designations specified or indicated. Install numbers, lettering and colors as approved in submittals and as required by code.

B. Install identification devices in accordance with manufacturer’s written instructions and requirements of NEC.

C. Sequence of Work:
1. Where identification is to be applied to surfaces that require a finish, install identification after completion of finish work.

D. Conduit Identification:
1. Identify Raceways of Certain Systems with Color Coding. Acceptable means of color identification are as follows:
    a. Factory-painted conduit.
    b. Band exposed or accessible raceways of the following systems for identification. Bands shall be pre-tensioned, snap-around colored plastic

sleeves, colored adhesive marking tape, or a combination of the two. Make each color band 2 inches wide, completely encircling conduit, and place adjacent bands of two-color markings in contact, side by side. Install bands at changes in direction, at penetrations of walls and floors, and at 40-root maximum intervals in straight runs. Apply the following colors:

i. Fire Alarm System: Red
ii. Sound/IC: Yellow
iii. Data: Blue
iv. MATV: Black
v. Security: Orange
vi. Legally Required Emergency Systems: Red with Black Stripe (Per NEC 700.10(A))

2. Identify Junction, Pull and Connection Boxes.

a. Code-required caution sign for boxes shall be pressured-sensitive, self-adhesive label indication system voltage in black, preprinted on orange background. Install on outside of box cover. Also label box covers on outside of cover with identity of contained circuits. Use pressure-sensitive plastic labels at exposed locations and similar labels or plasticized card stock tags at concealed boxes.

3. Label and paint the covers of the systems junction boxes as follows:

SYSTEM	COLOR (ALL COLORS ARE KWAL PAINT)	
Fire Alarm	Red Alert	AC118R
Sound/IC	Competition Yellow	7225A
Security	Fiesta Orange	AC107Y
Data	Neon Blue	7076A
MATV	Flat Black	
Legally Required EM System	Red/Black Stripe	

E. Underground Electrical Line Identification.

1. During trench backfilling, for exterior underground power, signal, and communications lines, install continuous underground line detectable marking tape, located directly above line at 6 to 8 inches below finished grade. Where multiple lines are installed in a common trench or concrete envelope, do not exceed an overall width of 16 inches; install a single line marker.

2. Install detectable marking tape for all underground wiring, both direct-buried and in raceway.

3. Provide red marker dye applied to concrete encased ductbank.

F. Conductor Color Coding.

1. Provide color coding for secondary service, feeder and branch circuit conductors throughout the project secondary electrical system as follows:

CONDUCTOR	208Y / 120V System	480Y / 277V System
Phase A	Black	Brown

Phase B	Red	Orange
Phase C	Blue	Yellow
Shared/Single Neutral	White	Gray
Neutral A (dedicated)	White w/Black Stripe	Gray w/Black Stripe
Neutral B (dedicated)	White w/Red Stripe	Gray w/Orange Stipe
Neutral C (dedicated)	White w/Blue Stripe	Gray w/Yellow Stipe
Equipment Ground	Green	Green
Isolated Ground	Green w/Yellow Strip	Green w/Yellow Stripe

2. Switch legs, travelers and other wiring for branch circuits shall be of colors other than those listed above.
3. Use conductors with color factory applied the entire length of the conductors except as follows:
    a. The following field-applied color-coding methods may be used in lieu of factory-coded wire for sizes larger than No. 10 AWG.
    b. Apply colored, pressure-sensitive plastic tape in half-lapped turns for a distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply the last two laps of tape with no tension to prevent possible unwinding. Use 1-inch-wide tape in colors as specified. Do not obliterate cable identification markings by taping. Tape locations may be adjusted slightly to prevent such obliteration.
    c. In lieu of pressure-sensitive tape, colored cable ties may be used for color identification. Apply three ties of specified color to each wire at each terminal or splice point starting 3 inches from the terminal and spaced 3 inches apart. Apply with a special tool or pliers, tighten for snug fit, and cut off excess length.

G. Power Circuit Identification.

1. Securely fasten identifying metal tags or aluminum wraparound marker bands to cables, feeders, and power circuits in vaults, pull boxes, junction boxes, manholes, and switchboard rooms with 1/4-inch steel letter and number stamps with legend to correspond with designations on Drawings. If metal tags are provided, attach them with approximately 55-lb monofilament line or one-piece self-locking nylon cable ties.
2. Tag or label conductors as follows:
    a. Future Connections: Conductors indicated to be for future connection or connection under another contract with identification indicting source and circuit numbers.
    b. Multiple Circuits: Where multiple branch circuits or control wiring or communications/ signal conductors are present in the same box or enclosure (except for three-circuit, four-wire home runs), label each conductor or cable. Provide legend indicating source, voltage, circuit number, and phase for branch circuit wiring. Phase and voltage of branch circuit wiring may be indicated by mean of coded color of conductor insulation. For control and communications/signal wiring, use color coding or wire/cable marking tape at terminations and at intermediate locations where conductors appear in wiring boxes, troughs, and control cabinets. Use consistent letter/number conductor designations throughout on wire/cable marking tapes.

3. Match identification markings with designations used in panelboards shop drawings, Contract Documents, and similar previously established identification schemes for the facility's electrical installations.

H. Apply warning, caution and instruction signs and stencils as follows:

1. Install warning, caution, or instruction signs where required by NEC, where indicated, or where reasonably required to assure safe operation and maintenance of electrical systems and of the items they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions or explanations are needed for system or equipment operation. Install butyrate signs with metal backing for outdoor items. Warning and caution signs shall be furnished and installed on, but not be limited to the following equipment and locations:

a. Entrances to rooms and other guarded locations that contain exposed live parts 600 volts or less; signs shall forbid unqualified personnel to enter.

b. Switch and Overcurrent device enclosures with splices, taps and feed-through conductors. Provide warning label on the enclosures that identifies the nearest disconnecting means for any feed-through conductors.

c. Entrances to buildings, vaults, rooms or enclosures containing exposed live parts or exposed conductors operating at over 600 volts: DANGER-HIGH VOLTAGE-KEEP OUT.

d. Metal-enclosed switchgear, unit substations, transformers, enclosures, pull boxes, connection boxes and similar equipment operating at over 600 volts shall have appropriate caution signs and warning labels.

e. Indoor and Outdoor substations operating over 600 volts. Provide warning signs, instructional signs and single-line diagrams in accordance with NEC 225.70.

I. Emergency Operating Signs: Install engraved laminated signs with white legend on red background with minimum 3/8-inch high lettering for emergency instructions on power transfer, load shedding, or other emergency operations.

J. Install equipment/system circuit/device identification as follows:

1. Apply equipment identification labels of engraved plastic-laminate on each major unit of electrical equipment in building, including central or master unit of each electrical system. This includes communication/signal/alarm systems, unless unit is specified with its own self-explanatory identification. Except as otherwise indicated, provide single line of text, with 1/4"-high lettering on 1-inch-high label (1 1/2-inch-high where two lines are required) white lettering in black field. White lettering in red field for Emergency Power Systems. Text shall match terminology and numbering of the Contract Documents and shop drawings. Apply labels for each unit of the following categories of electrical equipment.

a. Each service disconnect, to identify it as a service disconnect.

b. Panelboards (exterior and interior), electrical cabinets, and enclosures. For subpanels, identify feeder circuit served from.

c. Switches in fusible panelboards shall be labeled. Main switches shall be identified.

d. Access doors and panels for concealed electrical items.

e. Electrical switchgear and switchboards.

f. Motor control centers.

g. Motor starters, including circuit origination, HP, heater size, FLA, and mechanical equipment designation.

h. Disconnect switches.

i. Pushbutton stations.

j. Power transfer equipment.

k. Contactors.

l. Dimmers.

m. Control devices.

n. Transformers.

o. Power generating units, to include transfer switches.

p. Telephone switching equipment.

q. Clock/program master equipment.

r. Call system master station.

s. TV/audio monitoring master station.

t. Fire alarm master station or control panel.

u. Busduct – Label all cable tap boxes, bus plug-in units, etc. with plastic laminate labels designating load served.

v. Variable frequency drives.

w. Lighting Control Equipment.

x. Uninterruptable Power Supply.

K. Post Conductor-Identification-Means labels at locations of switchboards, distribution panels and branch circuit panels. The labels shall identify the color-coding used on ungrounded conductors for each voltage system used on the premises.

L. Apply Available-Fault-Current labels at the service entrance equipment.

M. Apply Source-of-Supply labels on the exterior covers of equipment (except in single- or two-family dwellings) as follows:

1. Each switchboard supplied by a feeder.

2. Each branch circuit panelboard supplied by a feeder.

3. Each disconnect switch serving elevators, escalators, moving walks, chairlifts, platform lifts and dumbwaiters.

4. Each dry type transformer (or primary-side disconnect switch at transformer). If the primary-side disconnect is remote from the transformer, both the remote disconnect and the transformer shall be labeled, and the transformer label shall also indicate the location of the disconnect.

5. Each feeder disconnect, branch circuit disconnect, panelboard or switchboard in a remote building or structure.

6. Each on-site emergency power source, with sign placed at service entrance equipment to comply with NEC 700.

N. The label shall identify the device or equipment where the power supply originates, and the system voltage, phase or line and system at all termination, connection and splice points. For example: Feeder Power Supply for Panel “XX” Originates at Panel “XX” (or Switchboard “XX”, Transformer “XX”, Switch “XX”, etc.); 120/208 volts, 3-phase, Phase Color Identification (or 120/240, 277/480, etc.).

O. Install Arc-flash hazard labels on the following equipment:

1. Each piece of service entrance equipment.

2. Each power distribution switchboard or panel.
3. Each individually mounted circuit breaker.
4. Each branch circuit panelboard.
5. Each motor control center.
6. Each individually mounted motor starter.
7. Each meter socket enclosure.

P. Apply circuit/control/item designation labels of engraved plastic laminate for disconnect switches, breakers, pushbuttons, pilot lights, motor control centers, and similar items for power distribution and control components above, except panelboards and alarm/signal components, where labeling is specified elsewhere.

Q. Install labels at locations indicated and at locations for best convenience of viewing without interference with operation and maintenance of equipment.

R. Engrave all receptacle plates other than those serving 120 volt, single phase devices. State voltage and amperage characteristics: Example; “208V 30A”.

S. Mark each device box (for each type of wiring device) with a permanent ink felt tip marker, indicating the circuit that the device is connected to: Example; “CKT A-1”

T. Label circuit breaker feeding fire alarm panel “Fire Alarm Circuit”. Using plastic laminate label, white lettering on a red background.

END OF SECTION 26 0553

SECTION 26 0573 - PROTECTIVE DEVICE STUDY

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK:

A. Studies in this section include the following:

1. Fault current protective device and equipment evaluation
2. Protective device coordination study
3. Arc-flash hazard analysis and study

1.3 QUALITY ASSURANCE:

A. Provide protective device and arc-flash hazard studies performed by qualified engineers of the equipment manufacturer or an approved consultant. Studies must bear the professional engineer's stamp of the engineer in responsible charge of the protective device studies. Perform all work in accordance with latest IEEE and ANSI standards.

1.4 SUBMITTALS:

A. Refer to Section 260502 for electrical submittal requirements.

PART 2 – STUDIES

2.1 FAULT CURRENT PROTECTIVE DEVICE & EQUIPMENT EVALUATION

A. Perform fault current analysis with the aid of a computer and appropriate software. Include as input data the maximum available short circuit contribution, resistance and reactance components of the branch impedances, the X/R ratios, base quantities selected, and other source impedances.

B. Coordination Criteria:

1. All overcurrent protective devices serving the essential electrical system shall be coordinated for the period of time that a fault's duration extends beyond 0.1 second. Provide overcurrent protection devices with larger frames sizes to ensure coordination has been achieved.

2. Coordination shall not be required as follows:

a. Between transformer primary and secondary overcurrent protective devices, where only one overcurrent protective device or set of overcurrent protective devices exist on the transformer secondary.

b. Between overcurrent protective devices of the same size (ampere rating) in series.

C. Calculate fault current close and latch duty values and interrupting duty values on the basis of assumed three-phase bolted short circuits at each switchgear bus, medium voltage controller, switchboard, low voltage motor control center, distribution panelboard,

branch circuit panel and other significant locations throughout the system. Include symmetrical fault currents, and X/R ratios in the fault current tabulations. For each fault location, list the total duty on the bus, as well as the individual contribution from each connected branch, with its respective X/R ratio. Calculate ground fault currents at each bus. Incorporate major motor contributions in determining momentary and interrupting ratings of protection devices.

D. Perform an evaluation to determine the adequacy of circuit breakers, molded case switches, automatic transfer switches, and fuses, by tabulating and comparing the short circuit ratings of these devices with the calculated fault currents. Apply appropriate multiplying factors based on system X/R ratios and protective device rating standards. Report problem areas or inadequacies in the equipment due to short circuit currents prior to release for fabrication of switchgear, switchboards and/or appliance panelboard.

2.2 PROTECTIVE DEVICE COORDINATION STUDY

A. Perform a protective device coordination study including the necessary calculations and logic decisions required to select power fuse ratings, protective relay characteristics and settings, ratios and characteristics of associated current transformers, and low voltage breaker trip characteristics and settings. Perform the studies in accordance with the latest applicable IEEE and ANSI standards.

B. Include all medium and low voltage classes of equipment in the coordination study from the building or plant service protective devices down to and including the largest rated device in the low voltage motor control centers and panelboards. Include the phase and ground overcurrent protection as well as settings of all other adjustable protective devices.

C. Develop time-current characteristics of the specified protective devices on log-log paper. Include complete titles, representative one-line diagram and legends, significant motor starting characteristics, complete parameters of transformers, complete operating bands of low voltage circuit breaker trip curves and fuses. Indicate on plots the types of protective devices selected, proposed relay taps, time dial and instantaneous trip settings, transformer magnetizing inrush and ANSI transformer withstand parameters, cable thermal overcurrent withstand limits and significant symmetrical and asymmetrical fault currents. Adhere to all restrictions of the National Electrical Code. Maintain proper coordination intervals and separation of characteristic curves.

D. Provide coordination plots for phase and ground protective devices on a system basis. Provide a sufficient number of separate curves to clearly indicate the coordination achieved.

E. Provide the selection and settings of the protective devices in a tabulated form listing circuit identification, IEEE device number, current transformer ratios and connection, manufacturer and type, range of adjustment and recommended settings. Provide a tabulation of the recommended power fuse selection for medium voltage fuses where applied in the system. Promptly report any discrepancies, problem areas, or inadequacies prior to release for fabrication of switchgear, switchboards and/or appliance panels.

2.3 ARC-FLASH HAZARD ANALYSIS AND STUDY

A. Perform an arc-flash hazard analysis and study. Include the necessary calculations required to determine the level of Personal Protection Equipment (PPE) that a worker must use, the Arc Flash Boundary in inches, and the incident energy at each location. This information shall be calculated and determined for each piece of service entrance equipment, each power distribution switchboard or panel, each separately-mounted circuit breaker, each motor control center, each individually mounted motor starter, and for each branch circuit panelboard.

B. Perform the analysis and study in accordance with IEEE 1584.

C. Furnish and install a label at each piece of service equipment, each power distribution switchboard or panel, each separately mounted circuit breaker, each motor control center, each individually mounted motor starter, and each branch circuit panel board. The label shall be an ANSI approved Arc Flash Warning Label that warns and instructs workers of the arc flash hazard, voltage, arc flash boundary, and required PPE (Personal Protective Equipment).

2.4 ANALYSIS/REPORT

A. Include the following in the report.

1. Description, purpose, basis and scope of the study and a single line diagram of that portion of the power system that is included within the scope of the study.
2. Tabulations of circuit breaker, fuse and other protective device ratings versus calculated short circuit duties and commentary regarding same. Include formulas and description of methods used.
3. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip settings, fuse selection, and commentary regarding same.
4. Fault current calculations including a definition of terms and guide for interpretation of computer printout.
5. Recommended size for power fuses and recommended settings for ground fault relays and for all adjustable trip relays, circuit breakers, etc.
6. Tabulation of arc-flash calculations for each location and tabulation of arc-flash hazard, voltage, boundary and required PPE for each equipment item listed in the arc-flash analysis.

2.5 PROTECTIVE DEVICE TESTING, CALIBRATION AND ADJUSTMENT

A. Provide adjustments to circuit breakers and switchboard AIC ratings as deemed necessary by the analysis/report, with no additional cost to the Owner. Provide over current protection devices with larger frame sizes to ensure coordination has been achieved.

B. Provide the services of a qualified field engineer employed by the equipment manufacturer, and necessary tools and equipment to test, calibrate and adjust the protective relays, ground fault relays and circuit breaker trip devices as recommended in the Protective Device Study.

2.6 TYPEWRITTEN DEVICE SETTING TABULATION:

A. Provide type written tabulation that includes all settings for each protective relay, ground fault relay and circuit breaker solid-state trip devices. Enclose the table in a protective plastic sleeve and affix to the main service entrance equipment.

END OF SECTION 26 0573

SECTION 26 0923 - OCCUPANCY SENSORS

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. This section is a Division-26 Basic Materials and Methods section, and is part of each Division-26 section making reference to wiring devices specified herein.

1.2 DESCRIPTION OF WORK:

A. The extent of occupancy sensor work is indicated by drawings and schedules.

B. Types of occupancy sensors in this section include the following:

1. Dual Technology Wall Switch
2. Dual Technology Wall Switch with Dimming and Daylight Control.
3. Dual Technology Ceiling Sensor w/ Control Pack

1.3 QUALITY ASSURANCE:

A. Comply with NEC and NEMA standards as applicable to construction and installation of occupancy sensors. Provide occupancy sensors that have been UL listed and labeled.

B. All sensors shall be capable of operating normally with electronic ballasts, PL lamp systems, motor loads and any other passive infrared or microwave systems.

1.4 SUBMITTALS:

A. Refer to Section 26 0502 for electrical submittal requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURER: The manufacturer shall have a minimum of five years of experience in the sensor and lighting control industry. Sensors and related relays shall be compatible with the specific lighting types controlled. All sensors shall be of the same manufacturer, mixing brands of sensors is not acceptable.

A. DUAL TECHNOLOGY WALL SWITCH: Where units are indicated provide a sensor that meets the following minimum requirements:

1. Sensor shall utilize PIR (Passive Infrared) to turn on the lights and then PIR or US (Ultrasonic) technologies to keep lights on.
2. Sensor shall incorporate an inrush current limiter circuit to protect the relay contacts.
3. Sensor shall utilize single or dual dry relay contacts for control of the lighting loads. Contractor shall verify requirements in coordination with the drawings.
4. Sensor shall have a self-adjusting time delay, selectable 5, 15 and 30 minutes.
5. Sensor shall have automatic sensitivity adjustment and be microprocessor controlled.
6. Sensor shall have light level sensing 0 to 200 footcandles.

7. Sensor shall have a 180 degree field of view, coverage up to 800 square feet and shall detect 6 inches of hand movement towards the sensor up to 300 square feet; and body motion towards the sensor up to 1000 square feet.
8. Sensor shall be rated for 0 to 800 watts at 120VAC and 0 to 1200 watts at 277VAC.
9. Sensor shall be automatic on and shall have an automatic to off override switch on the unit. Switch shall be equipped with an air gap switch to disconnect power to the lighting load.
10. Sensor shall have real time motion indicator on the front of the unit.
11. Sensor shall mount to a single gang switch box.
12. Subject to compliance with the above requirements. Provide models of one of the following:
    a. Douglas
    b. Greengate ONW-D
    c. Wattstopper

B. DUAL TECHNOLOGY WALL SWITCH WITH DIMMING AND DAY-LIGHT CONTROL: Where units are indicated, provide a sensor that meets the following minimum requirements:

1. Dual technology sensors shall have one of its two technologies, not require motion to detect occupancy.
2. Sensors shall offer a minimum on timer of at least 15 minutes, in order to prevent all cycling of lamps before they have burned for the lamp manufacturers minimum recommended time period.
3. Sensors shall utilize an occupancy time delay that keeps lights on after last detected occupancy. Factory default setting of the occupancy time delay shall be 15 minutes.
4. Manual adjustment to the occupancy time delay so as to increase it shall be accommodated.
5. Sensor shall be capable of switching both 120 VAC and 277 VAC.
6. Sensor shall recess into single gang switch box and fit standard GFI opening.
7. Sensor shall meet NEC grounding requirements by providing a dedicated ground connection and intrinsically grounding through its mounting strap.
8. Line and load wire connections shall be interchangeable.
9. Wall switch sensor shall have field programmable adjustments for selecting operational modes, occupancy time delays, minimum on time, and photocell set-point.
10. Sensor shall be capable of both auto-on and manual operation.
11. Combination photocell/dimming sensors set point and deadband shall be automatically calibrated through the sensors microprocessor by initiating the automatic set point programming procedure. Min and max dim settings as well as set point may be manually entered.

12. Subject to compliance with the above requirements, provide models of one of the following:

    a. Douglas

    b. Sensor-switch – N5X-PDT-D Series

    c. Wattstopper – DW-311 (No Daylight Dimming, use when daylighting is not required)

C. DUAL TECHNOLOGY CEILING SENSOR: Where units are indicated, provide a sensor that meets the following minimum requirements:

1. Sensor shall incorporate ultrasonic (microphonics) and infrared technologies in a single unit.
2. Sensor shall be Class 2, low voltage; capable of mounting in the ceiling for maximum coverage.
3. Sensor shall use internal microprocessor for motion signal analysis and automatic self-adjustment.
4. Sensor shall have automatic self-adjustment algorithm that adjusts timer and sensitivity settings to maximize performance and minimize energy usage.
5. Sensor shall have manual time-out adjustment from 8 minutes to 32 minutes and automatic time out from 8 minutes to 100 minutes.
6. Sensor shall have test time-out setting of 8 seconds, with automatic return to 8 minutes after one hour if sensor is left in test mode.
7. Sensor's microprocessor shall automatically extend timer by 1 hour in response to recognition to false off condition. After 5 hours, sensor reduces extended time by 30 minutes and continues to reduce by 30 minute increments over the next few days.
8. Sensor's microprocessor shall automatically reduce either PIR or ultrasonic sensitivity in response to false on condition.
9. Sensor microprocessor will automatically monitor PIR background threshold signal level and makes corresponding sensitivity adjustments automatically.
10. Sensor microprocessor algorithm shall incorporate automatic adaptation to continuous airflow.
11. For airflow that is so intense as to mask motion, sensor shall flash indicator LED code to indicate excessive airflow.
12. Sensor's microprocessor shall use a four week learning period and develop a circadian calendar.
13. An internal 24 hour 7 day clock establishes what periods the room is typically occupied, biasing sensor to keep lights on while normally occupied and off when normally unoccupied.
14. Sensor shall have selection settings for the following dual technology schemes:
    a. High Sensitivity and High Confidence (miser mode)
15. Sensor shall be available with either 180 degrees or 360 degrees coverage pattern.
16. Infrared lens shall have 360 degree field of view. Two types of lens shall be available, standard and extra dense.
17. Sensor shall have a variety of mask inserts for PIR coverage rejection to prevent false tripping.

18. Transducers shall be protected from tampering.
19. Sensor shall have manual adjustments for timer and sensitivities and override switches to force manual adjustment mode.
20. Sensor shall have adjustable sensitivity from 0% to 100% for both ultrasonic and infrared.
21. Controls shall be behind cover to resist tampering. All adjustments shall be accessible from the front of the sensor.
22. Sensor shall be available with a photocell adjustment from 20 to 3,000 Lux.
23. Sensor shall provide internal operating status and settings confirmation via LED motion lamp indicator.
24. Sensor shall have two (if 180 degree) or three (if 360 degree) real time LED motion indicators visible from the front of the unit: Red = infrared; green = ultrasonic.
25. Subject to compliance with the above requirements, provide models of one of the following:
    a. Douglas
    b. Hubbell-ATD Series
    c. Sensor Switch-CM-PDT Series
    d. Wattstopper-DT Series
    e. Mytech-Omni-DT Series
    f. Lithonia - LMTO Series
    g. Leviton – OSC UOW Series
    h. Greengate OMC – DT Series

D. 24 VDC POWER/CONTROL PACK: Where units are indicated, provide a power/control pack that meets the following minimum requirements:

1. Control module shall consist of a DC power supply and a dry contact relay for switching a lighting load.
2. Control module shall consist of a DC power supply and a dry contact relay for HVAC control.
3. Control module shall be available in versions to accept 120, and 277 VAC line voltages.
4. Output shall be 24VDC nominal, and shall be inherently safe, low voltage, limited power output (Class 2).
5. Output shall supply 100mA current, in addition to current consumed internally to operate internal relay.
6. Relay shall utilize normally open, silver alloy dry contacts, and shall be rated for a 20A ballast load at 120V and 277V.
7. Relay function shall not require more than 5 mA control current to operate.
8. Control module shall have line voltage wiring, consisting of input voltage and relay contact connections, exiting from one end, and low voltage DC connections, consisting of ground, power, and control wires, exiting from the other end.
9. Control module shall be sized to fit inside a standard 4” x 4” junction box.
10. Control module shall be equipped with a 1/2” EMT threaded male fitting on the line voltage end, such that it may be mounted to the outside of a junction box with the line voltage wiring internal to the box and the low voltage wiring external.

11. Control module shall be equipable with accessory 1/2” EMT threaded male fitting on the low voltage end, such that it may be mounted to the inside of a ballast cavity with the box and line voltage wiring internal to the cavity and the low voltage wiring external.
12. Slave module shall be available for switching additional circuits. Slave module has same construction and specifications as control module except without power supply function.
13. Subject to compliance with the above requirements, provide models of one of the following:
    a. Douglas
    b. Hubbell-CU Series
    c. Sensor Switch-PP-20 Series
    d. Wattstopper-BEP Series
    e. Mytech-MP Series
    f. Lithonia - LPCS Series
    g. Greengate SP20-MV Series
    h. Leviton – OSC/OSA Series

PART 3 – EXECUTION

3.1 INSTALLATION OF LIGHTING CONTROL EQUIPMENT:

A. Install occupancy lighting control system components and ancillary equipment as indicated, in accordance with equipment manufacturer's written instructions, and with recognized industry practices, to ensure that lighting control equipment complies with requirements.

B. Comply with requirements of NEC, and applicable portions of NECA's "Standard of Installation" pertaining to general electrical installation practices.

C. Coordinate with other electrical work, including raceways, and electrical boxes and fittings, as necessary to interface installation of lighting control equipment work with other work.

D. Contractor shall be on site as required, to adjust lighting control units for proper operation.

E. Mount the switchpack in a standard 4" junction box. Mount sensor to a standard 4” junction boxes. Refer to manufacturer supplied mounting instructions.

F. All lighting programing shall meet the requirements of the IECC 2018 or current energy code applied to the project.

3.2 FIELD QUALITY CONTROL:

A. Upon completion of installation and after circuitry has been energized, demonstrate capability and compliance of system with requirements.

B. System start-up: Provide a factory authorized technician to verify the installation and test the system.

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

D. Contractor shall visit the job site 3 months after the owner has taken occupancy and adjust any units not operating properly, otherwise remove and replace with new units.

3.3 PRODUCT SUPPORT AND SERVICES:

A. System Start-Up: Provide a factory authorized technician to verify the installation, test the system, and train the owner on proper operation and maintenance of the system. Before requesting start-up services, the installing contractor shall verify that:

1. The sensors have been fully installed in accordance with manufacturer's installation instructions.
2. Low voltage wiring for overrides and sensors is completed.
3. Accurate 'as-built' load schedules have been prepared.
4. Proper notification of the impending start-up has been provided to the owner's representative.
5. Programming of all switches, sensors, power packs, relays, etc. shall be completed by factory authorized technician, prior to final and training.

B. Factory support: Factory telephone support shall be available at no cost to the owner during the warranty period. Factory assistance shall consist of assistance in solving programming or other application issues pertaining to the control equipment. The factory shall provide a toll free number for technical support.

C. Functional Testing:

1. The owner shall hire a third party that will conduct and certify the functional testing.

2. Lighting controls devices shall be tested to ensure that control hardware and software are calibrated, adjusted, programmed, and in proper working conditions in accordance with the construction documents, manufacturer's instructions and code requirements. The following shall be performed:

a. Certify that sensors have been located, aimed and calibrated per manufacturer recommendations.

b. Status indicator operates properly.

c. Fixtures that are controlled by auto-on controls turn on to permitted level.

d. Fixtures that are controlled by manual on controls operate when manually activated.

e. Fixtures do not turn on incorrectly due to HVAC or movement outside the controlled area.

f. Confirm that occupancy sensors turn off after space is vacated and do not turn on unless space is occupied.

g. Simulate unoccupied conditions and confirm that vacancy sensors only turn on manually and turn off after space is vacated.

3. The party responsible for the functional testing shall provide documentation that the installed lighting controls meet or exceed all performance criteria and shall not be directly involved in the design or construction of the project.

3.4 WARRANTY:

A. Manufacturer shall provide a one (1) year limited warranty on lighting control system. A ten (10) year limited warranty shall be provided on the lighting control relays.

3.5 RECORD DRAWINGS:

A. Refer to Section 26 0502 for electrical Record Drawings Requirements (Following Lighting Controls).

3.6 MANUFACTURER AUTHORIZED PERSONNEL TRAINING:

A. Building Operating Personnel Training: Train Owner's building personnel in procedures for starting-up, testing and operating lighting control system equipment.

END OF SECTION 26 0923

SECTION 26 0943 - LIGHTING CONTROL EQUIPMENT

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-26 Basic Materials and Methods sections apply to work specified in this section.

1.2 DESCRIPTION OF WORK:

A. Provide a lighting control system, including all system components, wiring, and any ancillary equipment necessary for a complete and working system. The system shall include all necessary components to achieve control and monitoring of all lighting fixtures, supporting both relay-switched and dimmed lighting solutions and controlled receptacles.

B. Electrical drawings show general zoning intent and lighting control narrative.

C. Energy Code: The system shall comply with latest edition of IECC energy code.

D. Types of lighting control equipment specified in this section, includes the following:

1. Low voltage relay control panels
2. Occupancy sensors
3. Daylight sensors
4. Wallstations/Switches
5. Lighting Load Controllers (Room Controllers)
6. Emergency Lighting Control Units/Generator Transfer Devices

E. Requirements are indicated elsewhere in these specifications for work including but not limited to raceways, electrical boxes and fittings required for installation of lighting control equipment, not work of this section.

1.3 QUALITY ASSURANCE:

A. Manufacturers: Firms regularly engaged in the manufacturer of lighting control equipment and ancillary equipment, of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years. To ensure a uniform installation and single responsibility, all switching and dimming equipment described herein shall be supplied by a single manufacturer.

B. Installer: Qualified with at least 3 years of successful installation experience on projects with lighting control equipment installation work similar to that required for project.

C. NEC Compliance: The control system shall comply with all applicable National Electrical Codes regarding electrical wiring standards.

D. NEMA Compliance: The control system shall comply with all applicable portions of the NEMA Standard regarding the types of electrical equipment enclosure.

E. Codes and Standards: Provide units that meet the requirements of IEEE Std. 2000.1.1999.

F. Independent Testing Laboratory: Provide units that have been tested and listed under UL 916 energy management equipment.

G. Component Pre-testing: All control equipment shall undergo strict inspection standards. The equipment shall be previously tested and burned-in at the factory prior to installation.

1.4 SUBMITTALS:

A. Refer to Section 26 0502 for electrical submittal requirements.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. Manufacturer: Subject to compliance with requirements, provide lighting control equipment of one of the following;

1. Cooper Controls
2. Acuity nLight Controls
3. Hubbell Building Automation
4. Leviton Lighting Controls

B. The lighting controls as shown are based upon Cooper lighting controls. Prior approval and commitment to being able to provide similar and equal system is required before bidding this project. Any system different from Cooper Controls that requires additional relays, etc. not shown on plans due to lack of separation of relays and dimming zones must be accounted for and provided in the bid and must function as similar to that which is required in final installation.

C. Manufacturer's representative for division 26 and bidding controls shall be accountable for the comprehensive lighting controls package's finalization in alignment with the design intent depicted in the drawings and complying with IECC 2021 requirements. The lighting representative is required to develop detailed shop drawings demonstrating the lighting control system's topology and the essential connections necessary for its proper functioning. Lighting control devices shown are to provide general intent only. Manufacturer representatives to provide all additional devices and modify device locations as required to meet IECC 2021 requirements

2.2 SYSTEM DESCRIPTION:

A. The lighting control system shall provide seamless control and monitoring of all lighting included in the scope of work regardless of whether it is relay switched or dimmed.

B. The lighting control system shall consist of low voltage relay control panels with programmable switch inputs, the panel shall be microprocessor controlled with a touchscreen interface display. The touchscreen shall provide relay status information viewable through a protected windowed enclosure. All local programming shall be permissible through the self-prompting touchscreen.

C. Programmable intelligence shall include:

1. Time of day control (64 time-of-day/holiday schedules)

2. 32 holiday dates
3. Timed inputs (adjustable from 1 to 99 minutes)
4. Timed override (from touchscreen, adjustable from 1 to 999 minutes, then resumes normal schedule)
5. Pre-set controls
6. Auto daylight savings adjust
7. Low voltage Dimming/Central Dimming Controls:
    a. 0-10V dimming capability
    b. Daylighting control via 0-10V dimming relays and programming
    c. DMX or other dimming protocols as indicated on plans
8. Astronomical clock with offsets
9. Local control (from touchscreen and local switch)
10. Digital wallstations/switches
11. Flash warning of impending off for occupants
12. Network override

D. The controller shall permit lighting to be overridden on for after-hours use or cleaning. The controller shall provide priority and masking choices to allow for customizing the functions of switch inputs, thereby enabling wallstations/switches to function differently at different times of day. These overrides shall be digital, network or hard-wired inputs.

E. The lighting control system shall be fully programmable through PC programming software. Programming shall be permitted through a direct RS-232 connection, modem or TCP/IP.

1. Shall include with user-friendly software suitable for operation on computer workstations which serve as central control stations for the selection and operation of lighting scenes.

2. All software shall be programed by the vendor and delivered ready to use. This program shall include preparation of all graphics, and displays required as a part of this project.

F. The control system shall provide networking between lighting control panels. The network shall support up to a maximum of 254 control panels. Panels shall permit data sharing for global controls. All inputs shall be transferable over the network to create any switching pattern.

G. The lighting control system shall log all control events. Log reports shall be available through the integral touchscreen or enterprise software.

H. All lighting programing shall meet the requirements of the IECC 2021 or current energy code applied to the project.

2.3 EQUIPMENT:

A. Relay Panel

1. Enclosure: Shall be NEMA 1 rated, code gauge steel cabinet. Enclosure and contents shall be designed to operate in interior spaces with temperatures of 32°f - 104°f (0°-40°c) and 0-90% non-condensing humidity. Enclosure shall be available with optional recessed mounting hardware. See drawings for mounting

requirements and refer to schedules on drawings for sizes.

2. Interior: Interiors shall be sized to accept relays and will provide true on/off indication of relay status through LED's. The system shall employ all modular connectors to avoid repeat wiring in case of component failure. The system CPU board shall be mounted on quick release hinge pins. All connections for the dry contact inputs shall incorporate modular connectors.
3. Power Supply: The control panel shall incorporate the use of a multi-tapped transformer. The panel shall not require specification of voltage for each control location. The voltage of 120 and 277 VAC shall be available with each control panel.
4. Cover: Provide surface cover with captive screws in hinged, lockable configuration. A wiring schedule directory card shall be affixed to the covers back to allow identification of circuits/relays/load controlled. Schedules must be typed and related to final room names and numbers (not bid document room names and numbers).
5. High Voltage Barrier: The controller shall provide the ability to provide for either voltage separation or emergency circuit separation.
6. Relays: The system shall utilize normally open control relays, that are rated to 20A at 120/277 VAC. The relays shall be mechanically latching, and shall permit individual override and LED configuration of relay status. The relays shall be rated for 10 million operations.
7. System Controller: The system controller shall consist of an integral touchscreen that provides access to the main programming features. The touchscreen shall permit the user to manually command any or all relays individually.
    a. Provide master on/off control of a relay group while still allowing individual relays to be overridden by their local switch.
    b. The control system shall permit up to 32 dry contact inputs for override purposes. Momentary 3 wire or 2 wire (toggle) inputs shall be supported. Any input shall be software linked to any number or relays.
    c. The controller shall provide timers for each override. Each override timer shall be capable of 0-999 minutes. Software shall enable or disable overrides based on priorities, masks or time of day scheduling.
    d. The controller shall accept either dry contact or analog ambient light sensors. The controller shall provide power for the sensor. Sensors shall provide for outdoor, indoor or skylight applications and issue a command to the controller once the threshold is reached.
    e. Each control panel shall incorporate diagnostic aids for confirmation of proper operation. The control panel shall employ both a backlit touchscreen and LED's to indicate:
        i. Power
        ii. System OK
        iii. Network communications
        iv. System clock and date
        v. Programming confirmation
        vi. Control panel subnet network communications
8. Emergency Relay Panels: Shall work in accordance with all governing codes and compliances and all local codes having jurisdiction. Emergency Relay panels shall operate as normal powered relay panels during normal non-emergency power conditions. In case of emergency or power outage emergency designated

panels shall work independently and provide automatic and maintained full on power, illumination and control functioning to all designated egress luminaries throughout the building and project site.

9. Wallstations/Switches/Plates: The lighting controller shall support digitally addressable LED annunciated switches. Provide low voltage push-button switches in up to 6 button configurations. Provide factory engraved labeling for individual push-buttons. Provide in color to match wiring devices and coverplate to match devices and plates in Wiring Devices (Section 26 2726).

10. Photocells:

    a. Provide a photocontrol point that consists of an architecturally compatible sensor mounted in the appropriate location for measuring the available daylighting. Each sensor will have a separate calibration module mounted in an enclosure in the electrical closet.

        i. Exterior Lighting: Provide a hooded sensor that can be horizontally mounted on a ½" KO or threaded conduit. The unit shall employ a flat lens and work with a foot-candle range between 1-10 or 10-100 in 10% increments.

    b. Control Unit shall allow for either direct control of up to three devices. These devices can be a relay, or any other device which allows control by a three wire momentary contact.

    c. Control unit shall be switchable between four foot-candle measurement ranges (1- 10 FC, 10- 100 FC, 100- 1000 FC and 1000- 10,000 FC). Depending upon the sensor head and application.

    d. Control unit shall have separate trip points for the high and low response settings. These settings shall be entered via dial switches. LED's shall be provided to illustrate whether the sensor is below the 'low' setting, above the 'high' setting, or in the deadband range.

    e. Control unit shall allow for a momentary contact device to override the photocell relays to either an on or off state.

    f. Control unit shall employ a 3-minute time delay between switching outputs to avoid nuisance tripping. It shall be possible to disable the time delay to aid in initial setup and trouble shooting.

    g. Sensor devices shall be available to match application. Each sensor shall employ photodiode technology to allow a linear response to daylight in its given foot-candle range:

11. Low Voltage Dimming (0-10V):

    a. Capable of controlling any 0-10V source with the required dimming channels.

    b. 0-10V analog voltage signal.

    c. Provide isolated 0-10V output signal conforming to IEC 60929.

    d. Sink current via IEC 60929.

    e. Source current.

12. Indoor Lighting: Provide a sensor with a Fresnel lens providing for a 60° cone shape response area. The unit shall work with a range between 10-100 foot-

candles.

13. Skylights: Provide a daylight sensor with a translucent dome with a 180° field of view and respond in the range of 1,000

14. Wallstations: Provide low voltage push-button type switches up to 8 button configurations to match requirements of lighting control within the room. Provide factory engraved labeling for individual push buttons. Provide in a color to match wiring devices and coverplates to match devices and plates in Wiring Devices (Section 26 2726). Wallstation shall connect to the room controller via the room controller local network. Wallstations that require user interface to allow for raise/lower control of dimming, loads shall include a slider function or similar. All wallstations shall have the ability to be independently program or be re-programmed on site and without the need to replace or send the device to the manufacturer for re-programming.

15. Wiring:

    a. Provide manufacturer approved 18/2 AWG solid cabling (Dataline) with a topology free, polarity free wiring arrangement to connect lighting control devices.

        i. All dialog system cabling shall be white or gray.

    b. Provide Dataline cabling between centralized relay panel controller and other necessary building controllers via Dialog Network Dataline. The Dialog Network Dataline allows a maximum single wiring run of 1000ft and a total aggregated length of 3000ft from all datalines originating from an LCU located in the Master Panel CLCP. Provide standard School Network drop at the main CLCP for connection to the Global Web Server.

        i. Classrooms to be independent and not connected to the centralized system.

    c. Programming: Provide a RS-232 (RJ-R Connection) to allow programming through either a local connection or remotely through a modem.

    d. Provide wiring in conduit located within the walls and non-accessible ceilings. Provide wiring above accessible ceilings in conduit to system enclosure to system enclosure.

16. Systems Communicating & BACnet IP;

    a. Enterprise Software: Provide a PC based interface software that provide access to the lighting control system files within a Windows® environment. The software shall allow individual or network panel programming to be executed locally, via direct connection or remotely through a TCP/IP connection or modem.

    b. Ethernet Interface Module: Provide access to the control panels over a TCP/IP connection by converting sent information into RS-232 communication capable information.

    c. Automation Interface Module to district wide BMS: The control panel shall provide for data protocol translation and permit systems that utilize the Modbus® N2, BACnet or LonWorks communication protocols to operate individual relays or relay groups.

    d. Provide programming and training time to properly integrate into the Owner's BMS system. Program system per the owner's requirement. Train owner so as to allow them to have the ability to make changes to the system in the future.

B. Room Controllers:

1. The room controller shall provide the following functionality;
   a. Provide interface with room occupancy sensor to provide lighting and receptacle control and be programmable as either manual on/automatic off. Provide interface with room wallstations to provide multi-level switching and/or variable dimming. Provide interface with daylight sensors to provide daylighting controls of lighting fixture via multi-level (step dimming) and/or variable dimming.
2. The room controller shall be a fully functional lighting control system to match the room lighting and control requirements. The controller shall provide the following features:
   a. Separate compartments for line voltage, emergency voltage and low voltage connections.
   b. Breakouts for direct conduit connections.
   c. Dual voltage (120/277 VAC)
   d. Low voltage connections using standard RJ-45 connectors.
   e. Zero cross circuitry for each load.
   f. Relay and 0-10V dimming zone configuration to match room requirements.
   g. The ability to be independently program or be re-programmed on site and without the need to replace or send the device to the manufacturer for re-programming.
3. Emergency Lighting: When the room controller is provided with emergency relay, the controller shall be UL 924 Listed and monitor the normal power circuit. The UL 924 relay will track the normal power operation. Upon loss of normal power the emergency lighting will be forced on to full bright (if dimming) until normal power is restored. The following features shall be included:
   a. 120/277 VAC
   b. Push-to-test
4. Daylight sensors shall work with the room controller to provide automatic daylight dimming capabilities for loads connected to the room controller. The daylight sensor shall include the following features:
   a. An additional photodiode that measures only the visible spectrum.
   b. The sensor shall have three light level ranges;
      i. Low (3-300 LUX), high (30-3000 LUX) and direct sun (300-30,000 LUX).
   c. The sensor shall provide the capability of controlling multiple (up to three) daylight zones for dimming daylight harvesting.
   d. The sensor shall include an internal photodiode that measures light in a 60 degree angle cutting off the unwanted light from the interior of the room.
5. Ceiling Mounted Occupancy Sensors: Sensors shall utilize dual-technology (ultrasonic and infrared technologies) and have the following additional features:
   a. Sensor shall be class 2, low voltage; capable of mounting in the ceiling for maximum coverage.
   b. Sensor shall have automatic self-adjustment algorithm that adjusts timer and sensitivity settings to maximize performance and minimize energy

usage.

c. Sensor shall have 360 degree field of view.

d. Sensor shall incorporate non-volatile memory such that all settings and parameters are saved in protected memory.

e. Sensor shall have time delays from 10 to 30 minutes.

f. Sensor shall provide a visual means of indication that motion is being detected via an LED.

g. Sensors shall have readily accessible, user adjustable settings for time delay and sensitivity.

h. Provide internal additional isolated relay with NO, NC and common outputs for use with HVAC control, data logging and other control options.

6. Wallstations: Provide low voltage push-button type switches up to 8 button configurations to match requirements of lighting control within the room. Provide factory engraved labeling for individual push buttons. Provide in a color to match wiring devices and coverplates to match devices and plates in Wiring Devices (Section 26 2726). Wallstation shall connect to the room controller via the room controller local network. Wallstations that require user interface to allow for raise/lower control of dimming, loads shall include a slider function or similar. All wallstations shall have the ability to be independently program or be re-programmed on site and without the need to replace or send the device to the manufacturer for re-programming.

C. Emergency Power Control (CEPC)/ Emergency Lighting Control Units (ELCU)/Generator Transfer Devices (Required when not built into Room Controller, Relay Panel, etc):

1. The Emergency Power Control (CEPC)/Lighting Control Unit (ELCU) shall provide all required functionality to allow any standard lighting control device to control emergency lighting in conjunction with normal lighting in any area within a building. The unit shall be installed flush to the ceiling so that test switch & LED's are in plain view of room occupants as required by some local electrical codes.

2. The device shall automatically illuminate connected emergency loads upon utility power interruption, regardless of room switch position. (NEC 700.24)

3. Local room switch or lighting control shall turn both regular & emergency luminaires on at the same time (no dedicated emergency room switch required).

4. The emergency lighting control unit shall allow control of emergency lighting fixtures in tandem with normal lighting in an area while ensuring that emergency lighting will turn on immediately to full brightness upon loss of normal power supplying the control device. Emergency lighting operation shall be independent for each controlled area and shall not require a generalized power failure for proper operation.

5. The unit shall be compatible with 2-wire, 3-wire, 0-10V, & DALI dimming systems & ballasts.

6. The device shall be self-contained, measure 1.70" x 2.97" x 1.64," and provide integral one half inch pip nipple mount with snap in locking feature for mounting into a standard junction box KO.

7. The device shall have normally closed dry contacts capable of switching 20 amp emergency ballast loads @ 120-277 VAC, 60 Hz, or 10 amp tungsten loads @ 120 VAC, 60 Hz.

8. The device shall have universal rated voltage inputs provided for normal power sense and normal switched power at 120-277 VAC, 60 Hz.

9. The device shall have an integral momentary test switch. Pressing and holding this switch shall instantly force the unit into emergency mode and turn on emergency lighting. Releasing the test switch shall immediately return the unit to normal operation.

10. The unit shall provide dedicated leads and 24 VDC source for connection to remote test switch, fire alarm system, or other external system capable of providing a normally closed dry contact closure. Breaking contact between the terminals shall force and hold the emergency lighting on until the terminals are again closed. An integral LED indicator shall indicate the unit's current remote activation status.

11. The device shall provide separate LEDs to indicate the presence of normal and emergency power sources. The LEDs shall indicate the unit's current operational mode (normal or emergency).

12. The device's normal power input lead shall be connected to the line side of the control device such that any upstream fault causing a loss of power, including the tripping of the branch circuit breaker, will force the unit into the emergency mode and turn on the emergency lighting.

13. The unit shall automatically switch emergency lighting on and off as normal lighting is switched. When normal power is not available, the unit shall force and hold emergency lighting on regardless of the state of any external control device until normal power is restored.

14. The unit shall utilize zero crossing circuitry to protect relay contacts from the damaging effects of inrush current generated by switching electronic ballast loads.

15. The unit shall have UL 94-V0 or UL 94-5VA flame rating & be approved for installation above the suspended ceiling.

16. To ensure quality and reliability, the unit shall be manufactured by an ISO 9002 certified manufacturing facility and shall have a defect rate of less than 1/3 of 1%.

17. The device shall not generate any objectionable electrical or mechanical noise.

18. The unit shall be UL and cUL listed and labeled for connection to both normal and emergency lighting power sources.

PART 3 - EXECUTION:

3.1 INSTALLATION OF LIGHTING CONTROL EQUIPMENT:

A. Install lighting control system components and ancillary equipment as indicated, in accordance with equipment manufacturers written instructions, and with recognized industry practices, to ensure that lighting control equipment complies with requirements.

B. Comply with Requirements of NEC, and applicable portions of NECA's 'Standard of Installation' pertaining to general electrical installation practices.

C. Coordinate with other electrical work, including raceways, electrical boxes and fittings, as necessary to interface installation of lighting control equipment work with other work.

D. Electrical Identification: Refer to Section 26 0553 for requirements.

3.2 FIELD QUALITY CONTROL:

A. Upon completion of installation and after circuitry has been energized, demonstrate capability and compliance of system with requirements.

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

3.3 PRODUCT SUPPORT AND SERVICES:

A. System Start-Up: Provide a factory authorized technician to verify the installation, test the system, and train the owner on proper operation and maintenance of the system. Before requesting start-up services, the installing contractor shall verify that:

1. The control system has been fully installed in accordance with manufacturer's installation instructions.
2. Low voltage wiring for overrides and sensors is completed.
3. Accurate 'as-built' load schedules have been prepared for each lighting control panel.
4. Proper notification of the impending start-up has been provided to the owner's representative.
5. Programming of all wallstations/switches, relays, groups of relays and interfaces with building automation shall be completed by factory authorized technician, prior to final and training.

B. Factory support: Factory telephone support shall be available at no cost to the owner during the warranty period. Factory assistance shall consist of assistance in solving programming or other application issues pertaining to the control equipment. The factory shall provide a toll free number for technical support.

3.4 PROGRAMMING:

A. Program of all lighting control systems as directed by the electrical engineer and/or owner. Meet with the electrical engineer at their office prior to preparation of shop drawings to discuss specific programming and zoning requirements of system(s). Each networked or standalone system shall be programmed to revert back to its normal "ON" position one hour after selecting a scene or raising or lowering a lighting zone.

B. All lighting programing shall meet the requirements of the IECC 2021 or current energy

code applied to the project.

3.5 COMMISSIONING:

A. A lighting control system requires at least one site visit for proper commissioning. If multiple site visits are required, the first ensures that the contractor is trained to install the system correctly. On the second, the factory trained engineer will start up the system, ensure that it is operating according to specification, and perform initial programming. The third visit is for the purposes of refining the programming, and training the owner/end user on the system.

B. Provide factory-certified field service engineer to ensure proper system installation and operation under following parameters:

1. Certified by the equipment manufacturer on the system installed.

2. Site visit activities:

a. Verify connection of power feeds and load circuits.

b. Verify connection of controls.

c. Verify system operation control by control, circuit by circuit.

d. Obtain sign-off on system functions.

e. Demonstrate system capabilities, operation and maintenance and educate Owner’s representative on the foregoing.

3. At least three site visits to accomplish the following tasks:

a. Prior to wiring:

i. Review and provide installer with instructions to correct any errors in the following areas:

1. Low voltage wiring requirements

2. Separation of high and low voltage wiring runs

3. Wire labeling

4. Load schedule information

5. Switching cabinet locations and installation

6. Physical locations and network addresses of controls

7. Ethernet connectivity

8. Computer-to-network connections

9. Load circuit wiring

10. Connections to other systems and equipment
11. Placement and adjustment of Occupancy Sensors
12. Placement and adjustment of Photocells

b. After system installation:

i. Check and approve or provide correction instructions on the following:

1. Connections of power feeds and load circuits
2. Connections and locations of controls
3. Connections of low voltage inputs
4. Connections of the data network

ii. Turn on system control processor and upload any pre-programmed system configuration

iii. Verify cabinet address(es)

iv. Upload pre-programmed system configuration and information to switching and/or dimming cabinets

v. Check load currents and remove bypass jumpers

vi. Verify that each system control is operating to specification

vii. Verify that each system circuit is operational according to specification

viii. Verify that manufacturers' interfacing equipment is operating to specification

ix. Verify that any computers and software supplied by the manufacturer are performing to specifications

x. Verify that any remote WAN (Wide Area Network) connections are operating properly

xi. Have an owner's representative sign off on the above-listed system functions

c. Before project completion and hand-off:

i. Demonstrate system capabilities and functions to owner's representative

ii. Train owner's representative on the proper operation, adjustment, and maintenance of the system.

C. Notification: Upon completion of the installation, the contractor shall notify the manufacturer that the system is ready for formal checkout. Notification shall be given in writing a minimum of 21 days prior to the time factory-trained personnel are required on site. Each field installed RJ45 connection must be tested prior to system interconnection. A test report must be furnished to manufacturer prior to scheduling commissioning activity. Manufacturer shall have the option to waive formal turn-on.

D. Turn-On: Upon completion of all line, load and interconnection wiring, and after all fixtures are installed and lamped, Manufacturer's Certified Technician shall completely check the installation prior to energizing the system. Each installed relay system shall be tested for proper ON/OFF operations, and proper LED illumination. Each installed control cabinet shall be tested verifying that each controlled load adjusts to the selected setting and that all switch LED's illuminate properly.

E. Provide written commissioning report including space/room names and numbers indicating list of all lighting equipment and devices tested and verifying proper operation of the system. Report shall include corrections, programming information/file, warranties, and owner's representative sign off on the above-listed system functions.

F. At the time of checkout and testing, the owner's representative shall be thoroughly instructed in the proper operation of the system.

3.6 RETRO-COMMISSIONING:

A. During the one year warranty period, provide retro-commissioning services at three month, six month, nine month, and one year marks. Provide at least 4 hours of commissioning service for each of the four retro-commissioning periods. This will include meeting with the Owner to receive feedback on the system and making changes to the system including programming, task tuning.

3.7 MAINTENANCE:

A. Enable the end user to order new equipment for system expansion, replacements, and spare parts.

B. Make new replacement parts available for a minimum of ten years from the date of manufacture.

C. Manufacturing shall provide telephone technical support by factory personnel 24 hours a day, 7 days a week. Project cost overruns and delays can occur without this service. Answering services can add to frustration and delay the resolution of any problems or issues. Manufacturers who do not offer factory-direct technical support on a 24/7 basis should not be acceptable on this project.

D. Provide factory-direct technical support hotline 24 hours per day, 7 days per week.

E. Offer renewable annual service contracts, to include parts, factory labor, and annual training visits. Make service contracts available up to ten years after date of system commissioning.

3.8 WARRANTY:

A. Manufacturer shall provide a one (1) year limited warranty on lighting control system. A ten (10) year limited warranty shall be provided on the lighting control relays.

3.9 RECORD DRAWINGS:

A. Refer to Section 26 0502 for electrical O & M requirements.

3.10 TRAINING:

A. Provide four (4) hours of recorded training in two 2 hour sessions on the operation and use of the lighting control equipment, at job site, at no cost to the Owner.

B. Provide a USB Flash device to the owner containing the information specified below. The media shall include all information required to allow the Owner to change the schedules themselves. The media shall contain a minimum of following:

1. CAD drawing files of ‘as-built’ lighting control components and point to point connections.

2. General configuration programming.

3. Job specific configuration programming to include schedule.

C. Tutorial file on complete programming of lighting control system

END OF SECTION 26 0943

SECTION 26 2200 - TRANSFORMERS

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-26 Basic Materials and Methods sections apply to work specified in this section.

1.2 DESCRIPTION OF WORK:

A. Extent of transformer work is indicated by drawings and schedules. Work includes complete installation and electrical connections.

B. Types of transformers in this section include the following:

1. Dry-type Distribution Transformers

1.3 QUALITY ASSURANCE:

A. Comply with NEC as applicable to installation and construction of electrical power/distribution transformers; with applicable portions of NEMA Std. Pub. Nos. TR1 and TR27; and with applicable ANSI/IEEE standards pertaining to power/distribution transformers.

B. Comply with applicable portions of ANSI/UL 506; "Safety Standard for Specialty Transformers". Provide distribution transformers that have been UL listed and labeled.

C. All characteristics, definitions, and terminology, except as specifically covered in this specification, shall be in accordance with the latest revision of the following ANSI/IEEE, NEMA, and Department of Energy standards.

1. C57.12.00 – IEEE Standard for Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers.

2. C57.12.28 – Pad-Mounted Equipment - Enclosure Integrity.

3. C57.12.34 – IEEE Standard Requirements for Pad-Mounted, Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers (2500 kVA and Smaller) - High Voltage: 34500GrdY/19920 Volts and Below; Low-Voltage: 480 Volt 2500 kVA and Smaller (issued in March 2005 - combines C57.12.22 and C57.12.26).

4. C57.12.90 – IEEE Standard Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers and IEEE Guide for Short-Circuit Testing of Distribution and Power Transformers.

5. C57.12.91 – Guide for Loading Mineral-Oil-Immersed Transformers.

6. NEMA TR 1-1993 (R2000) – Transformers, Regulators and Reactors, Table 0-2 Audible Sound Levels for Liquid-Immersed Power Transformers.

7. NEMA 260-1996 (2004) – Safety Labels for Pad-Mounted Switchgear and Transformers Sited in Public Areas.

8. 10 CFR Part 431 – Department of Energy – Energy Conservation Program for Commercial Equipment: Distribution Transformers Energy Conservation Standards; Final Rule.

9. NEMA ST-20 - Dry-Type Transformers for General Applications
10. NEMA TP-1-2002 – Standards for transformer energy efficiency.

1.4 SUBMITTALS:

A. Refer to Section 260502 for electrical submittal requirements.

PART 2 - PRODUCTS

2.1 DRY -TYPE DISTRIBUTION TRANSFORMERS:

A. GENERAL: Except as otherwise indicated, provide manufacturer's standard materials and components as indicated by published product information, designed and constructed as recommended by manufacturer, and as required for complete installation.

B. MANUFACTURER: Subject to compliance with requirements, provide products of one of the following (for each type of transformer):

1. Acme Transformer Company
2. GE/ABB
3. Cutler Hammer Products, Eaton Corp.
4. Federal Pacific
5. Hevi-Duty Electric Div., General Signal Corp.
6. Jefferson Electric
7. Schneider Electric/Square D Co.
8. Hammond Power Solutions
9. Siemens Energy & Automation, Inc.

C. DRY-TYPE DISTRIBUTION TRANSFORMERS (GENERAL PURPOSE):

1. Provide factory-assembled, general-purpose, air-cooled, aluminum wound dry-type distribution transformers where shown; of sizes, characteristics, and rated capacities indicated. Provide primary winding with minimum of 4 full capacity taps; each 2-1/2 percent, two above and two below full-rated voltage for de-energized tap-changing operation.
2. Insulate with 220 degree C. UL recognized insulation system for 150° degree C rise above 40o ambient at full load.
3. Limit sound levels to the following (as determined by ANSI/NEMA standards):
   a. 30-50 KVA 45 dB
   b. 51-150 KVA 50 dB
   c. 151-300 KVA 55 dB
   d. 301-500 KVA 60 dB
   e. 501-1000 KVA 64 dB
4. Provide terminal enclosure, with cover, to accommodate primary and secondary coil wiring connections. Equip terminal leads with connectors installed, suitable for copper or aluminum wiring. Cushion-mount transformer with vibration isolation supports. Provide transformers with ventilated, heavy gauge sheet steel enclosures. Apply manufacturer's standard light gray indoor enamel over cleaned

and phosphatized steel enclosure. Provide transformers suitable for wall and floor mounting as indicated.

5. The percent impedance voltage, as measured on the rated voltage connection, shall be per Table 2.

Table 2 Percent Impedance Voltage (Dry-Type)	
KVA Rating (Secondary Voltage < 700 V)	Impedance
0 - 75	3.00 – 5.75%
112.5 - 225	4.00 - 5.75%
300 and above	5.00 - 5.75%

D. DRY-TYPE DISTRIBUTION TRANSFORMERS (K-RATED):

1. Provide factory-assembled, air-cooled, copper wound dry-type distribution transformers where shown; of sizes, characteristics, and capacities indicated, and UL listed for non-sinusoidal current loads of K-factor 13 (shown on drawings). See ANSI/IEEE C57.110-1986 for K-factor and UL Std 1561. Provide primary windings with a minimum of 4 full capacity taps; each 2-1/2 percent, two above and two below full-rated voltage for de-energized tap changing operator.

2. Insulate with 220 degree C UL recognized insulation system for 150° degree C rise above 40oC ambient at full load.

3. Include an electrostatic shield for attenuation of spikes, line noise, and transients. Wind coils with foil wrap to minimize effects caused by harmonic currents above the fundamental frequency. Provide transformer with neutral conductor and lugs sized at two times rated phase current.

4. Limit sound levels to the following:

   a. 30-50 KVA 45 dB

   b. 51-150 KVA 50 dB

   c. 151-300 KVA 55 dB

   d. 301-500 KVA 60 dB

   e. 501-1000 KVA 64 dB

5. Provide terminal enclosure, with cover, to accommodate primary and secondary coil wiring connections. Equip terminal leads with connectors installed, suitable for copper or aluminum wiring. Cushion-mount transformer with vibration isolation supports. Provide transformers with ventilated, heavy gauge sheet steel enclosures. Apply manufacturer's standard light gray indoor enamel over cleaned and phosphatized steel enclosure. Provide transformers suitable for wall and floor mounting as indicated.

6. The percent impedance voltage, as measured on the rated voltage connection, shall be per Table 3.

Table 3 Percent Impedance Voltage (Dry-Type, K-rated)	
KVA Rating (Secondary Voltage < 700 V)	Impedance
0 - 75	3.00 – 5.75%
112.5 - 225	4.00 - 5.75%
300 and above	5.00 - 5.75%

PART 2 – EXECUTION

2.1 INSTALLATION OF TRANSFORMERS

A. Install transformers as indicated, complying with manufacturer's written instructions, applicable requirements of NEC, NEMA and IEEE standards, and in accordance with recognized industry practices to ensure that products fulfill requirements.

B. Coordinate transformer installation work with electrical raceway and wire/cable work, as necessary for proper interface.

C. Connect transformer units to electrical wiring system; comply with requirements of other Division-26 sections.

D. MOUNTING: Provide concrete pad under all floor mounted equipment and equipment mounted at grade. Anchor transformer to pad with 3/8" expansion anchors at each corner of enclosure. Provide vertical and lateral support systems for all transformers that are supported from overhead structure. See drawings for support and attachment details. Provide neoprene vibration isolators at each anchor point.

E. GROUNDING: Provide tightly fastened equipment grounding and bonding connections for transformers.

F. TESTING: Upon completion of installation of transformers, energize primary circuit at rated voltage and frequency from normal power source and test transformers, including, but not limited to, audible sound levels, to demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at the site, then retest to demonstrate compliance; otherwise, remove and replace with new units and proceed with retesting.

END OF SECTION 26 2200

SECTION 26 2416 - PANELBOARDS

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. This section is a Division-26 Basic Materials and Methods section, and is part of each Division-26 section making reference to panelboards specified herein.

1.2 DESCRIPTION OF WORK:

A. The extent of panelboard and enclosure work, is indicated by drawings and schedules.

B. Types of panelboards and enclosures in this section include lighting and appliance panelboards, and power distribution panelboards.

1.3 QUALITY ASSURANCE:

A. Provide units that have been UL listed and labeled. Comply with NEC as applicable to installation of panelboards, cabinets, and cutout boxes. Comply with NEC pertaining to installation of wiring and equipment in hazardous locations. Comply with NEMA Stds. Pub No. 250, "Enclosures for Electrical Equipment (1000 volt maximum). Pub No. 1, "Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less".

1.4 SUBMITTALS:

A. Refer to Section 260502 for electrical submittal requirements.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

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

1. Square D Company (Basis of Design)
2. Cutler Hammer Products, Eaton Corp.
3. GE/ABB
4. Siemens Energy & Automation, Inc.

2.2 PANELBOARDS:

A. GENERAL:

1. Except as otherwise indicated, provide panelboards, enclosures and ancillary components, of types, sizes, and ratings indicated. Equip with number of unit panelboard devices as required for complete installation. Fully equip "spaces" with hardware to receive breaker or switch of size indicated. Provide CU/AL rated lugs of proper size to accommodate conductors specified.

B. POWER DISTRIBUTION PANELBOARDS:

1. Provide dead-front safety type power distribution panelboards as indicated, with switching and protective devices in quantities, ratings, types and with arrangement shown. Equip with aluminum bus bars, full-sized neutral bus and ground bus. Provide fusible or circuit breaker branch and main devices as

indicated. Series rated systems are not acceptable. See Section 262815, Overcurrent Protection Devices.

C. LIGHTING AND APPLIANCE PANELBOARDS:

1. Provide dead-front safety type lighting and appliance panelboards as indicated, with switching and protective devices in quantities, ratings, types, and arrangement shown. Provide bolt-on thermal magnetic type branch breakers. Where multiple breakers are indicated, provide with common trip handle. Series rated systems are not acceptable. Equip with aluminum bus bars, full-sized neutral bus, and ground bus.

D. PANELBOARD ENCLOSURES:

1. Provide galvanized sheet steel cabinet type enclosures, in sizes and NEMA types as indicated, code-gage minimum 16-gage thickness. Provide door-in-door hinged fronts. Provide fronts with adjustable indicating trim clamps, and doors with flush locks and keys, all panelboard enclosures keyed alike, with concealed door hinges and door swings as indicated. Equip with interior circuit-directory frame, and card with clear plastic covering. Provide baked gray enamel finish over a rust inhibitor. Provide enclosures fabricated by same manufacturer as overcurrent devices contained therein Bolt engraved plastic laminate labels indicating panel name and voltage on the interior and exterior of panelboards.

2. Provide floor to ceiling panel extensions for all surface mounted panels located outside of mechanical and electrical rooms.

E. FINISH:

1. Coat interior and exterior of surface with manufacturer's standard color; baked on enamel finish.

F. ELECTRICAL IDENTIFICATION:

1. Refer to Section 260553 for requirements.

PART 3 – EXECUTION

3.1 INSTALLATION OF PANELBOARDS:

A. GENERAL:

1. Install panelboards and enclosures where indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation", in compliance with recognized industry practices to ensure products fulfill requirements.

2. Provide a surge protective device on each panelboard located on the emergency distribution system. Refer to section 26 4313 for requirements.

B. MOUNTING:

1. Provide 4" high concrete curb under floor standing distribution panelboards.

2. Coordinate installation of panelboards and enclosures with cable and raceway installation work. Anchor enclosures firmly to walls and structural surfaces, ensuring they are permanently and mechanically secure. Arrange conductors neatly within enclosure, and secure with suitable nylon ties. Fill out panelboard's circuit directory card upon completion of installation work. Utilize actual final building room numbers, not architectural numbers used on drawings. Identify individual lighting circuits and individual receptacle circuits by room served. Label circuit breakers to identify location of subpanel or equipment supplied using room numbers and equipment names. Include room number with equipment circuit designations. All directories to be typewritten.

END OF SECTION 26 2416

SECTION 26 2713 - SERVICE ENTRANCE

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-26 Basic Materials and Methods sections apply to work specified in this section.

1.2 DESCRIPTION OF WORK:

A. Extent of service-entrance work is indicated by drawings and schedules.

B. Switchboards, panels, disconnects, transformers, etc., used for service-entrance equipment are specified in applicable Division-26 sections, and are included as work of this section.

C. Consult local utility relative to all costs for line extensions, connections, etc., and include all costs for bringing service to the facility in base bid. Confirm location of point of service before bidding.

D. Provide labor and materials as required to accomplish power company metering in accordance with power company standards and requirements.

E. Provide concrete pads of size and type required for service transformers. Verify location, size, openings, reinforcing requirements with local utility before beginning work. Comply with local utility code required clearance requirements.

1.3 QUALITY ASSURANCE:

A. Comply with NEC and NEMA standards as applicable to construction and installation of service-entrance equipment and accessories. Provide service-entrance equipment and accessories that are UL-listed and labeled, and equipment marked, "Suitable for use as Service Equipment".

1.4 SUBMITTALS: Refer to Section 26 0502 for requirements.

A. MAINTENANCE STOCK, FUSES: Refer to Section 26 0502 for requirements.

PART 2 – PRODUCTS

2.1 SERVICE - ENTRANCE EQUIPMENT:

A. GENERAL: Provide service-entrance equipment and accessories, of types, sizes, ratings and electrical characteristics indicated, that comply with manufacturer's standard materials, design and construction in accordance with published product information, and as required for complete installation, and as herein specified.

B. Provide each service entrance switchboard with Surge Protective Devices as required by Section 264313.

2.2 OVERCURRENT PROTECTIVE DEVICES:

A. GENERAL: Provide overcurrent protective devices complying with Division-26 section "Overcurrent Protective Devices", and as indicated on drawings.

2.3 METERING:

A. METER SOCKETS: Provide meter sockets that comply with requirements of local utility company supplying electrical power to service-entrance equipment of building project.

B. METERS: Provide meters, current and potential transformers, selector switches, wiring, etc. for a complete metering system. Provide meter of same manufacturer as switchboard (equal to Square D Power Logic Circuit Monitor, Class 3020, Model CM-3250), integrally mounted in service equipment, completely wired with control power input. Provide capability for metering the following data:

INSTANTANEOUS READINGS	DEMAND READINGS
RMS Current Values	Current Values
Phase A Current	Average Demand Current Phase A
Phase B Current	Average Demand Current Phase B
Phase C Current	Average Demand current Phase C
3-Phase Average Current	Peak Demand Current Phase A
Apparent RMS Current	Peak Demand Current Phase B
RMS Voltage Values	Peak Demand Current Phase C
Phase A-B Voltage	Real Power Values
Phase B-C Voltage	Average Demand Real Power
Phase C-A Voltage	Predicted Demand Real Power
Phase A-N Voltage	Peak Demand Real Power
Phase B-N Voltage	Phase C-N Voltage
Power Factor Values	Energy Readings
Phase A Power Factor	-
Phase B Power Factor	Energy Accumulated
Phase C Power Factor	Reactive Energy Accumulated
3-Phase Total Power Factor	-
3-Phase Total Power Values	-
Real Power, 3-Phase Total	-
Reactive Power, 3-Phase Total	-
Apparent Power, 3-Phase Total	-
Frequency	-
Temperature	-

C. Provide with integral display, selection keys, and indicting LEDs. For each instantaneous reading, provide a running maximum and minimum history in non-volatile memory, capable of externally operated reset. Provide "waveform capture" feature to allow subsequent analysis of actual current and voltage profile for harmonic distortion.

2.4 RACEWAYS AND CONDUCTORS:

A. GENERAL: Provide raceways and conductors complying with applicable Division-26 Basic Materials and Methods sections.

B. WALL AND FLOOR SEALS: Provide wall and floor seals complying with Division-26 Basic Materials and Methods section "Raceways".

C. Fluidized thermal backfill (FTB): Provide fluidized thermal backfill (FTB) around service lateral conduits (Service Lateral: Conductors/conduits between RMP transformer and meter. See NEC Article 230) when there are seven or more conduits specified. FTB shall comply with requirements of Pacificorp material specification ZG071.

PART 3 – EXECUTION

3.1 INSTALLATION OF SERVICE-ENTRANCE EQUIPMENT:

A. Install service-entrance equipment as indicated, in accordance with manufacturer's written instructions, and with recognized industry practices, to ensure that service-entrance equipment fulfills requirements. Comply with applicable installation requirements of NEC and NEMA standards.

B. Coordinate with other work, including utility company wiring, as necessary to interface installation of service-entrance equipment work with other work.

C. Install all floor standing service equipment on 4" high concrete curb and bolt equipment to curb with 3/8" anchors at each corner and at intervals not to exceed 8' along perimeter. Install concrete wiring trench under floor standing equipment; 12" deep, and 4" smaller in length and width than equipment base. Install grounding bushings on conduits penetrating trench.

3.2 GROUNDING:

A. Provide system and equipment grounding and bonding connections for service-entrance equipment and conductors, as required.

3.3 ADJUST AND CLEAN:

A. Adjust operating mechanisms for free mechanical movement.

B. Touch-up scratched or marred enclosure surfaces to match original finishes.

3.4 FIELD QUALITY CONTROL:

A. Upon completion of installation of service-entrance equipment and electrical circuitry, energize circuitry and demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.

END OF SECTION 26 2713

SECTION 26 2726 - WIRING DEVICES

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. This section is a Division-26 Basic Materials and Methods section, and is part of each Division-26 section making reference to wiring devices specified herein.

1.2 DESCRIPTION OF WORK:

A. The extent of wiring device work is indicated by drawings and schedules. Wiring devices are defined as single discrete units of electrical distribution systems that are intended to carry but not utilize electric energy.

B. Types of electrical wiring devices in this section include the following:

1. Receptacles
2. Switches
3. Timer Switches
4. 0-10V & ELV LED LAMP DIMMERS
5. Cord caps
6. Cord connectors
7. Flat Panel Display Wall Box

1.3 QUALITY ASSURANCE:

A. Comply with NEC and NEMA standards as applicable to construction and installation of electrical wiring devices. Provide electrical wiring devices that have been UL listed and labeled.

1.4 SUBMITTALS:

A. Refer to Section 260502 for electrical submittal requirements.

PART 2 - PRODUCTS

2.1 FABRICATED WIRING DEVICES:

A. GENERAL:

1. Provide factory-fabricated wiring devices, in types, and electrical ratings for applications indicated and complying with NEMA Stds. Pub No. WD 1.

B. Provide wiring devices (of proper voltage rating) as follows:

	RECEPTACLE	SWITCHES			
MFGR		1-POLE	3-WAY	4-WAY	W-PILOT
Hubbell	BR20XTR	HBL 1221	HBL 1223	HBL 1224	HBL 1221-PL

Bryant		1221	1223	1224	1221-PL
Pass Seymour	TR63X	20AC1	20AC3	20AC4	20AC1-RPL
Leviton	TWR20-X	1221	1223	1224	
Cooper	TR5362	1221	1273	1224	1221-PL

C. Provide devices in colors selected by Architect. Provide red devices on all emergency circuits.

D. SURGE PROTECTIVE (SPD) RECEPTACLES:

1. Provide SPD receptacles having 4 series parallel 130V MOV's capable of a minimum of 140 joules suppression. Provide units with visual (and audible) surge status indicators to monitor condition of surge circuit; visual indicator to be "on" when power present and suppression circuit is fully functional. (Audible indicator shall sound a "beep" alarm approximately every 30 seconds if suppression circuit has been damaged.) Provide NEMA 5-20R, 20 amp, 125V receptacle of one of the following manufacturers:

	MANUFACTURER	
SPECIFICATION GRADE	HUBBELL	PASS SEYMOUR
Duplex Recept-Visual only	5350	5352 XXXSP
Duplex Recept-Visual/Audible	5352	5362 XXXSP
Single Recept-Visual only	5351	N/A
Duplex Recept-Isol Gnd, Visual/Audible	IG5352S	IG5362 XXXSP
Single Recept-Isol Gnd, Visual only	IG5351S	N/A
HOSPITAL GRADE	HUBBELL	PASS SEYMOUR
Duplex Recept-Visual/Audible	8300HS	8300 XXXSP
Single Recept-Visual only	8310HS	N/A
Duplex Recept-Isol Gnd, Visual/Audible	IG8300HS	IG8300 XXXSP
Single Recept-Isol Gnd, Visual only	IG8310HS	N/A

2. Provide (1) SPD receptacle in all Flat Panel Display Wall Boxes (‘DP’ symbol)

3. Color of devices selected by Architect. Provide red devices on all emergency circuits.

E. GROUND-FAULT INTERRUPTER:

1. Provide general-duty, duplex receptacle, ground-fault circuit interrupters; feed-thru types, capable of protecting connected downstream receptacles on single circuit; grounding type UL-rated Class A, Group A, 20-amperes rating; 120-volts, 60 Hz; with solid-state ground-fault sensing and signaling; with 5 milliamperes ground-fault trip level; color as selected by Architect. Provide Hospital grade where required elsewhere by specification or drawings. Provide units of one of the following:

a. P&S/Sierra

b. Hubbell

c. Leviton

d. Square D

F. USB RECEPTACLE

1. Provide duplex receptacle with two (2) USB 3.0 amps, 5VDC, 2.0 Type A charging ports.

2. Provide products of one of the following:

a. Bryant – USB20-X

b. Cooper – TR7736-X

c. Hubbell – USB20X2-X

d. Legrand – TR5362USB-X

e. Leviton – T5832-X

G. TAMPER RESISTANT RECEPTACLES:

1. Provide tamper resistant receptacles in the following areas; Dwelling units, guest rooms and guest suites, child care facilities, education facilities, business offices, corridors, waiting rooms and the like in Clinics, medical/dental offices and outpatient facilities, assembly occupancies and Dormitories.

2. Provide products of one of the following:

a. Leviton-TWR20-X

b. Hubbell – BR20XTR

c. Pass Seymour – TR63X

d. Cooper – TR5362

H. WEATHER-RESISTANT RECEPTACLES

1. Provide weather-resistant receptacles in outdoor locations such as under roofed open porches, canopies, marquees, etc.

2. Provide products of one of the following:

a. Pass & Seymour 2095TRWRXXX.

b. Hubbell GFTR20XX

I. CORD CAPS AND CONNECTORS:

1. Provide 3, 4 and 5-wire grounding, cap plugs, and connectors of ampere and voltage rating required, for final equipment, and as indicated otherwise on drawings.

2. Provide products of one of the following:

a. Cooper

b. General Electric

c. Hubbell

d. Leviton

e. P&S

J. TIMER SWITCH:

1. Provide a timer switch with the following features and functionalities. Provide switch that mounts in a standard wall box. Provide a Decora style cover plate that matches the other switches on the project. Provide color of switch chosen by Architect.

   a. Provide Digital time switches that automatically turn lights off after a preset time. User programmable wall switch for astronomical and scheduled control. Electroluminescent back-lit LCD shows timer countdown. Compatible with all electronic ballasts, ELV, MLV, LED, and motor loads.

      i. Wattstopper TS-400: 120/277VAC; 50/60 Hz

      ii. Greengate

   b. Provide Astronomical time switches that automatically turns lighting or other loads on and off according to user programming. Time-out settings range shall range from 5 minutes to 12 hours for flexibility. Electroluminescent back-lit LCD shows timer countdown. Compatible with all electronic ballasts, ELV, MLV, LED, and motor loads. Program schedule per the owner's requirements.

      i. Wattstopper RT-200: 120/277VAC; 50/60 Hz

K. 0-10V & ELV LED LAMP DIMMERS:

1. Provide single-pole, semi-conductor modular type 0-10V control for 0-10V fluorescent ballasts/LED drivers & 3-wire fluorescent ballast/LED driver dimmers for fixtures; 60 hertz, with wattage and voltage as indicated, continuously adjustable slider control, and with electromagnetic filters to reduce noise and interference to minimum. Construct with continuously adjustable trim potentiometer for adjustment of low end dimming. Dimmer shall match lamp/ballast combination. Color as selected by Architect. Provide devices manufactured by one of the following:

   a. Pass & Seymour (Titan Series)

   b. Lutron (Nova Series)

   c. Lutron (Diva Series)

2.2 WIRING DEVICE ACCESSORIES:

A. WALL PLATES:

1. Provide stainless steel cover plates in all finished areas. Provide galvanized steel plates in unfinished areas. Provide blank coverplates for all empty outlet boxes.

B. WEATHER-PROTECTING DEVICE ENCLOSURES:

1. Where required for compliance with NEC 406-8 (receptacles installed outdoors for use other than with portable tools or equipment), provide weather-tight device covers that provide complete protection with the cord and cap inserted into the wiring device. Provide units that mount on either single or double gang devices.

2. Provide products of one of the following extra-duty low-profile expandable in-use weatherproof covers for exterior mounted installations:

a. Intermatic:

i.	WP7000W	Single-Gang/White Cover
ii.	WP7000G	Single-Gang/Gray Cover
iii.	WP7000BR	Single-Gang/Brown Cover
iv.	WP7200W	Double-Gang/White Cover
v.	WP7200G	Double-Gang/Gray Cover
vi.	WP7200BR	Double-Gang/Brown Cover

b. TayMac:

i.	ML500W	Single-Gang/White Cover
ii.	ML500G	Single-Gang/Gray Cover
iii.	ML500Z	Double-Gang/Brown Cover
iv.	ML2500G	Single-Gang/Gray Cover

c. Color chosen by architect.

3. Provide products of one of the following for roof mounted installations:
   a. Intermatic WP1020 or WP1030
   b. P&S WIUC10C or WIUC20c

2.3 FLAT PANEL DISPLAY WALL BOX:

A. Provide a factory assembled display wall box made of 14 gauge steel. Wall box shall have provisions for a UL Listed single gang box for mounting of duplex receptacle and additional back box with a minimum of (1) 1 ¼" conduit opening to allow for low voltage terminations. Coordinate low voltage plate configuration with drawings. Provide device manufactured by one of the following:

1. Stud Walls:
   a. FSR Metal Products – PWB-100
      i. Provide additional PN: 54406 Low-Voltage Conduit Entry Box (as required for conduit entry from top/bottom)
   b. FSR Metal Products – PWB-FR-450 (Use at fire rated walls)
2. Masonry Walls
   a. FSR Metal Products – PWB-CMU8

PART 3 – EXECUTION

3.1 GENERAL

A. Install wiring devices as indicated, in compliance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation" and in accordance with recognized industry practices to fulfill project requirements.

B. Coordinate with other work, including painting, electrical box and wiring work, as necessary to interface installation of wiring devices with other work. Install devices in boxes such that front of device is flush and square with coverplate. Drawings are small scale and, unless dimensioned, indicate approximate locations only of outlets, devices,

equipment, etc. Locate outlets and apparatus symmetrically on floors, walls and ceilings where not dimensioned and coordinate with other work. Verify all dimensioned items on job site. Consult architectural cabinet, millwork, and equipment shop drawings before beginning rough-in of electrical work. Adjust locations of all electrical outlets as required to accommodate work in area, and to avoid conflicts with wainscoat, back splash, tackboards, and other items.

C. Where stranded conductors have been utilized, provide solid pigtails to terminate at device.

D. Provide receptacles in surface raceway at 12” on center unless indicated otherwise.

E. Install wiring devices only in electrical boxes that are clean; free from excess building materials, dirt, and debris.

F. Install blank plates on all boxes without devices.

G. Delay installation of wiring devices until wiring work and painting is completed. Provide separate neutral conductor from panel to each GFI receptacle.

H. Install GFI receptacles for all receptacles installed in the following locations:

1. Restrooms, locker rooms, kitchens, within 6 feet of any sink, or when serving vending machines and electric drinking fountains.

2. Indoor wet locations, non-dwelling garages, elevator rooms and pits.

3. Outdoors, and on rooftops.

4. Dwelling unit garages, crawlspaces and unfinished basements, accessory buildings, boathouses, and receptacles for boat hoists.

5. Label all receptacles (non-GFI), protected downstream of a GFI receptacle or protected by GFI circuit breaker, with an indication that it is protected.

I. Where light switches or wall box dimmers are specified, provide a separate neutral for each phase of the branch circuits that switches or dimmers are connected.

J. Electrical Identification: Refer to Section 260553 for requirements.

3.2 PROTECTION OF WALL PLATES AND RECEPTACLES:

A. At time of substantial completion, replace those items, that have been damaged, including those stained, burned and scored.

3.3 GROUNDING:

A. Provide electrically continuous, tight grounding connections for wiring devices, unless otherwise indicated.

3.4 TESTING:

A. Prior to energizing circuitry, test wiring devices for electrical continuity and proper polarity connections. After energizing circuitry, test wiring devices to demonstrate compliance with requirements.

END OF SECTION 26 2726

SECTION 26 2815 - OVERCURRENT PROTECTIVE DEVICES

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. This section is a Division-26 Basic Materials and Methods section, and is part of each Division-26 section making reference to overcurrent protective devices specified herein.

1.2 DESCRIPTION OF WORK:

A. Extent of overcurrent protective device work is indicated by drawings and schedules and specified herein. Overcurrent protective devices specified herein are for installation as individual components in separate enclosures; and for installation as integral components of switchboard and panelboards. See Section 262413, Switchgear and Switchboards, and Section 262416, Panelboards.

B. Contractor shall verify type and cost of all overcurrent protective devices required within existing gear and panelboards. Contractor shall include the necessary cost to provide devices within their bid.

C. Types of overcurrent protective devices in this section include the following for operation at 600 Volts and below:

1. Molded case thermal circuit breakers
2. Molded case solid-state circuit breakers
3. Fuses

D. Refer to other Division-26 sections for cable/wire and connector work required in conjunction with overcurrent protective devices.

1.3 QUALITY ASSURANCE:

A. Comply with NEC requirements and NEMA and ANSI standards as applicable to construction and installation of overcurrent devices.

1.4 SUBMITTALS:

A. Refer to Section 260502 for electrical submittal requirements.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. Subject to compliance with requirements, provide products of one of the following (main and branch device manufacturer must be same as panelboard and/or switchboard manufacturer):

B. CIRCUIT BREAKERS AND FUSIBLE SWITCHES:

1. Cutler Hammer Products, Eaton Corp.
2. General Electric Co.
3. Square D Co.

4. Siemens Energy and Automation

C. MOLDED CASE THERMAL TRIP CIRCUIT BREAKERS:

1. Provide factory-assembled, molded case circuit breaker for power distribution panelboards and switchboards; and for individual mounting, as indicated. Provide breakers of amperage, voltage, and RMS interrupting rating shown, with permanent thermal trip and adjustable instantaneous magnetic trip in each pole. Series rated systems are not acceptable. Construct with overcenter, trip-free, toggle type operating mechanisms with quick-make, quick-break action and positive handle indication. Construct breakers for mounting and operating in any physical position and in an ambient temperature of 40 degrees C. Provide with mechanical screw type removable connector lugs, AL/CU rated, of proper size to accommodate conductors specified.

2. Circuit breakers 15 amps through 399 amps shall be molded case thermal trip circuit breakers.

D. MOLDED CASE SOLID-STATE CIRCUIT BREAKERS:

1. Provide factory-assembled, molded case solid-state circuit breakers for power distribution switchgear and switchboards. Provide breakers of amperage, voltage and RMS interrupting rating shown, and with solid-state trip mechanisms. Breakers shall be UL listed for application at 100% of their continuous ampere rating.

2. Circuit breakers 400 amps through 1199 amps shall be molded case solid-state circuit breakers.

3. Solid-state trip mechanisms shall have the following functions: Adjustable long time ampere rating; adjustable long time delay; adjustable short time pick up; adjustable short time delay and adjustable instantaneous pick up.

2.2 FUSES:

A. GENERAL: Except as otherwise indicated, provided fuses of type, sizes and ratings and electrical characteristics of a single manufacturer as follows. Provide fuses labeled UL Class L or UL Class R, current limiting and rated for up to 200,000 amperes. Provide Buss KAZ signal activating fuses where required elsewhere in specification.

B. Where fuses are shown feeding individual or groups of equipment items, comply with manufacturer's recommendation for fusing; adjust fuse size and type as necessary to comply with manufacturer's recommendation.

C. Provide and install spare fuse cabinet in main electrical room.

D. MAIN SERVICE AND FEEDER CIRCUITS: For fuse ratings over 600 amperes provide UL Class L Fuses (KRP-C, or A4BQ or LCL or KLPC). For fuse ratings up to 600 amperes, provide UL Class RK1 (KTN-R, KTS-R or A2K-R, A6K-R or NCCR, SCLR or KLN-R, KLS-R). If fuse directly feeds motors, transformers or other inductive load provide UL RK5 time delay (FRN-R, FRS-R or TR-R, TRS-R or ECN-R, ECS-R or FLN-R, FLS-R).

E. BRANCH CIRCUITS: For motor circuits, transformer circuits, or other inductive loads, provide UL Class RK5 (FRN-R, FRS-R or TR-R, TRS-R or ECN-R, ECN-S or FLN-R, FLS-A). For other circuits, provide UL Class RK1, (KTN-R, KTS-R OR A2K-R, A6K-R or NCLR, SCLR OR KLNR, KLSR).

F. MANUFACTURER: Subject to compliance with requirements, provide fuses of one of the following:

1. Bussman Mfg. Co.

2. Mersen (Ferraz Shawmut)

3. Reliance Fuse Div./Brush Fuse Inc.
4. Littlefuse, Inc.

PART 3 – EXECUTION

3.1 INSTALLATION OF OVERCURRENT PROTECTIVE DEVICES:

A. Install overcurrent protective devices as indicated, in accordance with the manufacturer's written instructions and with recognized industry practices to ensure that protective devices comply with requirements. Comply with NEC and NEMA standards for installation of overcurrent protective devices.

B. Coordinate with work as necessary to interface installations of overcurrent protective devices with other work.

C. Install fuses in overcurrent protective devices. For motor circuits, fuse sizes shown on drawings are for general guidance only. Size fuses in accordance with fuse manufacturer's recommendation for given motor nameplate ampere rating. Test operation. If nuisance tripping occurs, increase fuse size and disconnect device (if necessary) as required to provide nuisance free tripping. Adjust fuse size properly for ambient temperature, frequent starting and stopping of motor loads, and for loads with long start times. Include all costs in bid.

D. After the switchgear is energized and just prior to Substantial Completion, the contractor shall ensure that the field-adjustable circuit breakers and solid-state circuit breakers and associated trip mechanisms have been set to the appropriate settings as recommended by the equipment Manufacturer (or as recommended by the electrical contractor's Protective Device Study if section 260573 has been included in the project). Time-current trip curves and trip setting information as was required in the Submittal portion of this specification shall be made available by the contractor at this time. Provide adjustments to circuit breakers and switchboard AIC ratings as deemed necessary by the analysis/report, with no additional cost to the Owner. Provide over current protection devices with larger frame sizes to ensure coordination has been achieved.

E. Field test all ground fault protective devices for proper operation; test to be performed by representative of the manufacturer. Include verification of complete time current trip characteristics.

F. Electrical Identification: Refer to Section 260553 for requirements.

3.2 FIELD QUALITY CONTROL

A. Prior to energization of overcurrent protective devices, test devices for continuity of circuitry and for short-circuits. Correct malfunctioning units, and then demonstrate compliance with requirements.

END OF SECTION 26 2815

SECTION 26 2816 - MOTOR AND CIRCUIT DISCONNECTS

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. This section is a Division-26 Basic Materials and Methods section, and is part of each Division-26 section making reference to motor and circuit disconnect switches specified herein.

1.2 DESCRIPTION OF WORK:

A. Extent of motor and circuit disconnect switch work is indicated by drawings and schedule. Work includes complete installations and electrical connections.

1.3 QUALITY ASSURANCE:

A. Provide motor and circuit disconnect switches that have been UL listed and labeled. Comply with applicable requirements of NEMA Standards Pub. No. KS 1, and NEC.

1.4 SUBMITTALS:

A. Refer to Section 260502 for electrical submittal requirements.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. MANUFACTURER: Subject to compliance with requirements, provide products of one of the following (for each type of switch):

1. Cutler Hammer Products, Eaton Corp.
2. Square D Company
3. General Electric Company
4. Siemens Energy & Automation, Inc.
5. Cooper Bussmann

2.2 FABRICATED SWITCHES:

A. GENERAL: Provide disconnect and safety switches as indicated herein. Provide:

1. General duty switches on 240 Volt rated circuits.
2. Heavy duty switches on 480 volt rated circuits.
3. HP rated switches on all motor circuits.

B. GENERAL DUTY SWITCHES: Provide general-duty type, sheet-steel enclosed switches, fusible or non-fusible as indicated of types, sizes and electrical characteristics indicated; rated 240 volts, 60 hertz; incorporating spring assisted, quick-make, quick-break mechanisms. Provide single phase or three phase and with solid neutral as required by application. Equip with operating handle that is capable of being padlocked in OFF position. Provide NEMA 1 or NEMA 3R as required by application, unless noted. Provide

fusible switches with Class R rejection fuse clip kits.

C. HEAVY-DUTY SWITCHES: Provide heavy-duty type, sheet-steel enclosed safety switches, fusible or non-fusible as indicated, of types, sizes and electrical characteristics indicated; rated 600 volts, 60 hertz; incorporating quick-make, quick-break type mechanisms. Provide single phase or 3 phase, and with solid neutral as required by application, Equip with operating handle that is capable of being padlocked in OFF position. Provide NEMA 1 or NEMA 3R as required by application unless noted. Provide fusible switches with Class R rejection fuse clip kits.

D. FUSES: Provide fuses for switches, as required of classes, types and ratings needed to fulfill electrical requirements for service indicated. Provide spare fuses amounting to one spare fuse for each 10 installed but not less than three of any one type and size. See Section 262815 Overcurrent Protective Devices for fuse types.

E. Electrical Identification: Refer to Section 260553 for requirements.

PART 3 - EXECUTION

3.1 INSTALLATION OF MOTOR AND CIRCUIT DISCONNECT SWITCHES:

A. Install motor and circuit disconnect switches where indicated, complying with manufacturer's written instructions, applicable requirements of NEC, NEMA, and NECA's "Standard of Installation" and in accordance with recognized industry practices to ensure that products fulfill requirements.

B. Coordinate motor and circuit disconnect switch installation work with electrical raceway and cable work, as necessary for proper interface.

C. Install disconnect switches used with motor driven appliances, and motors and controllers within sight of controller position.

D. For disconnect switches serving motors controlled by variable frequency drives, provide late-make, early-break auxiliary contacts on each disconnect switch. Provide Heavy-Duty switch. Wire auxiliary contact to VFD safety contact, such that disconnecting the motor will shut down the drive first, and closing the switch will start the drive only after power is applied to the motor.

E. For all disconnect switches serving single elevator applications, provide a Cooper Bussman Quik-Spec™ Power Module™ Switch.

1. Elevator Shutdown
2. Shunt Trip Voltage Monitoring
3. Selective Coordination
4. Fire safety signal interface
5. Auxiliary Contact (Hydraulic Elevator)
    a. Wire auxiliary contact to auxiliary power such that disconnecting the motor will disconnect the auxiliary power.

END OF SECTION 26 2816

SECTION 26 2819 - SCOREBOARDS & ATHLETIC EQUIPMENT

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-26 Basic Materials and Methods sections apply to work specified in this section.

1.2 DESCRIPTION OF WORK:

A. Coordinate location of scoreboards is indicated by architectural, landscape drawings and schedules.

1.3 QUALITY ASSURANCE:

A. Comply with NEC as applicable to construction and installation of scoreboard components and accessories. Provide scoreboard components which are UL-listed and labeled.

PART 2 - PRODUCTS

2.1 SCOREBOARDS & ATHLETIC DEPARTMENT EQUIPMENT:

A. Provide a complete raceway and wiring system for scoreboards, timeclocks, miscellaneous motors, etc, including but not limited to, separate raceways for power and control wiring, cabinets, data, and miscellaneous items as required.
   1. Football Field – Mounted on Fieldhouse:
      a. DAKTRONICS – Full LED Video Display Scoreboard
         i. CCHS -- 13’2” H x 25’0” W x 11” D
      b. Play Clocks
      c. HUDL Focus Camera System
   2. Miscellaneous:
      a. Integrated Display and Scoring Solutions. Refer to architecture plans for additional locations.

PART 3 - EXECUTION

3.1 INSTALLATION OF SCOREBOARDS & ATHLETIC FIELD EQUIPMENT:

A. Install scoreboard and athletic field equipment conduit as indicated, in accordance with equipment manufacturer's written instructions and complying with applicable portions of NEC and NECA's "Standard of Installation".

B. See drawings for special instructions regarding installation of scoreboard conduit.

3.2 INSTALLATION OF BASIC WIRING SYSTEM MATERIALS:

A. Provide branch circuit and control wiring, raceways, and electrical boxes and fittings in accordance with Division-26 Basic Materials and Methods sections, "Raceways", "Wires and Cables", and "Electrical Boxes and Fittings".

END OF SECTION 26 2819

SECTION 26 2913 - MOTOR STARTERS

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. This section is a Division-26 Basic Materials and Methods section, and is part of Division-26 sections making reference to motor starters specified herein.

1.2 DESCRIPTION OF WORK:

A. Extent of motor starter work is indicated by drawings and schedules.

B. Types of motor starters in this section include the following:

1. AC Fraction Horsepower Manual Starters
2. AC Line Voltage Manual Starters
3. AC Non-Reversing Magnetic Starters
4. AC Combination Non-Reversing Magnetic Starters

1.3 QUALITY ASSURANCE:

A. Comply with NEC and NEMA Standards as applicable to wiring methods, construction and installation of motor starters. Comply with applicable requirements of UL 508, "Electric Industrial Control Equipment", pertaining to electrical motor starters. Provide units that have been UL-listed and labeled.

1.4 SUBMITTALS: Refer to Section 26 0502 for requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURER:

A. Subject to compliance with requirements, provide products of one of the following (for each type and rating of motor starter):

1. Allen-Bradley Co.
2. Appleton Electric Co.
3. Crouse-Hinds Co.
4. Eaton Corp., Cutler Hammer Products
5. GE/ABB
6. Siemens Energy & Automation, Inc.
7. Square D Co.

B. MAINTENANCE STOCK, FUSES: Refer to Section 26 0502 for requirements.

2.2 MOTOR STARTERS:

A. GENERAL: Except as otherwise indicated, provide motor starters and ancillary components; of types, sizes, ratings and electrical characteristics indicated that comply with manufacturer's standard materials, design and construction in accordance with published information and as required for complete installations.

B. THERMAL OVERLOAD UNITS: Provide thermal overload units, sized to actual running full load current, not to motor plate current. Size heaters for mechanical equipment after air and water balancing have been completed.

C. AC FRACTIONAL HP MANUAL STARTERS (EQUAL TO SQUARE D CLASS 2510): Provide manual, single-phase, 1 and 2 pole, 300 volt AC max, fractional HP motor starters, of types, ratings and electrical characteristics indicated; equip with one piece thermal overload relay with field adjustment capability of plus or minus 10 percent of nominal overload heater rating; for protection of AC motors of 1 HP and less. (For manually controlled motors in excess of 1 HP, see Line Voltage Manual Starters specified herein). Provide starter with quick-make, quick-break trip free toggle mechanisms, green pilot lights, and with lock-off toggle operated handle. Mount surface units in NEMA 1 enclosures, unless noted otherwise. Provide NEMA 3R enclosure in exterior or damp location unless noted otherwise. Provide flush mounted units with coverplate to match wiring device coverplates.

D. AC LINE VOLTAGE MANUAL STARTERS (EQUAL TO SQUARE D CLASS 2510): Provide line voltage manual starters, of types, ratings and electrical characteristics indicated; 2 or 3 pole, 600 volt AC max; equip with pushbutton operator, low voltage protection feature, and green pilot light. Provide starters with trip free mechanism such that contacts will open under load and remain open until thermal element has cooled, and unit is reset. Mount surface units in NEMA 1 enclosure, unless noted otherwise. Provide NEMA 3R enclosure in exterior or damp location, unless noted otherwise. Provide overlapping trim for flush mounted units.

E. AC NON-REVERSING MAGNETIC STARTERS (EQUAL TO SQUARE D CLASS 8536): Provide line voltage magnetic starters, of types, ratings and electrical characteristics indicated; 2 or 3 pole, 600 volt max, with thermal overload protection in all phases and inherent under voltage release. Equip units with holding contact, 2 normally open, and 2 normally closed auxiliary contacts, unless noted otherwise. Provide fused control transformer in each starter and 120V control coil. Mount hand-off-auto switch, red pilot light, and reset button in face of enclosure. Provide NEMA 1 enclosure unless noted otherwise. Provide NEMA 3R enclosure in exterior or damp location, unless noted otherwise. Equip all spare starters complete with items as specified herein.

F. AC COMBINATION NON-REVERSING MAGNETIC STARTERS (EQUAL TO SQUARE D CLASS 8539): Provide line voltage combination starters, of types, ratings and electrical characteristics indicated; 2 or 3 pole, 600 volts max with non-reversing magnetic starters as specified herein; in common cubicle or enclosure with motor circuit protector. Provide motor circuit protector, instantaneous trip circuit breaker as indicated and adjust to comply with manufacturer's recommendations. Mount hand-off-auto switch, red pilot light, and reset button in face of enclosure. Provide combination starters for individual mounting, or for group mounting in motor control center as indicated. Provide NEMA 3R enclosure in exterior or damp locations, unless noted otherwise. Provide NEMA 1 enclosures unless otherwise indicated.

G. AC COMBINATION NON-REVERSING MAGNETIC STARTERS (EQUAL TO SQUARE D CLASS 8538): Provide line voltage combination starters, of types, ratings, and electrical characteristics; 2 or 3 pole, 600 volt maximum with non-reversing magnetic starters as specified herein; in common cubicle or enclosure with fusible disconnect switch. Provide quick-make, quick-break, disconnect for NEMA sizes 1, 2, 3, and 4; and visible blade, automatic circuit interrupters with push-to-trip feature and separate fuse clips for larger NEMA sizes. Fuse all starters with dual-element (time-delay) fuses equal to Bussman FRN/FRS-R. Equip disconnect switch with Class R rejection fuse kits. Mount hand-off-auto switch, red pilot light, and reset button in face of enclosure. Provide combination starters for individual mounting, or for group mounting in motor control centers as indicated. Provide NEMA 1 enclosures unless otherwise indicated. Provide NEMA 3R enclosure in exterior or damp locations, unless noted otherwise.

PART 3 - EXECUTION

3.1 INSTALLATION OF MOTOR STARTERS:

A. Install motor starters as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC, NEMA standards, and NECA's "Standards of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

B. Install fuses in fusible disconnects, if any. Mount chart inside each starter indicating heater type, size, and ampere ratings available.

C. Electrical Identification: Refer to Section 260553 for requirements.

3.2 ADJUST AND CLEAN:

A. Inspect operating mechanisms for malfunctioning and, where necessary, adjust units for free mechanical movement.

B. Touch-up scratched or marred surfaces to match original finish.

3.3 FIELD QUALITY CONTROL:

A. Subsequent to wire/cable hook-up, energize motor starters and demonstrate functioning of equipment in accordance with requirements.

END OF SECTION 26 2913

SECTION 263213 - EMERGENCY ELECTRICAL SYSTEMS

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-26 Basic Materials and Methods sections apply to work specified in this section.

1.2 DESCRIPTION OF WORK:

A. Extent of emergency electrical system work is indicated by drawings and schedules.

B. Types of emergency system components specified in this section include the following:

1. Automatic Transfer Switches (ATS)

2. Emergency Generators (Diesel)

3. Exhaust and Fuel Systems

4. Remote Annunciator Panels

C. CONDUCTORS/CABLES, RACEWAYS, AND ELECTRICAL BOXES AND FITTINGS are specified in applicable Division-26 Basic Materials and Methods sections.

D. Refer to other Division-26 sections as applicable for work required in connection with emergency electrical systems.

E. Refer to Division-23 sections for fuel tanks, piping and accessories required in conjunction with engine-generator units; not work of this section.

1.3 QUALITY ASSURANCE:

A. Comply with NEC as applicable to wiring methods, materials, construction and installation of emergency electrical systems. Comply with applicable requirements of UL 924, "Emergency Lighting and Power Equipment" and UL 1008, "Automatic Transfer Switches". Provide system components, that are UL-listed and labeled.

B. Comply with applicable requirements of NFPA Nos. 37, (99), 101, and 110 pertaining to stationary combustion engines, (health care facilities), life safety code, and emergency and standby power supplies.

C. Comply with ANSI/NEMA Std. Pub. No. ICS 2, pertaining to AC automatic transfer switches. Comply with applicable requirements of ANSI/NEMA MG 1, "Motors and Generators", and MG 2, "Safety Standard for Construction and Guide for Selection, Installation and Use of Electric Motors and Generators". Comply with applicable portions of IEEE Std. 241, "IEEE Recommended Practice for Electric Power Systems in Commercial Buildings" pertaining to standby power.

1.4 SUBMITTALS:

A. Refer to Section 260502 for electrical submittal requirements.

PART 2 – PRODUCTS

2.1 GENERAL:

A. Provide emergency electrical systems and components, of types, ratings, and electrical characteristics indicated. Provide all system components thru one supplier to guarantee

total system responsibility. Provide system and components capable of start and load transfer within 10 seconds of power outage.

2.2 ENVIRONMENTAL CONDITIONS:

A. Provide system components and accessories as required to ensure proper system operation at rated capacities under the following environmental conditions:

1. Altitude: 4800 feet above sea level
2. Maximum ambient temperature: 50 degrees C.
3. Minimum ambient temperature: 0 degrees C.
4. Seismic Zone as indicated in General Structural Notes.

2.3 AUTOMATIC TRANSFER SWITCHES:

A. Provide contactor type automatic transfer switches compatible with electric sets, and of continuous ampere rating sufficient to meet requirements of both maximum set output and normal power service. Switches that employ interlocking handles and circuit breakers to affect transfer are not acceptable. Provide 4 pole switches where distribution system is provided with ground fault protective relaying, or where indicated on drawings. Provide switches of voltage and phase indicated, and with the following features and characteristics:

1. Provide precision calibrated voltage sensors to monitor the normal power source and signal the electric set to start on a partial loss of power on any phase or where feedback voltages exist. Provide adjustability to signal start-up when line voltage drops 5 percent to 20 percent below pick-up voltage setting, and to signal shutdown when line voltage returns to 75% to 100% of normal.
2. Provide a time delay relay, adjustable from 1 to 10 seconds, to delay the signal to start to avoid nuisance start ups on momentary voltage dips or power outages.
3. Provide voltage sensors to sense return of normal power; and a time delay, adjustable 2 to 60 minutes, to delay the retransfer of load to normal to avoid short term fluctuations in normal power restoration.
4. Provide an engine cool-down timer, adjustable from 0 to 5 minutes, for unloaded engine cool-down time. Timer shall engage after retransfer to normal.
5. Provide pilot light to indicate switch in normal position and pilot light to indicate switch in emergency position. Mount pilot lights in front face of enclosure.
6. Obtain operating current for transfer and retransfer from the source that the load is to be transferred. Provide automatic bypass to retransfer the load from the electric set to the normal source if the electrical set output interrupts after normal source restores voltage.
7. Provide switch to simulate an interruption of power from the normal source.
8. Provide manual operator with removable handle for manual operation of the switch.
9. Provide clock exerciser to automatically start the electrical set at regular intervals and allow it to run for a preset time period; minimum of 30 minutes per week. Equip with selector switch to permit selection of "without load" or "with load" operation.
10. Provide means to electrically disconnect the control section from the transfer switch for maintenance service during normal operation.
11. Provide a battery charger mounted inside the transfer switch enclosure.

12. Provide time delay neutral position transfer in both directions to allow transfer switch to be disconnected from both sources during transfer from one source to another. Time delay shall be adjustable from 0 to 5 seconds.

13. Provide (3) sets of N.O./N.C. auxiliary contacts (in addition to those for remote Ann. panel) that operate when the transfer switch is in the normal position.

14. Provide (3) sets of N.O./N.C. auxiliary contacts (in addition to those for remote Ann. panel) that operate when the transfer switch is in the emergency position.

15. Provide ammeter with 4-position selector switch marked “Off”, “1", “2",and “3" to read current in all three phases of the load circuit.]

B. RATING AND PERFORMANCE: Rate automatic transfer switch for continuous duty when enclosed in a non-ventilated NEMA 1 enclosure. Rate switch for all classes of load, both inductive and non-inductive, at 600 volts; and tungsten lamp load at 205 volts.

C. Switch must be capable of closing into and withstanding fault current of 65,000 amperes RMS symmetrical at 600 volts, for units 225 amps and larger and 30,000 amperes RMS symmetrical on units 200 amps and less.

D. CONSTRUCTION: Provide operating mechanism with sufficient mechanical and electrical interlocks to prevent simultaneous energizing both normal and standby service. Provide main contacts with arc suppression and heat dissipation devices to provide dependable transfer of highly inductive loads. Equip switch with terminal lugs for either copper or aluminum conductor.

E. ENCLOSURE: Enclose switch in heavy gauge, welded seam construction, NEMA 1 enclosure.

F. MANUFACTURERS: Subject to compliance with requirements, provide automatic transfer switches of one of the following:

1. ASCO, Inc.

2. Onan Corp.

3. Russelectric Co.

4. Zenith Controls, Inc.

5. Kohler Power System

6. Generac

2.4 ENGINE GENERATOR UNITS:

A. Provide 60 hertz alternating-current standby-diesel engine-driven generator units of voltage, phase and capacities indicated. Base rating of electric sets upon operation after deducting power required for output for all necessary operating accessories, (including remote or direct drive radiator fans, fuel pumps, etc.) and under environmental conditions specified. Provide electric sets rated and capable of producing KW specified at 0.8 power factor for continuous standby duty. Certify performance of the electric set series by means of independent testing laboratory tests for full power rating stability, and voltage and frequency regulation.

B. Provide stationary, water cooled, full diesel, compression ignition, four stroke cycle, multi-cylinder, in-line or V-type engine. Arrange engine for direct connection to an alternator current generator; do not exceed engine speed of 1800 RPM at full rated load. Completely assemble engine, alternator, and components on a single base before shipping.

C. OVERCURRENT PROTECTIVE DEVICES: Provide overcurrent protective devices mounted in generator enclosure to match ratings of overcurrent protective devices

providing service to normal power side of transfer switches.

D. LUBRICATION SYSTEM: Equip engine with a pressure lubricating system. Provide spin-on type full flow lubricating oil filters. Equip filter with bypass valve to insure oil circulation if filters are clogged. Include dipstick oil level indicator. Provide lube oil heater for engine generator units located outdoors or where ambient temperature requires lube oil heating.

E. ENGINE COOLING SYSTEM: Provide engine cooling system that operates fully automatically while the engine is running. The cooling system coolant shall use a combination of water and ethylene-glycol sufficient for freeze protection at the minimum winter outdoor ambient temperature of the application. All coolant pumps shall be centrifugal type. Each engine shall have an engine-driven primary pump.

F. The engine cooling radiator shall be:

1. Engine/skid mounted at the front of the mounting base. Provide coolant in accordance with manufacturer's recommendation.

G. Equip engine with thermostatically controlled water jacket heater on all water cooled units. On air-cooled engines provide an oil base heater. The heater voltage shall match available voltage at the site. Make all necessary connections of jacket and oil base heaters.

H. AIR CLEANER: Provide reusable element air cleaner of size and type recommended by the engine manufacturer.

I. STARTING: Equip engine with a 12 volt electric starting motor of sufficient capacity to crank the engine at a speed that will allow full diesel starting of the engine. Disengage starter automatically when engine starts.

J. Provide engine start-stop switch with functions including reset, run/start, stop and automatic mode. Provide adjustable cycle cranking and cool down operation.

K. Provide rack mounted lead-acid battery set mounted integrally with electric set base. Provide sufficient capacity for cranking the engine a minimum of 4 cranking periods with 2-minute intervals between cranks. Each cranking period shall have a maximum duration of 15 seconds. Provide capacity and voltage recommended by engine manufacturer. Equip with all necessary interconnecting cables. Provide suitable float type battery charger to maintain the batteries in charged condition.

L. BATTERY CHARGER: Provide suitable automatic SCR voltage regulated battery charger with a maximum charge rate, as recommended by the manufacturer, to maintain batteries at full capacity during standby conditions. Equip with ammeter to indicate charge rate and protect circuit by either fuses or circuit breakers. Design charger such that it will not be damaged during engine cranking.

M. ENGINE INSTRUMENTS: Provide a unit mounted console with the following items:

1. Lubricating oil pressure gauge
2. Lubricating oil temperature display
3. Coolant fluid inlet/outlet temperature display
4. Coolant temperature gauge
5. Run time meter
6. Fuel meter display
7. Tachometer display
8. Battery charge rate ammeter
9. Engine Start-stop switch

N. EXHAUST SYSTEM: Provide a critical type exhaust silencer, flexible exhaust connector, and all exhaust piping and insulation as required. Flexible sections shall be made of convoluted seamless tube without joints or packing. Expansion joints shall be the bellow type. Expansion and flexible elements shall be stainless steel suitable for diesel-engine exhaust gas at 1000 degrees F.

O. Comply with manufacturer's recommendations. Wrap the entire exhaust system, from manifold to roof or wall penetration with exhaust insulation blankets as manufactured by Advanced Thermal Products, Inc., Santa Ana, California. Install per manufacturer's instructions.

P. ENGINE PROTECTION DEVICES: Provide the following engine protection devices with indicating light annunciation for each device:

1. Low-oil pressure cut-out
2. High air temperature cut-out
3. Overspeed cut-out

Q. MOUNTING: Equip electric set with a suitable base for mounting on a level surface. Provide vibration isolators, rated for seismic zone specified herein, between the electric set and base. Concrete base shall be designed by a Structural Engineer. All costs arising from design shall be paid by Manufacturer.

R. FUEL: Provide engine capable of satisfactory performance on commercial grade diesel fuel as recommended by manufacturer.

S. GOVERNOR: Equip engine with a high performance isochronous electronic governor to maintain frequency within the limits, as specified below by controlling engine and alternator speed.

1. Stability: + or - 0.33 percent at rated load
2. Speed Regulation: 5 percent maximum load to rated load

T. The governor shall be configured for safe manual adjustment during operation of the engine-generator from 90 to 110 percent of rated frequency.

2.5 FUEL SYSTEM:

A. Equip engine with primary and secondary fuel filters with replaceable elements, and an engine driven fuel pump, all mounted on the engine. Provide fuel system piping of size and type recommended by the engine manufacturer. Provide fuel tank(s) as follow(s):

1. Provide fuel tank, sufficient for 24 hours operation at full load, mounted between generator support rails. Provide a secondary containment tank.

2.6 ELECTRIC ALTERNATOR:

A. Provide direct connected, engine driven, single bearing, synchronous type alternator with electrical characteristics indicated.

B. INSTANTANEOUS VOLTAGE DIP: Limit voltage dip of engine generator set to less than 30 percent upon application of full rated power. Accomplish voltage regulation by means of a solid state voltage regulator. Inherently regulated machines are acceptable in sizes under 6KW.

C. Stability: 1 percent of its mean value at any constant load from no load to full load for solid state regulators.

D. Regulation: Plus or minus 2 percent maximum no load to full load for solid state regulators.

E. Where more than 40 percent of the load is comprised of rectifiers and/or thyristors, provide power to voltage regulator by means of ceramic type permanent magnet pilot excitor, capable of 80 percent automatic controlled SCR/Thyristor loading.

F. Provide instrument panel and console with the following:

1. Manual reset circuit breaker
2. A.C. voltmeter
3. A.C. ammeter
4. Voltmeter-ammeter phase selector switch with "off" position
5. Frequency meter
6. Start-Stop switch
7. Remote start terminals
8. Solid state cycle cranking control
9. Engine safety alarm lights and contact
10. Provide automatic solid state overload protection, under frequency protection, and volts/hertz characteristics.

2.7 EMERGENCY POWER OFF (EPO):

A. The emergency generator shall be provided with a remote EPO (similar to a break glass station) located outside of the room housing the generator.

2.8 WEATHERPROOF ENCLOSURE:

A. Provide weatherproof enclosure for engine generator unit. Enclosure shall house all components including engine, alternator, batteries, battery charger, fuel tank and controls. Provide one piece roof with drip edge on all four sides and with formed roof stiffeners to support silencer. Provide angle iron frame around the entire bottom of the enclosure to attach to mounting surface. Provide doors on each side for access to engine, alternator and all components. Provide all doors with continuous piano type hinges with stainless steel pins. Provide lockable 2-point latches on all doors, keyed alike. Provide a welded fixed open air intake louver panel on each side to accomplish air intake. Provide a framed expanded metal core guard to accomplish air discharge. Assemble all components with plated bolts and nuts. Caulk all seams to prevent rust bleed through. Clean and paint all components with manufacturer's standard rust inhibiting primer. Provide finish coat paint color to match pad mounted transformer. All openings shall be provided with screen material to exclude entrance of rodents.

2.9 SAFETY SYSTEM AND REMOTE ANNUNCIATOR:

A. Provide all wiring, devices, equipment, and components to automatically activate the appropriate signals and initiate the appropriate annunciation as specified herein.

B. Provide remote annunciator panel in flush enclosure (locate as directed by Owner/Architect or as indicated on drawings) with the features specified and with audible and visual alarm indication of the following conditions:

1. Low engine temperature (engine heater not functioning).
2. High temperature prealarm - engine temperature approaching shut down.
3. Low oil pressure prealarm - engine oil pressure approaching shut down.
4. Unit shut down due to low oil pressure.

5. Unit shut down due to high temperature.
6. Unit shut down due to overcrank.
7. Unit shut down due to overspeed.
8. Emergency (or normal) power source supplying load.
9. Battery charger malfunction.
10. Low fuel - main tank contains less than a 3 hour supply.
11. Low battery voltage.
12. System ready no alarm conditions present, all controls in "automatic".
13. Audible alarm silence push button.

C. MANUFACTURER: Subject to compliance with requirements, provide engine-driven generator sets of one of the following:

1. Caterpillar Tractor Co.
2. Cummins Engine Co.
3. Kohler Co.
4. Generac

PART 3 – EXECUTION

3.1 INSTALLATION OF ENGINE-GENERATOR SYSTEMS:

A. Install standby engine-generator sets as indicated, in accordance with the equipment manufacturer's written instructions, and with recognized industry practices, to ensure that engine-generator sets fulfill requirements. Comply with NFPA and NEMA standards pertaining to installation of standby engine-generator systems and accessories.

B. Provide vibration isolation mounting and anchoring of generator set to concrete slab.

C. Install fuel oil and piping to standby generator equipment. Comply with manufacturer's instructions and recommendations.

D. Electrical Identification: Refer to Section 260553 for requirements.

3.2 GROUNDING:

A. Provide equipment grounding connections for system components.

3.3 TESTING:

A. Upon completion of installation of engine-generator system and after building circuitry has been energized with normal power source, (including all VFD’s and other motor starters), test engine-generator to demonstrate standby capability and compliance with requirements. Provide start-up and testing by factory authorized representative in accordance with manufacturer’s recommendations. Perform each of the following tests (as a minimum) and submit written report of results of each as part of the Operation and Maintenance Manuals required herein:

1. Mimic a normal power outage by de-energizing normal power source to the facility. Verify engine start, transfer, and operation of all loads satisfactorily. Re-energize normal power, and verify proper performance of load retransfer, engine cool down, and engine shut down. Record and report all results.
2. Mimic a generator test by operating the “test mode” switch (with facility still energized by normal power). Verify engine start, transfer, and operation of all

loads satisfactorily. Return “test” switch to normal, and monitor performance of load retransfer, engine cool down, and engine shut down. Record and report all results.

3. Perform a safety run test in accordance with the following:
   a. Provide all fluids, equipment, and test instrumentation to perform complete tests.
   b. Perform and record all engine manufacturer’s recommended pre-starting checks and inspections.
   c. Verify the proper operation of all controls, gauges, instruments, and set points.
   d. Verify the proper operation of the emergency stop switch, the over-speed limit switch, oil overfill limit, oil low limit, and the over- and under-frequency limits. Where digital controls prevent direct access to safety switches, the manufacturer’s representative shall utilize a field service computer and manufacturer’s field service software to demonstrate the control’s monitoring of engine speed, oil pressure and coolant temperature.
   e. Perform an engine load run test. Provide all fluids, equipment, load banks, and test instrumentation to perform complete tests.
4. Perform and record all engine manufacturer’s recommended prestarting checks and inspections.
5. Tests:
   a. Perform tests recommended by manufacturer and each electrical test and visual and mechanical inspection, except those indicated to be optional, for “AC Generators and for Emergency Systems” specified in NETA acceptance testing specification. Certify compliance with specification parameters.
   b. Continuous engine load run test:
      i. Provide a resistance load bank and make temporary connections for full load test.
      ii. Readings shall be taken at 15 minute intervals shall include the following:
         1. Output amperes, voltage, real and reactive power, power factor and frequency.
         2. Lube-oil pressure.
         3. Coolant, lube-oil, exhaust, and ambient temperatures.
      iii. Operative the engine generator set for 4 hours at 100% of rated load.
      iv. Remove load from the engine generator set. Shut down the engine generator set.
6. Perform tests required by NFPA 110 acceptance tests that are additional to those specified here including, but not limited to, a “cold start” test and a one step rated load pickup test. The AHJ (Authority Having Jurisdiction) shall be notified in advance and shall have the option to witness the tests.

7. Inspect lube oil filter for excessive metal, abrasive foreign particles, etc. If corrective action is necessary, perform all above run tests again after corrections have been made. Check all engine and mounting bolts for tightness and/or visible damage. Inspect and verify engine-generator shaft alignment by means of dial indicator.

B. After completion of all tests, provide engine fluid and diesel fuel to refill all engine fluids and refill diesel fuel tank to capacity.

3.4 SURGE PROTECTIVE DEVICES:

A. Provide a surge protective device on each switchboard and panelboard located on the emergency distribution system. Refer to section 26 4313 for requirements.

3.5 ON SITE TRAINING:

A. Conduct a training course for operating staff as designated by the Owner. The training period shall consist of a total of 8 hours of normal working time distributed between two shifts, and shall start after the system is functionally complete but prior to final acceptance. The course instruction shall cover pertinent points involved in operating, starting, stopping, servicing the equipment as well as all major elements of the operation and maintenance manuals. Additionally, the course instruction shall demonstrate all routine maintenance operations such as oil change, oil filter change, air filter change, etc.

3.6 FIELD ENGINEER:

A. Provide a qualified field engineer to supervise the installation of the engine generator set, transfer, etc., assist in the performance of the on-site tests, and instruct personnel as to the operational and maintenance features of the equipment.

3.7 SERVICE AND SUPPORT

A. The manufacturer of the generator set shall maintain service parts inventory at a central location that is accessible to the service location 24 hours per day, 365 days per year.

B. The generator set shall be serviced by the local service organization (during the warranty period) that is trained and factory certified in generator set service the supplier shall maintain an inventory of critical replacement parts at the local service organization, and in service vehicles. The service organization shall be on call 24 hours per day, 365 days per year.

END OF SECTION 263213

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SECTION 26 4313 - SURGE PROTECTIVE DEVICES (SPD)

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 26 Basic Materials and Methods sections apply to work specified in this section.

1.2 DESCRIPTION OF WORK:

A. Extent of SPD's work is indicated by drawings, schedules and specified herein. Work includes complete installation, electrical connections, testing, and commissioning.

1.3 QUALITY ASSURANCE:

A. Comply with NEC, NEMA and IEEE Standards as applicable to wiring methods, construction and installation of SPD's. Comply with applicable requirements of ANSI/IEEE C62.11, C62.41.2 and C62.45; NFPA 70 285 (Type 2), 75, and 78; and ANSI/UL 1449 4th edition. Provide complete packaged units that have been listed and labeled by Underwriters Laboratory. UL surge ratings (UL 1449) must be permanently affixed to the SPS's device.

1.4 SUBMITTALS:

A. Refer to Section 260502 for electrical submittal requirements.

PART 2 - PRODUCTS:

2.1 ACCEPTABLE MANUFACTURERS:

A. Subject to compliance with requirements, provide products manufactured by one of the following as indicated by "Location Category" herein.

1. Advanced Protection Technologies Inc.
2. Current Technology Inc.
3. Cutler Hammer, Inc.
4. L.E.A. International
5. Emerson Network Power Surge Protection Inc.
6. United Power Corporation
7. GE
8. Eaton
9. Surgelogic (Square D)

2.2 GENERAL:

A. Except as otherwise indicated, provide high energy surge protective devices, with high frequency line noise filtering, suitable for application in Category A, B, and C environments as indicated. Provide types, sizes, ratings and electrical characteristics indicated that comply with manufacturer's standard materials, design, and construction in accordance with published information and as required for a complete installation.

B. Provide externally mounted SPD units only.

2.3 VOLTAGE SURGE SUPPRESSION – GENERAL:

A. Electrical Requirements

1. Unit Operating Voltage – Refer to drawings for operating voltage and unit configuration.

2. Maximum Continuous Operating Voltage (MCOV) – The MCOV shall not be less than 115% of the nominal system operating voltage.

3. The suppression system shall incorporate thermally protected metal-oxide varistors (MOVs) as the core surge suppression component for the service entrance and all other distribution levels. The system shall not utilize silicon avalanche diodes, selenium cells, air gaps, or other components that may crowbar the system voltage leading to system upset or create any environmental hazards.

4. Protection Modes – The SPD must protect all modes of the electrical system being utilized. The required protection modes are indicated by bullets in the following table:

	Protection Modes			
Configuration	L-N	L-G	L-L	N-G
Wye	●	●	●	●
Delta	N/A	●	●	N/A
Single Split Phase	●	●	●	●
High Leg Delta	●	●	●	●

5. Nominal Discharge Current (In) – All SPDs applied to the distribution system shall have a 20kA In rating regardless of their SPD Type (includes Types 1 and 2) or operating voltage. SPDs having an In less than 20kA shall be rejected.

6. ANSI/UL 1449 4th Edition Voltage Protection Rating (VPR) – The maximum ANSI/UL 1449 4th Edition VPR for the device shall not exceed the following:

B. SPD Design

1. Maintenance Free Design – The SPD shall be maintenance free and shall not require any user intervention throughout its life. SPDs containing items such as replaceable modules, replaceable fuses, or replaceable batteries shall not be accepted. SPDs requiring any maintenance of any sort such as periodic tightening of connections shall not be accepted. SPDs requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.

2. Balanced Suppression Platform – The surge current shall be equally distributed to all MOV components to ensure equal stressing and maximum performance. The surge suppression platform must provide equal impedance paths to each matched MOV. Designs incorporating replaceable SPD modules shall not be accepted.

3. Electrical Noise Filter – Each unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be up to 50 dB from 10 kHz to 100 MHz using the MIL-STD-220A insertion loss test method. Products unable able to meet this specification shall not be accepted.

4. Internal Connections – No plug-in component modules or printed circuit boards

shall be used as surge current conductors. All internal components shall be soldered, hardwired with connections utilizing low impedance conductors.

5. Monitoring Diagnostics – Each SPD shall provide the following integral monitoring options:

   a. Protection Status Indicators - Each unit shall have a green / red solid-state indicator light that reports the status of the protection on each phase.

      i. For wye configured units, the indicator lights must report the status of all protection elements and circuitry in the L-N and L-G modes. Wye configured units shall also contain an additional green / red solid-state indicator light that reports the status of the protection elements and circuitry in the N-G mode. SPDs that indicate only the status of the L-N and L-G modes shall not be accepted.

      ii. For delta configured units, the indicator lights must report the status of all protection elements and circuitry in the L-G and L-L modes.

      iii. The absence of a green light and the presence of a red light shall indicate that damage has occurred on the respective phase or mode. All protection status indicators must indicate the actual status of the protection on each phase or mode. If power is removed from any one phase, the indicator lights must continue to indicate the status of the protection on all other phases and protection modes. Diagnostics packages that simply indicate whether power is present on a particular phase shall not be accepted.

   b. Remote Status Monitor – The SPD must include Form C dry contacts (one NO and one NC) for remote annunciation of its status. Both the NO and NC contacts shall change state under any fault condition.

   c. Audible Alarm and Silence Button – The SPD shall contain an audible alarm that will be activated under any fault condition. There shall also be an audible alarm silence button used to silence the audible alarm after it has been activated.

   d. Surge Counter – The SPD shall be equipped with an LCD display that indicates to the user how many surges have occurred at the location. The surge counter shall trigger each time a surge event with a peak current magnitude of a minimum of 50 ± 20A occurs. A reset pushbutton shall also be standard, allowing the surge counter to be zeroed. The reset button shall contain a mechanism to prevent accidental resetting of the counter via a single, short-duration button press. In order to prevent accidental resetting, the surge counter reset button shall be depressed for a minimum of 2 seconds in order to clear the surge count total.

      i. The ongoing surge count shall be stored in non-volatile memory. If power to the SPD is completely interrupted, the ongoing count indicated on the surge counter's display prior to the interruption shall be stored in non-volatile memory and displayed after power is restored.

The surge counter's memory shall not require a backup battery in order to achieve this functionality.

6. Overcurrent Protection

   a. The unit shall contain thermally protected MOVs. These thermally protected MOVs shall have a thermal protection element packaged together with the MOV in order to achieve overcurrent protection of the MOV. The thermal protection element shall disconnect the MOV(s) from the system in a fail-safe manner should a condition occur that would cause them to enter a thermal runaway condition.

7. Fully Integrated Component Design – All of the SPD's components and diagnostics shall be contained within one discrete assembly. SPDs or individual SPD modules that must be ganged together in order to achieve higher surge current ratings or other functionality shall not be accepted.

8. Safety Requirements

   a. The SPD shall minimize potential arc flash hazards by containing no user serviceable / replaceable parts and shall be maintenance free. SPDs containing items such as replaceable modules, replaceable fuses, or replaceable batteries shall not be accepted. SPDs requiring any maintenance of any sort such as periodic tightening of connections shall not be accepted. SPDs requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.

   b. SPDs designed to interface with the electrical assembly via conductors shall require no user contact with the inside of the unit. Such units shall have any required conductors be factory installed.

   c. Sidemount SPDs shall be factory sealed in order to prevent access to the inside of the unit. Sidemount SPDs shall have factory installed phase, neutral, ground and remote status contact conductors factory installed and shall have a pigtail of conductors protruding outside of the enclosure for field installation.

2.4 SYSTEM APPLICATION

A. The SPD applications covered under this section include distribution and branch panel locations, busway, motor control centers (MCC), switchgear, and switchboard assemblies. All SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C, B, and A environments.

B. Provide a surge protective device on each switchboard and panelboard located on the emergency distribution system. Refer to table below for category type.

Minimum surge current capacity based on ANSI / IEEE C62.41 location category			
CATEGORY	Application	Per Phase	Per Mode
C	Service Entrance Locations (Switchboards, Switchgear, MCC, Main Entrance)	250 kA	125 kA
B	High Exposure Roof Top Locations (Distribution Panelboards)	160 kA	80 kA
A	Branch Locations (Panelboards, MCCs, Busway)	120 kA	60 kA

C. Surge Current Capacity – The minimum surge current capacity the device is capable of withstanding shall be as shown in the following table:

D. SPD Type – all SPDs installed on the line side of the service entrance disconnect shall be Type 1 SPDs. All SPDs installed on the load side of the service entrance disconnect shall be Type 1 or Type 2 SPDs.

2.5 LIGHTING AND DISTRIBUTION PANELBOARD REQUIREMENTS

A. The SPD application covered under this section includes lighting and distribution panelboards. The SPD units shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category B environments.

1. The SPD shall not limit the use of through-feed lugs, sub-feed lugs, and sub-feed breaker options.
2. SPDs shall be installed following the load side of the main breaker. SPDs installed in main lug only panelboards shall be installed immediately following the incoming main lugs.
3. The panelboard shall be capable of re-energizing upon removal of the SPD.
4. The SPD shall be interfaced to the panelboard via a direct bus bar connection. Alternately, an SPD connected to a 30A circuit breaker for disconnecting purposes may be installed using short lengths of conductors as long as the conductors originate integrally to the SPD. The SPD shall be located directly adjacent to the 30A circuit breaker.
5. The SPD shall be included and mounted external of the panelboard.
6. The SPD shall be of the same manufacturer as the panelboard.
7. The complete panelboard including the SPD shall be UL67 listed.

B. Sidemount Mounting Applications Installation (SPD mounted external to electrical assembly)

1. Lead length between the breaker and suppressor shall be kept as short as possible to ensure optimum performance. Any excess conductor length shall be trimmed in order to minimize let-through voltage. The installer shall comply with the manufacturer's recommended installation and wiring practices.

C. Switchgear, Switchboard, MCC and Busway Requirements

1. The SPD application covered under this section is for switchgear, switchboard, MCC, and busway locations. Service entrance located SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C environments.
2. The SPD shall be of the same manufacturer as the switchgear, switchboard, MCC, and busway
3. The SPD shall be factory installed outside the switchgear, switchboard, MCC, and/or bus plug at the assembly point by the original equipment manufacturer
4. Locate the SPD on the load side of the main disconnect device, as close as possible to the phase conductors and the ground/neutral bar.
5. The SPD shall be connected through a disconnect (30A circuit breaker). The disconnect shall be located in immediate proximity to the SPD. Connection shall be made via bus, conductors, or other connections originating in the SPD and shall be kept as short as possible.
6. The SPD shall be external to switchgear, switchboard, MCC, and/or bus plug as a factory standardized design.
7. All monitoring and diagnostic features shall be visible from the front of the

equipment.

2.6 ENCLOSURES

A. All enclosed equipment shall have NEMA 1 general purpose enclosures, unless otherwise noted. Provide enclosures suitable for locations as indicated on the drawings and as described below:

1. NEMA 1 – Constructed of a polymer (units integrated within electrical assemblies) or steel (sidemount units only), intended for indoor use to provide a degree of protection to personal access to hazardous parts and provide a degree of protection against the ingress of solid foreign objects (falling dirt).

2. NEMA 4 – Constructed of steel intended for either indoor or outdoor use to provide a degree of protection against access to hazardous parts; to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (dirt and windblown dust); to provide a degree of protection with respect to the harmful effects on the equipment due to the ingress of water (rain, sleet, snow, splashing water, and hose directed water); and that will be undamaged by the external formation of ice on the enclosure. (sidemount units only)

3. NEMA 4X – Constructed of stainless steel providing the same level of protection as the NEMA 4 enclosure with the addition of corrosion protection. (sidemount units only)

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install SPD’s as indicated in accordance with manufacturers recommendations and as necessary to meet requirements. Install with conductors of minimum length practicable, but in no case exceeding 30" in length; minimum conductor size - #6 AWG copper.

B. Install conductors in straight runs with a minimum of turns or bends (minimum bend radius to be 90 degrees). Do not splice phase or ground conductors in SPD’s circuit. Torque all conductor terminations in accordance with manufacturer's recommendations.

3.2 FIELD QUALITY CONTROL:

A. Upon completion of installation of equipment, energize and demonstrate capability and compliance with requirements. Remove malfunctioning units, replace with new units and proceed with retesting.

END OF SECTION 26 4313

SECTION 26 5100 - INTERIOR AND EXTERIOR BUILDING LIGHTING

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-26 Basic Materials and Methods sections apply to work specified in this section.

1.2 DESCRIPTION OF WORK:

A. Types of lighting fixtures in this section are indicated by schedule and include the following:

1. LED (Light Emitting Diode)

1.3 QUALITY ASSURANCE:

A. Comply with NEC, NEMA and ANSI 132,1 as applicable to installation and construction of lighting fixtures. Provide lighting fixtures that have been UL-listed and labeled.

B. Components and fixtures shall be listed and approved for the intended use by a National Recognized Testing Laboratory (NRTL) including: UL, ETL, and CSA or equivalent

C. All led products shall comply with the latest version of Illuminating Engineer Society (IES) publications LM-79 and LM-80.

1.4 SUBMITTALS:

A. Refer to Section 260502 for electrical submittal requirements.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. Subject to compliance with requirements, provide products of one of the following (for each type of fixture):

1. LED:

a. Cree

b. Nichia

c. Samsung

d. Philips Lumiled

e. Osram

f. Xicato

2.2 INTERIOR AND EXTERIOR LIGHTING FIXTURES:

A. GENERAL:

1. Provide lighting fixtures, of sizes, types and ratings indicated complete with, but not necessarily limited to, housings, lamps, lamp holders, reflectors, ballasts, LED drivers, starters, and wiring. Label each fixture with manufacturer's name and catalog number. Provide all enclosed fixtures with positive latch

mechanisms; spring tension clips not acceptable. Provide all exterior fixtures with damp or wet location label as required by application.

B. SUPPORT REQUIREMENTS:

1. Provide all pendant and stem hung fixtures with flexible ball joint hangers at all points of support. Equip hooks used to hang fixtures with safety latches. Provide all detachable fixture parts, luminous ceiling accessories, louvers, diffusers, lenses, and reflectors with locking catches, screws, safety chain, or safety cable.

C. LIGHT EMITTING DIODE (LED) LUMINAIRES:

1. LED luminaires that can be serviced in place shall have a disconnecting means internal to the luminaries to disconnect simultaneously from the source of supply all conductors of the driver, including the grounded conductor. Disconnects shall not be required under the following exceptions:

a. Luminaries located in hazardous locations.

b. Luminaries used for egress lighting.

c. Cord-and-plug luminaries.

d. In industrial establishments with restricted public access where conditions of maintenance and supervision ensure that only qualified persons service the installation.

e. Where more than one luminaire is installed in a space and where disconnecting the supply conductors to the luminaire will not leave the space in total darkness.

f. Provide LED luminaires which are tested in accordance with IES LM-79, diodes tested in accordance with IES LM-80, and provide a minimum R9 rating of ≥ 50 (unless specified differently), a CRI rating of ≥ than 80 and L70 (6K) = 50,000 hours (IES TM-21). Provide with 0-10V dimming drivers as standard.

g. The fixture manufacturer(s) shall warrant the luminaires, in their entirety, to be free from defects in material or workmanship for at least 5 years from date of manufacture. Provide warranty in accordance with other sections of this specification and include a certificate of warranty from the fixture manufacturer with extended warranty information and proper forms and procedure description.

D. DIFFUSERS:

1. Where plastic diffusers are specified, provide 100 percent virgin acrylic compound; minimum thickness, .125 inches.

PART 3 - EXECUTION

3.1 INSTALLATION OF LIGHTING FIXTURES

A. Install lighting fixtures at locations and heights as indicated, in accordance with fixture manufacturer's written instructions, applicable requirements of NEC, NECA's "Standards of Installation", NEMA standards, and with recognized industry practices to ensure that lighting fixtures fulfill requirements.

B. Coordinate with other work as appropriate to properly interface installation of lighting fixtures with other work. Consult architectural reflected ceiling plan for exact location of all lighting fixtures.

C. Provide all necessary supports, brackets, and miscellaneous equipment for mounting of fixtures. Support all ceiling mounted fixtures from the building structure; independent of the ceiling system, unless noted. Support each recessed fixture (fluorescent incandescent, and/or HID) from the building structure with #12 ga. steel wire attached to each corner (in addition to supports normally provided for attachment to the ceiling system). Provide backing supports above (or behind) sheetrock, plaster and similar ceiling and wall materials. Support surface mounted ceiling fixtures from channel. Support ceiling mounted outlet boxes independent of the raceway system, and capable of supporting 200 pounds. Feed each recessed fixture directly from an outlet box with flex conduit as required; do not loop from fixture to fixture. See plans for additional details.

D. FIXTURE WHIPS:

1. Provide each lay-in light fixture with at least 36" (Not to exceed 72") of 3/8" steel flexible conduit.

2. With-in spaces utilizing 0-10v control schemes ie: Room Controllers, the fixture whip shall be comprised of a MC-PCS Cable (see Section 26 0532 Conduit raceways) with at least 36” and not to exceed 72” in length located above removable grid ceilings.

E. Coordinate lighting in mechanical room with duct and equipment locations to avoid obstruction of illumination.

F. Provide gypsum board protection as required, (acceptable to fire official having jurisdiction) to ensure fire rating of each ceiling that the fixtures are installed in.

G. COORDINATION MEETINGS:

1. Meet at least twice with the architect and ceiling installer. Hold first meeting before submittal of shop drawings to coordinate each light fixture mounting condition with ceiling type. During second meeting, coordinate fixture layout in each area.

a. Coordinate mounting height of pendant and wall mounted fixtures.

b. Coordinate conduit layout in all open ceiling spaces e.g. Gym, Commons, Auditorium, etc. with architect prior to rough-in.

2. Meet at least twice with the AV/Intercom systems Installer. Hold first meeting before submittal of shop drawings to coordinate each AV equipment, speaker mounting condition with ceiling type. During second meeting, coordinate AV equipment, speaker layout in each area.

3. Meet at least once with the mechanical installer prior to fabrication and installation of duct work. Coordinate depth and location of all fixtures and duct work in all areas.

H. ADJUST AND CLEAN:

1. Clean lighting fixtures of dirt and debris upon completion of installation.

2. Protect installed fixtures from damage during remainder of construction period. Repair all nicks and scratches to appearance of original finish.

3.2 FIELD QUALITY CONTROL:

A. Upon completion of installation of lighting fixtures, and after building circuitry has been energized, apply electrical energy to demonstrate capability and compliance with requirements.

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

C. At the time of Substantial Completion, replace lamps in interior lighting fixtures that are observed to be noticeably dimmed after the Contractor's use and testing, as judged by Architect/Engineer.

D. GROUNDING:

1. Provide equipment grounding connections for each lighting fixture.

END OF SECTION 26 5100

SECTION 26 9000 - SYSTEMS COMMISSIONING

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. Architectural, Structural, Mechanical and other applicable documents are considered a part of the electrical documents insofar as they apply as if referred to in full.

C. Refer specifically to Section 01810 and Section 01815 for responsibilities to aid a commissioning agent.

1.2 DESCRIPTION OF WORK:

A. System commissioning is not part of division 26, however will take place during construction. Division 26 contractor will be required to assist the commissioning agent with access to shop drawings and to various equipment required to be commissioned.

B. The purpose of the commissioning process is to provide the Owner/operator of the facility with a high level of assurance that the electrical and associated electrical systems have been installed in the prescribed manner and operate within the performance guidelines set in the design intent. The Commissioning Authority (CxA) will provide the Owner with an unbiased, objective view of the system installation, operation, and performance. This process is not to take away or reduce the responsibility of the design professionals or installing contractors to provide a finished product. Commissioning is intended to enhance the quality of system start-up and aid in the orderly transfer of systems to beneficial use by the owner. The CxA will be a member of the construction team, cooperating and coordinating all commissioning activities with the design professionals, construction manager, contractors, subcontractors, manufacturers, and equipment suppliers.

C. The systems requiring commissioning are:

1. Network Lighting Controls
2. Occupancy Sensors
3. Daylighting/Photocell Systems
4. Cable Trays
5. Fire Alarm Systems
6. Overload Protected Devices
7. Automatic Transfer Systems
8. Panelboards
9. Lighting
10. Local Lighting Controls
11. Receptacles
12. Raceways
13. Surge Protection Systems
14. Electrical Distribution
15. Motor Starters
16. Disconnects
17. Combination Starters

PART 2 – PRODUCTS: Not Used

PART 3 – EXECUTION: Not Used

END OF SECTION 26 9000

DIVISION 27– COMMUNICATIONS

27 1500	TELEPHONE & DATA SYSTEMS CSD
27 4100	AUDIOVISUAL SYSTEMS
27 5123	INTERCOMMUNICATIONS SYSTEM

Canyons School District

Network Cabling Global Specification

Information Technologies

Final Draft
Wednesday August 31, 2018

CANYONS School District

INFORMATION TECHNOLOGIES
8/31/2018

Scot McCombs
Director of IT

Table of Contents

CANYONS School District

I. GENERAL

A. Purpose

1. The purpose of this document is to provide a standard defining the structured communications cabling systems to be installed within Canyons School District facilities. It is geared toward leveraging our legacy cabling infrastructure while upgrading to more recent technologies in new installations. The goal is to accomplish this in the most economic and systematic fashion possible, and in a manner compliant with the latest codes, cabling standards and industry best practices.

2. Within this document, the facilities owner is Canyons School District, and shall be referred to as such, or as “Canyons School District” or simply as “Information Technologies”. Bidding low-voltage installers shall be referred to as “Contractor”.

3. This specification defines quality standards and practices common to all Canyons School District Information Technologies enterprise network cabling upgrades and greenfield (new) projects.

4. In addition to this global cabling standard, individual projects will also have associated documentation such as Requests for Proposals (RFP), facility drawings, project schedules and requirements pertaining to that particular job. Such collateral will be referred to in this document as “Project Specific Documentation” or simply “Construction Documents”. Any conflict between this general specification and any project specific documentation shall be brought to the attention of Canyons School District Information Technologies and must be resolved in writing by Canyons Schools.

5. It is the responsibility of the installing contractor to evaluate these general recommendations and adapt them effectively to actual projects. Contractor is responsible for identifying and bringing to the attention of Canyons School District Information Technologies any design directions that may be improved. All such changes shall be approved in writing from Information Technologies.

6. Note that while many portions of this global specification are addressed to "The Contractor", these requirements apply equally to anyone doing the network cabling and infrastructure work within Canyons School District, whether those persons are outside contractors or persons directly employed by Information Technologies.

B. Scope of Work - Typical

1. Contractor shall be solely responsible for all parts, labor, testing, documentation and all other associated processes and physical apparatus necessary to turn over the completed system fully warranted and operational for acceptance by Canyons School District Information Technologies

2. This specification includes structured cabling design considerations, product specifications and installation guidelines for low-voltage network systems and associated infrastructure including, but not limited to:

a. Cabling Sub-system 1 – Horizontal Copper

b. Cabling Sub-system 2 - Intra-building Fiber Backbone Cabling

c. Telecommunications Pathways

d. Communications Racks

e. Communications Grounding Systems

f. Cabling Labeling and Administration

3. In addition to systems specifications, this document also addresses applicable codes and standards, contractor qualifications and requirements, system warranties and system testing and acceptance.

4. Products to be used in Canyons School District Information Technologies telecommunications infrastructure are listed in “Appendix A” at the end of this document. All approved ‘equivalents’ must match performance specifications.

C. Applicable Regulatory References

1. Contractor is responsible for knowledge and application of current versions of all applicable standards and codes. In cases where listed standards and codes have been updated, Contractor shall adhere to the most recent revisions, including all relevant changes or addenda at the time of installation.

2. ANSI/TIA:

a. ANSI/TIA-526-7-A (July 2015) Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant

b. TIA-526.2-A (July 2015) Effective Transmitter Output Power Coupled into Single-Mode Fiber Optic Cable - Adoption of IEC 61280-1-1 ed. 2 Part 1-1: Test Procedures for General Communication Subsystems – Transmitter Output Optical Power Measurement for Single-Mode Optical Fibre Cable

c. ANSI/TIA-4994 (March 2015) Standard for Sustainable Information Communications Technology

d. ANSI/TIA-526-14-C (April 2015) Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant

e. ANSI/TIA-568.0-D (September 2015) Generic Telecommunications Cabling for Customer Premises (supersedes TIA-568-C.0 and TIA-568-C-1)

f. ANSI/TIA-568-C.2 (August 2009) Balance Twisted Pair Communications and Components Standards

g. TIA-568-C.2-1 (July 2016) Balanced Twisted-Pair Telecommunications Cabling and Components Standard, Addendum 1: Specifications for 100 Next Generation Cabling

h. TIA-568-C.2-2 (November 2014) Balanced Twisted-Pair Telecommunications Cabling and Components Standard, Addendum 2: Additional Considerations for Category 6A Patch Cord Testing

i. TIA-568-C.3 (June 2008) Optical Fiber Cabling Components Standard (will be superseded by ANSI/TIA-568.3-D after default ballot)

j. TIA-568-C.3-1 (October 2011) Optical Fiber Cabling Component Standard- Addendum 1, Addition of OM4 Cabled Optical Fiber and array connectors (will be superseded by ANSI/TIA-568.3-D after default ballot)

k. ANSI/TIA-568-C.4 (July 2011) Broadband Coaxial Cabling Components Standard

l. ANSI/TIA-568.1-D (September 2015) Commercial Building Telecommunications Infrastructure Standard (supersedes ANSI/TIA-C.1)

m. ANSI/TIA-569-D (April 2015) Telecommunications Pathways and Spaces

n. ANSI/TIA-598-D (July 2014) Optical Fiber Cable Color Coding

o. ANSI/TIA-570-C (August 2012) Residential Telecommunications Infrastructure Standard

p. ANSI/TIA-606-C (June 2017) Administration Standard for Telecommunications Infrastructure

q. ANSI/TIA-607-C (November 2015) Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises

r. ANSI/TIA-758-B (March 2012) Customer-Owned Outside Plant Telecommunication Infrastructure Standard

s. ANSI/TIA-862-B (February 2016) Structured Cabling Infrastructure Standard for Intelligent Building Systems

t. ANSI/TIA-942-B (July 2017) Telecommunications Infrastructure Standard for Data Centers (will be superseded by ANSI/TIA-942-B after balloting)

u. ANSI/TIA-1005-A (May 2012) Telecommunications Infrastructure Standard For Industrial Premises

v. ANSI/TIA-1005-A-1 (January 2015) Telecommunications Infrastructure Standard For Industrial Premises, Addendum 1- M12-8 X-Coding Connector - Addendum to TIA-1005-A

w. ANSI/TIA-1183 (August 2012) Measurement Methods and Test Fixtures for Balun-Less Measurements of Balanced Components and Systems

x. ANSI/TIA-1183-1 (January 2016) Measurement Methods and Test Fixtures for Balun-Less Measurements of Balanced Components and Systems, Extending Frequency Capabilities to 2 GHz - Addendum to TIA-1183

y. ANSI/TIA-1152 (September 2009) Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling

z. ANSI/TIA-1179 (July 2010) Healthcare Facility Telecommunications Infrastructure Standard

aa. ANSI/TIA-4966 (May 2014) Telecommunications Infrastructure Standard for Educational Facilities

bb. TIA-455-104-B (February 2016) FOTP 104- Fiber Optic Cable Cyclic Flexing Test (supersedes TIA-455-104-A)

cc. TIA/EIA-455-25-D (February 2016) FOTP-25 Impact Testing of Optical Fiber Cables

dd. TIA-604-18 (November 2015) FOCIS 18 Fiber Optic Connector Intermateability Standard – Type MPO-16

ee. TIA-604-5-E (November 2015) FOCIS 5 Fiber Optic Connector Intermateability Standard- Type MPO

ff. TIA-5017 (March 2016) Telecommunications Physical Network Security Standard

gg. TIA-TSB-155-A (Reaffirmed 10-6-2014) Guidelines for the Assessment and Mitigation of Installed Category 6 Cabling to Support 10GBASE-T

hh. TSB-184-A (March 2017) Guidelines for Supporting Power Delivery Over Balanced Twisted-Pair Cabling

ii. TSB-4979 (August 2013) Practical Considerations for Implementation of Multimode Launch Conditions in the Field

jj. TSB-190 (June 2011) Guidelines on Shared Pathways and Shared Sheaths

kk. TIA-TSB-162-A (November 2013) Telecommunications Cabling Guidelines for Wireless Access Points

ll. TSB-5018 (July 2016) Structured Cabling Infrastructure Guidelines to support Distributed Antenna Systems

mm. TIA-492AAAD (October 2009) Detail specification for 850-nm laser-optimized, 50-um core diameter/125-um cladding diameter class Ia graded-index multimode optical fibers

nn. TIA-455-243 (March 2010) FOTP-243 Polarization-mode Dispersion Measurement for Installed Single-mode Optical Fibers by Wavelength-scanning OTDR and States-of-Polarization Analysis

oo. TSB-172-A (February 2013) Higher Data Rate Multimode Fiber Transmission Techniques

3. ISO/IEC

a. ISO/IEC 11801 Edition 2.2: Information Technology – Generic Cabling For Customer Premises

b. ISO/IEC 24702 Edition 1.0: Information Technology – Generic Cabling – Industrial Premises

c. ISO/IEC 24764 Edition 1.0: Information Technology – Generic Cabling Systems For Data Centres

d. ISO/IEC 14763-2 Edition 1.0: Implementation and Operation of Customer Premises Cabling – Part 2: Planning and Installation

e. ISO/IEC 14763-3 Edition 1.1: Implementation and Operation of Customer Premises Cabling – Part 3: Testing of Optical Fiber Cabling

4. National Electric Codes

a. National Electrical Safety Code (NESC) (IEEE C2-2012)

b. ANSI/NFPA 70-2011, National Electrical Code© (NEC©)

c. ANSI/IEEE C2-207, National Electrical Safety Code®

d. National Electrical Code (NEC) (NFPA 70)

5. OSHA Standards and Regulations – all applicable

6. Local Codes and Standards – all applicable

7. BICSI – Building Industry Consultative Services International

    a. Telecommunications Distribution Methods Manual, 13th Edition

    b. ANSI/BICSI 005-2013, Electronic Safety and Security (ESS) System Design and Implementation Best Practices

    c. Information Transport Systems Installation Methods Manual (ITSIMM), 6th Edition

    d. ANSI/BICSI 002-2011, Data Center Design and Implementation Best Practices

    e. Network Systems and Commissioning (NSC) reference, 1st Edition

    f. ANSI/NECA/BICSI 568-2006, Standard for Installing Commercial Building Telecommunications Cabling

    g. NECA/BICSI 607-2011, Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings

    h. AV Design Reference Manual, 1st Edition

    i. Network Design Reference Manual, 7th Edition

    j. Outside Plant Design Reference Manual, 5th Edition

    k. Wireless Design Reference Manual, 3rd Edition

    l. Electronic Safety and Security Design Reference Manual, 3rd Edition

    m. Commercial Installation On-the-Job Training Booklet

    n. Telecommunications Project Management (TPM) reference, 1st Edition

8. Anywhere cabling standards conflict with electrical or safety codes, Contractor shall defer to the NEC and any applicable local codes or ordinances, or default to the most stringent requirements listed by either.

9. Anywhere standards, codes, specifications or project documents conflict, Contractor shall default to the standards of the country where the installation is taking place, or default to the more stringent of either. Where such resolutions are not clear, it is the responsibility of the Contractor to bring this to the attention of the local Canyons School District project manager to receive clarification in writing.

10. Knowledge and execution of applicable standards and codes is the sole responsibility of the Contractor.

11. Any violations of applicable standards or codes committed by the Contractor shall be remedied at the Contractor’s expense.

D. Substitution Policy

1. This is a performance-based specification based on the experience of Canyons School District Information Technologies in providing exceptional solutions for all of our facilities and departments. As such, substitution of specified systems is discouraged, but allowed if Contractor strictly follows the Canyons Substitution Policy outlined below. The right to determine suitability, compatibility, or acceptability of product/service offerings belongs exclusively to Canyons School District.

2. Contractors offering product substitutions or equivalents are responsible for showing equal or superior mechanical and transmission performance specifications to those products listed herein.

3. The process for substituting products other than those specified is as follows:

    a. Any Contractor wishing to offer structured cabling or associated infrastructure products other than those specified should submit a request for product substitution in writing at least ten (10) business days prior to the closing of the bid for which the substitution is requested.

    b. Written requests for substitution should be accompanied by three samples of the substitution product along with associated drawings, specification sheets and engineering documents for evaluation by Canyons School District.

    c. Any copper or fiber cabling products that carry signal shall be accompanied by third party laboratory performance test reports from an NRTL (Nationally Recognized Testing Laboratory) proving equivalency in transmission performance.

4. Equal product acceptance is exclusively at Canyons School District discretion.

5. Contractor shall assume all costs for removal and replacement of any substituted product installed without prior written approval. Such costs shall include but not be limited to labor, materials as well as any penalties, fees or costs incurred for late completion.

E. Contractor Qualifications

1. General

    a. Contractor must have at least 5 years documented experience installing and testing structured cabling systems of similar type and size.

    b. Contractor shall have offices and service personnel based with a fifty-mile radius of Canyons School District and be capable of same-day response to service calls.

    c. Contractor shall employ at least one BICSI Registered Communication Distribution Designer (RCDD) to sign-off on all designs offered, including stamping the design with their current BICSI/RCDD stamp.

    d. Contractor shall have the responsibility to obtain any of the necessary permits, licenses, and inspections required for the performance of data, voice, and fiber optic cable installations.

    e. Contactor shall be a current Panduit ONE℠ Partner, Silver or above, Leviton/Berk-Tek Certified Installer, Siemon/Mohawk Certified Installer, or accepted substitute manufacturer (See Substitution Policy). A copy of the corporate manufacturer certification must be included with quote.

f. At least 30 percent of the technicians on the job must have a current Panduit Certified Copper Technicians certificate, Leviton/Berk-Tek Certified Copper Technicians certificate, Siemon/Mohawk Certified Installer certificate, or accepted substitute manufacturer, to install copper distribution systems.

g. At least 30 percent of the technicians installing any Fiber Distribution Systems must have a current Panduit Certified Fiber Technicians certificate, Leviton/Berk-Tek Certified Fiber Technicians certificate or accepted substitute manufacturer certificate, to install fiber distribution systems

h. The Telecommunications contractor must provide a project manager to serve as the single point of contact to manage the installation, speak for the contractor and provide the following functions:

- Initiate and coordinate tasks with the Canyons School District Information Technologies Project Manager and others as specified by the project schedule.
- Provide day to day direction and-site supervision of Contractor personnel.
- Ensure conformance with all contract and warranty provisions.
- Participate in weekly site project meetings.
- This individual will remain project manager for the duration of the project. The contractor may change Project Manager only with the written approval of Canyons School District Information Technologies.

i. Contractor Project Manager must be manufacturer certified in the copper and fiber information distribution systems to be installed.

2. References

a. Communications Contractor shall provide with bid, a list of three reference accounts where similar Data, Voice, Fiber Optic Cable, and related equipment installation work was performed within the last year (twelve month period).

3. Termination of Services

a. Canyons School District Information Technologies reserves the right to terminate the Communication Contractor's services if at any time the Information Technologies Engineer determines the Communication Contractor is not fulfilling their responsibilities as defined within this document.

b. Contractor's appearance and work ethics shall be of a professional manner, dress shall be commensurate with work being performed.

c. Dress displaying lewd or controversial innuendos will strictly be prohibited.

d. Conduct on Canyons School District Information Technologies property will be professional in nature.

e. Any person in the Contractor's employ working on a Canyons School District Information Technologies project considered by Canyons School District Information Technologies to be incompetent or disorderly, or for any other reason unsatisfactory or undesirable to the Information Technologies, such person shall be removed from work on the Canyons School District Information Technologies project.

f. Upon termination, the Communications Contractor shall be restricted from the premises and compensated for the percentage of work completed satisfactorily.

4. Other Contractor Responsibilities

   a. Confirmation of Pathway and Cable Manager Sizing:

      - Wherever cabling pathways or managers are installed, it is the Contractor's responsibility to confirm pathway or manager sizing to represent no more than 30% fill according to manufacturer's fill charts based on projected cable densities when racking systems and cabling pathways are fully populated.
      - Pathways overfilled upon installation will not be accepted and shall be remedied at Contractor expense.

   b. Contractor is responsible for the removal and disposal of all installation and construction debris created in the process of the job. All work areas will be cleaned at the conclusion of the workday and no tools or materials shall be left in a manner as to pose a safety hazard.

   c. Contractor must remove all abandoned cable per Article 800 of the National Electrical Code and per TIA and BICSI standards, recycling these materials where possible. Removal of orphaned cable is mandatory. Contractors must consider this when placing bids.

   d. Contractor shall abide by the regulations set by local Canyons School District's Security Policy pertaining to access and conduct while on Canyons School District property.

   e. Contractor shall all obey all posted speed limits and parking regulations at the Canyons School District facilities where the work is being performed.

F. Warranty

1. General

   a. Contractor shall provide a minimum 3 year warranty on all copper and fiber permanent cabling links. A 25-year extended warranty is desired and will be considered as preferred. Costs to increase the warranty beyond 3 years should be included with ineligible costs, if part of an e-rate project.

   b. Upon acceptance of Warranty the contractor will mail a notification letter to the installer and a notification letter and warranty certificate to Canyons School District Information Technologies.

2. Contractor Warranty Obligations

   a. Installation firm (Contractor) must be a current Panduit ONE℠ Partner, Silver or above, Leviton/Berk-Tek Certified Installer, Siemon/Mohawk Certified Installer, or Canyons School approved equal manufacturer in good standing and shall include a copy of the company installation certification with the bid.

   b. Contractor shall name a supervisor to serve on site as a liaison responsible to inspect and assure all terminations are compliant to factory methods taught in Panduit Technician Certification Training, Leviton/Berk-Tek Technician Certification Training, Siemon/Mohawk MAC or Canyons School approved equal, and according to all Standards cited in the Regulatory References section of this document.

   c. Contractor liaison (project supervisor) shall have a current, up-to-date Panduit Certified Technician (PCT) certificate, Leviton/Berk-Tek Certified Technician certificate, Siemon/Mohawk, or Canyons School approved equal in both copper and fiber. Copies of the copper and fiber certificates of the Panduit,

Leviton/Berk-Tek, or Canyons School approved equal liaison shall be submitted with the bid. These requirements are the same for accepted equivalent manufacturers. See “Substitution Policy” for mandatory procedure when offering substitutions.

d. Fiber optic cabling system additions and upgrade to existing facilities (Brownfield) shall match the fiber type (OM/OS designation) of the system to which it is being installed. Contractor shall under no circumstances mix different OM/OS classes of cable or termination devices (connectors) within the same system.

e. All intra-building new fiber optic installations shall utilize an appropriate construction of OM3 or OM4 multi-mode fiber as specified herein.

f. All UTP cable pulled and terminated shall be Category 6a cable and connectivity whether new or legacy systems. The exception to this is the 25 pair Category 5E cable installed for building controls as specified in this document.

g. All UTP terminations within the Canyons School District Information Technologies greenfield (new) projects shall be terminated using the T568B pin-out (wire map). Legacy additions shall match the copper pin-out of the facility to which cabling is being added-to or upgraded.

h. Contractor shall install all racking and support structures according to cited Standards in such fashion as to maintain both cited industry standards as well as manufacturer recommendations for uniform support, protection, and segregation of different cable types,

i. Contractor is responsible for maintenance of maximum pulling tensions, minimum bend radius, and approved termination methods as well as adhering to industry accepted practices of good workmanship.

j. Contractor is responsible for understanding and submitting to Panduit or Leviton/Berk-Tek all documents required prior to project start to apply for the Panduit Certification PLUS or Pan/Gen system warranty, Leviton/Berk-Tek Limited Lifetime Warranty, or Siemon Premium Warranty. These include but are not limited to the project information form and SCS warranty agreement. These requirements are the same for accepted equivalent manufacturers. See “Substitution Policy” for mandatory procedure when offering substitutions.

k. Contractor is responsible for understanding and submitting to Panduit, Leviton/Berk-Tek, Siemon/Belden, or other, all documents required at project end. These include, but are not limited to: completed warranty forms, passing test reports and drawings of floor plans showing locations of links tested. These requirements are the same for accepted equivalent manufacturers. See “Substitution Policy” for mandatory procedure when offering substitutions.

l. Test results shall be delivered in the tester native format (not Excel) and represent the full test report, summaries shall not be accepted. Contact your Panduit, Leviton/Berk-Tek, Siemon/Belden, or Canyons School approved equal’s representative for a current list of approved testers, test leads and latest operating systems.

m. The Communications Contractor will correct any problems and malfunctions that are warranty-related issues without additional charge to Canyons School District Information Technologies for the entire warranty period.

n. The warranty period shall commence following the final acceptance of the project by Canyons School District Information Technologies and written confirmation of Warranty from Panduit, Leviton/Berk-Tek, or Siemon/Belden. These requirements are the same for accepted equivalent manufacturers. See

"Substitution Policy" for mandatory procedure when offering substitutions.

END OF SUB-SECTION SECTION I

II. Installation and Maintenance Guidelines

A. Maintenance of Patch Fields

1. Any persons, whether with a Contractor or Canyons School District, adding or moving copper or fiber optic patch (equipment) cords shall do so in a neat, workmanlike fashion in keeping with the original system cable management design concept and according to all industry best practices as outlined in cabling standards and applicable BICSI publications referenced in this document.

2. Persons performing such moves, adds or changes (MACs) shall further adhere to the following:

    a. Use existing cabling management pathways and take care to place cable like with like, maintaining original segregation strategies for separating fiber and copper cables as well as any separation necessary between different types of copper cables.

    b. Cables shall be dressed neatly within patch management pathways with care taken to maintain minimum bend radius of not less than 1 times the cord outer diameter for copper and not less than a 1" bend radius for fiber jumpers as per ANSI/TIA 568-C.0.

    c. All patch cords used shall be of same copper Category or fiber OM/OS designation as the media used in the permanent cabling links.

    d. Patching in all cases shall be done using factory terminated cords manufactured for that purpose. Hand terminated patch cords will not be accepted.

    e. All patch cords or jumpers must be completely contained within supplied cable management paths. Cables draped across the front of cabinets or racks will not be accepted and shall be remedied at Contractor's expense.

    f. Any persons installing or moving fiber optic patch cords for any reason will clean the connector with lint-free wipes and 99% or higher isopropyl alcohol before replacing the connector in a patch or equipment port.

    g. Any technicians, whether with Canyons School District or Contractors performing moves, adds or changes within patch field will label additions to the system according to the labeling conventions in place at that facility.

    h. Any persons with Canyons School District or installing Contractor performing moves, adds or changes within patch field will record the move according to record system in place at that facility.

B. Cable Pulling and Termination

1. General

    a. Contractor is responsible for installing systems according to all applicable codes and the standards cited in this document.

    b. Contractor shall use grommets to protect the cable when passing through metal studs or any openings that can possibly cause damage to the cable.

c. Do not deform the jacket of the cable. The jacket shall be continuous, free from pinholes, splits, blisters, burn holes or other imperfections.

d. Install proper cable supports, spaced less than 5 feet apart, and within manufacturer's requirements for fill ratio and load ratings.

e. Leave a pull string to the end of each conduit run. Replace pull string if it was used for a cable pull.

f. Note service loops may not touch the ceiling assembly and if so must be remedied at the Contractor expense.

g. Label every cable within 12 in. of the ends with self-laminating wire wrap cable appropriate to that cable size. Use a unique number for each cable segment as required by the project documentation and the labeling section of this document.

h. Dress the cables neatly with hook and loop cable ties in telecommunications rooms. Plastic ties are approved in pathways where cable bundles will not be reentered.

i. Contractor is responsible for using plenum-rated cable ties in plenum spaces.

j. Contractors installing cabling systems in Canyons School District facilities shall install plenum rated cable in all instances. Non-plenum cable is not allowed and shall be removed at Contractor's expense.

a. Copper

a. When making additions to legacy systems, Contractor shall match the cabling configuration (pinout) of the existing systems. Legacy systems at Canyons School District Information Technologies are in most cases T568B.

b. Within all new (greenfield) installations within Canyons School District facilities, contactor shall use copper pinout T568B.

c. All four pair Category 6a cable runs shall be kept to a maximum permanent link length of 83 meters when using a total 10 meters of 28 awg/small diameter patch cords.

d. Copper links that are 90 meters in permanent link, shall not exceed 6 meters (total) of patch cords when using 28 awg/small diameter patch cords.

e. Use low to moderate force when pulling cable. Maximum tensile load may not exceed 25' lbs. maximum pulling force per 4 pair cable.

f. No pathway, including conduits shall have greater than a 30% fill per manufacturer fill charts. Contractor is responsible for bringing to the attention of Canyons School District Information Technologies project manager any insufficiently sized conduit or cable pathways in project documentation.

g. Keep Category 6a cables as far away from potential sources of EMI (electrical cables, transformers, light fixtures, etc.) as required in cited TIA Standards.

h. All copper horizontal cabling shall have slack service loops no less than 12" at the work area (equipment outlet) and not less than 3 feet in the telecommunications room. Provide a 25' service loop for all cables for cameras.

i. Slack at the work area may be stored in the ceiling and in the telecommunications room may be wall

mounted or contained in pathways or racking systems if done in a neat, workmanlike fashion.

j. Service loops shall be stored in such fashion as to not violate bend radius, slack touching the drop ceiling is not allowed and must be remedied at Contractor expense.

k. Maintain the twists of the pairs all the way to the point of termination, or no more than 0.5" (one half inch) untwisted.

l. All UTP patching shall be accomplished using Category 6a rated modular patch panels as indicated elsewhere in this document.

m. All removed copper cable is to be disposed of in a Canyons School District Information Technologies recycling bin designated for “copper”, or removed from the property to be disposed of by Contractor if this is the instructions in the project documentation.

b. Fiber

a. When making additions to legacy systems, Contractor shall match the fiber type and fiber connectors used within that system.

b. Within all new (greenfield) fiber installations within Canyons School District Information Technologies, contactor shall use Panduit OptiCam, Leviton FastCam, Siemon/Beldenor or Canyons School approved equal LC connectors as specified in the fiber section of this document.

c. When installing fiber cable, Contractor shall maintain a minimum bend radius, both under pulling load and installed, per requirements outlined within TIA standards, or manufacturer’s recommendations, whichever is the most stringent.

d. Fiber terminations shall be done according to recommendations of TIA, manufacturer’s requirements and accepted industry best practices.

e. All unjacketed fiber shall be contained within appropriate fiber enclosures. Exposed tight-buffered or loose-tube strands will not be tolerated and shall be remedied at Contractor’s expense.

f. Contractor shall use fusion splices when terminating loose-tube fiber.

g. Contractor shall perform test setup and testing according to guidelines in the “Testing and Acceptance” section of this document.

h. All fiber backbone links will extend from each IDF directly to the MDF (Home Run) except where agreed to by exception with Canyons School District Director of IT.

END OF SUB-SECTION SECTION II

III. Cabling Systems and Associated Infrastructure

A. Cabling Subsystem I – Horizontal Cabling System

1. Slack (Service Loops) in Horizontal UTP Cable

    a. Contractor shall provide a minimum 12” slack or service loop at the equipment outlet (work area) on each terminated copper horizontal permanent link. Work area slack shall be contained within boxes behind the faceplate only if this may be done easily without violating cable bend radius.

    b. Where there is not sufficient space in the work area box, Contractor may pull work area slack into the ceiling space and properly store service loop with appropriately rated hook and loop cable ties. Cable slack shall in no instances touch the ceiling grid or associated drop ceiling components or fixtures.

    c. Contractor shall provide a minimum of 10 feet slack or service loop in the horizontal telecommunications room on each terminated copper horizontal permanent link, to be stored on the wall backboard using appropriate mounting fixtures built to that purpose (i.e. D-rings).

    d. Contractor should consult project-specific documentation or their Canyons Schools project liaison for other mounting methods where wall mount is not an option.

2. Metal Conduit

    a. Cable in horizontal runs in classrooms shall be routed and contained in metal conduit.

    b. No conduits shall have greater than a 30% fill per manufacturer fill charts. Contractor shall size conduit large enough to accommodate 50% growth. (i.e., conduit for 4 cables shall be sized to accommodate 6 cables) Contractor is responsible for bringing to the attention of Canyons School District Information Technologies project manager any insufficiently sized conduit or cable pathways in project documentation.

3. Electrical Boxes

    a. Contractor shall size work area boxes to accommodate no less than 12” cable slack on each terminated Category 6a UTP cable run.

    b. Contractor shall use double-gang boxes behind single-gang faceplates if necessary for storing 12” cable slack (service loop) without violating minimum bend radius of 4X cable outer diameter.

    c. In work areas where slack storage in cable box violates cable bend radius, Contractor should pull slack into ceiling and affix with plenum rated hook and loop (re-enterable) cable ties. If drop ceiling is present. Cable shall under no circumstances be laid upon drop ceiling.

4. Copper Jacks – Category 6A

    a. Category 6a, eight-position copper jacks shall be Panduit Mini-Com® TX6A™ 10Gig UTP, Leviton/Berk-Tek, or Canyons School approved equal Jack Modules.

b. Category 6a jacks at the work area shall be color black unless otherwise indicated in project-specific documentation.

c. Category 6a jacks shall further meet the following requirements:

- Exceed ANSI/TIA-568-C.2 Category 6A and ISO 11801 Class EA standards
- Meet requirements of IEEE 802.3af and IEEE 802.3at for PoE applications
- Be 100% tested to ensure NEXT and RL performance and be individually serialized for traceability.
- Color-coded, keyed jack modules mechanically and visually distinguish connections to prevent unintentional mating with unlike keyed or non-keyed modular plugs accommodating more discrete networks.
- Include MaTriX split foil tape to suppress the effects of alien crosstalk, allowing 10 Gb/s transmission even in high density 48-port, 1RU patch panels.
- Utilize patent-pending enhanced Giga-TX ™Technology for jack terminations which optimizes performance by maintaining cable pair geometry and eliminating conductor untwist.
- Meets ANSI/TIA-1096-A contacts plated with 50 microinches of gold for superior performance.
- Rated for 2500 cycles with IEEE 802.3af / 802.3at and proposed 802.3bt type 3 and type 4
- Require no punch down tool required; termination tool (EGJT) ensures conductors are fully terminated by utilizing a smooth forward motion without impact on critical internal components for maximum reliability.
- Have available a high-volume “gun-style” optional termination tool (TGJT) that reduces termination time by 25% and is ideal for high volume installations.
- Have guaranteed ability to be re-terminated a minimum of twenty times without measurable degradation of performance.
- Employ a blue termination cap to designate Category 6A performance at a glance and provides positive strain relief; help control cable bend radius and securely retain terminated cable.
- Have range to terminate 4-pair, 22 – 26 AWG, 100 ohm, solid or stranded twisted pair cable.
- Utilize a universal termination cap is color-coded for T568A and T568B wiring schemes for flexibility across installations.
- Accept 6 and 8-position modular plugs without damage to conductor pins.
- Identified options that include optional labels and icons.
- Be compatible with Mini-Com ® Modular Patch Panels, Faceplates, and Surface Mount Boxes.
- Have available optional RJ45 blockout device that blocks out unauthorized access to jack modules and potentially harmful foreign objects, saving time and money associated with data security breaches, network downtime, repair, and hardware replacement
- Have an optional dust cap keeps out dust and debris while not in use

d. See Appendix A for part numbers.

5. Flush Mount Equipment Outlets (Faceplates)

a. When adding horizontal cabling to existing facilities Brownfield within Canyons School District, Contractor shall match the existing cable plant in regards to color of existing raceway and faceplates.

b. Unless otherwise instructed on project-specific documentation, all Canyons greenfield (new) projects shall use Panduit Mini-Com® Classic Series sloped faceplates, Leviton faceplates with label cover, of international white (IW) color, or a Canyons School District approved equal.

c. Plastic sloped faceplates shall be in 4 or 6-hole single-gang configuration, or double-gang 8 hole configurations as needed for the number of cables at that workstation.

d. Plastic faceplates for greenfield applications shall further have the following properties:

- Accept Mini-Com® or Leviton Modules for STP and UTP, fiber optic, and audio/video, which snap in and out for easy moves, adds, and changes.
- Include label/label covers for easy port identification.
- Replacement label/label covers available.
- Optional icons available.

e. Some greenfield projects for Canyons School District will require Panduit Mini-Com® or Leviton stainless steel faceplates with label fields, in single-gang 4-hole or double-gang 8-hole configurations, (or Canyons approved equivalent). See project-specific documentation or consult the Canyons project liaison if clarification on faceplate type is needed.

f. Stainless faceplates, where used, shall meet the following criteria:

- Accept Mini-Com®, Leviton Modules for STP and UTP, fiber optic, and audio/video, which snap in and out for easy moves, adds, and changes.
- Include label/label covers for easy port identification.
- Replacement label/label covers available.
- Impact-resistant 304 stainless steel suitable for light industrial environments.

g. Contractor shall use blank inserts to reserve space on any unused positions (holes) in plastic or stainless plates.

h. See Appendix A for part numbers.

6. Horizontal Copper Cable

a. Inside 4 pair horizontal cable for Canyons School District facilities shall be CAT6a high-performance, jacketed, plenum rated General Cable, or Canyon School approved equivalent. Jacket colors shall be as follows: green to security cameras, gray to non-networked infrastructure [e.g., lighting controls, motion/fire sensors], blue to all network data drops, and yellow to A/V controllers and devices.

b. In addition, inside 4 pair Category 6a UTP copper cable must meet the following mechanical and performance criteria:

- UL Listed CMP-LP, UL Limited Power (LP) Certified
- Meet TIA TSB-184-A/ IEEE P802.3bt “LP” rating for Limited Power cable requirements
- Exceeds requirements of ANSI/TIA-568-C.2 Category 6A and ISO 11801 Class EA channel standards.
- Exceeds requirements of ANSI/TIA-568-C.2 and IEC 61156-5 Category 6A component standards.
- Meets requirements of IEEE 802.3af and IEEE 802.3at for PoE applications.
- Meets requirements of ANSI/TIA 862
- Meets requirements of ICEA S-116-732
- Third party tested to comply with ANSI/TIA-568-C.2.
- Cable diameter: Plenum 0.250 in nominal.
- Installation temperature range: (0°C to 60°C).
- Operating temperature range: (-20°C to 90°C).
- Include Encapsulated Isolation Wrap to suppress the effect of alien crosstalk allowing 10 Gb/s transmission, while minimizing cable diameter.
- Descending length cable markings enable easy identification of remaining cable which reduces installation time and cable scrap.

c. Outside run 4 pair horizontal cable for Canyons School District facilities shall be high-performance, black jacketed, General Cable CAT6a OSP cable constructed for wet or outside-plant applications, or Canyon School approved equivalent.

d. In addition, outside run 4 pair Category 6a UTP copper cable must meet the following mechanical and performance criteria:

- Outdoor horizontal cable drops shall use 23 AWG category 6A 4-pair UTP outdoor cable.
- Cable jacketing shall be black.
- Cable shall be intended for outdoor installation in buried conduit or as aerial cable.
- Installation temperature range (-30 to +60C)
- Operation temperature range (-45 to +80C)
- The cable core shall be Gel-filled construction to prevent moisture migration in underground and wet applications.
- OSP type cables shall have a nominal diameter less than or equal to .365”

e. See Appendix A at the end of this document for cable part numbers.

7. Distributor I (Horizontal Patch Panels)

a. Canyons School District Information Technologies copper patch panels in the horizontal patch fields shall be flat 1 RU or 2 RU Panduit modular Mini-Com® or Leviton Modular Faceplate Patch Panels, or approved equivalent as needed to accommodate UTP cable quantity.

b. Modular patch panels shall be standard density of 24 ports per rack unit.

c. Contractor shall populate modular panels with black Panduit or Leviton Category 6a jacks, or approved equivalent as described elsewhere in this document. See Appendix A for part numbers on jacks to go with modular patch panels.

d. Contractor shall pair modular patch panels in alternating fashion with workgroup switches allowing for use of 12” Category 6a patch cords for one-to-one switch patching, eliminating the need for horizontal cable managers between the switches and patch fields. See illustration below for example of one-to-one switch patching strategy.

Example of one-to-one switch patching

e. Patch Panels shall further meet the following criteria:

- Have release snap feature on faceplate to allow front access to installed modules.
- Accept Mini-Com®, Leviton or Canyons School approved equal Modules for UTP, fiber optic, and audio/video, which snap in and out for easy moves, adds, and changes.
- Be available in label versions available for easy port identification, with replacement label/label covers available.
- Mount to standard EIA 19" racks or 23" racks with optional extender brackets.

- Be available in angled patch panels to facilitate proper bend radius control and minimize the need for horizontal cable managers.

f. For detailed part numbers see “Appendix A” at the end of this document.

8. Copper Patch Cords

a. Copper patching of Category 6a links in Canyons School District facilities shall use blue Panduit 28 awg “small diameter” slim patch cords, Leviton High-Flex HD6, or Canyons School approved equal.

b. Security camera patch cables shall be green. If other color patch cords are needed to designate particular applications, see Appendix A for instructions on changing patch cord colors.

c. In telecommunications rooms utilizing individual workgroup switches, Contractor shall alternate patch panels with switches, using 12” patch cord lengths in “one-to-one” switch patching strategy as indicated in the patch panel section of this specification (above).

d. Core (chassis) switches shall utilize whatever length patch cords necessary for an efficient and neat, workmanlike installation.

e. Small diameter patch cords shall have the following characteristics:

- Cable diameter not more than 0.185 in. (4.7mm) nominal.
- Category 6A/Class EA channel and component performance.
- Exceeds all ANSI/TIA-568-C.2 Category 6A and ISO 11801 Class EA electrical performance requirements for all frequencies from 1 to 500 MHz
- FCC and ANSI compliance: Meets ANSI/TIA/EIA-1096-A; contacts plated with 50 micro inches of gold for superior performance.
- IEC compliance: Meets IEC 60603-7
- PoE compliance: Meets IEEE 802.3af and IEEE 802.3at for PoE applications in bundle sizes up to 48 cables.
- Operating temperature: 14°F to 140°F (-10°C to 60°C).
- Storage temperature: -40°F to 158°F (-40°C to 70°C).
- Plug housing: UL94V-0 rated clear Polycarbonate.
- Contacts: Gold plated phosphor bronze.
- RoHS compliance: Compliant.
- Flammability rating: CM/LSZH dual rated.

f. Note: These patch cords utilize 28 AWG conductors which do not meet the 22 to 26 AWG conductor size of patch cable referenced in ANSI/TIA-568-C.2, resulting in an increased attenuation de-rating value of 1.9. These patch cords support 96-meter channels that include 90-meter permanent links. And 6 meters of patch cord, or supports 93-meter channels with 10 meters of patch cords included in the channel.

g. See Appendix A for part numbers.

9. Surface Mount Raceway

a. On brownfield installations, Contractor shall match raceway to that already installed in the facility unless instructed otherwise in project-specific documentation.

b. On greenfield installations where environment (cinder block walls) or project documentation requires cable to be surface-mounted in the work area; horizontal cable shall be routed through Panduit LD10 International White (color), Leviton plastic latching-duct raceway or Canyons approved equivalent.

c. Areas requiring power and data be run through single raceway with partition (separator), Contractor shall utilize Panduit LDP10, Leviton, or Canyons School approved equal raceway or T-70 raceway system as needed to accommodate all cable with not more than a 30% fill according to manufacturer fill tables.

d. No raceway shall have greater than 30% fill upon installation, providing room for at least 50% growth in additional cables: i.e., a work area requiring 4 cables, raceway shall be sized to hold 6.

e. Contractor is responsible that raceway installation includes all associated fittings, drop ceiling fittings, couplers and 1” control-bend-radius fittings where appropriate.

f. Contractor shall not rely on the pressure sensitive adhesive foam to mount raceway, but rather use adhesive to hold raceway in place while screwing down the raceway to the structure beneath using anchors appropriate to the wall type at intervals not to exceed 2 ft (24 inches).

g. Standard LD-10 Panduit, Leviton or Canyons School approved equal raceway shall have the following features:

- For routing data and low voltage cabling.
- One-piece hinged design allows cables to be laid in.
- Factory applied adhesive backing speeds installation.
- FT4 rated.
- Terminates using surface mount outlet box solutions, Panduit Mini-Com, Leviton or Canyons School approved equal surface mount boxes.

h. Installations requiring raceway shall use the same faceplates used in flush-mount applications as specified in this document, mounted on Panduit “JB1”, Leviton surface boxes, or Canyons approved equivalent. Contractor shall not rely on adhesive-backing to hold surface boxes in place, but must use appropriate wall anchors for firm, permanent installation.

i. Some Canyons facilities may require metallic raceway systems. Consult project-specific documentation or the Canyons School District project liaison if clarification on raceway type is needed.

j. See Appendix A at the end of this document for part numbers.

C. Cabling Subsystems II - Intrabuilding Backbone Fiber

1. Fiber Cable

   a. On additions to existing Canyons School District fiber cable plant (brownfield projects), Contractor shall match existing fiber and connector types.

   b. In new (greenfield) Canyons School District projects, backbone fiber running between telecommunications rooms on the same floor, or between floors in the same building shall be General Cable indoor/outdoor, Berk-Tek, plenum-rated, armored, 50 micron cable of 12 or 24 strand count, or Canyons approved equal. See “Substitution Policy” for mandatory process if offering equivalents.

   c. Contractor shall install OM4 version of cable described for all telecommunications spaces that are spaced 300 meters or closer for use with 10G Ethernet. Note this will be almost all instances in Canyons School facilities.

   d. Fiber optic cable shall further have the following features:

      - Product Construction: Fiber: 4–144 fibers, 900 µm tight buffer, Color-coding per TIA/EIA 598 B.
      - Overall Strength Member: Water-swellable aramid fiber yarn
      - Inner Jacket: Flame-retardant compound.
      - Armor: Interlock aluminum.
      - Outer Jacket: Flame-retardant compound, UV-resistant black jacket, Sequential footage markings/
      - Features: Interlock armor provides outstanding mechanical protection, Interlock armor is flexible and easy to use tight buffer provides individual fiber protection, sub-units are numbered for identification.
      - Performance: Temperature: Storage -40˚C (-40˚F) to +70˚C (+158˚F), Installation 0˚C (+32˚F) to +50˚C (+122˚F), Operating -20˚C (-4˚F) to +70˚C (+158˚F).
      - Minimum Bend Radius: 20 X OD—Installation, 10 X OD—In-Service.
      - Maximum Crush Resistance: 1,500 lbs/in (2,627 N/cm).
      - Applications: Harsh premises environments requiring heavy-duty protection, outdoor use in ducts and underground conduits.
      - ETL Type OFCP for installation in any premises location when installed in accordance with NEC article 770.154 and 770.179.
      - Compliances: ETL Listed Type OFCP, CSA FT6, TIA 568 C.3, ICEA S-104-696, GR-409, RoHS Compliant Directive 2002/95/EC.

e. Contractor shall bond to ground armor from fiber backbones at both ends as indicated in the grounding section of this document; using armored cable grounding kits listed in the Appendix A grounding section.

f. See Appendix A for all fiber cable part numbers.

2. LC Fiber Connectors

a. All tight-buffered indoor fiber trunks shall be terminated using Panduit LC OptiCam®, Leviton FastCam Fiber Optic Connectors or Canyons approved equal.

b. LC cam connectors shall further have the following properties:

- Be a TIA/EIA-604 FOCIS-10 compatible connector that exceed exceeds TIA/EIA-568-B.3 requirements.
- Have connector backbone and boot colors that follow TIA/EIA-568-C.3 suggested color identification scheme.
- Have insertion loss: 0.3dB average (multimode and singlemode).
- Have return loss: >26dB (10Gig ™multimode), >20dB (multimode), >50dB (singlemode).
- Be a spring-loaded “Senior” rear pivot latch LC connector.
- Be a pre-polished cam style termination for in less than half the time of field polish connectors.
- Have patented re-termination capability provides yield rates approaching 100%.
- Feature a factory pre-polished fiber end face eliminates time-consuming field polishing to reduce installation costs, labor, scrap and the number of tools required.
- Be cam activated, with fiber and buffer clamp mechanisms that provide superior fiber and buffer retention with less sensitivity to fiber tensile loading.
- Utilize OptiCam® or FastCam Termination Tools that simplifies tooling and termination, and virtually eliminates operator error by providing a visual indication of proper termination after the cam step has been completed.
- Have a range of cable retention boot assemblies that consistently provide higher than industry standard cable retention.
- Include a non-optical disconnect that maintains data transmission under tensile loads for jacketed cable.
- Have ability to accept 900µm tight-buffered fiber with included boot(s), and accept 1.6mm – 2.0mm and 3.0mm jacketed cable with available OptiCam ®Cable Retention Boot Assemblies (ten per package).

c. See Appendix A for part numbers on LC fiber connectors.

3. Fiber Enclosures

a. Fiber cable terminations shall be contained in 1 RU, or 2 RU Panduit FCE series, Leviton rack mount fiber enclosures, or Canyons approved equal.

b. Contractor shall select enclosure size as needed for the number of fibers projected to be in that telecommunication space when fully populated. The average horizontal telecom room (Distributor 1) will

not require more than one single RU fiber enclosure, which will house up 48 OM3 fiber strands.

c. Contractor shall fill any unused enclosure space with a blank fiber adapter panel (FAP).

d. FCE enclosures shall further have the following properties:

- Be able to hold Panduit QuickNet ™ Fiber Optic Cassettes, Opticom ® Fiber Adapter Panels, or splice modules, Leviton or Canyons School approved equal.
- Have a slide-out, tilt-down drawer to provide full front access to all fibers and cables.
- Employ integral bend radius control and cable management appliances for fiber optic patch cords.
- Have rear cable management for proper slacking/spooling of trunk cable break-outs and interconnect cables.
- Have multiple trunk cable entry locations and include fiber optic cable routing kit (grommets, cable ties, spools, strain relief bracket, and ID/caution labels) for different installation configurations.

e. See Appendix A for part numbers.

4. Fiber Adapter Panels

a. FCE fiber enclosures shall be populated with OM3 fiber adapter panels containing 6 duplex fiber adapters.

b. Contractor is responsible to blank out any enclosure spaces where adapter panels are not used.

c. Adapter panels shall further have the following features:

- Loaded with TIA/EIA-604 FOCIS-10 compatible adapters.
- Exceed TIA/EIA-568-B.3 requirements.
- Adapter housing colors follow TIA/EIA-568-C.3 suggested color identification scheme.
- Snap quickly into the front of all Opticom ® components
- LC fiber adapter panels are Sr/Jr. to conserve enclosure space.
- Accept FOCIS-10 compatible senior LC connectors at either end and FOCIS-10 junior LC connectors at the inside end for behind the wall applications.
- Both ends accept FOCIS-10 compatible senior LC connectors.
- Junior end also accepts FOCIS-10 compatible junior (fixed ferrule/springless) LC connectors.
- Choice of phosphor bronze or zirconia ceramic split sleeves to fit specific network requirements; zirconia ceramic split sleeves are recommended for OM4/OM4 multimode and OS1/OS2 single mode applications.
- Every adapter is laser marked with Q.C. number to assure 100% traceability.
- LC adapters are also available in QuickNet ™ Fiber Optic Cassettes, Leviton Opt-X fiber modules

and cassettes or Canyons School approved equal.

d. See Appendix A for fiber adapter panels and blank adapter panels.

5. Fiber Patch Cords

a. Fiber patch fields within Canyons School District facilities shall utilize Leviton, Panduit “push/pull” fiber jumpers (fiber patch cords) or Canyons School approved equal that have the following properties:

- Push-Pull LC Duplex Fiber Optic Patch Cords shall feature the push-pull strain relief boot and duplex clip, to allow users easy accessibility in tight areas when deploying very high density LC patch fields.
- Jumpers shall be available in OM3, OM4 and single-mode and be available in in riser (OFNR), plenum (OFNP), and low smoke zero halogen (LSZH) rated jacket materials.

b. See Appendix A for part numbers.

6. Category 5E, 25-Pair Building Controls Backbone Cable

a. One gray jacketed, plenum rated, 25 pair Cat 5e cable shall be installed from the MDF to reach every individual IDF to serve as backbone for building controls.

b. 25 Pair 5E cable shall be General Cable or Canyons approved equivalent and shall meet the following mechanical and performance criteria:

- Conductors: • 25 pairs of 24 AWG solid bare annealed copper.
- Insulation: Non-Plenum: Polyolefin Plenum rated Fluoropolymer,
- Color Code: Standard except no bandmarking; only solid colors.
- Rip Cord: Applied longitudinally under jacket.
- Jacket: Plenum: Low-smoke, flame-retardant PVC.
- Separator: Plenum: Core filler.
- Nominal Cable Diameter: .5”.
- Nominal Cable Weight (lbs/1000 ft): 160 lbs.
- Temperature Rating Centigrade (Installed): 0 to +60.
- Temperature Rating Centigrade (Operation): -20 to +75.

c. 25 pair 5E control backbone shall be terminated on wall mount 100 Pr 110 blocks with C5 clips at the MDF end and on a 24-port patch panel in the IDF end.

d. The patch panel in the IDF end is to be installed below the fiber enclosure at the top of the rack with one available rack unit reserved below it.

e. 5E patching in the IDF shall use white jacketed small diameter Panduit, Leviton 5E patch cords or Canyons approved equivalent.

f. Copper backbone must likewise be installed in satellite buildings. Consult project-specific documentation or Canyons project liaison is clarification is needed.

g. See Appendix A for complete part numbers for fiber and copper backbone cable and termination hardware.

D. Cable Pathways

7. J-Hooks

a. Bundles of 120 Category 6a cables or less may be required to be routed above ceilings using J-hooks. Check project documentation for clarification.

b. J-hook systems used by Canyons School District Information Technologies shall be Panduit “J-Pro” series, Leviton or School approved equivalent.

c. Contractor installing J-hook systems shall space them no more than 5 feet apart as per TIA 569-C standard.

d. Contractor is responsible for proper sizing of J-hook systems based upon cable count and manufacturers recommendations for fill, with new J-hooks to have not more than 30% fill per manufacturer’s fill charts based upon projected worst case future bundle size.

e. If J-hooks are deemed too small by above criteria, Contractor shall bring this to the attention of Canyons School District for resolution in writing. J-hook pathways that will not have sufficient capacity should be replaced in the design with the proper sized basket tray for future cable additions and flexibility.

f. J-hook systems used by Canyons School District Information Technologies shall have the following properties:

- Patented design provides complete horizontal and vertical 1" bend radius control that helps prevent degradation of cable performance.
- UL 2043 and CAN/ULC S102.2 listed and suitable for use in air handling spaces.
- Pre-riveted assemblies allow for attachment to walls, ceilings, beams, threaded rods, drop wires and underfloor supports to meet requirements of a variety of applications.
- Wide cable support base prevents pinch points that could cause damage to cables.
- Cable tie channel allows user to easily install 3/4" (19.1mm) Tak-Ty ® Cable Ties to retain cable bundle.
- Durable non-metallic J Hook materials provide the ability to manage and support a large number of cables.
- Material: Black Nylon 6.6 J Hook with metal attachments.

g. See Appendix A for part numbers.

E. 19” Racks and Rack-mount Cable Managers

1. Four-Post Communications Racks

    a. Contractor shall mount IT equipment and patching systems on threaded rail 7 foot, 4-post racks, unless forced to use 2-post due to telecommunications room space constraints.

    b. All racks shall utilize threaded hole rails. Cage nut rails are banned within Canyons facilities and will not be accepted.

    c. 4-post racks shall be of 30”, 36”, or 41.5” depth as needed by mounted equipment. Contractor is responsible for confirming proper depth to be used.

    d. 4-post racks shall be the 4 Post Cable Management Rack System or Canyons School District approved equivalent, and must have the following features:

        - Independent adjustable front and rear mounting rails can be adjusted while the rack is secured to the floor.
        - Printed rack space identification on all equipment rails allows for quick location of rack spaces, speeding installation of rack mount items (shipped numbers up per TIA-606B specifications; can be set to number down by flipping the rails).
        - Rack is UL listed for 2,500 lbs. load rating.
        - Rear rail construction provides a clear ventilation path for side ventilated switches.
        - Multiple mounting holes in top flanges for securing ladder rack.
        - Weld nut construction eliminates the need for a second wrench increasing speed and ease of assembly.
        - Multiple mounting locations for vertical power strips on any of the four posts or on the adjustable mounting rails.
        - PatchRunner™ and NetRunner™ Vertical Cable Managers mount directly to the 4 post rack at any of the four corners to provide a flexible end-to-end cable management solution.
        - Paint piercing washers included to electrically bond rack for simplified grounding.

    e. See Appendix A for part numbers.

2. Two-post Communications Racks

    a. Contractors may use 19”, 2-post communications racks only in telecommunication rack spaces too small to use 4-post racks. Prior notification must be given to the CSD Director of IT.

    b. 2-post racks, when necessary, will be Panduit or Leviton black-powdered aluminum (or Canyons approved equivalent) and have the following properties:

        - 19" EIA rack, aluminum.
        - Dimensions: 96.0"H x 20.3"W x 3.0"D (2134mm x 514mm x 76mm).

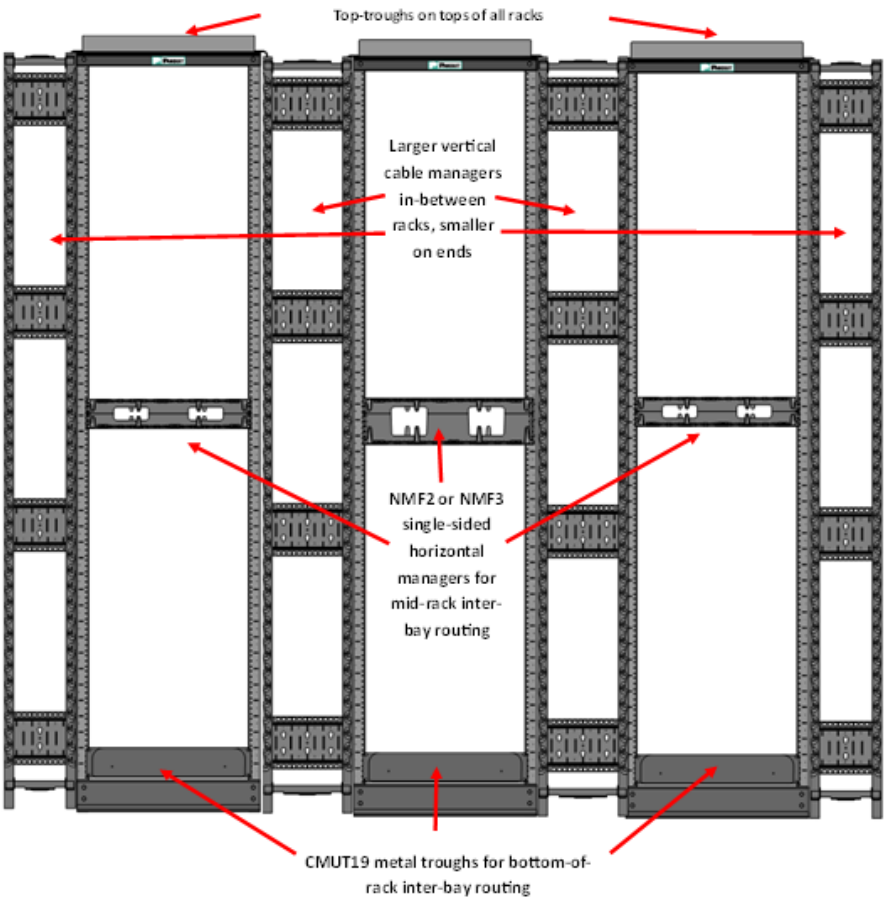
- Rack units numbering up from bottom to allow quick and easy location of rack mount items
- UL listed for 1,000 lbs. load rating.
- Double-sided #12-24 EIA universal mounting hole spacing with 24 #12-24 mounting screws included.
- Accepts all Panduit or Leviton cable management and patch panel products in addition to any industry standard 19" components or Canyons School approved equal.
- Includes paint piercing washers for assembly to assure electrical continuity between components as pert TIA 607-B Bonding and Grounding Standard.

c. In telecommunications rooms with multi-bay rack rows configured such that patching will take place between racks, Contractor is responsible to include in design interbay routing pathways at the top, middle and bottom of each bay to provide efficient and neat interbay routing.

d. Interbay routing shall be provided in the form of top troughs, interbay mid-rack path and flanged shelf at the bottom. (See “Illustration of Interbay Routing” below).

Illustration of Inter-bay Routing in Rack Systems

(Note: Doors left off vertical and horizontal managers for clarity)



e. For bottom-of-rack interbay routing where cable quantities exceed capacity of CMUT19 troughs, Contractor shall substitute 4RU trough CMLT19.

f. All racks shall be outfitted with a vertical grounding busbar along one rail, with all equipment bonded to ground according to TIA 607-B Bonding and Grounding Standard. See Bonding and Grounding section of this document for details.

g. See Appendix A for part numbers.

3. Rack-mounted Cable Management – Vertical Managers

a. Vertical cable managers shall be PatchRunner™ high capacity vertical Cable management system in sizes 6” wide, 8” wide, 10” wide and 12” wide, Leviton vertical cable management systems or Canyons School approved equivalent.

b. Contractor will use double-sided (front and back) vertical managers on fronts of 4-post racks.

c. All vertical cable managers shall have metal dual hinged doors.

d. Contractor shall choose vertical cable manager width according to manufacturer's fill tables to not represent more than a 35% fill at installation based on projected worst-case density when racks are fully populated.

e. Vertical cable managers shall have the following features:

- High density minimizes area required for network layout, freeing up valuable floor space.
- Allows mounting of many standard EIA 19" accessories, such as patch panels, vertically in the manager.
- Ventilated sidewalls provide maximum airflow for equipment cooling.
- Snap on finger sections can be removed to improve airflow, and breakaway fingers allow routing of large cable bundles.
- Large finger spacing accommodates up to 48 Cat6A cables.
- Optional sure-close dual hinged metal doors provide easy access to vertical pathway and provide visual and audible feedback on closure.
- Available in 7-foot version.

f. See Appendix A for part numbers.

4. Rack-mounted Cable Management – Horizontal Managers

a. One-to-one switch patching strategy largely eliminates the need for horizontal cable managers, but there still may be instances requiring them. One example is in the network core where chassis switches are used.

b. For these areas requiring horizontal cable managers, Contractor shall user double-sided NetManager ™ high capacity horizontal cable managers, Leviton horizontal cable managers or Canyons approved equal having the following features:

- Innovative inset fingers slope inward toward back of managers offering unobstructed access to network cabling for easier moves, adds, and changes.
- Large front finger openings easily accommodate Category 6a and 10 G/b E cables, speeding installation and reducing maintenance costs.
- Rear cable management finger spacing utilizes open D-rings for greater accessibility.
- Can be used to create large capacity horizontal pathways for routing cable.
- Patented front and rear dual hinged cover allows cable access without removing cover.
- Curved surfaces maintain cable bend radius.
- Pass-through holes allow for front to rear cabling.
- Built in cable retainers hold cable in place for easy moves, adds, and changes.
- Mount to 19" EIA racks and cabinets.

- Covers, #12-24 and M6 mounting screws included.
- Design fits flush to the front of the NetRunner ® High Capacity WMPVHCF45E and WMPVHC45E Vertical Managers or Leviton vertical cable managers.

c. See Appendix A for part numbers.

F. Cable Accessories

1. Cable Ties

a. Cable bundles on racks and in pathways shall be bundled with re-enterable hook and loop cable ties that come in continuous rolls.

b. Contractor is responsible for using plenum hook and loop ties in air-return spaces.

c. See Appendix A for part numbers.

2. Physical Security Devices

a. Some portions of Canyons School District networks require additional physical security devices. These take three forms:

b. Devices that block-out copper and fiber ports in patch fields and faceplates that require a special tool for removal.

c. Devices that lock-in copper patch cords and require a special tool for removal of those patch cords.

d. Devices that temporarily or permanently block USB ports on laptops and computers.

e. Areas where such devices are required will be called out in the project documentation.

f. See Appendix A for part numbers.

G. Communications Grounding Network

1. General

a. Contractor is responsible for bonding to ground all newly placed equipment and installed racks or cabinets per the TIA 607-B Standard.

2. Room Busbars

a. All Telecommunications spaces and distributor rooms shall have installed an appropriately sized wall-mount busbar with BICSI hole spacing that bonds to the building bonding backbone.

b. See Appendix A for appropriate room telecommunications grounding busbar.

3. Rack and Equipment Grounding

a. Contractor is responsible for properly grounding all network equipment, racks and cabinets and bonding

them to the wall mounted busbars as described in the TIA 607-C standard.

b. All newly installed racks and cabinets shall have installed a vertical busbar mounted along one equipment rail to serve as a clean, low-resistance bonding place for any equipment not equipped with a designated grounding pad.

c. Smaller equipment without an integrated grounding pad shall be bonded to the vertical busbar through the use of a thread-forming grounding screw that is anodized green and includes serrations under the head to cut through oxidation or paint on the equipment flange.

d. Larger equipment (chassis switches) with a designated grounding terminal shall be bonded to the vertical busbar with an EBC (equipment bonding conductor) kit built to that purpose.

e. Contractor shall take care to clean (wire brush, scotchbrite pads) any metallic surface to be bonded down to bare metal and apply a film of anti-oxidation paste to the surfaces prior to effecting the bond.

f. All bonding lugs on racks and busbars shall be of two-hole irreversible compression type. Mechanical lugs and single-hole lugs will not be accepted and shall be removed and replaced at Contractor's expense.

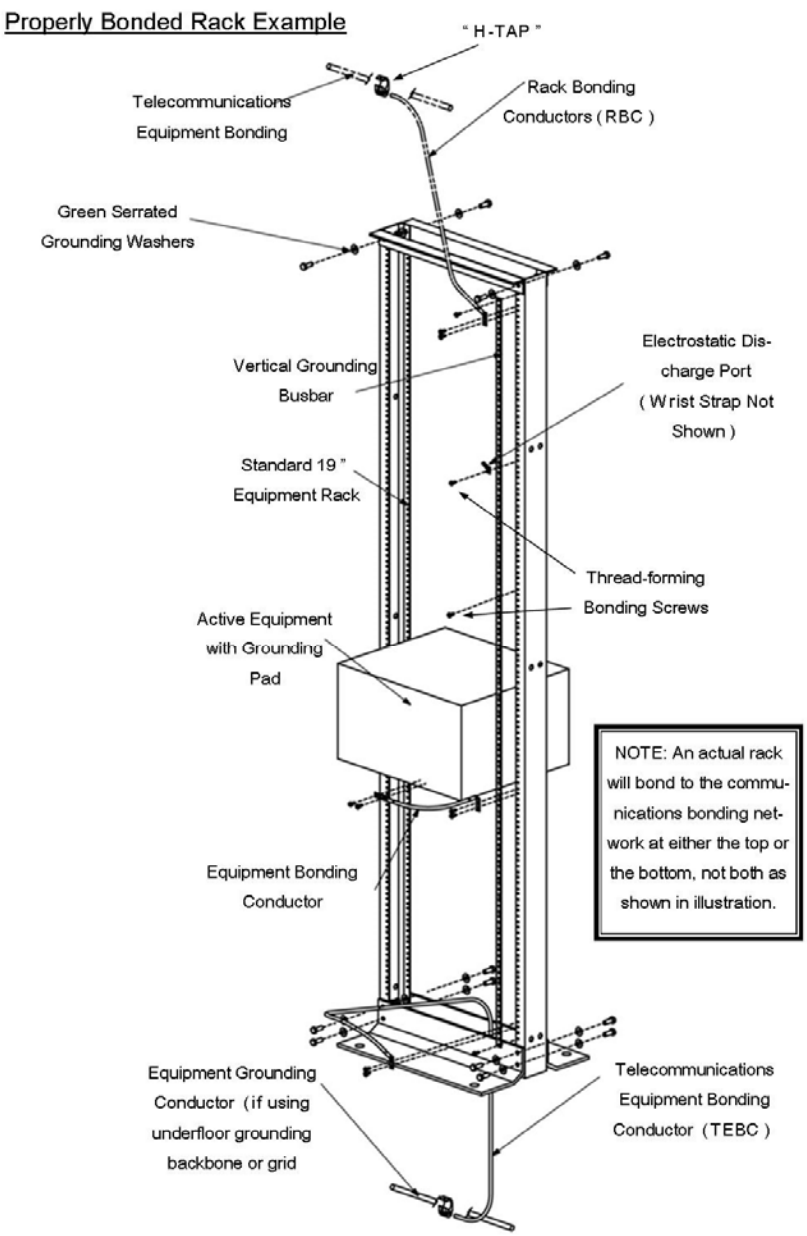
g. Every rack or cabinet shall have an individual bonding conductor into the grounding network, serially connecting (daisy chaining) of racks is expressly forbidden and will not be accepted.

h. Rack Bonding Conductors (RBC) may tap into an overhead or under floor aisle ground, or may run to the wall-mounted grounding busbar in smaller Telecommunications rooms containing 5 racks or less.

i. A minimum of every other rack or cabinet shall be outfitted with a properly installed and bonded ESD (electro-static discharge) port along with a wrist strap and lead to be used by any technicians servicing network equipment. On four post racks and cabinets, these ESC ports and straps shall be provided on front and back to be accessible and able to reach any active equipment needing servicing.

j. Armored cables shall be properly bonded to the earthing system on both ends with a kit built to that purpose.

k. For examples of rack grounding, refer to the illustration below:



END OF SUB-SECTION SECTION III

H. Communications Entrance Facilities

1. General

    a. All entrance facilities shall be installed, grounded and bonded per applicable building, fire and electrical codes

    b. A minimum of qty 1 (one) 4" metal conduit shall extend from the Canyons School District owned handhole/vault at the property line to the MDF.

    c. A minimum of qty 1 (one) 4" conduit (item b – above) shall contain qty 3 (three) 1.25" innerduct from the handhole to the MDF.

    d. All innerduct shall contain a secured pull string/tape.

IV. Network Labeling

A. General Requirements

1. When labeling any Canyons School District Information Technologies network system, whether existing or new, Contractor shall always adhere to the following requirements:

    a. Contractor shall, wherever possible pre-print labels using Panduit Easy-Mark software and laser jet printer, Leviton or Canyons approved equivalent.

    b. The Panduit PanTher (LS8E) hand-held thermal transfer printer, Leviton or Canyons approved equivalent shall be used on site to print labels that were unanticipated, or that become damaged in application.

    c. This labeling strategy shall, at a minimum, clearly identify all components of the system: racks, cables, panels and outlets, grounding, pathways and spaces like telecommunications rooms.

    d. Racks and patch panels shall be labeled to identify the location within the cable system infrastructure.

    e. All labeling information shall be recorded on the as-built drawings and all test documents shall reflect the appropriate labeling scheme.

    f. All label printing will be machine generated by either hand-held labeling systems or computer generated using programs and materials built specifically for communications labeling.

    g. Hand written labels will not be accepted and must be remedied at Contractors expense.

    h. Cabling system labels shall utilize materials designed to outlast the cabling elements to which they attach. Office quality labels will not be accepted.

    i. Cable labels shall be self-laminating, appropriately sized to the outside diameter of the cable and placed within view at the termination point on each end.

    j. Outlet, patch panel and wiring block labels shall be installed on, or in, the space provided on the device.

    k. Machine-generated labels shall be installed behind the clear lens or cover on any device that provides such an option.

l. All labels will be permanently affixed to installed cables, patch panels, racks, cabinets, and enclosures.

m. Labels shall be legible and placed in a position that insures ease or visibility. Label type must be as listed in Appendix A - Materials section at the end of this document.

n. Conduit shall be marked indicating the identification of the cable within.

o. All cabling added to existing “legacy” installations shall follow the labeling convention in place at that location.

p. All labeling of installed cabling in new (greenfield) projects shall satisfy all requirements of TIA 606-B, or be modified as indicated in the project specific documentation.

END OF SUB-SECTION IV

V. Testing and Acceptance

A. General

1. All cables and termination hardware shall be 100% tested for defects in installation and to verify cabling system performance under installed conditions.

2. All copper pairs or optical fibers of each installed cable shall be tested and verified prior to system acceptance.

3. Any defect in the cabling system performance or installation including but not limited to cable, connectors, feed through couplers, patch panels, and connector blocks shall be repaired or replaced in order to ensure 100% useable conductors or fibers in all cables installed.

4. All cables shall be tested in accordance with this document, the ANSI/TIA Standards, the PANDUIT® Certification Plus or PanGen™ System Warranty, Leviton/Berk-Tek Limited Lifetime Warranty, or Canyons School approved equal guidelines and best industry practice.

5. If any of these are in conflict, the Contractor shall bring any discrepancies to the attention of the project team for clarification and resolution.

a. Copper Link Testing

1. All twisted-pair copper cable links shall be tested for compliance to the requirements in ANSI/TIA 1152 and ANSI/TIA 568-C.2 for the appropriate Category of cabling installed using a test unit meeting a minimum IEC IIIe level of accuracy.

2. All testers used must have been factory calibrated by the manufacturer within one year of use or according to factory calibration recommendations, whichever is the more stringent.

3. Contractor shall set references according to manufacturer’s recommendation prior to each day’s testing and reset references anytime tester is left unused for more than two hours.

4. For warranty purposes, Contractor shall perform the appropriate Permanent Link test. Channel Link testing is rendered void by the movement of patch cords and can be run but not used for final acceptance criteria.

b. Fiber Testing

1. All installed fiber shall be tested for link-loss in accordance with ANSI/TIA-C.0 and shall be within limits specified within ANSI/TIA-C.3, or as spelled out in the project documentation.

2. For horizontal cabling system using multimode optical fiber, attenuation shall be measured in one direction at either 850 nanometer (nm) or 1300 nm using an LED light source and power meter.

3. Attenuation testing shall be performed with a stable launch condition using two-meter jumpers to attach the test equipment to the cable plant. The light source shall be left in place after calibration and the power meter moved to the far end to take measurements.

4. Backbone single-mode fiber cabling shall be tested at the 1310 and 1550 wavelengths in both directions.

5. Test set-up and performance shall be conducted in accordance with ANSI/568-C.0 standard, Method B.

6. Where links are combined to complete a circuit between devices, the Contractor shall test each link from end to end to ensure the performance of the system. Only basic link-loss testing with a power meter is required. The contractor can optionally install patch cords to complete the circuit and then test the entire channel. The test method shall be the same used for the test described above.

7. The values for calculating loss shall be those defined in the ANSI/TIA 568-C.3 Standard. If the link loss requirements defined within the standard are in conflict with those referenced in the project documentation, Contractor shall immediately bring this to the attention of Information Technologies for resolution.

c. System Documentation

1. Upon completion of the installation, the telecommunications contractor shall provide three (3) full documentation sets to Canyons Schools for approval. Documentation shall include the items detailed in the sub-sections below.

2. Documentation shall be submitted within ten (10) working days of the completion of each testing phase. This is inclusive of all test results and draft as-built drawings. Draft drawings may include annotations done by hand. Machine generated (final) copies of all drawings shall be submitted within 30 working days of the completion of each testing phase.

3. Contractor shall submit with drawings a diagram of each telecommunications room with indicating which cabling drops will terminate in which rooms (classrooms). This is both to give an idea of contractor cable plant design, as well as to facilitate future troubleshooting.

4. At the request of the Information Technologies Engineer, the telecommunications contractor shall provide copies of the original test results in tester native format, not spreadsheet.

5. Information Technologies may request that a 10% random field re-test be conducted on the cable system, at no additional cost, to verify documented findings. Tests shall be a repeat of those defined above. If findings contradict the documentation submitted by the telecommunications contractor, additional testing can be requested to the extent determined necessary by Information Technologies, including a 100% re-test. This re-test shall be at no additional cost to the Canyons School District Information Technologies.

d. Test Results

1. Documentation shall be provided in electronic format within three weeks after the completion of the project. The media shall be clearly marked on the outside front cover with the words “Project Test Documentation”, the project name, and the date of completion (month and year).

2. The results shall include a record of test frequencies, cable type, conductor pair and cable (or outlet) I.D., measurement direction, reference setup, and crewmember name(s). Documentation shall also include test equipment name, manufacturer, model number, serial number, software version and last factory calibration date.

3. Unless the manufacturer specifies a more frequent calibration cycle, an annual calibration cycle is anticipated on all test equipment used for this installation.

4. The test document shall detail the test method used and the specific settings of the equipment during the test as well as the software version being used in the field test equipment.

5. Printouts generated for each cable by the wire (or fiber) test instrument shall be submitted as part of the documentation package. Alternately, the telecommunications contractor may furnish this information in electronic form.

6. The media shall contain the electronic equivalent of the test results as defined by the specification along with the software necessary to view and evaluate the test reports.

7. When repairs and re-tests are performed, the problem found and corrective action taken shall be noted, and both the failed and passed test data shall be documented.

8. The As-Built drawings are to include cable routes and outlet locations. Their sequential number as defined elsewhere in this document shall identify outlet locations.

9. Numbering, icons, and drawing conventions used shall be consistent throughout all documentation provided. The School District will provide floor plans in paper and electronic (DWG, AutoCAD) formats on which as-built construction information can be added.

10. These documents will be modified accordingly by the Telecommunications Contractor to denote as-built information as defined above and returned to the Canyons School District.

11. The Contractors shall annotate the base drawings and return a hard copy (same plot size as originals) and electronic (AutoCAD) form.

END OF SUB-SECTION V

Appendix A – Materials List

Manufacturer	Part Number	Description
		COPPER DISTRIBUTION
General Cable	**7141819**	CAT6A GenSPEED ® 10 UTP plenum (CMP), 4-pair, UTP copper cable, 0.25 OD – blue
General Cable	**2131752E**	25 pair, plenum rated, Category 5E cable – gray.
General Cable	**8136100**	CAT6A GenSPEED® Outside Plant Cable
Panduit	**CJ6X88TGBL**	Category 6A, RJ45, 8-position, 8-wire, 10 Gb/s UTP Mini-Com® universal jack module has TG-style termination – color black. For other standard colors, replace suffix “BL” with IW (Off White) with EI (Electric Ivory), WH (White), AW (Arctic White), IG (International Gray), OR (Orange), RD (Red), BU (Blue), GR (Green), YL (Yellow), or VL (Violet). Canyons School District standardize on black unless otherwise indicated in project documentation. NOTE MODULAR PATCH PANELS MUST BE POPULATED WITH JACKS AS WELL AS STAINLESS FACEPLATES.
Panduit	**CMBBL-X**	Mini-Com blank module to blank out open spaces (holes) on faceplates and patch panels. For colors other than black replace “BL” with IW (Off White) with EI (Electric Ivory), WH (White), or IG (International Gray).
Panduit	**CPPL24WBLY**	24-port patch panel with labels, supplied with six factory installed CFFPL4 type front removable snap-in faceplates. Contractor to populate black Cat 6 jacks as specified in this document.
Panduit	**CPPL48WBLY**	48-port patch panel with labels, supplied with six factory installed CFFPL4 type front removable snap-in faceplates. Contractor to populate with black Cat 6 jacks as specified in this document.
Panduit	**UTP28X**BU**	Category 6A Performance, 28AWG, UTP patch cord. For lengths 1 to 50 feet (increments of one foot), replace ** with desired length in feet. For standard cable colors other than Off White, replace “BU” with color code: BL (Black), RD (Red), YL (Yellow), GR (Green), OR (Orange), GY (Gray), PK (Pink), or VL (Violet).
Panduit	**CFPSL4IWY**	Single gang, plastic, sloped vertical faceplate accepts four Mini-Com® Modules.
Panduit	**CFPSL6IWY**	Double gang, plastic, sloped vertical faceplate accepts eight Mini-Com® Modules. For labels use
Panduit	**UICFPSE8IW-2G**	Double-gang, plastic, sloped vertical faceplate holds up to eight Mini-Com® Modules.
Panduit	**CFPL4SY**	Single gang, stainless steel vertical faceplate accepts four Mini-Com ® Modules. Requires minimum 1.9" wide electrical box for proper mounting.
Panduit	**CFPL8S-2GY**	Double gang, stainless steel vertical faceplate accepts eight Mini-Com® Modules.
Panduit	**P110KB1005Y**	Panduit Pan-Punch 100 pair 110 block termination kits for 25pr 5E cable. Field terminated. Includes a base, 5-pair connector kit with five 5-pair connectors per row of 25 pairs, two label holders, and two white designation labels.
		FIBER DISTRIBUTION SYSTEMS
General Cable	**BE0121ANU-ILPA**	Plenum-rated, indoor/outdoor tight-buffered, armored OM3 12 strand fiber cable.
General Cable	**BE0241ANU-ILPA**	Plenum-rated, indoor/outdoor tight-buffered, armored OM3 24 strand fiber cable.
General Cable	**BL0121ANU-ILPA**	Plenum-rated, indoor/outdoor tight-buffered, armored OM4 12 strand fiber cable. (Use OM4 for any telecom rooms that are further than 300M apart).
General Cable	**BL0241ANU-ILPA**	Plenum-rated, indoor/outdoor tight-buffered, armored OM4 12 strand fiber cable. (Use OM4 for any telecom rooms that are further than 300M apart).
Panduit	**FLCDMCXAQY**	LC OptiCam® 10Gig™ 50/125µm Multimode Duplex Fiber Optic Connector for 900µm tight-buffered fiber installation.
Panduit	**FCE1U**	Opticom® QuickNet™ Rack Mount Fiber Enclosures, holds up to four QuickNet™ Cassettes, FAP adapter panels, or FOSM splice modules. Dimensions: 1.73"H x 17.60"W x 16.30"D (43.9mm x 447.0mm x 414.0mm).

Panduit	**FCE2U**	Opticom® QuickNet™ Rack Mount Fiber Enclosures, holds up to eight QuickNet™ Cassettes, FAP adapter panels, or FOSM splice modules. Dimensions: 3.48"H x 17.60"W x 16.30"D (88.4mm x 447.0mm x 414.0mm).
Panduit	**FAP6WAQDLC**	LC 10Gig™ FAP loaded with six LC 10Gig™ Duplex Multimode Fiber Optic Adapters (Aqua) with phosphor bronze split sleeves.
Panduit	**FAPB**	Blank fiber adapter panel – reserves space for future use.
Panduit	**FX2ERQNQNSNM*** **	OM4 push/pull LC jumper/patch cord. Riser rated. *** At end of part number is for length in meters. Comes in 1 M increments up to 20 meters, then in lengths of 20 M, 25 M, 30 M, and 35 M. Put length in the following (3 digit) format: 001 for 1 M, 020 for 20 M, etc.
		RACKS AND CABLE MANAGERS
Panduit	**R4P**	4 post EIA rack with #12-24 threaded rails. Dimensions: 84.0"H x 23.25"W x 30.0"D (2134mm x 591mm x 762mm).
Panduit	**R4P36**	4 post EIA rack with #12-24 threaded rails. Dimensions: 84.0"H x 23.25"W x 36.0"D (2134mm x 591mm x 914mm).
Panduit	**R4P42**	4 post EIA rack with #12-24 threaded rails. Dimensions: 84.0"H x 23.25"W x 41.5"D (2134mm x 591mm x 1054mm). FOR TOP OF RACK INTERBAY ROUTING.
Panduit	**R4PWF**	Top trough with waterfall for 4-post racks creates pathway above rack. Dimensions: 1.9"H x 26.1"W x 8.5"D (50mm x 662mm x 216mm).
Panduit	**R2P**	19" EIA 2-post rack, aluminum. Dimensions: 84.0"H x 20.3"W x 3.0"D (2134mm x 514mm x 76mm).
Panduit	**R2PPEVWF**	Waterfall Trough for 2 Post Rack and PatchRunner high capacity ™ Vertical Cable Managers. FOR TOP-OF-RACK INTERBAY ROUTING.
Panduit	**PEV6**	High capacity dual-sided vertical manager. Dimensions: 83.5"H x 6.0"W x 28.1"D(2120mm x 152mm x 714mm).
Panduit	**PED6**	Dual hinged metal door. Dimensions: 82.8"H x 6.1"W x 1.7"D (2103mm x 155mm x 43mm).
Panduit	**PEV8**	High capacity dual-sided vertical manager. Dimensions: 83.5"H x 8.0"W x 28.1"D (2120mm x 203mm x 714mm).
Panduit	**PED8**	Dual hinged metal door. Dimensions: 82.8"H x 8.1"W x 1.7"D (2103mm x 206mm x 43mm).
Panduit	**PEV10**	High capacity dual-sided vertical manager. Dimensions: 83.5"H x 10.0"W x 28.1"D (2120mm x 254mm x 714mm).
Panduit	**PED10**	Dual hinged metal door. Dimensions: 82.8"H x 10.1"W x 1.7"D (2103mm x 256mm x 43mm).
Panduit	**NM1**	Horizontal Cable Manager High Capacity Front and Rear 1 Rack Unit. 1.7"H x 19.0"W x 13.1"D (44mm x 482mm x 332mm).
Panduit	**NMF1**	Horizontal Cable Manager High Capacity Front Only 1 Rack Unit. 1.7"H x 19.0"W x 6.2"D (44mm x 482mm x 157mm).
Panduit	**NM2**	Horizontal Cable Manager High Capacity Front and Rear 2 Rack Units. 3.5"H x 19.0"W x 13.1"D (88mm x 482mm x 332mm).
Panduit	**NMF2**	Horizontal Cable Manager High Capacity Front Only 2 Rack Units. 3.5"H x 19.0"W x 6.2"D (88mm x 482mm x 157mm). FOR MID-RACK INTERBAY ROUTING.
Panduit	**NMF3**	Horizontal Cable Manager High Capacity Front Only 3 Rack Units. 5.2"H x 19.0"W x 6.2"D (133mm x 482mm x 157mm). FOR MID-RACK INTERBAY ROUTING.
Panduit	**CMUT19**	2 RU upper trough with 1.3" bend radius mounts to the top of a standard 19" EIA rack. Dimensions: 3.5."H x 19.0"W x 4.5"D (89mm x 483mm x 114mm). FOR BOTTOM-OF-RACK INTERBAY PATHWAY.
Panduit	**CMLT19**	4 RU lower trough with 1.3" bend radius mounts to the bottom of a standard 19" EIA rack. Dimensions: 8.0"H x 19.0"W x 4.5"D (203mm x 483mm x 114mm). FOR BOTTOM-OF-RACK INTERBAY PATHWAY. LARGER OPTION THAN CMUT19 IF NEEDED.
		CABLE PATHWAYS
Panduit	**J-Pro J-Hook system**	Panduit J-Pro System. Plenum rated composite J-hooks with hardware available for various hardware applications.
B-line	**WB400**	B-line basket tray.

Panduit	**LD10IW10-A**	LD10 International White Plastic Raceway, see catalog or www.panduit.com for fittings. For 8' sections order LD10IW18-A.
Panduit	**LD2P10**	Dual Power/Data Raceway channel plastic raceway for concurrently running power and data. See catalog or www.panduit.com for fittings.
Panduit	**JBX3510IW-A**	Single gang two-piece snap together outlet box with adhesive backing. Box accepts Pan-Way ® Screw-On Faceplates or any NEMA standard single gang faceplate. For use with Pan-Way ® T45 or LD profile raceway. 5.00"L x 3.26"W x 1.62"H (127.1mm x 82.7mm x 41.1mm). Breakouts for 1/2", 3/4", or 1" diameter conduit.
Panduit	**JBP2IW**	Double gang two-piece screw together outlet box. Box accepts Pan-Way ® Screw-On Faceplates or any NEMA standard double gang faceplates. For use with Pan-Way ® LD profile raceway. 5.05"L x 5.05"W x 1.62"H (128.2mm x 128.2mm x 41.1mm). Breakouts for 1/2" or 3/4" diameter conduit.
Panduit	**T70BIW10**	Panduit T-70 dual channel plastic raceway for concurrently running power and data in computer labs. See catalog or www.panduit.com for partitions and fittings. For 8 foot sections replace "10" in part number with "8".
Panduit	**T70CIW10**	Cover for T-70 dual channel raceway. For 8 foot sections replace "10" in part number with "8".
		BONDING AND GROUNDING
Panduit	**ACG24K**	#6 AWG (16mm2) jumper for armored cable diameter up to 0.84" (21.3mm); 24" (609.6mm) length; factory terminated on one end with LCC6 two-hole copper compression lug and the other end with grounding terminal; provided with two each #12-24 and M6 thread-forming screws and a black polypropylene terminal cover.
Panduit	**LCC series**	Panduit two-hole compressing lugs for code conductors in BICSI hole spacing.
Panduit	**HTCT series**	Panduit HTAPs. Must be selected according AWG size of run and tap conductors.
Panduit	**CLRCVR series**	Panduit clear covers for HTAPs. Must be selected according to HTAP being covered.
Panduit	**RGS134-1Y**	Grounding strip (vertical busbar) for newly installed racks or cabinets with screw rails. 78.65" (2m) length; .67" (17mm) width; .05" (1.27mm)thickness; provided with .16 oz. (5cc) of antioxidant, one grounding sticker and three each #12-24 x 1/2" and M6 x 12mm thread-forming screws.
Panduit	**RGCBNJ660P22**	Jumper kit for bonding individual racks or cabinets into grounding backbone. #6 AWG (16mm²) jumper; 60" (1.52m) length; 45° bent lug on grounding strip side; provided with .16 oz. (5cc) of antioxidant, two each #12-24 x 1/2", M6 x 12mm, #10-32 x 1/2" and M5 x 12mm thread forming screws and a copper compression HTAP* for connecting to a #6 to #2 awg sized bonding backbone.
Panduit	**GJ672UH**	Rack jumper (and cabinet) kits for smaller TR (5 bays or less) to bond individual rack or cabinet directly back to wall mounted busbar. One 72" length #6 AWG green wire with yellow horizontal stripe. Jumper is pre-terminated on one end with LCC6-14JAWH-L and the other end with LCC6-14JAW-L. This rack grounding jumper is 72" long. For other lengths replace the "72" in the part number. Available lengths are 72, 96, 120, 144, 168, 192, 216, 240, 264 and 288 inches.
Panduit	**RGESD2-1**	Two-hole ESD port with 5/8" hole spacing; provided with an ESD protection sticker, .16 oz. (5cc) of antioxidant, and two each #12-24 x 1/2" and M6 x 12mm thread-forming screws. LOCATE ONE WITHIN REACH OF ALL EQUIPMENT. WORKS WITH WRIST STRAP RGESDWS.
Panduit	**RGESDWS**	Adjustable fabric ESD wrist strap with 6' coil cord, banana plug, 1 megaohm resistor and 4mm snap. LOCATE ONE WITHIN REACH OF ALL EQUIPMENT. WORKS WITH ESD PORT RGESD2-1.
Panduit	**RGTBSG-C**	Green thread-forming bonding screws for use to mount equipment that does not have a built-in grounding pad (terminal).
Panduit	**RGEJ1024PHY**	24" long pre-terminated equipment grounding jumper #10 AWG (6mm²) jumper; bent lug on grounding strip side to straight lug on equipment; provided with .16 oz. (5cc) of antioxidant and two each #12-24 x 1/2", M6 x 12mm, #10-32 x 1/2" and M5 x 12mm thread-forming screws. FOR EQUIPMENT LIKE CHASSIS SWITCHES WITH BUILT-IN GROUNDING PAD (TERMINAL).
Panduit	**RGEJ1036PFY**	36" long pre-terminated equipment grounding jumper#10 AWG (6mm²) jumper; bent lug on grounding strip side to straight lug on equipment; provided with .16 oz. (5cc) of antioxidant and two each #12-24 x 1/2", M6 x 12mm, #10-32 x 1/2" and M5 x 12mm thread-forming screws. FOR EQUIPMENT LIKE CHASSIS SWITCHES WITH BUILT-IN GROUNDING PAD (TERMINAL).

Panduit	**GB2B0306TPI-1**	Wall mounted telecommunications busbar suitable for small telecom room. Pre-assembled with BICSI/TIA-607-B hole spacing. Bar is 1/4" x 2" x 12" in size.
Panduit	**GB2B0514TPI-1**	Wall mounted telecommunications busbar suitable for med telecom room. Pre-assembled with BICSI/TIA-607-B hole spacing. Bar is 1/4" x 2" x 24" in size.
Panduit	**GB4B0624TPI-1**	Wall mounted telecommunications busbar suitable for main grounding busbar in medium sized facility. Pre-assembled with BICSI/TIA-607-B hole spacing. Bar is 1/4" x 4" x 20" in size.
Panduit	**LTYK**	Wall mounted busbar label kit. Label kit includes printed tag and one flame retardant cable tie.
		NETWORK LABELING SOFTWARE – FOR INK JET/LASER PRINTER
Panduit	**PROG-EM2GO**	Easy-Mark Labeling Software for PC, supplied on USB Flash Drive. For preprinting communications labels on laser/inkjet printer.
Panduit	**S100X150YAJ**	Self-laminating cable labels for Category 6 cable for use with Easy-Mark software and laser/ink jet printer.
Panduit	**C261X035Y1J**	Patch Panel labels for use with Easy-Mark software and laser/ink jet printer.
Panduit	**C195X040Y1J**	Faceplate labels for single gang stainless or sloped plastic - use with Easy-Mark software and laser/ink jet printer.
Panduit	**C288X040Y1J**	Faceplate labels for double gang stainless - use with Easy-Mark software and laser/ink jet printer.
Panduit	**S100X650YAJ**	Cable label for indoor/outdoor tight-buffered armored fiber optic cable. For use with Easy-Mark software and ink jet printer.
Panduit	**S100X160YAJ and NWSLC-3Y**	Label and turn-tell sleeve for labeling fiber jumpers. For use with Easy-Mark software and ink jet printer.
Panduit	**C200X100FJJ**	1" high, white, vinyl tape labels for labeling grounding busbars, racks, cabinets and pathways. For use with laser/ink jet printer.
		NETWORK LABELING – HANDHELD LABELER
Panduit	**LS8EQ-KIT-ACS**	Panduit PanTher hand-held label printing system in kit. Includes LS8EQ printer with QWERTY keypad, one cassette of S100X150VAC self-laminating labels, six AA alkaline batteries, LS8E-ACS, LS8-CASE, LS8-PCKIT, LS8-IB, LS8-WS, quick reference card and operator's manual. USE FOR LABELS THAT MUST BE PRINTED ON THE JOB SITE.
Panduit	**S100X150VAC**	Self-laminating cable labels for Category 6 cable for use with PanTher LS8E hand-held printer.
Panduit	**C261X035Y1C**	Handheld printer labels for modular faceplate patch panels.
Panduit	**C195X040Y1C**	Faceplate labels for single gang stainless - use with PanTher handheld labeler.
Panduit	**C288X040Y1C**	Faceplate labels for double gang stainless - use with PanTher handheld labeler.
Panduit	**S100X650VAC**	Cable label for indoor/outdoor tight-buffered armored fiber optic cable. For use with handheld labeler.
Panduit	**S100X160VAC and NWSLC-3Y**	Label and turn-tell sleeve for labeling fiber jumpers. For use with hand-held labeler.
Panduit	**T100X000VPC-BK**	1" high, continuous black on white, vinyl tape labels for labeling racks, cabinets and pathways with PanTher LS8E handheld labeler.
		PHYSICAL SECURITY LOCKING DEVICES
Panduit	**PSL-DCJB-C**	Package of 100 RJ45 jack blockout devices and one removal tool. Color red.
Panduit	**PSL-USBA-L**	Package of 50 USB Type 'A' blockout devices and one removal tool. Color red.
Panduit	**PSL-USBB-L**	Package of 50 USB Type 'B' blockout devices and one removal tool. Color red.
Panduit	**PSL-DCPLX-BL-C**	Package of 100 RJ45 plug lock-in devices compatible with flush mount jacks, and one installation/removal tool. Color black.

Panduit	**PSL-DCPLRX-BL-C**	Package of 100 RJ45 plug lock-in devices compatible with recessed jacks, and one installation/removal tool. Color black.
		CABLE TIES – HOOK AND LOOP
Panduit	**TTS-35RX0**	.75” wide, continuous roll Hook and Loop Cable Ties, black. 35 ft roll. Carton qty 10 rolls.
Panduit	**HLSP1.5S-X12**	Plenum rated hook and loop cable ties for air return spaces. Maroon color, perforated at 6” length.
Panduit	**HLSP3S-X12**	Plenum rated hook and loop cable ties for air return spaces. Maroon color, perforated at 6” length.

<END OF APPENDIX A>

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SECTION 27 4100 - AUDIOVISUAL SYSTEMS

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-26, 27 & 28 basic materials and methods sections apply to work specified in this section.

C. Refer to specification 26 0553 for conduit and junction box color requirements.

D. All unshielded category 'UTP' and/or optical fiber cable, for AV equipment, used on this project shall match the horizontal cabling within the building.

1. Category cables used for transporting video, audio and controls simultaneously from transmitters to receivers and/or switchers shall follow the Manufacturer's recommend cabling specifications.

1.2 ADMINISTRATIVE REQUIREMENTS:

A. BNA Project Contact:

1. Eric Mangum, CTS-D
   a. Phone: 801-532-2196
   b. Email: emangum@bnaconsulting.com

2. Jaime Verhaal, CTS-D
   a. Phone: 801-532-2196
   b. Email: jverhaal@bnaconsulting.com

B. Bid Submittal:

1. Equipment Costs: Breakout cost of material and labor as different line items.

C. Coordination:

1. Coordinate final inspection of the systems installed, with Audiovisual (AV) Consultant, three (3) weeks in advance.

2. Obtain GANTT chart for construction time frame from the General Contractor.

3. Coordinate with Electrical contractor to meet at least twice with the ceiling installer. Hold first meeting before submittal of shop drawings to coordinate the mounting condition of all ceiling-mounted AV equipment with ceiling type. During second meeting, coordinate the location of all ceiling-mounted AV equipment in each area.

4. Meet at least once with the mechanical installer prior to fabrication and installation of duct work. Coordinate depth and location of all loudspeaker and duct work in all areas.

5. Meet with Electrical contractor prior to pathway rough-in to coordinate AV system requirements in each area.

6. Meet at least once, prior to rough-in, with horizontal cabling installer to verify all AV network requirements. Coordinate cable color according to specification 26 0553.

7. Meet at least twice with owner and programmer to coordinate AV network requirements. Hold the first meeting after submittal of shop drawings to coordinate network protocols, including but not limited to: IP address schedules, MAC address schedules, patchbay schedules, security requirements, and VLANs. Hold the second meeting prior to AV system deployment.

8. Coordinate color and finish of all AV system components with Architect or Electrical contractor as appropriate.
9. Coordinate all AV system components within millwork/furniture with millwork shop drawings prior to rough-in.
10. Notify AV Consultant when rough-in is complete and ready to inspect. AV Consultant and Electrical Engineer to sign off on rough-in prior to rough-in resuming rough-in for typical rooms.

D. Contractor is responsible for coordinating with all other trades for equipment locations, mounting requirements, supports and plenum space requirements.

1.3 DESCRIPTION OF WORK:

A. Provide the specified systems in a complete and operating condition with all necessary materials and labor to fulfill the requirements and the intent of the drawings and specifications. Except as otherwise indicated, provide manufacturer's standard system components. Contractor shall furnish all cables, materials and equipment, whether specifically mentioned herein or not, to ensure a complete and functional system.

B. Master quotes do not relieve contractor from preforming due diligence for equipment type, equipment quantity, and quantity of room types. Any errors, conflicts, or omissions between the drawings and/or specifications and master quotes shall be the responsibility of the contractor to resolve.

C. Bidders wishing to provide equipment other than the equipment specified shall submit proposed substitute equipment to AV Consultant eight (8) working days prior to bidding. Submittals for prior approval shall include description of equipment, design intent, complete riser diagrams for proposed equipment, equipment specifications, cut sheets of proposed equipment, reason for alternate equipment. AV Consultant may request physical equipment to test and demo. Acceptance of proposed equipment by AV Consultant shall not relieve AV contractor from responsibility to provide audio-visual systems equal to those specified in this Section. Contractor shall be ultimately responsible for providing complete and working audio-visual systems that function, control and operate in the same manner as the specified equipment. AV Consultant has final say if proposed equipment is equal to the specified equipment. Equipment that AV Consultant is not familiar with will require the contractor to provide manufacturer training at manufacturer's facility and have a manufacturer representative present at time of commissioning.

D. Refer to section 2.2 for approved equals of basis of design equipment.

E. Equipment submitted in the bid proposal that has not been approved by AV Consultant in writing will not be accepted and shall be replaced by approved equipment at contractor's expense. Equipment not listed within this specification, or contract documents, that is required for a complete and working system, shall be of professional grade, new and used in the same manner as needed for a complete and working system.

F. Input plates shall match the color and style being used throughout the project.

G. All control processors and controllers are to be on an unswitched power connection and connected to an uninterrupted power supply if indicated within the design.

1.4 DEFINITION OF TERMS:

A. Approve: The term "approved," where used in conjunction with the Engineer's action on the Contractor's applications and requests, is limited to the Engineer's duties and responsibilities as stated in General and Supplementary Conditions.

B. Configure: The term "Configures" or "Configuration" is used to describe set up of components which includes menu based settings, image alignment, dip switches, setup wizards, EDID, etc. required for standard functionality.

C. Contractor: the term “Contractor” refers to the company contracted to perform the work within this specification and associated documents.

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

E. Furnish, Install, and Provide: Refer to 26 0500 for definition.

F. General: Basic Contract definitions are included in the General Conditions.

G. Graphical User Interface (GUI): The term “Graphical User Interface (GUI)” is used to describe the user interface from a touch screen. This is a custom interface provided with the programming of the system.

H. Indicated: The term "indicated" refers to graphic representations, notes, or schedules on the Drawings, other paragraphs or schedules in the Specifications, and similar requirements in the Contract Documents. Where terms such as "shown," "noted," "scheduled," and "specified" are used, it is to help the reader locate the reference; no limitation on location is intended.

I. Installer: An "Installer" is the Contractor, or an entity engaged by the Contractor, either as an employee, subcontractor, or sub-subcontractor, for performance of a particular construction activity, including installation, erection, application, and similar operations. Installers are required to be experienced in the operations they are engaged to perform.

J. Programming: The term “Programming” is used to describe writing computer code or a sequence of logic to perform an operation from a triggering event. Programming will be installed on a control processor or similar platform identified within the documents.

K. Programmer: the term “Programmer” is the company or entity engaged by the programming company, either as an employee, subcontractor, or sub-subcontractor, for providing the programming services.

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

M. Substitutions: Requests for changes in products, materials, equipment, and methods of construction required by Contract Documents proposed by the Contractor after award of the Contract are considered requests for "substitutions."

1.5 QUALITY ASSURANCE:

A. Installer:

1. Integrating firm shall have worked satisfactorily for a minimum of five (5) years of completing systems equal to this scope, quality, type and complexity.
2. Key personnel assigned to the project shall each have minimum of ten (10) years of experience in completing systems equal to this scope, quality, type and complexity.
3. Contractor shall be a factory authorized distributor of all equipment specified for the geographical area of the project.
4. Contractor shall maintain complete installation and service facilities for the duration of the project contract.
5. Contractor shall have current manufacturer certificates for all AV systems and equipment listed within this specification.
6. Contractor shall be in good standing with the owner.
7. Contractors that do not meet the above requirements cannot bid on this project.

B. Contractor must follow the standards described within:

1. BICSI/AVIXA AV Design Reference manual.
2. ANSI/AVIXA 2M-2010 Standard guide for Audiovisual Systems Design and Coordination Processes.
3. ANSI/AVIXA 10:2013 Audiovisual Systems Performance Verification Guide.

C. All work shall be done by expert technicians qualified in the field with knowledge of specified systems. Workmanship shall comply with industry best practices concerning grounding, shielding, cable dressing, cable termination and equipment mounting.

D. PRE-APPROVED INSTALLERS:

1. AVI-SPL
2. Cache Valley Electric
3. Ford AV
4. GenComm
5. Marshall Industries
6. Performance Audio
7. Poll Sound
8. Wasatch Electric
9. WEBB AV
10. TPI (Technology Providers Inc.)
11. Bids submitted by non-approved installers will not be accepted.
12. Bidders not pre-approved shall submit in writing the following for review at least eight (8) working days prior to bid:
    a. List of qualifications including:
        i. Industries certifications including manufacturers.
        ii. Approved resale manufacturers.
    b. Past and current projects within the last five (5) years similar in scope and size.
    c. Three (3) Different referrals from the owners of three (3) different projects within the last five (5) years.

1.6 SUBMITTALS: Refer to specification 26 0502 for shop drawing submittal requirements.

1.7 WARRANTY:

A. Systems shall be guaranteed for a period of one (1) year from the date of substantial completion against defective materials, inferior workmanship or improper installation adjustment. Guarantee shall cover all parts and labor, etc. required to maintain the functionality at the time of system completion.

1. System completion shall be signed off by the programmer, contractor, and the owner. At that time the system will be considered complete.

B. If system failure causes the audiovisual system to be inoperative or unusable for its intended purpose, contractor, when notified of the problem, shall repair the system to be operational and usable within three (3) business days. If defective components cannot be repaired in time, provide temporary equipment as required.

C. The contractor shall utilize their existing service department for warranty calls. Trouble shooting of system components shall be performed before adjustment to the programing is required.

D. Contractor shall honor equipment warranties for term established by manufacturer if greater than warranty time frame mentioned above.

PART 2 – PRODUCTS

2.1 GENERAL:

A. All equipment shall be installed as shown on the drawings and in strict accordance with the specifications. Any errors, conflicts, or omissions discovered in the specifications or the drawings shall be submitted in writing to the AV Consultant for clarification.

B. Equipment lists are provided to identify quality and functional expectations. They may not be complete. Coordinate with devices shown on drawings, system risers and equipment lists for system intent. Provide a complete and functional system as described within the construction documents.

2.2 MANUFACTURER APPROVED EQUALS:

A. The Manufacturers listed below have the potential to be considered equals, as it relates to the system design intent and the equipment specified herein. Refer to section 1.3.C. for substitution requirements. Any equipment chosen as equal to what has been specified in section 2.4 will be the responsibilities of the AV Integrator to coordinate all resulting changes and guarantee a complete and functional system e.g. rough-in requirements, programming, etc. Please note that some components have been chosen over others for features and/or size limitations. Equipment listed below with an asterisk have feature and/or size limitations and may not be substituted.

1. Amplifiers – Ashly, Crown, Lab Gruppen, LEA Professional, Powersoft, and QSC
2. Assisted Listening Systems – Listen Technologies, Williams AV
3. Cables – Belden, Crestron, Extron, Gepco/General, Ice, Kramer, Liberty, and Westpenn cables
4. Controls – Crestron, Extron and QSC
5. Displays – LG, NEC, Planar, Panasonic, Samsung, Sharp, and Sony
6. DSPs – Biamp, Extron, QSC and Symetrix
7. Equipment racks – AtlasIED, Chief, Lowell and Middle Atlantic
8. Loudspeakers – AtlasIED, Bose, Community, JBL and QSC
9. Microphones – AKG, Audio Technica, Audix, Lectrosonics, Sennheiser and Shure
10. Mounts – Chief and Premier mounts
11. Network equipment – Cisco, Luxell, and Netgear
12. Networked Audio – Attero tech (QSC), Extron, and RDL
13. Projection Screens – Da-Lite and Draper
14. Video Equipment – AMX, Crestron, and Extron
15. Wall plates – Attero tech (QSC), Crestron, Extron, RCI Custom, Liberty Panelcrafters and RDL

2.3 GENERAL EQUIPMENT REQUIREMENTS:

A. The equipment specified in this document aims to fulfill the intended functional requirements by precisely identifying the necessary equipment. Depending on the timing of component orders and the project timeline, there may be instances where certain equipment needs to be replaced with newer models. In the event that the indicated equipment is unavailable or has been replaced, the supplier or contractor shall provide a new model that offers comparable functionality.

B. Loudspeakers:

1. Provide applicable mounting equipment as needed, including but not limited to; back boxes, mounting hardware, safety equipment, and seismic restraints.

C. Video Signal:

1. The equipment listed below is considered to be equal replacement parts for a point-to-point video solution as it relates to the system design intent. Equipment listed in section 2.4 override the equipment listed below.

a. Cable Equalizer for cable lengths exceeding 30’ but no more than 75’ or that have more than two (2) union connections. Connect to external power supply and do not use the 5 volts within the HDMI cable.

i. Extron – HD 4K 101 Plus or Kramer – PT-3H2

b. Point to point HDBaseT extension, 18 Gbps, 4k60 4:4:4 at 100 Meters:

i. Crestron – DM-TX-4KZ-100-C-1G with DM-RMC-4KZ-100-C. or Extron – DTP2 T 211 with DTP2 R 211.

c. HDMI cables intended for client device connection and that are less than 15’ shall be a flexible cable and support 18 Gbps, 4k60 4:4:4 for the entire length of the cable.

d. Equipment that is not preapproved by the AV Consultant in writing will not be accepted and will be replaced with the approved equipment at no cost to the Owner.

D. Audio Signal:

1. The equipment listed below is considered to be equal replacement parts for a point-to-point video solution as it relates to the system design intent. Equipment listed in section 2.4 override the equipment listed below.

a. Passive or Active audio summing adapter. Extron – ASA 131 or RDL – STA-1

b. Isolation transformer: RDL – EZ-HK1

E. Cables grouped together shall be dressed in expandable nylon loom, similar to Techflex - Flexo

F. Equipment Racks:

1. All AV equipment racks within this specification shall have the following accessories and/or features, either rack mountable or built into the rack, depending on the model of the rack. Refer to bid documents for all rack mounted equipment. Provide the following accessories as referred to in elevations. RUs are indicated in the elevations and noted with a # symbol in the part number.

2. General Equipment

a. Shelving: Middle Atlantic – SS; 1RU shelf.

b. Drawers:

i. Nonlocking: Middle Atlantic – D#

ii. Locking: Middle Atlantic – D#LK

c. Header panel, located at the top of the rack, AV contractor to submit their logo to RCI for inclusion in the Header panel. If AV contractor has another company that makes the Header panel, provide that information to the AV Consultant.

i. RCI Custom – BNA001-200120MM-01

d. Blank plates: Middle Atlantic – EB#

e. Surge protection for all devices located within the rack. Surge protector shall be: 20 AMPs, rack mountable or mount to a side rail and at least 1,000 joules of protection.

i. Recommended Surge protector is Middle Atlantic – PD-920R-SP. Additional acceptable manufacturers are: Furman, Juice Goose, Tripplite and SurgeX.

f. Horizontal, vertical, and entry cable management.

i. All cabling shall be straight off of the back of equipment to horizontal supports connected to equipment rack. Cabling shall follow support to vertical supports when going into other components and/or out of the equipment rack.

ii. Cabling secured to other cabling and supported from the connector is not acceptable.

iii. Separate AC power and other signal types from each other.

g. Provide 20 Amp rated power strips as necessary.

h. Sequencers

i. Provide a Middle Atlantic – PDS-620R or Furman – CN-2400S Sequencer.

ii. All equipment racks with the following equipment shall have a sequencer within the equipment rack. AV integrator to follow industry standards when using sequencers.

1. Amplifiers

2. Video processors without control processors

i. Passive Thermal Management

i. Vented rear door with no less than 60% open area.

ii. Solid blank panels on the front of the rack in all unused rack spaces.

iii. Stack power amplifiers without open rack space between.

iv. Top of equipment cabinet to be open or vented.

v. Provide passive thermal management in all racks unless noted above.

2.4 EQUIPMENT REQUIRED PER ROOM TYPE

AV SYSTEMS PROGRAMMING			
TYPE	DESCRIPTION	MANFR.	MODEL NO.
-	AV SYSTEMS PROGRAMMING ALLOWANCE REFER TO SECTION 3.3 FOR SCOPE OF PROGRAMMING	BNA CONSULTING	$12,500.00 SYSTEMS PROGRAMMING ALLOWANCE
END OF SCHEDULE			

FIELDHOUSE / WEIGHT ROOM EQUIPMENT SCHEDULE			
TYPE	DESCRIPTION	MANFR.	MODEL NO.
R1			SUPPLIED BY OTHERS

	DRAWER, PULL OUT, RACK MOUNT LATCHING W/LOCK, 3RU	MIDDLE ATLANTIC	D3LK
	BNA LOGO BLANK PANEL, 1RU WITH RJ45 KEYSTONE JACK FOR SERVICE PORT AND PATCH CABLE TO ETHERNET SWITCH	RCI CUSTOM	BNA001-200120MM-01
	20A POWER CONDITIONER WITH LIGHTS & VOLT/AMMETTER	FURMAN	PL-PRO DMC
CD	CD PLAYER WITH BLUETOOTH AND AUX INPUT, AM/FM TUNER	TASCAM	CD-400U
WMH	WIRELESS HANDHELD MICROPHONE, WIRELESS RECEIVER KIT	SHURE	QLXD24/SM58 QTY: REFER TO PLANS
	ANTENNA SPLITTER	SHURE	UA221
M2D	2 CH INPUT, 2-XLR/1/4" COMBO, AES67 / DANTE, 48V PHANTOM POWER, PoE	QSC	Axon D2i
BXT	AES-67/DANTE, 2-GANG WALL PLATE, WITH 4 CH INPUT, BLUETOOTH, L/R-RCA, L/R-3.5mm, 2 CH OUTPUT, L/R-3.5mm	QSC	unD6IO-BT
BT	BLUETOOTH, 1-GANG WALL PLATE WITH RECEIVER	RDL	DB-BT1A TX-TPR3A
	NETWORK SWITCH, MANAGED, PoE+, 125W (8) 1GB POE+ AND 1X1G +1SFP PORTS	NETGEAR	M4250-9G1F-PoE+
TP7	TOUCH PANEL, 7" DIAGONAL, POE WALL MOUNT	QSC	TSC-70-G3
DSP	UNIFIED CORE WITH 8 LOCAL AUDIO I/O CHANNELS, 64X64 NETWORK I/O CHANNELS WITH 8X8 SOFTWARE-BASED DANTE LICENSE INCLUDED, USB AV BRIDGING, DUAL LAN PORTS, VOIP, 8x8 GPIO AND 8 AEC PROCESSORS	QSC	CORE 8 FLEX
1A, 1B, 1C	POWER AMPLIFIER, 4 CHANNEL X 600 WATTS (2400 TOTAL), 70V	POWERSOFT	QUATTROCANALI 2404 DSP
A2	LOUDSPEAKER, SURFACEMOUNT, 8-INCH, 2-WAY, 105 DEGREE CONICAL COVERAGE, 60W - 70V. COLOR BY ARCHITECT	ATLAS IED	SM82T-WH
A1	LOUDSPEAKER, 12", 2-WAY, HIGH POWER W/ ROTATABLE HORN	JBL	AM7212 / 00
A	FLAT PANEL ARTICULATING MOUNT, EXTENDS 25°, MAX 200LBS LOAD, 200 X 200 mm VESA, LANDSCAPE	CHIEF	PNRUB
D75	LCD, 75" DIAGONAL, UHD 4K, 16/7 OPERATION, 350 NIT, 20W SPK, 2-HDMI, 1-USB, 1-LAN, 400x400 VESA, RS232, WIFI AND BLUETOOTH	SAMSUNG	QB75B
END OF SCHEDULE			

VIP \ KITCHENETTE EQUIPMENT SCHEDULE			
TYPE	DESCRIPTION	MANFR.	MODEL NO.
R3	EQUIPMENT RACK, WALL MOUNT 21" TALL, 22" DEEP, 12 RU WITH PLEXI FRONT DOOR	MIDDLE ATLANTIC	DWR-12-22PD

	BNA LOGO BLANK PANEL, 1RU WITH RJ45 KEYSTONE JACK FOR SERVICE PORT AND PATCH CABLE TO ETHERNET SWITCH	RCI CUSTOM	BNA001-200120MM-01
	20A POWER CONDITIONER WITH LIGHTS & VOLT/AMMETTER	FURMAN	PL-PRO DMC
WMH	WIRELESS HANDHELD AND LAVALIER COMBO MICROPHONE SYSTEM	SHURE	QLXD124/85 QTY: REFER TO PLANS
	ANTENNA SPLITTER	SHURE	UA221
DEC	A/V DECODER, 4K UHD OVER IP, POE; AES67/DANTE	VISIONARY SOLUTIONS	DuetD
TxH	A/V ENCODER (WALL PLATE), 4K UHD OVER IP, POE; DANTE W/ BLUETOOTH AUDIO	VISIONARY SOLUTIONS	DuetE-WP-BT
	NETWORK SWITCH, MANAGED, PoE+, 480W (24) 1GB AND 4SFP+ PORTS	NETGEAR	M4250-26G4XF-POE+
KP1	SINGLE-GANG NETWORKED CONTROLLER	QSC	AXON C1
DSP	UNIFIED CORE WITH 8 LOCAL AUDIO I/O CHANNELS, 64X64 NETWORK I/O CHANNELS WITH 8X8 SOFTWARE-BASED DANTE LICENSE INCLUDED, USB AV BRIDGING, DUAL LAN PORTS, VOIP, 8x8 GPIO AND 8 AEC PROCESSORS	QSC	CORE 8 FLEX
AMP 1D	POWER AMPLIFIER, 2 CHANNEL X 320 WATTS, 70V	POWERSOFT	MEZZO 322 A
C4	LOUDSPEAKER, 6", CEILING TWO-WAY, 120 DEGREE COVERAGE	JBL	CONTROL 47C/T
T	FLAT PANEL TILT MOUNT, 14°, MAX 200LBS LOAD, 878 X 500 mm VESA, LANDSCAPE	CHIEF	LTM1U
D65	LCD, 65" DIAGONAL, UHD 4K, 16/7 OPERATION, 350 NIT, 20W SPK, 2-HDMI, 1-USB, 1-LAN, 400x400 VESA, RS232, WIFI AND BLUETOOTH	SAMSUNG	QB65B
D75	LCD, 75" DIAGONAL, UHD 4K, 16/7 OPERATION, 350 NIT, 20W SPK, 2-HDMI, 1-USB, 1-LAN, 400x400 VESA, RS232, WIFI AND BLUETOOTH	SAMSUNG	QB75B
P1	WUXGA, 5300 LUMEN, 4K 60P INPUT SUPPORT, COLOR BY ARCHITECT.	SONY	VPL-PHZ51 (PROVIDE PROJECTOR AND CEILING MOUNTING)
SC1	CEILING, MOTORIZED, 16x10, 87"X139" SCREEN DA-MAT MATERIAL CONTRACTOR TO COORDINATE FINAL BLACK DROP REQUIRED PRIOR TO ORDERING	DA-LITE	TENSIONED CONTOUR ELECTROL SKU: 37612L
END OF SCHEDULE			

LEGACY ROOM 100 EQUIPMENT SCHEDULE			
TYPE	DESCRIPTION	MANFR.	MODEL NO.
HD	HDMI PASS-THROUGH WALL PLATE. PROVIDE DECORA COVER	C2G	39710
1E	POWER AMPLIFIER 1 CHANNEL X 60 WATTS, 70 V	EXTRON	MPA 601 70V

C4	LOUDSPEAKER, 6", CEILING TWO-WAY, 120 DEGREE COVERAGE	JBL	CONTROL 47C/T
T	FLAT PANEL TILT MOUNT, 14°, MAX 200LBS LOAD, 878 X 500 mm VESA, LANDSCAPE	CHIEF	LTM1U
D75	LCD, 75" DIAGONAL, UHD 4K, 16/7 OPERATION, 350 NIT, 20W SPK, 2-HDMI, 1-USB, 1-LAN, 400x400 VESA, RS232, WIFI AND BLUETOOTH	SAMSUNG	QB75B
END OF SCHEDULE			

CONFERENCE ROOM EQUIPMENT SCHEDULE			
TYPE	DESCRIPTION	MANFR.	MODEL NO.
Tx	4K/60 HDMI DTP2 TRANSMITTER WITH AUDIO EMBEDDING	EXTRON	DTP2 T 211
Rx	DTP HDMI RECEIVER WITH AUDIO DE-EMBEDDING	EXTRON	DTP HDMI 4K 230 Rx
TB1	FURNITURE BOX 1 SEE DRAWINGS FOR CONNECTIONS	EXTRON	CABLE CUBBY 500 (BLACK)
DA	TWO OUTPUT 4K/60 HDMI DA	EXTRON	DA2 HD 4K PLUS
1F	POWER AMPLIFIER 2 CHANNEL X 100 WATTS, 70 V	EXTRON	XPA U 1002 70V
C4	LOUDSPEAKER, 6", CEILING TWO-WAY, 120 DEGREE COVERAGE	JBL	CONTROL 47C/T
T	FLAT PANEL TILT MOUNT, 14°, MAX 200LBS LOAD, 878 X 500 mm VESA, LANDSCAPE	CHIEF	LTM1U
D85	LCD, 85" DIAGONAL, UHD 4K, 16/7 OPERATION, 350 NIT, 20W SPK, 2-HDMI, 1-USB, 1-LAN, 400x400 VESA, RS232, WIFI AND BLUETOOTH	SAMSUNG	QB85B
END OF SCHEDULE			

PART 3 – EXECUTION

3.1 INSTALLATION OF AV SYSTEMS:

A. Provide AV systems and ancillary equipment as indicated on drawings and in accordance with equipment manufacturer's written instructions, the NEC, and with industry best practices.

B. Coordinate all work performed by other contractors pertaining to the AV system, including raceways, electrical boxes and fittings.

C. Pathway Requirements:

1. General:

a. All pathways shall be designed, constructed, grounded and installed in accordance with all recommendations delineated within TIA 569-B and Standard TIA 942.

b. Prior to placing any cable pathways or cable, the contractor shall survey the site to determine job conditions will not impose any obstructions that would interfere with the safe and satisfactory placement of the cables. Field coordinate alternate pathway requirements with other trades onsite.

New pathways shall not exceed distance limitations defined within this specification. Notify the Engineer of the changes for final approval prior to proceeding with the change.

2. Conduits:

   a. Contractor shall provide a minimum of 1-1” EMT conduit from device to accessible ceiling space unless otherwise noted. Then utilize non-continuous cable support from devices to connecting device. Refer to AV symbol schedule for specific conduit requirements.

      i. Provide non-continuous open top cable supports every 5’ above accessible ceiling.

   b. Provide conduit from device to device in open and/or exposed ceilings. Ceilings with clouds are considered open/exposed ceiling.

   c. Achieve the best direct route parallel with building lines with no single bend greater than 90 degrees or an aggregate of bends in excess of 180 degrees between pull points or pull boxes.

   d. Provide large radius elbows on all bends.

   e. Conduit runs shall not have continuous sections longer than 100 feet without a pull box. Refer to rough-in schedule for conduit fill capacity.

   f. AV conduits should not be routed over or adjacent to heat sources such as boilers, hot water lines, or steam lines. Neither should they be routed near large motors, generators, photocopy equipment, or electrical power cabling and transformers.

   g. After installation, conduits shall be clean, dry, unobstructed, capped for protection, labeled for identification, reamed and fitted with bushings.

   h. A 200lb pull cord (nylon, 1/8” minimum) shall be installed in any empty conduit.

3. Open Top Cable Support Requirements:

   a. Non-continuous cable supports shall provide a bearing surface of sufficient width to comply with required bend radii of high-performance cables

   b. Non-continuous cable supports shall have flared edges to prevent damage while installing cables.

4. Pull Box Requirements:

   a. NEC sized pull boxes are not acceptable. Follow BICSI and EIA/TIA 569-B guidelines for pull box sizing.

   b. Provide pull boxes in sections of conduit that are 100 feet or longer, contain more than two 90 degree bends, or contain a reverse bend.

   c. Conduits that enter a pull box from opposite ends should be aligned.

   d. Pull boxes shall have a length 12 times the diameter of the largest conduit.

   e. All pull boxes must be accessible.

D. Cabling System:

1. Follow T568B scheme for copper category cabling terminations.

2. Provide a minimum 6” service loop in each AV system junction box. Cables shall be coiled in the in-wall boxes if adequate space is present to house the cable coil without exceeding manufacturers bend radius.

3. In a false ceiling environment, a minimum of 3 inches shall be maintained between cable supports and false ceiling. At no point shall cable(s) rest on lay-in ceiling grids or panels.
4. Cable shall be installed above fire-sprinkler systems and shall not be attached to the system or any ancillary equipment or hardware. The cable system and support hardware shall be installed so that it does not obscure any valves, fire alarm conduit, boxes, or other control devices.
5. Cables shall not be attached to ceiling grid seismic support wires or lighting fixture seismic support wires. Where support for AV cable is required, the contractor shall install appropriate carriers to support the cabling.
6. Any cable damaged or exceeding recommended installation parameters during installation shall be replaced by the contractor prior to final acceptance at no cost to the Owner.
7. Pulling tension for balanced twisted pair shall not exceed 25lbf and for optical fiber shall not exceed 50lbf.
8. Pair untwist at the termination shall not exceed 0.125”. The cable jacket shall be maintained as close as possible to the termination point.
9. Cable shall not be draped on, tied or otherwise secured to electrical conduit, plumbing, ventilation ductwork or any other equipment. Cable shall be secured to building supports or hangers or to additional blocks or anchors specifically installed for this purpose.
10. Group multiple cabling together with expandable nylon loom, similar to Techflex - Flexo, when cabling exists a cavity and connects to a device. Cabling within a lectern, podium or millwork shall have expandable nylon loom sleeve as well.

E. Grounding System:

1. All grounding and bonding shall be done according to ANSI J-STD-607-A, TIA 942, and NEC.
2. All cabinets/racks shall utilize paint piercing grounding washers, to be used where rack sections bolt together, on both sides, under the head of the bolt and between the nut and rack.
3. All racks shall further utilize a full-length rack ground strip attached to the rear of the side rail with the thread-forming screws provided to ensure metal-to-metal contact. Similar to Panduit RGS.
4. All active equipment shall be bonded to ground. If the equipment manufacturer provides a location for mounting a grounding connection, that connection shall be utilized. All active equipment shall be bonded using the appropriate jumper for the equipment being installed using the thread-forming screws. Similar to Panduit RG.
5. Racks shall have individual, appropriately sized conductors bonded to the grounding backbone. Do not bond racks or cabinets serially – daisy-chained rack grounds will not be accepted.
6. Refer to electrical diagrams for additional ground connection requirements.

F. Cabling groups and conduit separation:

1. Refer to “CABLING GROUPS AND CONDUIT SEPARATION SCHEDULE”, located on the drawings

G. Firmly secure all equipment in place that is not intended for portability.

H. Mount projectors permanently and provide mechanical index ensuring precise alignment of the projected image.

I. Provide adequate structural support for AV system components. Provide fastenings and supports with a safety load factor of at least five.

3.2 LABELING

A. The contractor shall develop and submit for approval a labeling system for the cable installation. The Owner will negotiate an appropriate labeling scheme with the contractor. At a minimum, the labeling system shall clearly identify all components of the system: racks, cables, panels and wall plates. The labeling system shall designate the cables origin and destination and a unique identifier for the cable within the system. All labeling information shall be recorded on the as-built drawings and all test documents shall reflect the appropriate labeling scheme.

B. All AV pathways, cables, connecting hardware, equipment, racks, patch panels, outlet/connectors, and grounding system shall be labeled in accordance with TIA/EIA 606-A.

C. All labels shall meet UL 969 requirements for legibility, defacement and adhesion requirements. Handwritten, Ink, or Laser Printing labels are not allowed. Labels shall be uniform in physical size and text height with minimal blank space. Provide labels using thermal transfer print. Heat shrinking or wraparound labels are required, flag style labels are not allowed.

D. Provide laminated plans (minimum size 11x17) of all AV as-built plans (including one-line diagrams) in each and every AV Rack.

E. Label each equipment with the date (month/year) that it was installed along with the IP address, if applicable, and equipment type.

3.3 CONTROL SYSTEM FUNCTIONALITY:

A. GENERAL:

1. The control processing and digital signal processing programming required for AV sub-systems as defined in section 2.4 of this specification shall be completed by BNA Consulting.

    a. The General AV sub-systems require configuration and are not included in BNA's programming scope of work.

    b. Configuring of system components will be part of the Contractors scope of work. Contractor shall provide IP address, MAC address, Serial numbers, etc to BNA for coordination with the program.

    c. IP address will be coordinated by the programmer and shared with contractor for implementation into specific devices.

    d. If the contractor chooses to provide their own programming services, it must match the functional intent as defined by BNA Consulting exactly. No exceptions.

2. The successful bidder for this specification section (27 4100) shall contract BNA Consulting for performance AV programming services.

    a. The allowance defined in section 2.4 for the performance AV systems programming services shall be included in the bid as a line item.

    b. Contracting shall take place once shop drawings are submitted. The Programming phase shall begin upon final review of AV contractor shop drawings.

3. Control programs & DSP configuration programs shall be designed to match the schematic system wiring as shown in approved shop drawings.

4. The AV contractor must field wire each system in accordance with the final reviewed shop drawings.
    a. Any deviations made to shop approved shop drawings will be subject to additional programming service fees.
5. Before programming services commence, the AV contractor shall confirm that all connections are complete, and all equipment is powered up and functional.
    a. Written documentation including site progress photos shall be provided to BNA Consulting prior to commencement of the programming phase.

B. ROOM FUNCTIONS:

1. Field House controls/functionality
    a. All inputs and outputs shall be coordinated with AV riser diagram.

C. Amplifiers shall be set to go to stand by after 30 minutes of no audio detection.

3.4 CYBER SECURITY

A. Contractor shall change all default username and passwords for all network devices provided. A Strong Password should include at a minimum the following:
    1. Be at least 12 characters in length
    2. Contain both upper and lowercase alphabetic characters (e.g. A-Z, a-z)
    3. Have at least one numerical character (e.g. 0-9)
    4. Have at least one special character (e.g. ~!@#$%^&*()_-+=)
    5. Cannot contain full words

B. No written username or passwords shall be located in any areas of installation.

C. Network devices to be set up on a separate network other than owner's LAN ensuring no internal or external users can access system without authorization.

D. Follow manufacturers hardening guide and use best industry practices to secure network and devices provided by contractor and associated with system.

3.5 FIELD QUALITY CONTROL:

A. TESTING:
    1. Refer To Section 27 4101 For Additional Requirements.

B. At the time of final commissioning, if the AV consultant determines that the systems are not sufficiently complete to do a final punch list, and was not notified at least three (3) days prior to the visit, then a return visit will be required. The AV Consultant's return visit will be paid for in advance by the AV integrator at a flat rate of $1,200 per person, at no cost to the owner.

3.6 OPERATING AND MAINTENANCE MANUALS: Refer to Section 26 0502 for requirements.

3.7 TRAINING:

A. Provide one (1) session of one (1) hours each of training on the operation of each system, at job site, at no cost to owner. Systems shall be complete and have been finalized by the AV Consultant prior to training.

B. Training shall be recorded using a video recording device that support a minimum resolution of 1080P/60 with an integrated microphone connection for an external microphone and a camera tri-pod mount. Presenter shall be wearing a lapel microphone that connects to the recording device and a Tri-pod shall be used for stabilizing the

recording device. Recordings that are shaky, poor audio and/or video quality, incomplete, or other issues will not be accepted and the contractor will be responsible for providing a new recording and training within five (5) business days of notification. Provide a digital copy, in MP4 format, on a USB flash drive to the Owner and AV Consultant. Also locate a USB flash drive with the training videos, programing, etc. in the as-built drawer of the main equipment rack. Digital copies sent as a link are not acceptable. identify within the Operating and Maintenance manuals, in the first section, where the flash drive is stored. Clearly label the flash drive as training videos. The second training shall take place within two months of the first training and all questions shall be answered.

3.8 RECORD DRAWINGS: Refer to Section 26 0502 for requirements.

END OF SECTION 27 4100

SECTION 27 4101 - AUDIOVISUAL SYSTEM INTEGRATOR VERIFICATION CHECKLIST

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-27 4100 section apply to work specified in this section.

1.2 ADMINISTRATIVE REQUIREMENTS:

A. This Document is intended to be completed and supplied to the AV Consultant prior to the final punch visit. Refer to specification 27 4100 for system components.

B. Installing contractor shall make copies of this document for large systems. Include all copies in the O & Ms and provide all copies to the AV Consultant.

1.3 DESCRIPTION OF WORK:

A. Refer to “INTEGRATOR VERIFICATION CHECKLIST” at the end of this section, for system verification requirements. Fill out the form and return to the AV Consultant prior to the final punch.

B. Upon completion of installation of each system and after electrical circuitry has been energized, demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units on site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with testing.

C. Before inspection by owner and AV Consultant, and after completion of the installation, conduct system tests and make necessary corrections for proper system operation.

D. Adjust, balance and align equipment for optimum quality and to meet the manufacturer’s published specifications.

E. All limiters and/or compressors shall be set to prevent operators from over-adjusting sound levels and damaging system components, while maintaining the highest amount of gain possible.

F. System shall have no audible hum, noise, RFI, or distortion when operating under normal conditions. System shall reproduce material at the loudspeakers rated output level without audible distortion. All input levels shall be pre-set so system may be operated without causing unstable feedback under normal use.

G. System shall have no image distortion, hum bars, color shift, or any other picture distortion while operating under normal conditions. Provide cable equalizers or an HDBaseT video solution. Cable equalizer shall be located near display and powered, on all cables that are more than 30 feet in length or with more than four (4) connection points. Refer to section 2.3.B in this specification for a list of pre-approved equipment. Adjust gain controls for optimum signal-to-noise with 0 dBu at a line-level input.

H. Perform polarity checks of loudspeaker lines by means of a polarity tester or use DC source at one end of each line and a voltmeter at the other end. Loudspeaker lines shall be identically polarized with respect to color coding.

I. Loose parts and poor workmanship or soldering shall be replaced.

J. Sweep Loudspeaker systems with high-level sine wave or 1/3 octave pink noise source. Correct causes of buzzes or rattles related to Loudspeakers or enclosures. Notify owner of external causes of buzzes or rattles.

K. Equalize the loudspeakers to produce less than 6 dB total variation between 500 Hz and

8000 Hz (+/- 3 dB).

L. Contractor shall provide system testing as described herein using up-to-date and industry accepted test equipment appropriate to the types of links being tested and in accordance with the latest edition of IEC 61935-1. AV Contractor shall own and have access to a handheld Quantum Data 780C tester to allow for on-site verification testing and troubleshooting of HDMI and digital video networks and analog video displays. All test equipment used shall be factory calibrated within one year of use with references set daily prior to testing.

M. Contractor shall provide HDCP compliant device with digital cables, and digital HDCP content for testing of routing and HDCP compliant distribution and switching. Also provide analog VGA output equipment for testing of video switching, scaling, and distribution if analog is included with this project.

N. Horizontal cabling contractor shall test all twisted pair cabling used within the AV system following the standards in specification 27 1500 under the testing section. Provide documentation of testing to AV Consultant prior to final walk through.

PART 2 – PRODUCTS

2.1 SECTION NOT USED

PART 3 – EXECUTION

3.1 AUDIOVISUAL SYSTEMS INTEGRATOR VERIFICATION CHECKLIST

Project Title		Date	
City, State		Integrator	
Room/Area			

Audio/Video Signal Processors/Switchers					
Location	Rack #	Manufacturer & Model #	Serial #	Total Channels (In, Out)	Unused Channels (In, Out)

Power Amplifiers						
Location	Rack #	Amp #	Manufacturer & Model #	Serial #	Total Channels	Watts/Channel

Loudspeakers Zones

Location	Rack #	Amp #	Amp Chan	Manufacturer & Model #	Serial #	Calculated Impedance	Measured Impedance

Wireless Microphone Receivers					
Location	Rack #	Manufacturer & Model #	Serial #	Usable Frequency Range	Chosen Frequency

Portable & Miscellaneous Equipment			
Description	Location	Quantity	Manufacturer & Model #.

Sign below to confirm you have received portable & miscellaneous equipment listed above.

Owner Signature: _____
Date:_____

Title:_____

Personal Delivering Equipment: _____

General Items

Title	Description	Initial	Notes
Labeling	Verify that all cabling, equipment, and wall plates are labeled per specifications and as noted on drawings		
Cable management	Verify that proper cable management has been provided and that everything looks well-ordered.		
Power	Verify that power supplies are secured and in an accessible area.		
Sequencer	Verify that the sequencer(s) are setup correctly for industry standard power on/off function.		
Cyber Security	Verify that all default passwords have been changed. Provide all login information to the owner representative		
System testing	Verify that all systems have been tested and are in working order.		
System Certification	Verify system has been tested with industry standard testing equipment including the use of Quantum Data 780C		
Cabling	Verify that all cabling on the project meets the document requirements.		
Network	Verify that the owner has all of the needed information for all devices on the network. Provide this information to the owner via a spread sheet.		
Network	Verify that all IP address are within the owner's network scheme.		
Network	Verify that VLANS are setup as indicated in drawings and within owner's network infrastructure		
System One-lines	Verify that each equipment rack contains a set of one-lines diagrams for system installed. Refer to specifications for one-line requirements.		
Thermal Management	Verify active thermal management is setup correctly and working properly.		
Training	Verify training has been scheduled with the owner representative.		

Audio Performance

Title	Description	Initial	Notes

Audio Signal Distribution	Verify that audio signal is being transported and distributed according to project documentation.		
Phantom Power	Verify that the correct phantom power is provided at the correct locations according to project documentation.		
Gain Before Feedback	Verify that the audio system is capable of reproducing speech above nominal operating levels without audible distortion or feedback.		
Rough Balance (input)	Verify that all inputs have the same nominal level.		
Gain Structure	Verify that proper gain structure has been followed from each input to output		
Rough EQ	In systems with equalization capability, equalize the loudspeakers to produce less than 6 dB total variation between 500 Hz and 8000 Hz (+/- 3 dB).		
DSP Programming	Verify that DSP systems have been programmed to allow signal routing, balance, and EQ. DSP programming should be saved in editable form prior to final commissioning visit.		
Rough Balance (output)	Verify that loudspeaker zones reproduce program content at the same level (+/- 1 dB).		
Emergency Muting	Verify that any required muting or operational changes are in accordance with location regulations in the event of a life safety or similar emergency.		
Assistive Listening	Verify that the assistive listening system functions as a complete personal listening system at specified levels without distortion or excessive background noise.		
Loudspeakers	Verify that there is no hum, noise, RFI, or distortion when operating under normal conditions.		
Loudspeakers	Verify that there are no rattles or buzzes with a high-level sign wave or 1/3 octave pink noise.		
Loudspeaker Zoning	Verify that loudspeaker zones are assigned correctly according to project drawings and specifications.		
Loudspeaker Impedance	Verify that all loudspeaker circuits have correct impedance as defined in the project drawings and specifications. Note measured impedance on previous page.		

Loudspeaker Alignment	Verify that loudspeakers are mounted and aligned as shown in project documentation.		
Loudspeaker Polarity	Verify that all loudspeakers in a given space are wired with the same polarity.		
Loudspeaker Tap Settings	Verify the tap settings on all constant voltage loudspeakers.		
Loudspeaker Delays	Verify that loudspeakers are set with the proper delay. Refer to drawings and specifications for requirements		

Control System Performance

Title	Description	Initial	Notes
Functionality	Verify that the control system functions according to project documents.		
Automatic controls	Verify that the automatic features work ie: room combining, video detection, etc..		
Lighting controls	Verify that the lighting system presents are correctly recalled by the control system as indicated in project documents.		
Shade controls	Verify that the shade controls are correctly recalled by the control system as indicated in project documents.		
Sequencer	Verify the sequencer is controlled as noted in project documents. If no specific requirements are noted, sequencer will be powered on/of from the front panel.		

Video Performance

Title	Description	Initial	Notes
Video Routing & Switching	Verify that all video signals are properly routed, switched, scaled, and displayed according to project documents.		
Projector Alignment	Verify that projectors and screens provide a projected image that is properly aligned and fills the projection area.		
Projector Alignment	Verify that projector and screen are in the correct locations, correctly aligned and keystone correction is not in use.		
Projector Interactivity	Verify that projector touch sensors are calibrated and working per manufacture instructions. Provide offset hardware as needed.		
Image Scaling	Verify that all displayed images are scaled to the full native resolution of displays and projectors in all cases where scaling hardware is specified.		

Image Quality	Verify that all displayed images are correctly focused and are free from distortion.		
Aspect Ratio	Verify that all displayed images maintain the proper aspect ratio and image geometry. Key-stoning and stretching should not be used. Any exceptions to this should be noted.		
Display Image setting	Displays are set to dot to dot or full. Images shall fill the screen without cropping.		
Signal Bandwidth	Verify that all equipment from endpoint to endpoint supports the resolution/data rate as indicated in the documents.		
System Certification	Verify system has been tested with industry standard testing equipment including the use of Quantum Data 780C		

3.2 OPERATING AND MAINTENANCE MANUALS: Include a copy of this document within the Operation and Maintenance Manuals.

END OF SECTION 27 4101

SECTION 27 5123 - INTERCOMMUNICATION SYSTEMS

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-26, 27 & 28 basic materials and methods sections apply to work specified in this section.

C. Refer to specification 27 1500 for category and/or optical fiber cable and connectivity specifications and color requirements. Category cables used for transporting video, audio and controls simultaneously from transmitters to receivers and/or switchers shall follow manufacturer's recommend cabling specifications, refer to manufacturer for requirements.

1. Fiber Optic Cable: Fiber optic cable is the designated media cabling for school backbone inter-building and intra-building wiring. This includes all MDF to IDF or IDF to IDF and vertical riser applications.
2. Copper Cable: Unshielded Twisted Pair (UTP) with the specified category cabling must be used for the horizontal wiring from the MDF, IDF, or CP to the individual communications outlets.
3. Rack and PoE Switches Requirement: low voltage contractor is responsible for equipment racks, and/or communications cabinets. The racks must be installed in the MDF and IDFs to support communications systems equipment and the communications distribution system and must match the current School District Standard. Communications distribution cables must be terminated in jackfields and punch-down blocks mounted in the equipment racks or communications cabinets.
4. All intercom cabling shall be installed by division 27 1500 contractor. Coordinate pathways as required.

1.2 ADMINISTRATIVE REQUIREMENTS:

A. Bid Submittal:

1. Equipment Costs: Breakout cost of material and labor as different line items.
2. Provide separate line items for each section that you are being bid on.

a. Contractor shall not provide a single number with all of the sections/scopes combined.

B. All bids shall be based on the expansion of the existing district's Intercommunication and Bell Schedule Server Systems and must be compatible with the existing Rauland-Borg Systems - No Exceptions. Equipment as specified herein. The catalog numbers and model designations are that of the RAULAND BORG CORPORATION.

C. Coordination:

1. Coordinate final inspection of the systems installed, with the intercommunications system design consultant, three (3) weeks in advance.
2. Obtain GANTT chart for construction time frame from the General Contractor.

3. Coordinate with Electrical contractor to meet at least twice with the ceiling installer. Hold first meeting before submittal of shop drawings to coordinate the mounting condition of all ceiling-mounted intercommunications equipment with ceiling type. During second meeting, coordinate the location of all ceiling-mounted intercommunications equipment in each area.
4. Meet at least once with the mechanical installer prior to fabrication and installation of duct work. Coordinate depth and location of all loudspeaker and duct work in all areas.
5. Meet with Electrical contractor prior to pathway rough-in to coordinate Intercom system requirements in each area.
6. Meet at least once, prior to rough-in, with horizontal cabling installer to verify all required drop points are accounted for. Coordinate cable color according to specification 27 1500.
7. Coordinate all intercommunications system components within millwork/furniture with millwork shop drawings prior to rough-in.
8. Meet at least twice with owner to coordinate network requirements. Hold the first meeting before submittal of shop drawings to coordinate network protocols, including but not limited to: IP address schedules, MAC address schedules, patchbay schedules, security requirements, and VLANs. Hold the second meeting prior to system deployment.
9. Coordinate color (including custom color) and finish of all intercommunications system components with Architect prior to ordering. Architect may require custom color of grills, face plates, etc.. AV contractor shall paint or have devices painted by others. The cost for custom colors shall be within the AV Contractors Bid.
10. Coordinate all system components within millwork/furniture with millwork shop drawings prior to rough-in.

1.3 DESCRIPTION OF WORK:

A. This section includes a fully operational IP platform for school internal communications system incorporating school safety notifications and general communications including but not limited to the following:

1. The platform shall provide complete internal communications employing IP Technology including the minimum functions listed.
    a. Two-way Loud Speaking Internal Intercommunications.
    b. Bell Event announcement
    c. Emergency announcement that will override any pre-programmed zones assuring that all Emergency/Lockdown etc., are heard at each and every loudspeaker location.
    d. Capability of prerecording emergency announcements that can be activated by a Soft Key or via a dedicated call-switch.
    e. Atomic Time Synchronization with Class Change Tones utilizing multiple, programmable schedules for each zone.
    f. Web-based, permission driven user interface.
2. The system shall support a minimum of 1,000 level priorities which shall be user definable, allowing each end point to place a minimum of 5 different priority calls at the same time.

3. Any authorized administrator shall be able to call from outside the school into any classroom, zone or entire school directly via the School District supplied SIP enabled Telephone Network. This shall allow remote monitoring, call-in annunciation and two-way conversation from outside the facility as well as paging into the system. (Compliance with NEMA Standard SB-40 for emergency communications in K-12 Schools)
4. Authorized system users shall be able to create a minimum of twenty (20) automated sequences with emergency instructions, emails and relay activations and replay them. Automated message strings shall be, manually played from a single-button access on the console, on a SIP connected telephone, a panic button or from the web interface.
5. Paging and two-way loud speaking features shall be accessible from any system console or SIP connected telephone.
6. The platform shall synchronize its system time to the network timeserver or a web-based time server.
7. Installation shall be locally survivable for intercom, paging bells, and emergencies such as lockdown, even when the district connection is unavailable.
8. This specification establishes a minimum level of quality, features, and performance for individual components as well as the integrated system.

B. Equipment submitted in bid proposal that has not been approved by AV Consultant in writing will not be accepted and shall be replaced by approved equipment at contractor's expense. Equipment not listed within this specification, or contract documents, that are required for a complete and working system, shall be of professional grade and used in the same manner as needed for a complete and working system.

C. Input plates shall match the color and style being used throughout the project.

D. Contractor is responsible for coordinating with all other trades for equipment locations, mounting requirements, supports and plenum space requirements.

E. All control processors and controllers are to be on an unswitched power connection.

F. All cabling shall be installed in 1" diameter conduit (minimum). Conduit shall be a continuous path from source to within close proximity to final destination.

G. Integration of the intercommunications system to the school district's telephone system. (SIP TO SIP INTEGRATION)

H. CRISIS LOCKDOWN

1. The system can automatically broadcast emergency instructions throughout an entire campus when an alarm (e.g. lockdown, lockout, shelter, evacuation, security, fire) is tripped or manually activated. The emergency instructions are preprogrammed and require no user intervention. The system provides redundant alarm annunciation over intercom/paging speakers and is not meant to replace primary fire alarm or security systems.

    a. Shall provide ability to initiate pre-programmed announcements on paging system.

    b. Shall provide ability to clear status by individual location, region, or global.

c. Shall provide ability to place in Lockdown, Shelter, or Evacuation Mode.

d. Shall provide pop up alarms on Lockdown, Shelter, or Evacuation events.

e. Shall provide pop up alarms on any location color status change

f. Shall provide ability to initiate lockdown of access-controlled doors.

g. Shall provide ability to send email and/or SMS text alerts to authorities or first responders.

h. Shall provide ability to open two-way chat to educators, administrators and first responders.

i. Interconnect the Fire Alarm system to the intercommunications system such that upon activation of any initiating device, a preset audible alarm will be sent to all intercom speakers. In addition, the contractor shall provide all controls necessary between the two systems such that upon silencing the alarm on the fire alarm panel, it automatically silences the audio file in the intercom system.

j. Interconnect the Access Control system to the intercommunications system such that upon activation of an Emergency Lockdown or Preventative Lockdown from the administrative console, web browser, app, etc., a communication protocol will be sent from the intercom system to the access control system that will allow for all controlled doors to be locked, a designated campus wide communication throughout the building, emails, SMS text, etc. A minimum of two types of initiations process shall be programmed e.g. “Emergency Lockdown or “Preventative Lockdown” In addition, the contractor shall provide all controls necessary between the two systems such that the system can easily be reprogrammed to meet the needs of the School District.

I. Intercommunications system contractor shall participate in a mandatory pre-construction meeting no more than sixty (60) days prior to ordering equipment, and before work can begin. Contractor is responsible for coordinating meeting. The meeting will be held at design consultant’s office. All submittals, shop drawings, and bill of materials shall be completed and submitted to design consultant for review eight (8) working days prior to this meeting.

1. Intercommunications contractor shall attend the electrical pre-construction meeting per specification 26 0500.

1.4 QUALITY ASSURANCE:

A. Intercom System Qualifications:

1. Local distributer for district wide intercom solution. Intercom system shall match current solution.

B. Manufacturers:

1. Firms regularly engaged in manufacture of sound equipment, components and accessories, of types, capacities and characteristics required, whose products have been in satisfactory use in similar service for not less than five (5) years.

Equipment supplier shall be authorized representative of the manufacturer of each major piece of equipment and be currently authorized by the manufacturer to furnish, install and service that particular equipment.

2. Manufacturers of intercom systems shall not be the installation party for this system. There must be a 3rd party independent representative for the installation. Refer below for 3rd part representative requirements.

C. Installer:

1. Qualified with at least five (5) years of successful installation experience with similar systems.
2. Integrating firm shall have worked satisfactorily for a minimum of five (5) years of completing systems equal to this scope, quality, type and complexity.
3. Key personnel assigned to the project shall each have minimum of (10) years of experience in completing systems equal to this scope, quality, type and complexity.
4. Contractor shall be a factory authorized distributor of all equipment specified for the geographical area of the project.
5. Contractor shall maintain complete installation and service facilities for the duration of the project contract.
6. Contractor shall have current manufacturer certificates for system and equipment listed within this specification.
7. All contractors biding on this project must have local representation that is within four (4) hours of the job site.

D. Contractor must follow the standards described within:

1. BICSI/AVIXA AV Design Reference manual.
2. ANSI/AVIXA 2M-2010 Standard guide for Audiovisual Systems Design and Coordination Processes.
3. ANSI/AVIXA 10:2013 Audiovisual Systems Performance Verification Guide.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.

F. Comply with NFPA 70 and with NEMA Standard SB-40 for Emergency Communications in K-12 schools.

G. Comply with UL 60950.

1.5 SUBMITTALS: Refer to Section 26 0502 for requirements.

1.6 WARRANTY:

A. Systems shall be guaranteed for a period of one (1) year from the date of substantial completion against defective materials, inferior workmanship or improper installation adjustment. Guarantee shall cover all parts and labor.

B. If system failure causes audiovisual system to be inoperative or unusable for its intended purpose, contractor, when notified of the problem, shall repair system so it will be operational and usable within three (3) business days. If defective components cannot be repaired in time, provide temporary equipment as required.

C. Contractor shall supply a one (1) year warranty on all system programming from the date of substantial completion. During this time period, upon owner request, the contractor shall provide programming changes up to four (4) times free of charge. During this time the programs shall be password protected. At any time during the (1) year, the owner can terminate the warranty and request the programming of each system. At this time the programs are to be turned over to the owner and all passwords are to be removed. The owner shall own all rights to the programming after this time, to be used in this facility.

D. Contractor shall honor equipment warranties for term established by manufacturer if greater than warranty time frame mentioned above.

E. Prior to the end of the 1-year warranty. The Intercom Integrator shall preform the following:

1. Three (3) months prior to end of warranty remind the owner and design consultant that the end of the warranty is approaching. At this time coordinate the events below with the owner and notify the design consultant of the time of the walk through(s).

2. One (1) month prior to end of warranty, walk through campus and verify all components are working. Supply list of components with location, type equipment and status to the design consultant and Owner. Correct any and all malfunctions as necessary.

PART 2 - PRODUCTS

2.1 SOUND SYSTEMS:

A. The platform shall utilize state of the art IP Technology, Call-in Notification, School Safety Paging and Evacuation tones, IP infrastructure, Atomic Time Synchronization with Class Change Tones utilizing multiple, programmable schedules for each zone, Two-way hands-free Internal Intercommunications and Paging, and Program Distribution. The system shall be easy to learn and operate. All standard programming shall be web based and user friendly to allow the system administrator the ability to easily program system features.

B. Provide complete and satisfactorily operating school communications and school safety as described herein, using materials and equipment of types, sizes, ratings, and performances as indicated. Use materials and equipment that comply with referenced standards and manufacturers' standard design and construction, in accordance with published product information. Coordinate the features of all materials and equipment so they form an integrated system, with components and interconnections matched for optimum performance of specified functions.

C. The platform shall be a single electronic system consisting of a minimum of ten (10) intercom channels per facility, (classroom) IP loudspeakers, corridor loudspeakers, inside and outside horns, call-in switches, and SIP phone integration.

D. Each Classroom shall be provided with an IP Speaker module interface and call- in switch, each with their own annunciation path and priority.

E. Call-ins may automatically annunciate (display of priority and location) to administrative consoles, SIP enabled phones and outside phones.

F. Call-ins shall be programmed to automatically change priority and annunciation route based on age of call-in and original priority.

G. Call-ins may have priority and annunciation routing changed by user action from a console or SIP enabled phone.

H. Call-in annunciation routing shall include playing pre-recorded audio over speakers, sending a pre-configured e-mail and/or activating relays.

I. The platform shall lend itself to expansion by simple addition of hardware modules.

J. The platform shall directly connect to the WAN/LAN without the need for a separate server at each school location. Configuration, including bell schedules, calendars, and emergency sequences can remotely be created, changed, stored and downloaded to the system by an authorized user from a browser-based interface.

K. The platform 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.

L. The platform shall provide the ability to selectively communicate or monitor individual classrooms in emergency situations from any telephone within the facility or outside the facility to any other location within the facility; all communication within the classroom shall be hands free and will not require any interaction by the classroom user.

M. IP addressable loudspeaker modules for individual rooms shall be system programmable and may be assigned any two, three, four, five or six-digit number as well as name and description. Any extension may be reassigned at any time.

N. IP-enabled two-way voice communication shall be available from any provided telephone or administrative console through any loudspeaker in the system. This shall allow hands free communication to any classroom or any individual loudspeaker unit. A programmable pre-announce tone shall sound immediately before the intercom path is opened and a supervisory tone shall continue to sound at regular intervals when loudspeaker monitoring is active, complying fully with all privacy legislation. Pre announce tone and supervisory tones shall be disabled during designated emergencies automatically.

O. Integrated Master Clock with unlimited schedules, unlimited events, and automatic Daylight Savings time correct. Up to five (5) schedules may be active on any given day for each school. User shall be able to select from twenty-five (25) standard included tones or unlimited user created and uploaded audio files for class change signaling and messaging. In addition, scheduled events shall include relay actions and email notifications. The platform shall allow control of the bell schedules via the district WAN/LAN without the need for a separate computer at the school location. Bell schedules can remotely be created, changed, stored and downloaded to the system by an authorized user from a browser-based interface.

2.2 SYSTEM FUNCTIONS/SOFTWARE

A. Server Software TCU2000SW (Existing)

1. Provides district wide paging, bell event scheduling, emergency notification and configuration for entire district.

2. Reports on feature usage, system activity, etc. shall be available from the district-wide web interface.

3. Ability to perform configure system and initiate system features via district wide web-based interface.

4. The software has the ability to sync system time to the Atomic Clock Signal or to the school's or districts network time server

5. The software will provide a web-browser to deliver district wide emergency paging, pre-recorded messages and tones from any authorized computer in the facility or the district. The software must be capable of automatically notifying district personnel via the WAN of an alarm condition.

6. The software can automatically broadcast page emergency instructions via associated system hardware throughout an entire district when an alarm (e.g. lockdown, lockout, security, fire) is initiated via the web-based interface. The emergency instructions are preprogrammed and require no user intervention. The system provides redundant alarm annunciation over intercom/paging loudspeakers and is not meant to replace primary fire alarm or security systems

7. The software shall support VoIP Telecenter Campus Controllers for a minimum of 1000 facilities.

8. The software shall support a minimum of 50,000 IP Loudspeaker modules, district wide.

B. VoIP Single Campus Controller Rauland-Borg Telecenter Series TCC2000 with the following features and capabilities:

1. Provides call routing for paging and intercom for a single facility

2. System shall connect to the district provided Telephone Network via a SIP connection.

3. The VX Works based Operating System and system programming database shall be stored in non-volatile flash memory. The Operating System can be easily upgraded through configuration without requiring replacement of any chips.

4. Support a flexible numbering plan allowing two, three, four, five, or six-digit extensions.

5. SIP interface to a district provided Telephone Network shall be capable of allowing connected phones to display classroom call-ins, answer internal intercom call-ins, make pages and change priorities of call-ins in progress.

6. Direct Dialing, two-way amplified voice intercom between any provided telephone or admin console and loudspeaker without the use of a press to talk or talk listen switch.

7. Ability to place up to five (5) levels of call-in from any call-in switch per area.

8. The ability to answer intercom call-ins registered at pre-selected telephones.

9. The ability to automatically escalate incoming call-ins to an alternate

administrative console or SIP telephone or group of telephones if they remain unanswered for a predetermined amount of time.

10. The ability to remotely locate IP Campus Controller. The controller shall not need direct connection to any classroom via home run or distributed wiring. It shall communicate solely through the IP LAN network.

11. Single button access from any telephone on the system to distribute emergency announcements within the facility to all or select locations equipped with loudspeakers. Emergency announcements originating from any assigned administrative telephone shall have priority over all regular system functions.

12. Store a minimum of forty-eight (48) hours of Bell Event Schedules, all emergency notification sequences as well as facility wide configuration.

13. System has the ability to sync system time to the Atomic Clock Signal or to the school's or districts network time server.

14. System's SIP Interface shall provide:

    a. Audio paging access from any telephone to any single intercom loudspeaker, zone (group) of intercom/paging loudspeakers, or all loudspeakers/paging horns throughout the entire facility.

    b. Single button access from any telephone on the system to initiate alarm signals within the facility to all or select locations equipped with loudspeakers. A minimum of twenty-five (25) separate distinct alarm signals shall be provided. Alarm signals originating from any assigned administrative telephone shall have priority over all regular system functions.

15. The system will have the ability to utilize a web-browser and USB microphone to deliver district wide live emergency paging, pre-recorded messages and tones from any authorized computer in the facility or the district. The system must be capable of automatically notifying district personnel via the WAN of an alarm condition.

16. The system can 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 are preprogrammed and require no user intervention. The system provides redundant alarm annunciation over intercom/paging loudspeakers and is not meant to replace primary fire alarm or security systems.

C. IP addressable Modules TCC2011:

1. System shall provide multiple IP addressable modules for intercom, paging and relay activation.

    a. All modules are POE 802.3af compliant

    b. All Modules support DHCP

    c. All Modules connect to network with a single RJ45 connector

2. IP Loudspeaker Module shall interface to school's data network, a loudspeaker,

and multiple call switches.

a. A minimum of five (5) levels of call-in can be placed from an IP Loudspeaker Module. The call-ins route to designated administrative consoles and select SIP connected telephones and can only be cleared from the system once answered. If a call-in is not answered within a preprogrammed time the call-in may reroute to other telephones and consoles, and announce over selected or all loudspeakers.

b. The ability to belong to one or more of a minimum of one-hundred (100) independent zones for zone paging, program/music distribution zones and class change tone reception; this assignment is a programmable function, change able by time of day. Each IP Loudspeaker Modules location shall be programmed in software to belong to any combination of software zones. Software/hardwired zones must be configured as part of an unlimited number of district wide groups for school district emergency announcements. These district announcements must be accessed via microphone, a web-browser or telephone.

c. IP Loudspeaker Modules shall be designed to mount near ceiling and wall loudspeakers and in the plenum space.

3. IP-addressable Zone Paging Module TCC2022:

a. Zone paging module shall connect multiple loudspeakers for all page, zone paging, bells, audio events and, emergency notification.

b. Zone Paging Modules shall be rack and wall mountable.

c. Zone Paging modules shall be able to belong to one or more of 100 independent zones for live paging, bells, pre-recorded audio and emergency notification

D. Audio Paging/Program Amplifiers: Stewart Audio – CVA25-1 25V, and/or Atlas Sound – CP400.

1. Power amplifier(s) shall be provided to provide a minimum of 2 watts of power to all paging loudspeakers, and 7 watts of power to all paging horns.

2. The maximum load on the paging/program amplifiers shall be 80% of the rated maximum output of the amplifiers.

3. Provide 25-volt transformer output for all zones that connect more than one (1) loudspeaker together and/or the distance from amplifier to the loudspeaker is greater than 25’.

4. Any exterior zone shall be connected to a 200-watt amplifier channel.

E. Normal/Emergency Call Switch – Rauland TCDPB2 Dual Level Call-in Switch Cancel

1. Normal/Emergency Call Switches indicated on the drawings shall provide the following functions and features:

a. One (1) “Normal” call switch that shall activate a distinctive “NORM” level call from a single button activation. The button shall be clearly marked “NORM” and will route the call-in to any one or more Administrative

Telephones or SIP interface to offsite telephones. This button may also be used as a “check-in” button during crisis situations.

b. One (1) “Emergency” call switch that shall activate a distinctive “EMERGENCY” level call from a single button activation. The button shall be red in color and shall be clearly marked “EMERGENCY” and will route the call-in to any one or more Administrative Telephones or SIP interface for quick and easy response from an Administrative Telephone or off-site telephone.

F. SIP Gateway

1. The SIP Gateway shall provide a communications path to the phone system from the intercom system.

G. Loudspeakers:

1. AtlasIED and Quam loudspeaker assemblies are the basis of design. Intercom manufacturer equivalent loudspeakers are allowed if they meet the function and form of the loudspeakers listed below.
2. Loudspeaker cabling for common zones shall use a 16 AWG 2-pair stranded conductor cable assembly unless otherwise noted. Refer to Audiovisual Cable and Conduit Schedule on the drawings for approved cabling manufacturer.
3. Type ‘IC1’ - loudspeaker assembly (lay-in tile):
   a. Quam – System 5 or equal
   b. 1’x2’ ceiling tile replacement loudspeaker with 5 oz. magnet and 5 watt 24/70V transformer. 92dB SPL 1W/1M with 99dB max SPL at maximum tap. 65Hz – 17kHz frequency response ±3dB and 100-degree dispersion angle.
4. Type ‘IC2’ - loudspeaker assembly (hard lid ceiling):
   a. Atlas – SD72W w/ 76-8 mounting ring and BMTT95-8 enclosure
   b. Quam – C10X/BU/WS w/ SSB-7 mounting ring and ERD-8U enclosure
   c. Gyp loudspeaker with 10 oz. magnet and 5 watt 24/70V transformer. 95dB SPL 1W/1M with 102dB max SPL at maximum tap. 60Hz – 8kHz frequency response ±3dB and 90-degree dispersion angle.
5. Type ‘IC3’ - loudspeaker assembly (structurally mounted):
   a. Atlas – SD72W w/ BMTT95-8 enclosure
   b. Quam – C10X/BU/WS w/ ERD-8U enclosure
   c. Open ceiling direct mount to structure loudspeaker with 10 oz. magnet and 5 watt 24/70V transformer. 95dB SPL 1W/1M with 102dB max SPL at maximum tap. 60Hz – 8kHz frequency response ±3dB and 90-degree dispersion angle.
6. Type ‘IC4’ - loudspeaker assembly (lay-in tile IP);
   a. Intercom Manufacturer specific assembly with an IP Addressable module and loudspeaker.
7. Type ‘IW1’ - loudspeaker assembly (recessed wall mount interior):
   a. Quam – 8C5PAX/TBLU w/ ES-8 enclosure and BS8W grill

b. Indoor recessed wall 8” loudspeaker with 5 oz. magnet and 5 watt 24/70V transformer. 92dB SPL 1W/1M with 99dB max SPL at maximum tap. 65Hz – 17kHz frequency response ±3dB and 100-degree dispersion angle.

8. Type ‘IW2’ - loudspeaker assembly (recessed wall mount exterior):

a. Atlas – VTF-152UCN or VTF-157UCN w/ AR Adapter Ring

b. Exterior recessed wall 4” loudspeaker with 5 watt 24/70V transformer. 96dB SPL 1W/1M with 107dB max SPL at maximum tap. 600Hz – 5.5kHz frequency response ±5dB and 170-degree dispersion angle.

9. Type ‘IW3’ loudspeaker assembly (exterior hour):

a. Atlas – AP-15T

b. Exterior Horn with compression driver and 15 watt 24/70/100V transformer. 106dB SPL 1W/1M with 120dB max SPL at maximum tap. 400Hz – 14kHz frequency response ±5dB and 70-degree dispersion angle.

H. Cabling:

1. Provide and install appropriate number of analog and horizontal cables, patch cables, for all terminated data drops, between switches, etc. so that building-wide networking will be operational once all installation is complete.

a. Provide manufacturer recommended cabling for all locations shown on plans.

b. Horizontal/Category provided per specification 27 1500 (i.e. IP addressable Speakers, Classroom Modules, Call Switches, Zone Modules, Console, Controller, etc.)

c. Provide cabling rated for the environment that it is installed in (i.e. underground conduit, conduit in slab on grade). All cabling installed in wet locations shall be listed for use in wet locations.

d. All associated intercom wiring cable shall be yellow.

I. Vandal Resistant call-in station – Quam CIS4/8

1. Device shall provide 2-way communication from location to main office. Connect call switch to IP module, mount IP module on secure side of wall/door.

J. UPS – Juice Goose – SCV-20001 or equal

1. Contractor to verify UPS load requirements prior to purchase of UPS. Intercom system shall maintain power for 30 minutes after building loses power.

K. Clocks:

1. Clocks shall be battery powered. The contractor shall provide a fresh battery and install each clock set to the correct local time. Room types will have different size requirements.

2. 12" clock – American Time and signal – E56BAQD304BF

a. Provide 1 clock per the following room types:

i. Learning Studio/Classrooms

ii. Collaboration Area
iii. Offices
iv. Work rooms
v. Conference rooms

3. 15" clock – American Time and signal – E66BAQD304BF (Recreational Space Clock)

a. Provide 1 clock per the following room types:

i. Gymnasiums (provide 1 on each side of the dividing curtain)
ii. Music rooms
iii. Shops
iv. Kitchen
v. Commons/learning stairs
vi. Media center

4. Provide wire guard on all clocks in locations where other devices are protected. Coordinate with fire alarm plans for locations requiring wire guards.

2.3 INTERCOMMUNICATION, PROGRAM DISTRIBUTION, CLOCK/TIME SIGNALING SYSTEM

A. Separately addressable paging zones shall be provided as indicated on the drawings. Zones shall be capable of being grouped for various call scenarios as defined or requested by the owner.

B. Refer to the intercom drawings for identification of zones, zone types, and ceiling construction type.

1. Individual zones are designated with “Z-ID”.

2. Common and exterior distributed zones are identified with a unique zone number “Z-#X#”.

3. Intercom drawings are intended to be printed in color in addition to having the zone information under the room tag.

C. Space requirements:

1. Classrooms/Teaching spaces.

a. The IP module/loudspeakers for each space shall be utilized for the intercommunication system.

b. One (1) Call switch shall be provided in each room near the CSA antenna location. Refer to drawings for location of devices.

c. One (1) Clock located above the entrance door.

2. Shared spaces between Classrooms/Teaching spaces.

a. The IP module/loudspeakers for each space shall be utilized for the intercommunication system.

b. One (1) Call switch shall be provided on the wall adjacent to the main hallway.

c. One (1) Clock located above the entrance door.

d. These rooms will be used as shelter in place rooms for adjoining classrooms.

3. Specialty Teaching spaces with high ambient noise floor (Wood/Metal/AG shops, Band/Choral/Orchestra rooms, etc).

    a. Distributed ceiling recessed loudspeakers (Qty. as required) at 14’ by 14’ minimum spacing, type as required for ceiling construction.

    b. Visual strobe located in a highly visible area.

    c. One (1) Call switch shall be provided at the primary teaching station. Coordinate location of primary teaching location with drawings.

    d. One (1) Clock located above the entrance door

4. Private Offices, Conference rooms, Faculty Lounges & Work Rooms (outside of the main office/administration suite)

    a. One (1) ceiling mounted loudspeaker, type as required for ceiling construction.

    b. Connect to adjacent corridor zone you enter the office from.

    c. Offices off of a classroom shall be on the same zone as the classroom.

    d. Refer to floor plans for offices that require an individual zone.

5. Gymnasium

    a. Wall mounted horn type loudspeaker above the entrance door. If there is a dividable curtain provide a loudspeaker for each side along with one on the stage, if applicable.

    b. Additional loudspeakers may be required as needed to maintain adequate coverage (< 6dB level variation).

    c. One (1) Call switch shall be provided co-located with any light switches adjacent to each entrance from within the school.

6. Cafeteria/Commons/Dining

    a. Ceiling mounted loudspeakers, Qty. and type as required for ceiling construction and adequate coverage (< 6dB level variation).

7. Kitchen

    a. Ceiling mounted loudspeakers, Qty. and type as required for ceiling construction and adequate coverage (< 6dB level variation).

    b. One (1) Call switch shall be provided co-located with any light switches adjacent to main entrance.

    c. Within the Kitchen office provide a two-way system with call button and loudspeaker.

8. Corridors, Vestibules & Open Collaboration/Circulation areas

    a. Distributed ceiling recessed loudspeakers (Qty. as required) at 20’ minimum spacing, type as required for ceiling construction.

    b. Rooms that are wider than 25’ shall require an additional row of loudspeakers and located on a maximum of a 20’ x 20’ spacing centered in the room.

    c. Coordinate with ceiling devices and locate adjacent to smoke detectors

when within few feet of one. Loudspeakers shall be in line with any lighting within the space

d. Provide a minimum of one (1) loudspeaker for each space type

9. Stairwells

a. One (1) ceiling mounted loudspeaker, type as required for ceiling construction.

b. Connect to the adjacent corridor zone unless otherwise specified.

10. Restrooms

a. One (1) ceiling mounted loudspeaker, type as required for ceiling construction.

b. Connect to the adjacent corridor zone

c. Do not provide loudspeakers in single use restrooms adjacent to a corridor zone. Locate corridor loudspeakers within 10 to 12 feet of the door.

11. Administration Suite (Private offices, Conference rooms, Nurse areas, work rooms, reception, etc. within the main administration suite)

a. Distributed ceiling recessed loudspeakers (Qty. as required) at 20' minimum spacing down corridors and 14' x 14' in open areas, type as required for ceiling construction.

b. Provide a minimum of one (1) loudspeaker for each space type.

c. Provide a minimum of one (1) loudspeaker on an individual zone in the reception area and adjacent areas where it would be heard in the reception area. General pages from the reception area shall not play over this zone, it shall only be used for prerecorded messages.

12. Building Exterior

a. Distributed recessed loudspeakers (Qty. as required) to cover all sides of the building and all entrances.

b. Coordinate and co-locate loudspeaker rough-in with exterior fire alarm horn strobe locations.

c. Provide unique zone for each side of the building (North/South/East/West)

d. Provide 'IW3' type loudspeakers on areas with:
   i. Playground equipment
   ii. Fields
   iii. Other play surfaces

e. Provide 'IW2' type loudspeakers on the front of the building and in locations where the property line is less than 30' from the building.

13. Rooms smaller than 100 sqft and that are adjacent to a corridor/hallway will not require a loudspeaker when an announcement is audible within the room. Audible within the room shall be defined as 15 dB above the ambient noise within the room.

a. Vestibules are excluded from small rooms and will require a loudspeaker

tied to the adjacent corridor zone.

14. Field coordinate the tap setting on each loudspeaker to be 15dB above the ambient noise floor. The ambient noise floor shall be measured when the area is fully occupied. The following areas have the anticipated noise floor:

    a. Hallways – 80 dB

    b. Classrooms – 70 dB

    c. Offices/conference rooms – 60 dB

    d. Gym/multipurpose rooms – 85 dB

    e. Exterior areas – Max tap setting

D. All class-change bell signaling shall be sounded over the intercommunication system.

1. Each dialing administrative console in the system shall be programmable for the following options:

    a. Allow zone paging.

    b. Allow All-Page announcements.

    c. Allow Executive Override.

    d. Allow Emergency paging.

    e. Allow activation of Time Zone tones.

    f. Set the priority level and target display of "normal" calls.

    g. Set the priority level and target display of "emergency" calls.

    h. Assignment of architectural number.

    i. Class of Service.

    j. Assignment of associated speaker to paging zone.

    k. Automatic Call-Back-Busy.

    l. Call Forward-No Answer.

    m. Call Forward-Busy.

    n. Allow activation of security monitoring functions on a per room and per zone basis.

E. All class-change signaling shall be sounded over system loudspeakers as programmed.

PART 3 - EXECUTION

3.1 GENERAL

A. Wiring shall be installed in metallic conduit to cable trays and provided with necessary junction and pull boxes. All wiring shall be color coded and in accordance with the manufacturer’s instructions, local and national codes. Care shall be exercised in wiring to avoid damage to the cables. All boxes shall be plumb and square. Cables shall be pulled continuous without splicing, leaving ends in lengths as directed by the manufacturer’s representative.

B. After all circuits and cables have been pulled and completed from one extremity to the other, the electrical contractor shall check all circuits free of opens, shorts and grounds. The electrical contractor shall identify and tag all cables at the head end.

C. Provide all equipment, wiring, conduit, boxes, rough-in, etc., according to the plans and specifications.

D. The manufacturer's representative shall make all final connections to the equipment, shall test and adjust the systems, and shall instruct the proper parties as to care and operation.

E. Any additional equipment required for a fully functional system to meet the intent of the specifications shall be provided whether or not specifically listed herein.

F. Mount punch down block for system terminations, within the equipment rack.

G. Test the reception at each clock location, per manufacturer's instruction, to determine the actual location with the Architect.

3.2 INSTALLATION OF SOUND SYSTEMS:

A. Install sound systems as indicated, in accordance with equipment manufacturer's instructions, and with recognized industry practices, to ensure that system equipment complies with requirements. Comply with requirements of NEC and applicable portions of NECA's "Standard of Installation" practices.

B. Carefully match input and output impedances and signal levels at signal interfaces. Provide matching networks where required.

C. Coordinate with other electrical work, including cable/wire, raceways, electrical boxes and fittings, as appropriate to interface installation of clock and program systems work with other work.

D. Control Circuit Wiring:

1. Install control circuits in accordance with NFPA 70 and as indicated. Provide number of conductors as recommended by system manufacturer to provide control functions indicated or specified.

2. The contractor shall mount a main distribution frame behind the Integrated Electronic Communications Network console. All wires shall be laid down on terminal punch blocks and identified by the actual room location it serves. All the communications points shall be wired into this main distribution frame, laid down in sequence, and identified by which line it is on and the point position it serves.

3. All housings are to be located as specified and shown on drawings.

4. Make installation in strict accordance with approved manufacturer's drawings and instructions.

5. The contractor shall provide necessary transient protection on the AC power feed, all station lines leaving or entering the building, and all central office trunks. All protection shall be as recommended by the equipment supplier and referenced to earth ground.

E. Wiring Within Enclosures:

1. Provide adequate length of conductors. Bundle, lace, and train the conductors to terminal points with no excess. Provide and use lacing bars.

2. Provide physical isolation from each other for speaker-microphone, line-level, speaker-level, and power wiring. Run in separate raceways, or where exposed or in same enclosure, provide 12-inch minimum separation between conductors to speaker-microphones and adjacent parallel power and telephone wiring. Provide physical separation as recommended by equipment manufacturer for other Integrated Electronic Communications Network system conductors.

F. Identification of Conductors and Cables:

1. Use color coding of conductors and apply wire and cable marking tape to designate wires and cables so all media are identified in coordination with system wiring diagrams.

G. Weatherproofing:

1. Provide weatherproof enclosures for items to be mounted outdoors or exposed to weather.

H. Repairs:

1. Wherever walls, ceilings, floors, or other building finishes are cut for installation, repair, restore, and refinish to original appearance.

I. Pathway Requirements:

1. General:

a. All pathways shall be designed, constructed, grounded and installed in accordance with all recommendations delineated within TIA 569-B and Standard TIA 942.

b. Prior to placing any cable pathways or cable, the contractor shall survey the site to determine job conditions will not impose any obstructions that would interfere with the safe and satisfactory placement of the cables. Arrangements to remove any major obstructions not identified on plans need to be determined at that time with the Engineer.

2. Conduits:

a. Contractor shall provide a minimum of 1-1” EMT conduit from device to device unless otherwise noted. Refer to AV Symbol schedule for specific conduit requirements.

b. Provide conduit from device to device in open and/or exposed ceilings. Ceilings with clouds are considered open/exposed ceiling.

c. Achieve the best direct route parallel with building lines with no single bend greater than 90 degrees or an aggregate of bends in excess of 180 degrees between pull points or pull boxes.

d. Conduit runs shall not have continuous sections longer than 100 feet without a pull box. Refer to rough-in schedule for conduit fill capacity.

e. Intercommunication system conduits shall not be routed over or adjacent to heat sources such as boilers, hot water lines, or steam lines, nor should they be routed near large motors, generators, photocopy equipment, or electrical power cabling and transformers.

f. After installation, conduits shall be clean, dry, unobstructed, capped for protection, labeled for identification, reamed and fitted with bushings.

g. A 200lb pull cord (nylon, 1/8" minimum) shall be installed in any empty conduit.

3. Pull Box Requirements:

a. NEC sized pull boxes are not acceptable. Follow BICSI and EIA/TIA 569-B guidelines for pull box sizing.

b. Provide pull boxes in sections of conduit that are 100 feet or longer, contain more than two 90-degree bends, or contain a reverse bend.

c. Conduits that enter a pull box from opposite ends should be aligned.

d. Pull boxes shall have a length 12 times the diameter of the largest conduit.

e. All pull boxes must be accessible.

J. Cabling System:

1. Follow T568B scheme for copper category cabling terminations.

2. Provide a minimum 6" service loop in each system junction box. Cables shall be coiled in the in-wall boxes if adequate space is present to house the cable coil without exceeding manufacturers bend radius.

3. In a false ceiling environment, a minimum of 3 inches shall be maintained between cable supports and false ceiling. At no point shall cable(s) rest on lay-in ceiling grids or panels.

4. Cable shall be installed above fire-sprinkler systems and shall not be attached to the system or any ancillary equipment or hardware. The cable system and support hardware shall be installed so that it does not obscure any valves, fire alarm conduit, boxes, or other control devices.

5. Cables shall not be attached to ceiling grid seismic support wires or lighting fixture seismic support wires. Where support for cable is required, the contractor shall install appropriate carriers to support the cabling.

6. Any cable damaged or exceeding recommended installation parameters during installation shall be replaced by the contractor prior to final acceptance at no cost to the Owner.

7. Pulling tension for balanced twisted pair shall not exceed 25lbf and for optical fiber shall not exceed 50lbf.

8. Pair untwist at the termination shall not exceed 0.125". The cable jacket shall be maintained as close as possible to the termination point.

9. Cable shall not be draped on, tied or otherwise secured to electrical conduit, plumbing, ventilation ductwork or any other equipment. Cable shall be secured to

building supports or hangers or to additional blocks or anchors specifically installed for this purpose.

K. Cabling groups and conduit separation:

1. Refer to “CABLING GROUPS AND CONDUIT SEPARATION SCHEDULE”.

L. Firmly secure all equipment in place that is not intended for portability.

M. Mount projectors permanently and provide mechanical index ensuring precise alignment of the projected image.

N. Provide adequate structural support for Intercommunications system components. Provide fastenings and supports with a safety load factor of at least five.

O. Coordinate with access control system installer for programming and proper interfacing of the intercom system to initiate lockdown procedures as directed by the School District.

1. The contractor shall include in the base contract all costs required to program the multiple lockdown procedures based upon the requirements and direction of the owner.

3.3 GROUNDING:

A. All grounding and bonding shall be done according to ANSI J-STD-607-A, TIA 942, and NEC.

B. All cabinets/racks shall utilize paint piercing grounding washers, to be used where rack sections bolt together, on both sides, under the head of the bolt and between the nut and rack.

C. All racks shall further utilize a full-length rack ground strip attached to the rear of the side rail with the thread-forming screws provided to ensure metal-to-metal contact. Similar to Panduit RGS.

D. All active equipment shall be bonded to ground. If the equipment manufacturer provides a location for mounting a grounding connection, that connection shall be utilized. All active equipment shall be bonded using the appropriate jumper for the equipment being installed using the thread-forming screws. Similar to Panduit RG.

E. Racks shall have individual, appropriately sized conductors bonded to the grounding backbone. Do not bond racks or cabinets serially – daisy-chained rack grounds will not be accepted.

F. Refer to electrical diagrams for additional ground connection requirements.

3.4 LABELING

A. The contractor shall develop and submit for approval a labeling system for the cable installation. The Owner will negotiate an appropriate labeling scheme with the contractor. At a minimum, the labeling system shall clearly identify all components of the system: racks, cables, panels and wall plates. The labeling system shall designate the cables origin and destination and a unique identifier for the cable within the system. All labeling information shall be recorded on the as-built drawings and all test documents shall reflect the appropriate labeling scheme.

B. All labels shall meet UL 969 requirements for legibility, defacement and adhesion requirements. Handwritten labels are not allowed. All labels shall maintain consistent typeface, size and color.

C. Provide laminated plans (minimum size 11x17) of all INTERCOMMUNICATIONS as-built plans (including riser diagrams) intercom rack. Contractor shall be responsible for providing a 1RU drawer.

D. Label each equipment with the date (month/year) that it was installed along with the IP address, if applicable, and equipment type.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Services:

1. Provide services of a duly factory authorized service representative for this project location to supervise the field assembly and connection of components and the pre-testing, testing, and adjustment of the system.

B. Inspection:

1. Make observations to verify that units and controls are properly labeled, and interconnecting wires and terminals are identified. Provide a list of final tap settings of paging speaker line matching transformers.

C. Testing:

1. Rectify deficiencies indicated by tests and completely re-test work affected by such deficiencies at Contractor's expense. Verify by the system test that the total system meets the Specifications and complies with applicable standards.

3.6 OCCUPANCY ADJUSTMENTS:

A. When requested by the Architect within one year of date of Substantial Completion, provide on-site assistance in adjusting sound levels, resetting matching transformer taps, and adjusting controls to suit actual occupied conditions.

3.7 TRAINING

A. The contractor shall provide and implement a complete and comprehensive staff training program for all administrators, facility staff members and teachers. This mandatory training program will provide school staff a complete understanding of how to utilize and properly operate all functions.

B. The training program shall be implemented by a staff member/trainer employed by the contractor. The trainer must be factory certified to provide training on their product.

C. All staff development training is to be coordinated through the owner’s designated representative. As training sessions are completed, the trainer will provide the school’s administrative staff and school district’s staff a document listing all of the staff and faculty members who attended, received and completed the training program.

D. Provide a minimum of (4) 6-hour sessions of in-service training with this system. These sessions shall be broken into segments that will facilitate the training of individuals in the operation of this system. Operators Manuals and Users Guides shall be provided at the

time of this training.

E. Schedule training with Owner through the Architect, with at least 14 days advance notice.

F. Training shall be video recorded. Two (2) digital copies shall be given to the owner.

G. Intercom Integrator shall coordinate with District a time for two (2) personnel from the district to attend manufacturer training at the manufacturing facility. Provide at least 1 day to travel to the facility, three (3) days of training on this intercom system and one (1) day to travel back home. Coordinate this with the district two (2) months prior to travel. Training shall take place during construction of this project. All expenses associated with this trip will be covered by the Intercom Integrator.

3.8 CLEANING AND PROTECTION

A. Prior to final acceptance, the contractor shall vacuum and clean all system components and protect them from damage and deterioration. All general areas within and around all equipment rack/cabinets in the facility will be swept, vacuumed, and cleaned up.

3.9 OPERATING AND MAINTENANCE MANUALS: Refer to Section 26 0502 for requirements.

3.10 RECORD DRAWINGS: Refer to Section 26 0502 for requirements.

END OF SECTION 27 5123

DIVISION 28 – ELECTRONIC SAFETY AND SECURITY

SECTION 28 0501 - COMMON REQUIREMENTS FOR ACCESS CONTROL, IP VIDEO SURVEILLANCE, & INTRUSION DETECTION SYSTEMS

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. Architectural, Structural, Mechanical, Electrical and other applicable documents are considered a part of the security documents insofar as they apply as if referred to in full.

C. Contractors must review the entire set of plans and specifications. Reviewing only the security specifications is not acceptable.

D. Division 26, 27 & 28 basic materials and methods sections apply to work specified in this section, including but not limited to for requirements for raceways, trays, boxes, and fittings, and supporting devices, and other sections, as applicable.

E. Refer to specification 26 0553 Electrical Identification for cabling, conduit, and junction box color requirements.

F. Refer to specification 27 1500 Telephone Data Systems for the specified category cabling and optical fiber cabling, connectivity specifications, additional pathway requirements, and installation standards.

G. This specification does not address other Division 28 sections, such as the Nurse Call System and/or Fire Alarm and Detection Systems.

1.2 ENGINEER CONTACT INFORMATION:

A. BNA Security Contact(s):

1. Drayton Bailey
   Phone: 801-532-2196
   Email: Drayton@BNAConsulting.com

2. Dan Varney
   Phone: 801-532-2196
   Email: DVarney@BNAConsulting.com

1.3 DESCRIPTION OF WORK:

A. Security work is defined as any Division 28 system specified, including but not limited to access control, intrusion detection, and/or video surveillance systems.

B. The extent of security work is indicated on drawings and/or specified in Divisions 26, 27 and 28 sections of the specification. Provide all labor, materials, equipment, supervision, and service necessary for complete and working systems.

C. Provide the specified systems in complete operating condition with all necessary materials and labor to fulfill the requirements and the intent of the drawings and specifications. Except as otherwise indicated, provide manufacturer’s standard system components. The contractor shall provide all cables, materials, and equipment, whether specifically mentioned herein or not, to ensure a complete and functional system.

D. The contractor is responsible for coordinating with all other trades for equipment locations, mounting requirements, supports, and plenum space requirements. Contractor shall provide plenum rated cabling if required per the mechanical drawings.

E. Contractor shall provide ¾" EMT conduit from devices to accessible ceiling space, then utilize non-continuous cable support devices (e.g. j-hooks) back to the designated head-end equipment panels, utilizing cable tray if on project.

F. All security systems installed shall allow seamless integration and operate with one another (Access Control - IP Video Surveillance - Intrusion Detection).

G. All raceways and enclosures shall be securely fastened and/or mounted as per the currently adopted version of the National Electrical Code (NFPA 70). All work must be completed in a neat and workmanlike manner.

1.4 BID SUBMITTAL:

A. Contractors shall provide a detailed scope of work document for all services provided.

B. Contractors shall provide a complete bill of materials for all components, accessories, and hardware to be provided to assemble a complete working system as described within the contract documents.

C. Contractors shall provide a breakout cost of material and labor as different line items. Bids must include line-item pricing for major parts and components of the system.

D. Contractors shall submit manufacturer certifications for all systems provided. Certifications must be from the local office providing the installation.

E. All permitting costs shall be included in the base bid.

F. All equipment shall be installed as shown in the drawing sheets and in strict accordance with the specifications and to the owner's requirements. Any errors, conflicts, or omissions discovered in the specifications, or drawings, shall be submitted in writing to the security consultant for clarification in an RFI prior to the bid.

1.5 QUALITY ASSURANCE:

A. MANUFACTURERS: Firms regularly engaged in the manufacture of security system equipment and components of the types described here in and whose products have been in satisfactory use in similar applications for not less than 5 years.

B. The integrated firm shall have worked satisfactorily for a minimum of five years of completing systems equal to this scope, quality, type, and complexity.

1. Key personnel assigned to the project shall each have a minimum of (5) years of experience in completing systems equal to this scope, quality, type, and complexity.
2. The installation contractors must be manufacturer-authorized for the geographical area where the project is located.
3. The contractor shall maintain complete installation and service facilities for the duration of the project contract.
4. The installing contractors shall have current manufacturer certifications for all security systems and equipment listed within this specification. Certifications must be from the local office providing the installation.

C. All work shall be done by expert technicians qualified in the field with knowledge of specified systems. Workmanship shall comply with industry best practices concerning grounding, shielding, cable dressing, cable termination and equipment mounting.

D. All technicians are required to have proper state licensing to perform work within this specification.

E. List of qualifications include:

1. Industries certifications including manufacturers.

2. Past and current projects within the last five years are similar in scope and size.
3. Provide three referrals from the owners of three separate projects completed within the last five years.

1.6 GENERAL COORDINATION:

A. Meet with Electrical Contractor prior to pathway rough-in to coordinate system requirements in each area and review each security device that requires 120V power.

B. Meet with Owner's IT Department prior to ordering equipment to coordinate IT services to equipment.

C. Meet with Low Voltage Cabling Contractor (Division 27 1500) at least once, prior to rough-in, to verify all category cabling needs to equipment.

D. Regular inspections are required and shall be scheduled by the contractor through the Owner/Architect at least twenty-four hours in advance.

E. Coordinate color and finish of all components with Architect.

F. Notify engineer of any modifications between contract documents and submittals. It is the contractor's responsibility to ensure compliance with the documents.

G. Contractor's Project Manager will be required to schedule and provide weekly updates via remote meeting and/or email communications on progress of installation and update project schedule if any dates change from original completion.

1.7 SUBMITTALS:

A. Refer to specification 26 0502 "Electrical Submittals and Spare Parts" for submittal requirements.

PART 2 – PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Provide complete raceway system for security system including but not limited to, raceway, outlets, cover plates, backboards, cabinets, grounding and miscellaneous items as required.

B. Provide plywood terminal backboards, 4' x 8' x ¾" unless otherwise noted for all security equipment unless otherwise noted to be installed in racks.

PART 3 – EXECUTION:

3.1 GENERAL REQUIREMENTS

A. Provide and install the proper finger wire duct with covers within each head-end enclosure panel per project requirements.

B. Provide and install Velcro to neatly bundle cables. All cabling shall be installed in a neat and workmanlike manner.

C. Install systems as indicated, in accordance with equipment manufacturers' written instructions, and with recognized industry practices, to ensure that system equipment complies with requirements. Comply with NEC requirements and applicable portions of NECA's "Standards of Installation" practices.

D. Coordinate all equipment locations and mounting details with other trades and suppliers.

E. Provide at least one duplex receptacle on dedicated power circuit next to specified panels.

F. Grounding: Provide grounding connections sufficiently tight to assure permanent and effective ground.

G. Conceal raceways and conduits unless otherwise noted in specifications and drawings. Where exposed raceways are permitted, run parallel/perpendicular to walls.

PART 4 – TESTING:

4.1 GENERAL REQUIREMENTS:

A. Testing: Upon completion of installation of system and after energized, demonstrate system compliance with intent.

B. Coordinate the final inspection of the systems installed with the owner and the security consultant at least three weeks in advance of the project being completed.

PART 5 – LABELING & TRAINING

5.1 GENERAL REQUIREMENTS:

A. The contractor shall develop and submit for approval a labeling system for the device and cable installation. Coordinate with the owner and negotiate an appropriate labeling scheme with the contractor. At a minimum, the labeling system shall clearly identify all components of the system: racks, cables, panels, and wall plates. The labeling system shall designate the cables' origin and destination and a unique identifier for the cable within the system. All labeling information shall be recorded on the as-built drawings and all test documents shall reflect the appropriate labeling scheme.

B. All labels shall meet UL 969 requirements for legibility, defacement, and adhesion requirements. Handwritten labels are not allowed. All labels shall maintain consistent typeface, size, and color.

5.2 TRAINING:

A. Provide two sessions that consist of two hours each of training on the operation and functionality of each system installed at the job site, and at no cost to owner. Systems shall be complete and have been finalized by the owner and GC prior to training.

B. The security contractor will terminate, program, and test control equipment. As built drawing package (refer to specification 26 0502 "Electrical Submittals and Spare Parts" for as-built drawing package requirements) shall be provided to the owner before any training and commissioning shall begin. System loops will be tested, and any fault conditions found shall be corrected immediately by the contractor.

5.3 CYBERSECURITY

A. Contractor shall change all default usernames and passwords for all network devices provided. A Strong Password should -

1. Be at least 8 characters in length.
2. Contain both upper and lowercase alphabetic characters (e.g., A-Z, a-z)
3. Have at least one numerical character (e.g., 0-9)
4. Have at least one special character (e.g., ~! @#$%^&*()_-+=)

B. No written username or passwords shall be in any of the areas of the installations, except in the O&M manual.

C. Network devices to be set up on a separate network other than the owner's LAN ensuring no internal or external users can access the systems without authorization. Follow manufacturers hardening guides and use best industry practices to secure network and devices provided by contractor and associated with the systems.

5.4 WARRANTY AND SERVICE:

A. The minimum warranty period shall be one year, the warranty period will begin when the system completion documents are submitted to the owners and the system has successfully passed all tests and inspections. Included in the completion documents will be a warranty and service contact form, this form will be filled out by the burglar alarm contractor, all necessary contact information shall be included to guarantee a response to the system site within *24 Hours of The Request For System Service*. Only qualified technicians capable of making needed repairs and/or system programming are accepted to respond for service.

B. Contractor shall honor equipment warranties for term established by manufacturer if greater than warranty time frame mentioned above.

C. During the warranty time period:

1. Systems designed for 24/7 operation shall be repaired and/or replaced within 24 hours of time of notification. If defective components cannot be repaired in time, provide temporary equipment as required.

2. During the warranty time period and upon the owner's request, the contractor shall provide programming changes up to four times, or four hours free of charge.

END OF SECTION 28 0501

SECTION 28 1600 - INTRUSION DETECTION SYSTEM

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-26, 27 & 28 basic materials and methods sections apply to work specified in this section.

C. Division 28 0501 Common Work Results for Electronic Safety & Security, apply to this section.

1.2 DESCRIPTION OF WORK:

A. Provide a complete and operational intrusion detection system that communicates with a certified central monitoring/reporting station.

B. The system, as indicated in the drawings, schedules, diagrams, and specifications, shall include, but is not limited to: head-end control & slave panels, power supplies, backup batteries, arming/disarming keypads, audible sirens, motion detectors, glass break sensors, shock sensors, heat/CO detectors, door/window/garage/roof position contacts, protective enclosures, cover plates, backboards, grounding, access control integration, all necessary wiring and cabling, and any other items required to ensure a fully functional system.

C. The contractor shall furnish all cables, materials, and equipment, whether specifically mentioned herein or not, to ensure a complete and functional system.

D. Provide all necessary materials and labor to fulfill all the requirements and the intent of the drawings and specifications.

E. Equipment lists are provided to set equipment expectations and may not be complete. Coordinate with devices shown on drawings for system intent. Provide a complete and functional system as described within the construction documents.

F. Changes, adjustments, or deviations from this standard by the contractor that are not approved in writing by the owner are the sole responsibility of the contractor and may be ordered corrected at any time before or after completion of the job.

G. The monitoring service is not included in the scope of work.

1.3 QUALITY ASSURANCE:

A. Pre- Pre-Approved, Manufacturer Certified, & State Licensed Contractor:

1. Nelson Fire Systems

B. Bidder not pre-approved:

1. See Division 28 0501, Part 1.5

PART 2 – WIRING

2.1 WIRING SPECIFICATIONS:

A. All of the intrusion detection system security cabling outer jacketing color shall be Gray, jacketed, stranded, CMP rated, UL listed, and approved by the owner.

B. All system wiring (except line voltage and telephone connections) shall be minimum 18AWG, jacketed, stranded, CMP rated, UL listed, copper cable, unless otherwise noted.

C. Telephone connections shall be minimum 4-pair, UTP, CMP, category CAT6 cable that connects to the panel telephone line connection terminals via an RJ31X telephone jack and cord. Direct wiring of telephone lines to panel circuit board is not acceptable.

2.2 WIRE COLOR CODE:

A. WIRING: Provide the following wiring for the security system components:

1. Keypad, Duress / Panic / Hold-Up Button: UL Listed, 22 AWG 4 Conductor Stranded, CMP (if applicable)
2. Door / Window / Roof Hatch Contact: UL Listed, 22 AWG 2 Conductor Stranded, CMP (if applicable)
3. Motion Detector, Glass Break, Smoke / Heat / CO Detector: UL Listed, 18 AWG 4 Conductor Stranded, CMP (if applicable)
4. Siren / Strobe: UL Listed, 18 AWG 2 Conductor Stranded, CMP (if applicable)

PART 3 – EXECUTION:

3.1 AUTHORIZED HEAD-END & OPERATING EQUIPMENT MANUFACTURE:

A. BOSCH

3.2 AUTHORIZED MOTION DETECTOR MANUFACTURES & REQUIREMENTS:

A. Manufactures:

1. BOSCH, Takex, Resideo/Honeywell, OPTEX

B. Each motion detector shall be independently zoned and device wiring shall be home run to the head-end control panel or zone expander.

C. Loop supervision resistors shall be installed inside the motion detector. Motion detectors shall be wired to monitor for device trouble and tamper when so equipped.

D. Mount security devices a minimum of 3 feet from any heat or air movement sources.

3.3 AUTHORIZED POSITION CONTACTS MANUFACTURES & REQUIREMENTS:

A. Manufactures:

1. BOSCH, Nascom, GRI, Resideo/Honeywell, Magnasphere

B. Match the contact to the door frame color as closely as possible.

C. The Div.28 access control contractor will be providing and installing the DPDT contacts and cabling.

D. Prior to starting any work coordinate a meeting with the Div.28 access control contractor on where they will need to install the cabling from the DPDT contacts back to.

E. Loop supervision resistors are to be installed as close to the door contact as possible. All door contacts shall be independently zoned and device wiring shall be home run to the head-end control panel or zone expander location.

F. For splicing cables together, the preferred way is via soldering. If soldering is not an option utilize B-type silicone wire connectors.

3.4 AUTHORIZED BUTTON MANUFACTURES & REQUIREMENTS:

A. Manufactures:

1. Resideo/Honeywell, Bosch, Sentrol, Potter, Alarm Controls, Security Door Controls, Securitron, STI, Edwards Signaling, and Schlage.

B. Hold-Up, Duress, or Panic type signals will neither be audible nor visible but will send a silent signal to the central monitoring station of the emergency.

C. Prior to starting any work coordinate with the owner and the millwork drawings for the exact button mounting locations.

3.5 AUTHORIZED AUDIBLE SOUNDERS & STROBE MANUFACTURES & REQUIREMENTS:

A. Manufactures:

1. Amseco, Elk, Resideo/Honeywell, ATW, Kidde-Edwards, Federal Signal Corp, Elk, and Potter.

2. Prior to starting any work coordinate with the owner for the exact location and height the audible sounder will be mounted at.

3.6 AUTHORIZED BATTERY MANUFACTURES & REQUIREMENTS:

A. Manufactures:

1. Yuasa, PowerSonic, UltraTech, and Elk.

B. Provide rechargeable sealed lead acid backup batteries.

C. Provide all intrusion detection panels with 12V 8Ah rechargeable backup batteries that will provide minimum standby power capacity for 24 hours.

3.7 HEAD-END CONTROL PANEL PLUG-IN POWER TRANSFORMER:

A. The intrusion detection plug-in transformer must be plugged into a duplex outlet that is circuited to emergency backup power and located next to the intrusion detection head-end control panel.

B. The transformer must be plugged in and connected to outlet using the anchoring screw that is provided with the transformer.

PART 4 – INSTALLATION REQUIREMENTS:

4.1 CONTROL AND AUXILIARY EQUIPMENT:

A. Install the intrusion detection security system to the manufacturer's specifications and instructions. Utilize recognized industry practices, to ensure that the system and the equipment comply with the requirements. Comply with the requirements of NEC and applicable portions of NECA's "Standards of Installation" practices.

B. Coordinate all equipment locations and mounting details with other trades and suppliers.

C. System enclosures shall be surface mounted no higher than 72” AFF to the top off enclosure and installed only after all wallboard and painting work is complete. All wiring shall enter system enclosures through minimum 1 ¼” nipple located on the top far right-hand side of the enclosure. Plastic bushings are required on all stubbed conduits out nipples.

D. Provide at one duplex receptacle on dedicated emergency powered circuit that is located next to head-end intrusion detection panel.

E. Mounting Devices:

1. Prior to starting any work coordinate a meeting with the owner and review and verify each device mounting location, height, and orientation.

2. Mount security devices a minimum of 3 feet from heat or air movement sources.

F. Grounding:

1. Provide all grounding cabling and connections to be sufficiently tight to assure permanent and effective ground.

G. Configure the system for full operation. Include owner in the process as much as feasible to understand their intended operation and insure full transfer of operations to them.

H. Provide a fully functional and operational system to ensure the entire system is operating as intended and in accordance with the owner's policy.

I. Label all cables on both ends in all boxes, panels, and racks according to owner's standards.

END OF SECTION 28 1600

SECTION 28 2205 - ACCESS CONTROL SYSTEM

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. Refer to Division 8 for the door hardware schedule and requirements.

C. Division-26, 27 & 28 basic materials and methods sections apply to work specified in this section.

D. Division 28 0501 Common Work Results for Electronic Safety & Security, apply to this section.

1.2 DESCRIPTION OF WORK:

A. Provide a complete and operating access control system as indicated in the drawings schedules, diagrams, and specifications, and is hereby defined to include, but not be limited to: access control head-end panels, mercury controller and I/O boards, enclosures, power supplies, back-up batteries, credential card readers, raceway, outlets, cover plates, jacks, backboards, cabinets, grounding, IP video surveillance system integration, intrusion detection system integration, protective enclosures, and all required wiring.

B. The contractor shall furnish all cables, materials, and equipment, whether specifically mentioned herein or not, to ensure a complete and functional system.

C. Provide all necessary materials and labor to fulfill all the requirements and the intent of the drawings and specifications. Except as otherwise indicated, provide manufacturer's standard system components.

D. Contractor is responsible for coordinating with the Division 8 door hardware contractor to review the door hardware specification and ensure all components requiring a connection are installed.

E. Equipment lists are provided to set equipment expectations and may not be complete. Coordinate with devices shown on drawings for system intent. Provide a complete and functional system as described within the construction documents.

1.3 COORDINATION (ACCESS CONTROL SPECIFIC):

A. Coordinate with the owner, the Division 8 contractor, and Division 26 contractor prior to starting any work or rough-in to coordinate exact location and rough-in of end devices and door functionality. Carefully review Division 8 package (including door hardware schedule and specification) prior to bid and include all components requiring a connection by Division 26 & 28. Meet with Division 8 post-bid and prior to purchase of any equipment. It is not the Security Engineer's responsibility to complete the coordination between Division 8 and Division 26 & 28 for exact locations, connections, and rough-in.

B. All door hardware specified shall be reviewed upon award of the bid and before ordering any equipment.

C. During construction, each location showing equipment shall be walked by the contractor and any discrepancies on door hardware fit, finish, and function shall be brought to the architect and security engineer's attention immediately. It is the contractor's responsibility to provide a complete and functioning system and door opening.

D. Division 26, 27, and 28 contractors shall verify electrical service provided prior to ordering any electrical equipment serving electronic door hardware equipment and has the final responsibility for properly coordinating the electrical work, including the exact location of

the electrical connection(s).

E. Obtain submittals of all door hardware equipment from door hardware specification and Division 8 and 28 contractor(s). Carefully review door hardware submittal and advise in writing of any discrepancies.

F. The contractor shall include necessary wiring and programming for fire-alarm panel tie-in and door release. Contractor is responsible to schedule and coordinate with the fire alarm contractor. It is the responsibility of the Contractor to review the Division 8 package (specifications and door hardware schedule) to confirm which doors require fire alarm release.

G. Prior to starting any work coordinate with the owner, the Div.8 and Div.26 contractors and discuss how the ADA equipment will need to be programmed to operate with the access control system. The access control contractor shall include the necessary wiring to the ADA operators.

H. Coordinate all interfaces between door hardware and electrical contractor, including any additional panel interface modules and licensing to provide interface between PoE/wireless electronic locks.

I. Provide a dedicated 20-amp circuit for access control panel equipment.

1.4 QUALITY ASSURANCE:

A. Pre-Approved Manufacturer Certified & State Licensed Contractors:

1. Stone Security
2. Security 101

B. Bidders not pre-approved:

1. See Division 28 0501, Part 1.5.

PART 2 – PRODUCTS

2.1 GENERAL REQUIRMENTS:

A. Provide a complete and operable open platform / mercury-based access control system that meets the owner's requirements, operates to the manufacturer specifications, and maintains building security.

B. The network appliance shall be able to run on an existing TCP/IP network and accessible, configurable, and manageable from any network-connected PC with a browser and/or client.

2.2 AUTHORIZED EQUIPMENT MANUFACTURE:

A. LENEL / ONGUARD

2.3 GENERAL EQUIPMENT REQUIREMENTS:

A. Provide necessary equipment as a baseline to ensure a complete access control system is achieved:

1. Access Control Head-End Equipment, Control Boards, Power Supplies, Etc.

Description	Manufacturer	Part Number
Access Control Workstation	-	Owner Provided
Intelligent Dual Reader Controller	Lenel	LNL-X2220
Intelligent Single Door Controller	Lenel	LNL-X2210

Intelligent System Controller	Lenel	LNL-X3300
Advanced Dual Reader Controller	Lenel	LNL-X4420
Output Control Module	Lenel	LNL-1200
Dual Reader Interface Module	Lenel	LNL-1320-S3
Single Reader Interface Module	Lenel	LNL-1300
Input Control Module	Lenel	LNL-1100
4 Door Power Supply ACS Enclosure	LifeSafety Power	FPO75-B100C4D8PE2M
8 Door Power Supply ACS Enclosure	LifeSafety Power	FPO150-B100C8D8PE4M1
16 Door Power Supply ACS Enclosure	LifeSafety Power	FPO150/250-2C82D8PE8M2
Rechargeable Sealed Back-Up Battery	Yuasa, UltraTech Power Sonic, Elk	12V 8Ah

2. End Devices

Signo 40-Std.Wall Credential Card Reader	HID Global	40NKS-02-000000
Signo 20-Mullion Style Credential Card Reader	HID Global	20NKS-02-000000
Request to Exit Motion	Bosch	DS160
Request to Exit Motion Trim Plate	Bosch	TS160 (if applicable)
Push To Exit Button	Securitron	EEB (or equivalent)
DPDT Recessed Door Position Contacts	Nascom	1” & Wide Gap
DPDT Garage Door Position Contacts	Nascom	Track/Rail Mounted & Wide Gap
Momentary Door Release Button	Alarm Controls	TS-18
Duress / Panic Button	Honeywell	269R

B. Equipment lists are provided to set equipment expectations and may not be complete. Coordinate with devices shown on drawings, system risers and equipment list for system intent. Provide a complete and functional system as described within the construction documents.

1. The Div.28 access control contractor shall provide and install all integrated credential card reader electrified lockset combinations.
2. The Div.28 access control contractor shall provide all the power supplies for electrified door hardware equipment. Coordinate & verify with Div.8 contractor for the exact power requirements.
3. The Div.28 access control contractor shall coordinate, discuss, and verify with the architect, owner, Div.8 & 26 contractors the door hardware that is going to be provided & installed.
4. The Div.28 access control contractor shall provide and install all DPDT position contacts and cabling for the access control system and the intrusion detection system. Coordinate, discuss, and verify with the owner and the Div.28 intrusion detection contractor all of the doors that will be getting position contacts and where the wiring will need to be installed back to.
5. The Div.28 access control contractor shall provide the request to exit motions and trim plates, the push to exit buttons, and the momentary & duress/panic buttons that tie into and operate with the access control system.
6. Provide 1 year of software updates for access control software.

2.4 POWER SUPPLIES:

A. The DC voltage power supply shall provide dual output fused ports of either 12 or 24 VDC and receive its power input from 120VAC. Units shall be expandable by adding additional modules for up to three power modules. Power modules shall provide power capabilities from 75 to 250W. The system shall provide configurations for power distribution, control & signaling, fire alarm interface, fail safe/fail secure locking control, and shall be a standard feature of the system.

B. Locate separate power supplies by the access control panels. Provide additional

enclosures if needed.

C. Provide all access control panels and electrified door hardware power supplies with 12V sealed lead rechargeable backup batteries that will provide minimum standby power capacity for 24 hours.

D. Provide a category cable as required to each device for remote functionality such as control, status reporting, information logging, remote battery testing, fault reporting / restore, and shall interface with multiple control and monitoring modules to extend the remote functionality to multiple individual outputs for direct control, extended information gathering and reporting.

2.5 CREDENTIAL CARD READERS:

A. Connect contactless smart credential card reader with pigtail cable.

B. Tamper detection on the credential card readers shall be programmed to send a notification through the access control system in the event of damage or tampering.

C. Credential card readers must support mobile phone credentials.

D. Mount card readers on a 4 square j-box with a single gang mud ring. Do not provide a junction back box for mullion style credential card readers; route wiring though mullion/door frame.

PART 3 – EXECUTION

3.1 INSTALLATION OF ACCESS CONTROL SYSTEM:

A. GENERAL: Install the access control system as indicated, in accordance with the equipment manufacturer's specifications, written instructions, and with recognized industry practices, to ensure that system equipment complies with requirements.

B. Comply with the requirements of NEC, and applicable portions of NECA's "Standards of Installation" practices.

C. Prior to starting any work, coordinate and verify the access control layout, wiring, equipment device locations, and mounting details with the owner, architect, and any other trades and suppliers that are applicable, and get written approval.

D. COORDINATION MEETINGS:

1. Meet at least twice with the door hardware systems installer. Hold the first meeting before the submittal of shop drawings to coordinate electronic door hardware components for each door, rough-in requirements, and door schedules. Hold the second meeting before the physical installation of components to verify raceway and cabling, equipment list, any changes have been accounted for, and site conditions for each area.
2. Review and coordinate access control system layout and wiring with owner.

E. NETWORK DEVICES: Provide network cable(s) to any networked devices for access control system and coordinate terminations.

F. Grounding: Provide grounding connections sufficiently tight to assure permanent and effective ground.

G. Testing: Upon completion of installation of system and after energized, demonstrate system compliance with intent.

H. WIRING & TERMINATIONS: All components of this system will need to be in accordance with the manufacture’s specifications & recommendations. All final connections shall be made by a qualified & certified technician familiar with the manufacture’s equipment and adhering to the owner’s procedures.

I. ON-SITE EQUIPMENT: The contractor shall provide their own installation equipment unless they have written permission from the owner to use any of the owner's equipment (lifts, ladders, tools, etc.) onsite. It is the contractor's responsibility to provide all labor and equipment costs in their proposals.

J. ZONING: Each detector, door position switch, and sensing device shall be considered a location. Multiple doors at a common entry can be considered one location. The system shall be programmed to log and detect individual status of a monitored door based on a schedule. Doors with a door contact must have the ability to receive alerts for that specific opening if the door is opened during a certain time and/or left open for a specific time (60 seconds).

K. LABELING: The contractor shall develop and submit for approval a labeling system for the cable installation. Coordinate with the owner and negotiate an appropriate labeling scheme with the contractor. At a minimum, the labeling system shall clearly identify all components of the system: racks, cables, panels, and wall plates. The labeling system shall designate the cable's origin and destination and a unique identifier for the cable within the system. All labeling information shall be recorded on the as-built drawings and all test documents shall reflect the appropriate labeling scheme.

1. All labels shall meet UL 969 requirements for legibility, defacement, and adhesion requirements. Handwritten labels are not allowed. All labels shall maintain consistent typeface, size, and color.
2. Provide laminated plans (minimum size 11x17) of all Security Systems as-built plans (including riser diagrams) at each telecom room/panel location.

L. Occupancy Adjustments: When required within one year of date of substantial completion, provide on-site assistance in adjusting and reprogramming to suit actual occupied conditions. Provide 1 visit to the site for this purpose without additional cost.

M. Mounting Height: Credential card readers and intercoms should meet all ADA mounting requirements. Card readers shall be mounted 48" from the floor to the top of the card reader.

N. Roof Access Hatch/Door: Verify each roof access hatch/door location with the owner and install a door position contact on each one. Each roof hatch door position contact shall be tied into the access control system, and into the intrusion detection system that will provide a scheduled notification when opened.

O. Request to Exit Motions: Prior to installation coordinate with the owner the location of the request to exit motions above the door.

P. Provide all relays required to tie access control system into fire alarm system.

Q. ADA OPERATION: The security contractor is responsible for integrating access control and ADA operators. coordinate with the owner, Division 8 and 26 contractors to for operation and functionality.

1. ADA Door Opener/Actuator: Provide connection to door opener/actuator to access control system. Program credential card reader and ADA operator per IBC requirements. Provide all necessary cabling, relays, and equipment from the ADA operators and actuators to tie into access control system. Program credential card reader and ADA operator to operate per the Owner's requirements. At a minimum, the ADA actuator shall be disabled during lockout and closure periods.

3.2 WIRING:

A. Pathway Requirements:

1. See specification 28 0501 for requirements.

B. Cabling:

1. See specification 27 1500 for category cable requirements.
2. All Security cable outer jacketing shall be Yellow; UL Listed; and CMP rated.
3. Access Control Cabling: Provide the following cable from the access control head-end panel(s) to the junction box located above each door that has access control door hardware equipment installed on them:
   a. Access Control Composite Cable: *Windy City Wire #4461030-OSDP.*
4. Provide the following cables from the end devices to the junction box located above the secure side of the door, within the accessible ceiling space.
   a. Credential Card Reader: *(1) (OSDP) 22/1P OAS Lo-Cap, RS-485, 120 Ohms + 18-02 Twisted Non-Shielded, Jacketed, Stranded, UL listed, & CMP rated.*
   b. Request for Exit Motion: *(1) 22AWG 4/C, Jacketed, Stranded, UL listed, & CMP rated.*
   c. Electrified Door Hardware Equipment: *(1) 18AWG 4/C, Jacketed, Stranded, UL listed, & CMP rated.*
   d. DPDT Position Contact: *(2) 22AWG 2/C, Jacketed, Stranded, UL listed, & CMP rated.*
   e. Push to Exit Button: *(1) 18AWG 4/C, Jacketed, Stranded, UL listed, & CMP rated.*
   f. Panic / Duress Buttons, Momentary Door Release Buttons: *(1) 18AWG 4/C, Jacketed, Stranded, UL listed, & CMP rated.*
5. The access control contractor shall provide, install, terminate, and test all necessary communication cabling to facilitate seamless communication between the existing access control panel and the new access control panel. Cabling must meet industry standards, be properly labeled, and organized. Post-installation testing is required for performance verification. Compliance with relevant regulations and guidelines is mandatory.
6. Wiring by Divisions 26: The electrical connections/terminations for certain equipment provided under door hardware divisions has not been specifically indicated on the electrical drawings and must be provided by and field coordinated by the door hardware trade requiring such electrical connections. Electrical contractors shall review architectural drawing, and door hardware specifications and coordinate with said contractors to confirm electrical needs.

3.3 SYSTEM CONFIGURATION AND PROGRAMMING:

A. Configure the system for full operation. Include owner in the process as much as feasible to understand their intended operation and insure full transfer of operations to them.

B. Provide a fully functional and operational system to ensure the entire system is operating as intended and in accordance with the owner’s policy.

C. Label all cables on both ends in all boxes, panels, and racks according to owner’s standards.

D. The contractor shall include in the base contract all costs required to program lockdown procedures based on the owner's requirements and direction.

E. The contractor shall include necessary programming for fire-alarm panel tie-in and door release based upon the requirements and direction of the owner and/or AHJ.

F. Contractor shall input database of all required card holders and desired schedules for users and/or groups. It is the contractor’s responsibility to coordinate with the owner on which card holders have access to which openings.

END OF SECTION 28 2205

SECTION 28 2300 - IP VIDEO SURVEILLANCE SYSTEM

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-26, 27 & 28 basic materials and methods sections apply to work specified in this section.

C. Division 28 0501 Common Work Results for Electronic Safety & Security, apply to this section.

1.2 DESCRIPTION OF WORK:

A. Provide a complete and operating IP camera and video surveillance system as indicated in the drawings and plans, and is hereby defined to include, but not be limited to: IP surveillance cameras, IP surveillance camera mounting hardware & equipment, IP surveillance camera memory cards, in-line surge protectors, long range point-to-point ethernet link & PoE extenders, video management system (VMS) IP surveillance camera IP licenses, power supplies, category jacks/modules, RJ45 modular plugs, input plates/enclosures, equipment racks, category patch panels, category patch cords, PoE network switches, remote mobile client application, integration with access control system and the intrusion detection system, protective enclosures, and all wiring and cabling that is normally and reasonably required.

B. Provide all necessary materials and labor to fulfill all the requirements and the intent of the drawings and specifications.

C. Equipment lists are provided to set equipment expectations and may not be complete. Coordinate with devices shown on drawings for system intent. Provide a complete and functional system as described within the construction documents.

1.3 COORDINATION:

A. The contractor shall coordinate the color and finish of all camera components with the architect or electrical contractor, as appropriate. Black camera finishes shall be provided for all cameras installed in locations with dark surroundings, whether wall-mounted or ceiling-mounted.

1.4 QUALITY ASSURANCE:

A. Pre-Approved, Manufacture Certified, and State Licensed Installation Contractors:

1. Stone Security
2. Security 101

B. Bidders not pre-approved: See Division 28 0501 Part 1.5.B.

PART 2 – PRODUCTS

2.1 GENERAL REQUIREMENTS:

A. The network appliance shall operate on the existing TCP/IP network and must be accessible, configurable, and manageable from any network-connected PC using a browser and/or client software.

2.2 AUTHORIZED EQUIPMENT MANUFACTURE(S):

A. NDAA Compliant & ONVIF Compatible Video Management System (VMS) Operating Software Manufacturer:

1. Milestone

B. NDAA Compliant & ONVIF Compatible IP Surveillance Camera Manufacture:

1. AXIS Communications

2.3 IP SURVEILLANCE CAMERA REQUIREMENTS:

1. IP surveillance cameras shall be supported by the video management system manufacturer.
2. All IP surveillance cameras are labeled on the plans and shall be PoE or PoE+.
3. IP surveillance cameras must have appropriate IP and IK ratings for the environments in which they are being installed.
4. *Exterior* surveillance cameras regardless of their locations shall have enclosures that are IP66 & IK10 rated or better. These types of enclosures ensure protection against external elements and vandalism for the camera's internal operating components and wiring.
5. Exterior surveillance cameras may be domes or other environmental styles of housing which suits the general appearance of the facility.
6. All exterior and interior IP surveillance camera transmission cables must be protected from lightning and power surges using in-line ethernet surge protectors.
7. Provide each IP surveillance camera with a minimum of one removable 64GB micro SDXC memory card for edge recording storage.
8. Coordinate all camera locations, wiring, and rough-in requirements with owner and supplier prior to rough-in.
9. All IP surveillance cameras shall be equipped with one 100BASE-TX Fast Ethernet port or faster, using a standard RJ45 modular plug and shall support auto negotiation of network speed (100 Mbps and 10 Mbps) and transfer mode (full and half duplex)
10. Provide camera types and quantities as indicated on the associated drawings.

2.4 Video Management System (VMS)

A. Provide VMS IP surveillance camera licenses, fees, and any software upgrade agreements for a minimum of 1 year.

B. Setup motion masking on any outside trees or non-critical areas. (Verify with owner or consultant)

C. Set-up any user required privacy masking for personal areas and information sensitive areas.

D. The contractor shall set up the video management system mapping feature to show all locations of the IP surveillance cameras.

E. The contractor shall set up each IP surveillance camera resolution, focus, view, and layout to the owner’s specifications.

F. Set up and program the video management system to record the IP surveillance cameras on motion detection/activation at 15 FPS, and continuous recording at 1 FPS.

G. Adjust motion recording and compression to optimize storage.

H. Contractor to ensure all software is on the latest firmware and version of video management software.

I. If the project specifies any VMS or IP surveillance camera analytics, install and program

the analytics, and optimize them according to the camera's environment.

J. Name and number all IP surveillance cameras and views to the owner’s requirements.

K. The system shall allow archiving to be enabled on a per-camera basis, with the option for the user to select the specific hard drive to store each camera’s archive. The archive database will be stored on the selected hard disk drive.

2.5 WIRING / CABLING, AND PATHWAYS:

A. See Specification 27 1500 Telephone Data Systems for cabling and 28 0500 for pathway requirements.

PART 3 – EXECUTION

3.1 INSTALLATION OF THE IP SURVEILLANCE CAMERAS & VIDEO SURVEILLANCE SYSTEM (VMS):

A. Install all IP cameras at locations shown on drawings and after conducting a walk-through with the owner to verify exact locations.

B. Coordinate all cabling work, patch cabling and labeling with owner.

C. The contractor shall configure and program all IP surveillance cameras views, focus, frame rates, resolutions, and IP addressing.

D. The contractor shall be responsible for coordinating work with the owner and the IT staff to coordinate devices on network specific to the video surveillance system.

E. Prior to starting any work, the contractor shall coordinate a meeting with the owner and review and verify all IP surveillance camera mounting locations, their heights, and the orientation of the cameras to ensure the most ideal views are met.

3.2 FIELD QUALITY CONTROL:

A. Testing: Upon completion of installation of the IP surveillance cameras and the video surveillance system operating software and after electrical circuitry has been energized, test the compatibility and compliance to requirements. Where possible, correct malfunctioning equipment at the site, then retest to demonstrate compliance; otherwise, remove and replace equipment with new units, and proceed with retesting.

3.3 SYSTEM CONFIGURATION, PROGRAMMING, & COMMISSIONING SERVICES:

A. Configure the system for full operation. Include owner in the process as much as feasible to understand their intended operation and insure full transfer of operations to them.

B. Provide a fully commissioned system to ensure the entire system is operating as intended and in accordance with Owner requirements ~~policy~~.

C. Contractor is to program the system and train the authorized personnel how to perform all necessary functions of the video surveillance system. Refer to Division 28 0501 Common Work Results for Electronic Safety & Security Part 5.2.

END OF SECTION 28 2300

SECTION 28 3111 - FIRE ALARM AND DETECTION SYSTEM

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-26 Basic Materials and Methods sections apply to work specified in this section.

1.2 DESCRIPTION OF WORK:

A. Provide a new addressable fire alarm and detection system.

1. Provide and install NAC/booster panels as needed throughout the project.

B. Provide new duct smoke detectors and fan relays at all fan units 2000 CFM and over. Shut down all supply and return fans upon a general alarm signal.

C. Provide laser-based air sampling/very early warning smoke detection as specified herein. System to be utilized for open area coverage with sampling points placed in piping at locations where smoke detectors are required by NFPA standards.

D. Install all wiring in steel conduit (3/4" minimum). All conduit runs shall form a complete loop from the fire alarm control panel.

E. Provide vandal resistant cages to protect horn/strobes, smoke and heat detectors as indicated on drawings and, in gyms whether shown or not. Securely fasten security cages as required. Provide backing and bracing as required to ensure that attachment extends beyond the ceiling materials. Cages shall have two pieces, one backplate and one cover to attach to backplate. Provide cages/guards on horn/strobes that are clear and do not limit their effect on the field performance with the listing requirements.

F. Comply with NEC as applicable to construction and installation of fire alarm and detection system components and accessories. Provide components and systems, which are UL-listed and labeled for fire alarm. Provide fire alarm and detection systems and accessories, which are FM approved. Comply with State and local requirements as applicable.

G. The fire alarm system supplier shall be UL, UUJS Listed as a Local, Auxiliary, Remote Station, and Proprietary Signaling Services company. The UL Certification number shall be submitted with the bid documentation.

H. The project shall be UL Certificated. Upon completion of the project, provide to the owner, a certificate from the UL Listed supplier with the project specific certificate. Certificate and number shall be documented and included as part of the closeout documentation.

I. Ensure that the fire alarm supplier has a minimum of (1) NICET Level IV, and (3) NICET Level III technicians on staff.

J. Comply with applicable provisions of current NFPA Standard 72 National Fire Alarm and Signaling Code (as applicable), local building codes, the most current adopted revision of the International Building Code (IBC), the International Fire Code (IFC), the International Mechanical Code (IMC), and meet requirements of local authorities having jurisdiction.

K. Carefully review all Division 23 drawings for all fire/smoke dampers. Fire/smoke dampers are NOT shown on electrical plans. Electrical contractor is responsible for coordinating 120V emergency power to all dampers and providing fire alarm connections to each one. See mechanical drawings for all locations.

L. Provide a fire alarm duct detector within 5-feet of any fire/smoke damper as required to comply with IMC 607.5.4.1. The duct detector shall be listed for the air velocity, temperature and humidity at the point where it is to be installed. A duct detector will not be required at a fire/smoke damper located on a corridor wall where the corridor has smoke detection devices installed. For dampers installed within an un-ducted opening in a wall, a spot-type detector listed for releasing service shall be installed within 5-feet horizontally of the damper. Provide a fire alarm relay at each fire/smoke damper. Provide a test switch at each location where the damper is located above an inaccessible ceiling or is located more than 10 feet above the finished floor. Coordinate the location of test switches with owner/architect.

M. Provide all CO detectors serving mechanical rooftop equipment with a monitor module and relay and shut down the unit served by the CO detector.

1.3 SUBMITTALS: Refer to Section 26 0503 for requirements.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. MANUFACTURER: Provide fire alarm and detection system of Gamewell-FCI; By Nelson Fire Systems. Fire alarm supplier shall be Gamewell-FCI Platinum Level Distributor.

2.2 FIRE ALARM AND DETECTION SYSTEMS:

A. GENERAL: Provide an electrically operated, electrically supervised fire alarm system as described herein. Include control units, power supplies, alarm initiating and indicating devices, conduit, wire, fittings and accessories required to provide a complete operating system. Enclose entire system in raceway. Provide basic wiring materials which comply with Division 26, Basic Materials and Methods Sections for raceways, conductors, boxes, fittings, supports, etc. Minimum wire size to be #14 AWG copper.

B. SYSTEM TYPE: Analog addressable, non-coded. Either manual activation of a fire alarm station or activation of an automatic initiating device energizes all fire alarm signaling devices, sounding a non-coded alarm and providing device identification on an annunciator panel.

C. SYSTEM OPERATION: Provide system such that any manual station or automatic initiating device annunciates all alarm indicating units (bells, horns, buzzers, chimes, visual alarm lamps, etc.) continuously until the manual station or initiating device is restored to normal and the fire alarm control unit reset. Annunciate alarm signals by device at the control panel and all remote annunciators. Provide all conductors, raceway, equipment and labor to accomplish the following:

D. Deactivate air supply and return fan units simultaneously by means of a supervised master fan shutdown relay with slave relays as required. Restart air units automatically after panel has been reset. Provide a bypass switch for master fan shut down relay for drill purposes, and indicate by a locked-in lamp that the circuit has been bypassed.

E. Selectively activate and/or deactivate fan units as required.

F. Release all magnetic door holders upon activation of an alarm from any device by use of a master relay in the control panel.

G. Provide supervised circuits for the following:

1. Close dampers upon activation of an alarm from any device through the HVAC interface relays at the Fire Command Center.
2. Recall elevators, upon activation of an alarm, to the floor of building egress unless the alarm is on the egress floor, in which case recall elevator to the level designated by the Fire Marshall. Cooperate with the elevator supplier to ensure complete operable system. Provide shunt trip breaker(s) as required.

H. Central Station Monitoring. Provide an interface to the building security panel for fire alarm signal transmission to the district central station. Provide dry contacts at the main fire alarm control unit for 'Alarm', 'Supervisory', and 'Trouble'. Connections shall be supervised by the security alarm panel.

I. Provide fire alarm control panel with capability of shutting down individual initiating devices for maintenance purposes without affecting the continued operation of other initiating devices.

J. Provide manual fire alarm stations in boiler rooms, kitchen and main administrative office.

K. Provide external alarm horns sufficient to be heard in all outdoor within the vicinity of the building.

L. Sprinkler Supervision. Provide a signal initiating and supervisory circuit to each PIV (post indicator) valve, and to each sprinkler riser and subdivision. Provide continuous alarm signal upon actuation of any water flow signal initiating device. Sound alarm until the condition has been corrected and the panel manually reset as required by UL864. Provide separate alarm zones for: (1) alarm zones from "waterflow alarms", (2) alarm zones from "supervisory alarm" indicating sprinkler system trouble. Provide 120 VAC power to all alarm bells furnished under Division 23. Review final fire sprinkler drawings and coordinate for panel, flow and tamper switch locations.

M. Provide relays, monitor modules and connections as required at control panel of kitchen hood suppression system for initiation of alarm signal to fire alarm control panel. Connect hood suppression control panel to shunt trip breakers as required.

N. Provide all required wiring from gas shut off valve to the hood suppression control panel. Make all connections to insure a properly operating system. Verify with Mechanical Contractor.

2.3 FIRE ALARM CONTROL PANEL:

A. The fire alarm control panel shall be microprocessor-based. Each loop shall be capable of 159 analog addresses and 159 monitor and/or control addresses.

B. The fire alarm control panel shall contain a 80 digit alphanumeric display and permit the user to perform all necessary functions including but not limited to the following:

1. Alarm/Trouble Acknowledge.
2. Alarm Silence
3. Reset
4. Lamp Test
5. Control of Initiating Devices (on/off)

6. Control of output modules (on/off)
7. Change sensitivity of devices
8. Change time
9. Walk test
10. View 4000 event history log.

C. The fire alarm control panel shall be capable of alarm verification. The control panel shall indicate which smoke detector is in alarm during the pre-alarm window.

D. All alarm signals shall be locked in at the panel until the operated device is returned to it's normal condition and the control panel is manually reset.

E. Alarm or trouble activation of initiating points shall be represented in English on the alphanumeric display on both the remote operating panel and the fire alarm control panel indicating the address of the specific device, i.e. Device L4S76, Smoke Detector, 1st floor Rm. 17.

F. Each initiating and signal circuit shall be electrically supervised for opens, shorts, and ground faults in the wiring.

G. The occurrence of any fault shall activate the system trouble circuitry but shall not interfere with the proper operation of any circuit that does not have a fault condition.

H. The system communication loops shall be capable of being wired using Class "A" (Style 6) supervised circuits (a ground fault on either conductor or a break shall not prevent a device from operating on either side of the break)

I. The fire alarm control panel shall contain circuitry permitting the transmission of trouble and alarm signals over leased phone lines by the means of reverse polarity. There shall be a supervised disconnect switch to allow testing of the fire alarm control panel without transmitting an alarm to the central station.

J. The fire alarm control panel shall include the following features.

1. Auxiliary SPDT fire alarm actuated contacts.

2. Auxiliary SPDT supervisory alarm actuated contacts.

3. Auxiliary SPDT trouble actuated contacts.

4. A solid-state power transfer circuit that shall switch to standby power automatically and instantaneously if normal power fails or falls below 15% of normal ("brown out" conditions). This electronic circuit shall allow the batteries to be effectively "floated" on the operating system to avoid upsetting the normal microprocessor scan and minimize resultant nuisance troubles and/or alarms.

5. A ground fault detector to detect positive or negative grounds on the initiating circuits, signal circuits, power circuits, and telephone line circuit. A ground fault code on the alphanumeric display shall provide indication of either a positive or negative ground fault and shall operate a general trouble but shall not cause an alarm to be sounded.

6. A short circuit error message shall be a standard feature of the fire alarm control panel. Each communication loop shall be monitored and shall have a distinctive error message.

7. Lightning protection shall be a standard feature of the fire alarm control panel and shall be incorporated in the power supply circuit, common control circuits, signal circuits, and telephone line circuit.

8. Individual PTC overcurrent protection shall be provided for the following: smoke detector power, main power supply, signal circuit #1, signal circuit #2, battery standby power, and auxiliary output.

9. The fire alarm control panel shall be of dead-front construction. One key shall allow access to all operator functions.

10. Opening the main door shall expose all components for inspection or adjustment without further dismantling of the cabinet, control unit, or wiring.

11. It shall be possible to check and adjust the sensitivity of all analog devices from the main fire alarm panel.

K. The fire alarm control panel shall have batteries capable of powering the system for (24) hours in standby condition and (5) minutes in alarm.

L. There shall be no special tools required for the programming of devices. A standard slot head screwdriver only.

M. Provide (16) separate bypass switches for the functions listed below with separate red, green, and yellow LED's per switch:

Strobe/Horn bypass
Fan/Damper shutdown bypass
Door holder bypass
Separate switch for each addressable loop bypass

Owner shall designate purpose for any unused switches.

N. Provide one (1) Gamewell-FCI ANX-SR and one (1) Gamewell-FCI FP-GATE-3 for interface to existing district Gamewell-FCI FocalPoint system. Provide new graphics and populate all new fire alarm system point information. Test communication signals from building to FocalPoint system. Two (2) network IP addresses at the new fire alarm control unit will be required for connection to the FocalPoint system. Coordinate with the district IT department for network connections.

O. In the event of a power outage, the control panel shall be capable of storing and printing the last 4000 events, including during the power outage.

2.4 REMOTE OPERATING PANEL: Gamewell-FCI Model: LCD-E3

A. Remote Operating Panel (Provide color as selected by Architect)

B. The Remote Operating Panel shall contain 80 digit alphanumeric display providing status of all devices including the fire alarm control panel.

C. The Remote Operating Panel shall permit the user to perform all necessary functions including but not limited to the following:

1. Alarm/Trouble Acknowledge
2. Alarm Silence
3. Reset
4. Lamp Test

5. Control of Initiating Devices (on/off)
6. Control of Output Modules (on/off)
7. View Event Log
8. Change time
9. Walk test

2.5 MONITOR MODULE: Gamewell-FCI Model: AMM-2F/AMM-4F

A. Remote identification module devices shall be attached to any single normally open initiating device (heat detector, waterflow switch, duct detectors, sprinkler, tamper switches, kitchen hood, pull station, etc.). The modules shall supply addressing and status information to the Fire Alarm Control Panel through the signaling line circuit.

2.6 CONTROL POINT MODULE: Gamewell-FCI Model: AOM-2RF

A. The control point module shall be connected to the same loop as the initiating devices, and shall provide two relay outputs (Form "C" 2 Amp @ 30 VDC, resistive only).

B. This relay output shall be used to perform auxiliary functions.

C. When the AOM is activated, the red "ACTIVE" LED shall be on solid. Under normal conditions, the green "ON LINE" LED shall flash.

2.7 DOOR HOLDER: Gamewell-FCI Model: DH-FC1

A. The door holder shall be wall mounted, semi-recessed; be powered at 120 VAC; and have 35 lbs. of holding force and be of a brushed aluminum finish.

2.8 MANUAL FIRE ALARM STATION: Gamewell-FCI Model: MS-7AF

A. Provide red enclosure, manual fire alarm stations with the following features:

1. suitable for semi-flush mounting.

2. Addressable alarm type electrically compatible with system requirements.

3. Double Action

2.9 PHOTOELECTRIC DETECTORS (GAMEWELL-FCI: ASD-P W/ADB-PL2F W/B210LP BASE):

A. All photoelectric detectors shall be capable of being replaced without disconnecting any wires or wire connectors from the base of the detector. Each detector shall be installed on a separate base. The detector base shall be capable of receiving a photoelectric, ionization, or electronic thermal detector. All photoelectric detectors shall be UL 268 listed. All detectors shall have two viewable LEDs to indicate the status of the device.

2.10 DUCT FIRE DETECTORS: Gamewell-FCI Model: DNR

A. Provide photoelectric type with UL 268A listings. If duct smoke detector is not readily accessible, provide with a remote indicating light and remote test station.

2.11 THERMAL DETECTORS: Gamewell-FCI Model: ATD-RL2F

A. Thermal detectors shall operate on the Rate-of-Rise principal. The detectors shall have a fixed temperature rating of 135 degrees Fahrenheit. Exception: in Boiler rooms, provide temperature rating of 200 degrees Fahrenheit.

1. The heat detector shall consist of a base and a head.

2. The base shall be capable of accepting either a smoke detector or a 135 (or 200) degree heat detector.
3. The head shall automatically restore to its normal standby condition when the temperature returns to its normal range.

2.12 AUDIOVISUAL ALARM HORNS: Gamewell-FCI Model: P2W/P2RK

A. Provide audio-visual alarm horns with selectable multi-candela strobes (15/30/75/110 cd) and selectable horn (90 or 95 dba). Provide outdoor devices listed for exterior use. Provide white devices inside and red devices outside. Synchronize all strobes.

2.13 VISUAL ALARM STROBES: Gamewell-FCI Model: SW

A. Provide visual alarm strobes with selectable multi-candela strobes (15/30/75/110 cd). Provide white devices. Synchronize all strobes.

2.14 CARBON MONOXIDE (CO):

A. Provide a System Sensor CO1224T carbon monoxide detector with Realtest Technology. Provide detectors with the following features:

1. Compliance with UL2075.
2. Trouble relay.
3. Wiring supervision with SEMS Terminals.
4. A six year end-of-life timer.
5. Sounder base for sound audible alarm.

2.15 VISUAL ALARM STROBE (CO detection) (Gamewell-FCI Model SCW-P)

A. Provide a white ceiling mounted visual alarm strobe with a CO label and a blue lens #LENS-BC.

2.16 AUXILIARY RELAY: Gamewell-FCI Model: PR-1

A. Remote auxiliary relay boards shall be rated at 10 AMPS @ 120 VAC. A red LED shall light to indicate relay activation. All relays shall transfer on general alarm and latch on until reset. All relays shall be supervised. The control output provided can be used in conjunction with fire alarm applications (i.e. fan controls, dampers, doors, and any other general alarm control).

2.17 INITIATING MODULES: Gamewell-FCI Model: AMM-4F

A. Provide style "6" initiating modules capable of receiving and annunciating an alarm from any detector, even with a single fault condition on any initiating circuit.

B. Power all smoke detectors from the "Style 6" initiating loop wiring. For systems which power smoke detectors separately from the "Style 6" loop, provide monitoring for both the power source and the independent initiating wiring, so that complete trouble and alarm indication is achieved by loop. Provide capability to operate all smoke detectors, even with a single fault condition on the smoke detector power wiring.

2.18 SIGNALING MODULES: Gamewell-FCI Model: AOM-2SF

A. Provide signaling as required. Provide power adequate to sound all signaling devices concurrently. Provide supervised indicating circuits for polarized 24V D.C. alarm signaling devices.

2.19 SUPPLEMENTAL NOTIFICATION CIRCUITS: Gamewell-FCI Model: HPFF8

A. Provide supplementary notification appliance circuit panel(s) as required. The 'SNAC' shall be capable of supplying up to four Class A, Style Z notification appliance circuits. The panel shall contain its own battery charger, regulated power supply, and shall be supervised for ground fault, overcurrent, open circuits and low battery conditions. Ground fault, battery and circuit trouble conditions shall transmit a trouble signal to the main fire alarm control panel.
Locate all Supplementary Notification Appliance Circuit power supplies as indicated on drawings.

2.20 SYSTEM CONFIGURATION PROGRAMMING:

A. To help the owner in programming, system changes, and servicing, the fire alarm system shall have the following functions:

1. The FACP shall be capable of an auto-configuration, which, via a password, all analog devices and panel modules are automatically programmed into the system. At this point the system will operate as a general alarm system without any other programming.

2. If any two devices are addressed the same, the LED's on both devices will light steady and the panel will read "extra address with the address number".

3. If any device is installed and not programmed into the system, the LED will light steady and the panel will read the same as above.

2.21 BATTERIES/POWER SUPPLIES:

A. Provide standby batteries capable of operating fire alarm system for minimum of 24 hours, then operating all indicating units for at least five minutes. Locate batteries in fire alarm control unit, or in similar type enclosure located as directed. Provide all interconnecting wiring. Place batteries which vent hydrogen gas in separate enclosure. Provide 30 percent spare capacity.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS:

A. Install fire alarm and detection systems as indicated, in accordance with equipment manufacturer's written instructions and complying with applicable portions of NEC and NECA's "standard of installation".

B. Install wiring, raceways, and electrical boxes and fittings in accordance with Division 26 Basic Materials and Methods section, "Raceways", "Wires and Cables", and "Electrical Boxes and Fittings", and in accordance with other sections, as applicable. Label all junction boxes "F.A." and paint box and cover red, per Section 16135.

C. All wire used on the fire alarm system shall be U.L. Listed as fire alarm protective signaling circuit cable per NEC, Article 760.

D. If twisted or shielded wire is required or recommended by the manufacturer it must be used.

E. Review proper installation procedure for each type of device with equipment supplier before installation.

F. Provide Two (2) network IP addresses at the new fire alarm control unit for connection to the FocalPoint system. Coordinate with the district IT department for network connections.

G. Coordinate the mechanical units that are protected by Carbon Monoxide Detectors and shut down the unit upon detection of CO. Verify exact requirements with the Fire Marshal.

H. Label the end of wires in all boxes including panel, power supplies, pull boxes, etc.V

I. Label circuit breaker feeding fire alarm panel: “Fire alarm circuit”. Use plastic laminate label, white letters on red background.

J. Where smoke or heat detectors are specified, install device a minimum of three feet from adjacent air supply diffusers to ensure proper operation of device.

K. Refer to NFPA for spacing and exact placement of fire alarm devices.

L. Provide one set of approved, stamped, fire alarm system drawings on site throughout construction, and make available for Fire Marshal reference.

M. Upon completion of the Fire Alarm System Installation, a test of the entire fire alarm and CO monitoring system is required prior to a scheduled inspection in the presence of a representative from the Utah State Fire Marshal’s Office. Include a 24-hour secondary power test.

N. Provide one set of instructions on operation of the Fire Alarm System and one set of the As-Built Drawings in a cabinet, located at or near the Fire Alarm Control Unit (FACU), or Fire Alarm Control Panel (FACP) as approved by the Architect and Fire Marshal. Label the cabinet “SYSTEM RECORD DOCUMENTS”.

3.2 GUARANTEE:

A. Furnish a three-year guarantee for all equipment, materials and installation, including all labor, transportation, and equipment.

B. Emergency Response. The fire alarm equipment supplier shall provide an emergency response within four hours of any reported system failure to resolve the problem on a continuous basis.

3.3 PRE-TEST:

A. The contractor shall with a representative of the manufacturer conduct a test 3 days before the final test to verify operation of all devices. Any problems must be corrected before the final test.

3.4 FINAL TEST:

A. Before the installation shall be considered completed and acceptable, a test on the system shall be performed as follows:

1. The contractor's job foreman, a representative of the manufacturer, a representative of the owner, shall operate every building fire alarm device to ensure proper operation and correct annunciation at the control panel. Fan shutdown and door holder circuits shall operate.

2. Conduct a full 24 hour test of battery operation. System shall be put on the batteries for a full 24 hours and all notification appliances shall be operational for a period of 5 minutes.

3. The supervisory circuitry of the initiating and indicating circuits shall also be verified.

4. Provide printout demonstrating successful performance of all devices.

3.5 LABELING:

A. All devices shall be labeled with their appropriate address. The labels shall be 18 point pressure sensitive labels.

B. All initiating devices shall be programmed to include the device address and a complete user text English location description, i.e. Device L4S76, Smoke Detector, 1st floor Rm.17.

C. Label the end of all wires in all boxes including panels, power supplies, pull boxes, etc.

3.6 AS BUILT DRAWINGS:

A. A complete set of CAD "as-built" drawings showing installed wiring, color coding, specific interconnections between all equipment, and internal wiring of the equipment shall be delivered to the owner upon completion of the system. Vendor shall not request drawings from the Engineer. Vendor shall request current architectural drawings from the Architect and include all cost with bid.

B. A building map shall be supplied to the owner indicating the exact location of all devices along with the addresses of the individual devices. Install building fire alarm map adjacent to the fire alarm panel and all remote operating panels. Provide high quality plastic sign (map holder) with two layers. The back layer shall be painted black. The front layer shall be a clear center for viewing the CAD fire alarm drawing. The building map shall indicate the various devices by the use of different colors (minimum of five colors).

C. Provide a CD to the Owner containing the information specified below. The CD shall include all information required to allow the Owner to change the fire alarm program themselves. The CD shall contain a minimum of the following:

1. CAD drawing files of building fire alarm map
2. CAD drawing files of as-built fire alarm components and point to point connections.
3. General configuration programming.
4. Job specific configuration programming.

3.7 OPERATING AND MAINTENANCE MANUALS:

A. Operating and maintenance manuals shall be submitted prior to testing of the system. Manuals shall include all service, installation, and programming information.

3.8 TRAINING:

A. Provide four (4) hours training on the operation and installation of fire alarm system, at job site, at no cost to owner.

END OF SECTION 16721

DIVISION 31 - EARTHWORK

SECTION 31 1000 - SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Removing existing vegetation as indicated on demolition plan.
   2. Clearing and grubbing.
   3. Stripping and stockpiling topsoil.
   4. Removing above and below-grade site improvements.
   5. Disconnecting, capping or sealing, abandoning site utilities in place, and removing site utilities.
   6. Temporary erosion and sedimentation control measures.

B. Related Sections include the following:
   1. Division 01 Section "Temporary Facilities and Controls" for temporary utilities, temporary construction and support facilities, temporary security, protection facilities, and temporary erosion and sedimentation control procedures.
   2. Division 02 Section "Selective Site Demolition" for demolition of buildings, structures, and site improvements.
   3. Division 31 Section "Earth Moving" for soil materials, excavating, backfilling, and site grading.

1.3 DEFINITIONS

A. Topsoil: Natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches in diameter; and free of subsoil and weeds, roots, toxic materials, or other non-soil materials.

1.4 MATERIAL OWNERSHIP

A. Except for stripped topsoil or other materials indicated to remain on Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site. Stripped topsoil shall only be removed from the property upon approval from the Owner.

1.5 SUBMITTALS

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

B. Record drawings, according to Division 01 Section "Project Record Documents," identifying and accurately locating capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.6 QUALITY ASSURANCE

A. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.7 PROJECT CONDITIONS

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

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

B. Improvements on Adjoining Property: Authority for performing site clearing indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.

1. Do not proceed with work on adjoining property until directed by Architect.

C. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.

D. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.

E. Do not commence site clearing operations until temporary erosion and sedimentation control measures are in place.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. Satisfactory Soil Materials: Requirements for satisfactory soil materials are specified in Division 31 Section "Earth Moving."

1. Obtain approved borrow soil materials off-site when satisfactory soil materials are not available on-site.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Locate and clearly flag trees and vegetation to remain or to be relocated.

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

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

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction, sediment and erosion control Drawings, a sediment and erosion control plan, specific to the site, that complies with EPA 832/R-92-005 or requirements of authorities having jurisdiction, whichever is more stringent.

B. Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.

C. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.3 UTILITIES

A. Owner will arrange for disconnecting and sealing indicated utilities that serve existing structures before site clearing, when requested by Contractor.

1. Verify that utilities have been disconnected and capped before proceeding with site clearing.

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

1. Arrange with utility companies to shut off indicated utilities.
2. Owner will arrange to shut off indicated utilities when requested by Contractor.

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

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

D. Excavate for and remove underground utilities indicated to be removed.

E. Removal of underground utilities is included in Division 21, Division 22, Division 26, Division 27, and Division 28 Sections covering site utilities.

3.4 CLEARING AND GRUBBING

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

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

1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches and compact each layer to a density equal to adjacent original ground.

3.5 TOPSOIL STRIPPING

A. Remove top 1-2” of soil including all weeds, grass, brush and other vegetation and haul this material off-site before stripping topsoil. Actual depth of soil removal from site may vary depending on the amount of roots and plant material in the top 1-6” of soil. The base bid shall be to strip up to 3” of soil, etc. from the site and dispose of it off-site. If additional material is deemed necessary for removal from the site, a change order will be issued. Consult with Landscape Architect on-site prior to stripping soil so that a visual inspection can be done. Contractor shall review the topsoil report already completed with the Landscape Architect at this meeting. See appendix ‘A’ for topsoil report.

B. Strip only from 3” depth to 12” depth (the first 1-3” being disposed off of-site) of topsoil in a manner to prevent intermingling with underlying subsoil or other waste materials. This depth of topsoil stripping may need to be modified based on the results of the topsoil test noted above and also based on observations at the meeting to be held on-site as discussed above. The contractor shall calculate how much soil is needed for the lawn areas and planter areas and then only needs to strip that much soil (less the amendments).
1. Remove subsoil and non-soil materials from topsoil by screening all topsoil from trash, debris, weeds, roots, and other waste materials greater than ½ inch in any dimension.
2. Amount of topsoil that needs to be stockpiled shall be determined by the following:
    a. Strip all soils under buildings, structures, hardscaped/paved areas per civil, architectural, mechanical and structural drawings.
    b. Strip enough topsoil based on quantity needed to install 4” depth of amended soil in lawn areas and 12” depth of amended soil in planter areas.
    c. Topsoil depths in lawn and planter areas may be deeper than noted if at no additional cost to the Owner.

C. Stockpile stripped topsoil materials away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust.
1. Limit height of topsoil stockpiles to 6 feet.
2. Do not stockpile topsoil within tree protection zones.
3. Minimize overworking of topsoil so that physical properties of topsoil are retained. Topsoil should be stripped and piled in a location that will not interfere with construction. Topsoil shall not be moved from location to location. Topsoil shall not be driven over with any equipment. Overworking of topsoil may invalidate the reuse of it for landscaping purposes. If topsoil is unusable due to overworking it, moving it, driving over it unnecessarily, etc, contractor shall at his own expense import topsoil to replace damaged topsoil as required. Contractor shall also bear the expense of disposal of any unusable stripped topsoil. Landscape contractor shall provide a second soils test for stockpiled topsoil prior to reuse in landscaped areas. Adjustments may need to be made to amendments depending on results of topsoil test.
4. Dispose of excess topsoil as specified for waste material disposal as directed by the Owner. Owner retains all rights to stripped topsoil. Owner shall approve any removal of stripped topsoil from site however the contractor shall bear the cost to remove such soil as approved by the Owner.
5. Stockpile surplus topsoil to allow for landscaping per plans. Depths of topsoil in lawn areas can be deeper than what is specified if excess soils are available for the extra depths, however, the Civil engineer must approve this and determine that all grading and drainage requirements can still be met by having deeper topsoil depths in lawn areas.

Consult with Owner and Civil Engineer on-site prior to site work to discuss this and determine appropriate course of action to be taken.

3.6 SITE IMPROVEMENTS

A. Remove existing above-grade and below-grade improvements as indicated and as necessary to facilitate new construction. Refer to project plans for improvements to be abandoned in place.

B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.

1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut length of existing pavement to remain before removing existing pavement. Saw-cut faces vertically.
2. Paint cut ends of steel reinforcement in concrete to remain to prevent corrosion.

3.7 DISPOSAL

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

1. Separate recyclable materials produced during site clearing from other non-recyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities.

END OF SECTION

SECTION 31 2000 - EARTH MOVING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Preparing subgrades for slabs-on-grade, walks, pavements, lawns and grasses and exterior plants.
2. Subbase course for concrete walks and pavements.
3. Subbase and base course for asphalt paving.
4. Subsurface drainage backfill for walls and trenches.
5. Excavation and backfilling for buildings and structures.
6. Excavation and backfilling for utility trenches.

B. Related Sections include the following:

1. Division 1 Section "Temporary Facilities and Controls" for temporary controls, utilities, and support facilities.
2. Division 2 Section "Site Clearing" for temporary erosion and sedimentation control measures, site stripping, grubbing, stripping and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.
3. Division 2 Section "Dewatering" for lowering and disposing of ground water during construction.
4. Division 2 Section "Excavation Support and Protection" for shoring, bracing, and sheet piling of excavations.
5. Division 2 Section "Exterior Plants" for planting bed establishment and tree and shrub pit excavation and planting.
6. Division 3 Section "Cast-in-Place Concrete" for granular course if placed over vapor retarder and beneath the slab-on-grade.

1.2 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material 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. Base Course: Course placed between the subbase course and hot-mix asphalt paving.

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

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

E. Drainage Course: Course supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

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

G. Fill: Soil materials used to raise existing grades.

H. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material 3/4 cu. yd. or more in volume that exceed a standard penetration resistance of 100 blows/2 inches when tested by an independent geotechnical testing agency, according to ASTM D 1586.

I. 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.

J. Subbase Course: Course placed between the subgrade and base course for hot-mix asphalt pavement, or course placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

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

L. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.3 SUBMITTALS

A. Product Data: For the following:

1. Each type of plastic warning tape.

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

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

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

1.4 QUALITY ASSURANCE

A. Preexcavation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.5 PROJECT CONDITIONS

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

1. Notify Architect not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Architect's written permission.
3. Contact utility-locator service for area where Project is located before excavating.

B. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations. Use imported structural fill for structurally loaded areas and pavements. All earthwork shall be in accordance with the project geotechnical study.

B. Satisfactory Soils: ASTM D 2487 Soil Classification Groups GW, GP, GM, SW, SP, and SM, or a combination of these groups; free of rock or gravel larger than 6 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter. Min 70% passing the ¾" sieve and max 50% passing No. 200 Sieve with a max Plasticity Index is set at 15 max.

C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487, or a combination of these groups.
1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

D. Imported Structural Fill and Backfill: Naturally occurring or artificially graded mixture of sands and gravels (non-expansive granular soil), free of organics, vegetation, sod, trash, frozen materials, clay clods or other deleterious materials such as trash, frozen clods, clay clods, etc., with 100% passing the 4" sieve, a min of 70% passing the ¾" sieve, and 20% max passing the No. 200 Sieve. Liquid Limit is set at 30 max and Plasticity Index is set at 10 max. Structural Fill should be well-graded with a maximum particle size of 4 inches.

E. Base Course at all Site Concrete Work: Sound, crushed, or uncrushed rock or gravel and sand, well graded as follows: (refer to APWA specs for base course.)

Sieve	% by Weight Passing Sieve
1 1/2"	100
1"	90 -100
¾"	70 – 85
½"	60 – 80
3/8"	55 – 75

#4	40-65
#16	25 – 40
#200	7 – 11 (non-plastic)

Provide a 4 inch minimum of base course material beneath all site concrete work.

F. Bedding Course: Type A-1-a or A-1-b (AASHTO Classifications soils per City Requirements.)

G. Drainage Course: Narrowly graded mixture of sand, crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 200 sieve. Provide a minimum of 4 inch depth under all concrete building slab areas or as shown on plans.

H. Cobble Material: Naturally or artificially graded mixture of angular rock. 4” to 12” in diameter.

I. Drain Rock: For Fill in submerged area 3” Minus washed rock and pea gravel material with 0-25 passing the No 10, 0-15 Passing the No 40 and 0-5 Passing the No 200 Non Plastic should be used. If free draining fill is adjacent to soil containing a significant amount of sand or silt/clay, precautions should be taken to prevent the migration of fine soil into the free drain fill. This would include the use of filter fabric between the two soil types. Fabric to be approved by geotechnical engineer.

2.2 ACCESSORIES

A. Detectable Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored as follows:

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

PART 3 - EXECUTION

3.1 PREPARATION

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

B. Preparation of subgrade for earthwork operations including removal of vegetation, topsoil, debris, obstructions, and deleterious materials from ground surface is specified in Division 2 Section "Site Clearing."

C. Protect and maintain erosion and sedimentation controls, which are specified in Division 2 Section "Site Clearing," during earthwork operations.

D. Provide protective insulating materials to protect subgrades and foundation soils against freezing temperatures or frost.

3.2 DEWATERING

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

B. Pump ground water out of excavations and dispose of ground water in accordance with City requirements.

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

1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

3.3 EXPLOSIVES

A. Explosives: The use of explosives is NOT allowed, unless specifically permitted by City Officials.

3.4 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.

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

3.5 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections. *Refer to geotechnical report for any over excavation requirements and depth of required structural fill for footing*. All undocumented fill found on site and indicated in the geotechnical report must be removed beneath footings and foundations.

1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work. Bottom of excavation to be compacted with a minimum of 4 passes of a approved non vibratory roller prior to erection of forms or placement of structural fill. If soft spots are encountered over excavate and stabilize as recommended in the geotechnical report.

2. Excavations below or near ground water elevations (within 12” of ground water) shall extend below the footing, foundation or structure a minimum of 24” or as indicated in the

plans and backfilled with cobble and drainage rock to stabilize the foundation support. End dump cobble and spread to a maximum of 15" loose lifts and compact cobbles by dropping a backhoe bucket uniformly over the surface at least 3 times. The first layer of structural backfill shall be "worked into" the underlying open graded fill to reduce long term settlement of the fill material. Provide drainage fabric separation when shown on plans.

3. Excavation for Underground Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch. Do not disturb bottom of excavations intended as bearing surfaces.

4. Excavate 12" deeper than the required elevation required in rock areas or unyielding bearing material and backfill with imported engineered fill.

3.6 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades. Subgrade to be prepared by proof-rolling to a firm non yielding surface to identify soft spots. If soft spots are encountered over excavate and stabilize as recommended in the geotechnical report (2' deep replacement min.)

3.7 EXCAVATION FOR UTILITY TRENCHES

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

1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.

B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit, unless otherwise indicated.

1. Clearance: 12 inches each side of pipe or conduit.

C. Trench Bottoms: Excavate trenches 4 inches deeper than bottom of pipe elevation to allow for bedding course. Hand excavate for bell of pipe.

1. Excavate trenches 12 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

2. Excavate 16 inches minimum deeper than the elevation required for utilities that are to be placed at or near ground water (within 12 inches of ground water) and backfill with 12" min of drainage rock for pipe stabilization. Place drainage fabric over drainage rock prior to placement of pipe bedding material. Wrap the pipe zone material in drainage fabric if the pipe is below ground water level. Coordinate with City inspector if additional measures are required for utility support.

3.8 SUBGRADE INSPECTION

A. Notify Architect when excavations have reached required subgrade.

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

C. Proof-roll subgrade below the building slabs and pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades. DO not route construction traffic over subgrade.

1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.
2. Proof-roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with 2' of imported structural granular fill to stabilize soft areas or as directed.

D. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work. Soft spots caused by routing construction equipment over subgrade will be repaired without additional compensation.

E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

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. Lean concrete fill, with 28-day compressive strength of 2500 psi, may be used when approved by Architect.

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

3.10 STORAGE OF SOIL MATERIALS

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

1. Stockpile soil materials away from edge of excavations. Do not store within 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, subdrainage, dampproofing, waterproofing, and perimeter insulation.
2. Surveying locations of underground utilities for Record Documents.
3. Testing and inspecting 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.

B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.12 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.

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

C. Trenches under Footings: Backfill trenches excavated under footings and within 18 inches of bottom of footings with bedding course material; fill with concrete to elevation of bottom of footings. Concrete is specified in Division 03 Section "Cast-in-Place Concrete Miscellaneous Cast-in-Place Concrete."

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

1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

E. Place and compact final backfill of satisfactory soil to final subgrade elevation.

F. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.13 SOIL FILL

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

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

1. Under grass and planted areas, native soils may be used as longs as they meet compaction requirements outlined in section 3.15 (top 6" topsoil).
2. Under walks and pavements and artificial turf areas, use satisfactory soil material (fill as defined in the geotechnical report).
3. Under steps and ramps, use structural fill.
4. Under building slabs, use structural fill.
5. Under footings and foundations, use structural fill.
6. Under utility lines and utility structures, use bedding course material
7. Pipe zone (bottom of pipe to 1 foot over the top of pipe), use bedding course material

C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.14 SOIL MOISTURE CONTROL

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

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

3.15 COMPACTION OF SOIL BACKFILLS AND FILLS

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

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

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

1. Under structures, building slabs, steps, and pavements and artificial turf, compact each layer of backfill or fill soil material at 96 percent.
2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 95 percent.
3. Under unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 90 percent.
4. For utility trenches, refer to city standards for utility trenching (96 percent min.). All fill and compaction in utility trenches both onsite and offsite must meet these requirements.

3.16 GRADING

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

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

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

1. Lawn or Unpaved Areas: Plus or minus 1 inch.
2. Walks: Plus or minus 1/2 inch (not to exceed ADA max guidelines in ADA route).
3. Pavements: Plus or minus 1/2 inch (not to exceed ADA max guidelines in ADA parking).
4. Artificial Turf: Plus or minus 1/2 inch (Laser graded for precision)

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

3.17 SUBBASE AND BASE COURSES

A. Place subbase and base course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place subbase and base course under pavements and walks as follows:
   1. Place base course material over subbase course under hot-mix asphalt pavement.
   2. Shape subbase and base course to required crown elevations and cross-slope grades.
   3. Place subbase and base course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
   4. Compact subbase and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.

3.18 DRAINAGE COURSE

A. Place drainage course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:
   1. Place drainage course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick. Compact over drainage piping with 4 passes of smooth drum roller as required by pipe manufacture.
   2. Compact drainage course material using 4 passes of a smooth drum 5 ton vibratory roller or equivalent each layer to required thickness.

3.19 FIELD QUALITY CONTROL

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

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

C. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect.

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

   1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least 1 test for every 2000 sq. ft. or less of paved area or building slab, but in no case fewer than 3 tests.
   2. Foundation Wall Backfill: At each compacted backfill layer, at least 1 test at each spot footing and for each 50 feet or less of wall length, but no fewer than 2 tests.
   3. Trench Backfill: At each compacted initial and final backfill layer, at least 1 test for each 150 feet or less of trench length, but no fewer than 2 tests.

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

F. Contractor to provide the owner and engineer with a post construction topographic survey of the entire site within the project limit line indicating that the construction complies with the grades shown on sheet grading plans. The elevations shown on the grading plan are at finish surface (final elevation.) The elevations will be surveyed at the top of subgrade layer placed in the field (allowing for the thickness of the artificial turf and crusher course). Refer to the architectural plans for turf thickness requirements. Refer to earthwork specifications for grading tolerances allowed for the final surfaces. This survey is to be provided to the owner/architect for use by the engineer of record to prior of the final grading of the artificial turf. Contractor to regrade areas that do not meet the design grade elevations and slopes shown on the plans.

G. The contractor to schedule the engineer of record in writing 3 days minimum before placement of concrete curbing, flatwork, or asphalt paving. All areas must be formed and have compacted base course in place for the engineer to complete a random spot grade check before asphalt and concrete construction. The random grade checks are for general conformance to slopes and grading shown on plans using a smart level. Random checks do not alleviate the contractor's responsibility to ensure grading is in conformance with plans and specifications and satisfy performance of his work. Within 2 days of the random spot check, results of the spot checks and areas of non compliance will be provided to the contractor and architect.

3.20 PROTECTION

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

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

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

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

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

3.21 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Transport surplus satisfactory soil to designated storage areas on Owner's property. Stockpile or spread soil as directed by Architect.

1. Remove waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

END OF SECTION

SECTION 31 2216 - FINE GRADING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Perform fine grading work required to prepare site for paving finish grading and for landscape finish grading and soil preparation as described in Contract Documents.

B. Related Sections:
   1. Section 329113: Finish grading and soil preparation for landscaping.
   2. Section 311000: Site clearing.

1.2 REFERENCES

A. American Society For Testing And Materials:
   1. ASTM D 1557-02, 'Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort.'

1.3 QUALITY ASSURANCE

A. Pre-Installation Conference: Participate in pre-installation conference.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION

3.1 EXAMINATION

A. Do not commence work of this Section until grading tolerances are met.

3.2 PREPARATION

A. Protection: Protect utilities and site elements from damage.

B. Surface Preparation:
   1. Before grading, dig out lawn, trees, shrubs, etc. by their roots and remove from site. Remove from site all rocks larger than 1/2 inches in size and foreign matter such as building rubble, wire, cans, sticks, concrete, etc. Excavate down deep enough in new planters to allow for new 12” depth of imported and amended topsoil and rock depth per plans.
   2. Remove imported paving base material or concrete present in lawn or planting areas down to natural subgrade or other material acceptable to Landscape Architect. This shall be performed as part of the base bid and shall be done at no additional cost to the Owner.

3. Remove existing lawn and enough existing soil to allow for new topsoil and sod. In lawn areas where existing trees are located, only strip the lawn but not a 4" depth of soil within the tree drip zone as this will affect the roots of existing trees. Once outside the rootzone of the trees that will remain in place, the 4" depth of topsoil shall be added prior to laying new sod. Taper topsoil as necessary to create a smooth transition between old and new lawn areas.
4. Limit use of heavy equipment to areas no closer than 6 feet from building or other permanent structures.
5. See demolition plans for additional requirements.

C. Contractor shall field verify all existing and proposed utilities, trees, plants, buildings, structures, roads, curb and gutter, sidewalks, irrigation system, utilities, easements, setbacks, Right-of-ways, etc. to make sure no conflicts exist between existing conditions and proposed plans. Contractor shall be responsible to make on-site field adjustments as may be required due to discrepancies found during construction. Contractor and Owner agrees to hold In-Site Design Group harmless for any and all such discrepancies including costs associated with such discrepancies including repair, replacement or anything related to such discrepancies.

3.3 PERFORMANCE

A. Site Tolerances:
1. Maximum variation from required grades shall be 1/10 of one foot.
2. To allow for final finish grades of planting areas, fine grade elevations before placing topsoil are:
   a. New Sod Areas: Approx. 5-3/4 inches below top of walk or curb.
   b. Tree Areas: 19 to 19-1/2 inches below top of walk or curb under 6" deep Decorative Rock areas. Areas of rock with no trees will only need to be excavated enough to keep the top of rock below the top of the adjacent curb, walk, etc. per plans and details.

B. Do not expose or damage existing tree roots that are to be protected in place. Contractor shall confirm with Owner all vegetation that shall remain in place prior to demolition of the project. Refer to demolition plans and/or tree protection plans for additional information.

C. Distribute approved imported topsoil, amendments, rock, wood mulch, etc. per plans. Remove organic material, rocks and clods greater than 1/2 inch in any dimension, excavated planter soil, excavated lawn soil and other materials and other objectionable materials from the site at no additional cost to the Owner as part of the base bid.

D. Unless otherwise noted on civil plans, slope grade away from building for 12 feet minimum from walls at slope of 1/2 inch in 12 inches minimum unless otherwise noted. Direct surface drainage in manner indicated on Civil Drawings by molding surface to facilitate natural run-off of water. Fill low spots and pockets with specified fill material and grade to drain properly.

END OF SECTION 31 2216

DIVISION 32 – EXTERIOR IMPROVEMENTS

SECTION 32 0101 - PLANT MAINTENANCE

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Provide maintenance for new landscaping as described in Contract Documents.

B. Related Sections:
   1. Section 329001: Common Planting Requirements.

PART 2 - PRODUCTS: Not Used

PART 3 - EXECUTION

3.1 PERFORMANCE

A. General:
   1. Before beginning maintenance period, plants shall be in at least as sound, healthy, vigorous, and in approved condition as when delivered to site, unless accepted by Landscape Architect in writing at final landscape inspection
   2. Maintain all new lawn and landscaping from completion of landscape installation to 60 days after Final Completion Meeting and 100% Owner acceptance.
   3. Replace landscaping that is dead or appears unhealthy or non-vigorous as directed by Architect at end of maintenance period. Make replacements within 5 days of notification. Lawn that does not live and has to be replaced shall be guaranteed and maintained an additional 60 days from date of replacement.

B. Sodded Lawn:
   1. Maintain sodded lawn areas until lawn complies with specified requirements and throughout maintenance period.
   2. Water sodded areas in sufficient quantities and at required frequency to maintain sub-soil immediately under sod continuously moist 3 to 4 inches deep.
   3. Cut grass first time when it reaches 3 inches high. Continue to mow at least once each week throughout maintenance period. Remove clippings. The Owner will provide lawn mowing.
   4. Apply weed killer as necessary to maintain weed-free lawn. Apply weed killer in accordance with manufacturer's instructions during calm weather when air temperature is between 50 and 80 deg F.
   5. At end of 60 day maintenance period, fertilize lawns with 16-16-8 (or per Owner’s/Manufacturers/Landscape Architects directive) at rate recommended by Fertilizer Manufacturer.

C. Trees:
   1. Maintain by pruning, cultivating, and weeding as required for healthy growth.
   2. Restore planting basins.
   3. Tighten and repair stake and guy supports and reset trees to proper grades or vertical positions as required.

4. Spray as required to keep trees and shrubs free of insects and disease.
5. Provide supplemental water by hand as needed in addition to water from sprinkling system. The contractor shall plan to hand water all trees at least 3 times during the first winter (with a water truck). This shall be part of the base bid. Trees that are not established tend to dry out in the first winter months. If hand watering is not done, the contractor shall be required to warranty all trees for a period of two years instead of 1 year.
6. Adjust run time of sprinklers and drip as necessary (during maintenance period and during 1 year warranty period) in order to avoid over or under watering of lawn and trees including adding and/or adjusting quantity, size, etc. of drip emitters, sprays and rotors.
7. Provide at least monthly visual inspections (during the 1 year warranty period) of project during normal growing season to monitor and make sure tree and lawn are not being over or under watered. Prepare and file a monthly report of findings to Architect and Owner. Make adjustments to system based on findings at no additional cost to Owner including reprogramming of controller and/or adjusting quantity and size of emitters to trees each month during the first year (growing season only) as necessary.

END OF SECTION 32 0101

SECTION 32 1216 - HOT-MIX ASPHALT PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Asphalt paving.
2. Pavement-marking.

B. Related Sections include the following:

1. Division 2 Section "Earthwork" for aggregate subbase and base courses and for aggregate pavement shoulders.

1.2 DEFINITIONS

A. Hot-Mix Asphalt Paving Terminology: Refer to ASTM D 8 for definitions of terms.

B. DOT: Department of Transportation.

1.3 SYSTEM DESCRIPTION

A. Provide hot-mix asphalt paving according to materials, workmanship, and other applicable requirements of standard specifications of state or local DOT.

1. Standard Specification: Comply with APWA specifications, Latest edition, and with local governing regulations of more stringent than herein specified.
2. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.

B. Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the Work.

C. Qualification Data: For manufacturer.

D. Material Test Reports: For each paving material.

E. Material Certificates: For each paving material, signed by manufacturers.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer.

1. Manufacturer shall be a paving-mix manufacturer registered with and approved by authorities having jurisdiction or the DOT of the state of Utah.

B. Testing Agency Qualifications: Qualified according to ASTM D 3666 for testing indicated, as documented according to ASTM E 548.

C. The OWNER will engage materials testing service for quality control during base and asphalt placement operations.

D. Contractor Responsibility for Testing: Advise testing agency sufficiently in advance of operations to allow for completion of quality tests, and for assignment of personnel.

Deliver samplers of proposed base materials to testing agency for analysis and approval.

Assist testing agency representative to safely have access to the site during placement operations

E. Frequency of Tests: Owner's testing agency will be instructed to conduct field density tests of materials as follows:

Aggregate Base Course: Conduct one test for each 1000 square feet of each lift of material completed to 95% minimum of maximum dry density determined b ASTM D 1557-78.

Asphaltic Surface Course: Conduct one test for each 1000 square feet of material compacted to 96% minimum of design density as determined by ASTM D 1559-78 (Marshall Method).

F. Grade Control: Establish and maintain required lines and elevations.. Lay base course within plus or minus 1/4 inch in 10 feet of required elevations.

G. Asphalt-Paving Publication: Comply with AI MS-22, "Construction of Hot Mix Asphalt Pavements," unless more stringent requirements are indicated.

H. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp or if the following conditions are not met:

1. Tack Coats: Minimum surface temperature of 60 deg F.
2. Asphalt Base Course: Minimum surface temperature of 40 deg F and rising at time of placement.
3. Asphalt Surface Course: Minimum surface temperature of 60 deg F at time of placement.

PART 2 - PRODUCTS

2.1 AGGREGATES

A. General: Use materials and gradations that have performed satisfactorily in previous installations.

B. Coarse Aggregate: ASTM D 692, sound; angular crushed stone, crushed gravel, or properly cured, crushed blast-furnace slag.

C. Fine Aggregate: ASTM D 1073, sharp-edged natural sand or sand prepared from stone, gravel, properly cured blast-furnace slag, or combinations thereof.

1. For hot-mix asphalt, limit natural sand to a maximum of 20 percent by weight of the total aggregate mass.

D. Mineral Filler: ASTM D 242, rock or slag dust, hydraulic cement, or other inert material.

2.2 ASPHALT MATERIALS

A. Asphalt Cement: ASTM D 3381 for viscosity-graded material, use AC-10. ASTM D 6373 for penetration-graded material, use PG 58-22 or PG58-28 per current APWA Specifications.

B. Tack Coat: ASTM D 977, emulsified asphalt or ASTM D 2397, cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.

C. Water: Potable.

D. Undersealing Asphalt: ASTM D 3141, pumping consistency.

2.3 AUXILIARY MATERIALS

A. Herbicide: Commercial chemical for weed control, registered by the EPA. Provide in granular, liquid, or wettable powder form.

B. Pavement – Marking Paint: Latex, waterborne emulsion, lead and chromate free, ready mixed, complying with FS TT-P-1952, with drying time less than 3 minutes.

1. Color: White, Yellow, Red, and Blue (Coordinate with Owner)
2. White for parking stripes (Coordinate with Owner)
3. Yellow for safety markings. (Coordinate with Owner)
4. Reflective white for crosswalks. White and blue for international accessibility symbols.
5. Red for curb marking, where indicated by Fire Marshall.

2.4 MIXES

A. Hot-Mix Asphalt: Dense, hot-laid, hot-mix asphalt plant mixes approved by authorities having jurisdiction; designed according to procedures in AI MS-2, "Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types"; and complying with the following requirements:

1. Provide mixes to comply with the APWA Stds.

2. 1/2 inch aggregate for parking areas, playgrounds and access roadways.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that subgrade is dry and in suitable condition to support paving and imposed loads.

B. Proof-roll subbase using heavy, pneumatic-tired rollers to locate areas that are unstable or that require further compaction.

C. Proceed with paving only after unsatisfactory conditions have been corrected.

3.2 REPAIRS

A. Leveling Course: Install and compact leveling course consisting of hot-mix asphalt surface course to level sags and fill depressions deeper than 1 inch in existing pavements.

1. Install leveling wedges in compacted lifts not exceeding 3 inches thick.

B. Crack and Joint Filling: Remove existing joint filler material from cracks or joints to a depth of 1/4 inch.

1. Clean cracks and joints in existing hot-mix asphalt pavement.
2. Use emulsified-asphalt slurry to seal cracks and joints less than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.

3.3 SURFACE PREPARATION

A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.

1. Sweep loose granular particles from surface of unbound-aggregate base course. Do not dislodge or disturb aggregate embedded in compacted surface of base course.

B. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.

1. Mix herbicide formulated by manufacturer for that purpose.

C. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd.

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.4 HOT-MIX ASPHALT PLACING

A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.

1. Place hot-mix asphalt base course in number of lifts and thicknesses indicated.
2. Place hot-mix asphalt surface course in single lift.
3. Spread mix at minimum temperature of 250 deg F.
4. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes, unless otherwise indicated.
5. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.

B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.

1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete a section of asphalt base course before placing asphalt surface course.

C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.5 JOINTS

A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions with same texture and smoothness as other sections of hot-mix asphalt course.

1. Clean contact surfaces and apply tack coat to joints.
2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.
3. Offset transverse joints, in successive courses, a minimum of 24 inches.
4. Construct transverse joints as described in AI MS-22, "Construction of Hot Mix Asphalt Pavements."
5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
6. Compact asphalt at joints to a density within 2 percent of specified course density.

3.6 COMPACTION

A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or vibratory-plate compactors in areas inaccessible to rollers.

1. Complete compaction before mix temperature cools to 185 deg F.

B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.

C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:

1. Average Density: 96 percent of reference laboratory density according to AASHTO T 245, but not less than 94 percent nor greater than 100 percent.

D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.

E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.

F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.

G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

3.7 INSTALLATION TOLERANCES

A. Thickness: Compact each course to produce the thickness indicated within the following tolerances:

1. Base Course: Plus or minus 1/2 inch.
2. Surface Course: Plus 1/4 inch, no minus.

B. Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:

1. Base Course: 1/4 inch.
2. Surface Course: 1/8 inch.
3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and to prepare test reports.

1. Testing agency will conduct and interpret tests and state in each report whether tested Work complies with or deviates from specified requirements.

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

C. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.

D. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.

E. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to ASTM D 979.

1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D 2041, and compacted according to job-mix specifications.
2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D 1188 or ASTM D 2726.

    a. One core sample will be taken for every 1000 sq. yd. or less of installed pavement, with no fewer than 3 cores taken.

F. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

3.9 DISPOSAL

A. Except for material indicated to be recycled, remove excavated materials from Project site and legally dispose of them in an EPA-approved landfill.

1. Do not allow excavated materials to accumulate on-site.

END OF SECTION

SECTION 32 1313 - SITE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes exterior cement concrete pavement for the following:

1. Driveways and concrete pads
2. Curbs and gutters
3. Walkways

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Design Mixtures: For each concrete pavement mixture.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products who complies with ASTM C 94 requirements for production facilities and equipment.

B. ACI Publications: Comply with ACI 301, “Specification for Structural Concrete,” unless modified by requirements in the Contract Documents.

PART 2 - PRODUCTS

2.1 CONCRETE MATERIALS

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

1. Portland Cement: ASTM C 150, Type II, gray.

B. Normal-Weight Aggregates: ASTM C 33, Class 4S coarse aggregate, uniformly graded. Provide aggregates from a single source.

C. Water: ASTM C 94.

D. Air-Entraining Admixture: ASTM C 260.

E. Chemical Admixtures: ASTM C 494, of type suitable for application, certified by manufacturer to be compatible with other admixtures and to contain no more than 0.1 percent water-soluble chloride ions by mass of cementitious material.

2.2 CURING MATERIALS

A. Sonneborn - KURE- N -SEAL 30 – One coat required on all exterior concrete.

2.3 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.

2.4 STEEL REINFORCEMENT

A. Epoxy-Coated Reinforcing Bars: ASTM A 615, Grade 60, deformed bars, ASTM A 775, epoxy coated, with less than 2 percent damaged coating in each 12-inch bar length.

B. Bar Supports: bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars or dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice".

2.5 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to ACI 301, with the following properties:

1. Compressive Strength (28 Days): 4000 psi.
2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.45.
3. Slump Limit: 4 inches, plus or minus 1 inch.
4. Air Content: 6-1/2 percent plus or minus 1.5 percent.
5. Cement: 6-1/2 bag mix.

2.6 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94. Furnish batch certificates for each batch discharged and used in the Work.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Proof-roll prepared subbase surface below concrete pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding.

3.2 EDGE FORMS AND SCREED CONSTRUCTION

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

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

3.3 STEEL REINFORCEMENT

A. General: Comply with CRSI’s “Manual of Standard Practice” for fabricating, placing, and supporting reinforcement embedded in concrete flatwork.

3.4 JOINTS

A. General: Form construction, isolation, and contraction joints and tool edging true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of pavement and at locations where pavement operations are stopped for more than one-half hour unless pavement terminates at isolation joints.

C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.

D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness to match jointing of existing adjacent concrete pavement.

E. Edging: Tool edges of pavement, gutters, curbs, and joints in concrete after initial floating with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate tool marks on concrete surfaces.

3.5 CONCRETE PLACEMENT

A. Moisten subbase to provide a uniform dampened condition at time concrete is placed.

B. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.

C. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

D. Screed pavement surfaces with a straightedge and strike off.

E. Commence initial floating using bull floats or darbies to impart an open textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

3.6 FLOAT FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.

B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats, or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

1. Medium-to-Fine-Textured Broom Finish: Draw a soft bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.

3.7 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot

temperatures.

A. Comply with ACI 306.1 for cold-weather protection.

B. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. Ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screening, and bull floating or darbying concrete, but before float finishing.

C. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

D. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these methods.

3.8 PAVEMENT TOLERANCES

A. Comply with tolerances of ACI 117 and as follows:

Elevation: 1/4 inch.
Thickness: Plus 3/8 inch, minus 1/4 inch.
Surface: Gap below 10-foot-long, unleveled straightedge not to exceed 1/4 inch.
Joint Spacing: 3 inches.
Contraction Joint Depth: Plus 1/4 inch, no minus.
Joint Width: Plus 1/8 inch, no minus.

3.9 REPAIRS AND PROTECTION

A. Remove and replace concrete pavement that is broken, damaged, or defective or that does not comply with requirements in this Section.

B. Protect concrete from damage. Exclude traffic from pavement for at least 14 days after placement.

C. Maintain concrete pavement free of stains, discoloration, dirt, and other foreign material. Sweep concrete pavement not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION

SECTION 32 1316 – EXTERIOR COLORED CONCRETE PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Exterior colored concrete paving as shown on drawings.

B. Related Sections include the following:

1. Division 32 Section "Concrete Paving" for exterior cement concrete pavement.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include manufacturer's technical data, application instructions, and recommendations for integrally colored concrete.

B. Samples: For color verification. Submit sample chip of specified color indicating color additive number and required dosage rate. Samples indicate general color and may vary from concrete finished in field according to specifications.

1.4 QUALITY ASSURANCE

A. Perform work in accordance with specification Section 321313 "Concrete Paving". Conform to ACI 301 and hot or cold weather requirements.

B. Obtain materials from same source and maintain high degree of consistency in workmanship throughout project.

C. Installer Qualifications: Engage an experienced installer (applicator) who is experienced in colored concrete finishing.

D. Colored Concrete Mock-Up: Provide full-scale mock-up. Construct at least one month before start of other concrete work to allow concrete to cure before observation.

1. At location on project as selected by Architect, demonstrate methods of obtaining consistent visual appearance.
2. Retain samples of cements, sands, aggregate, and color additives used in mock-up for comparison with materials used in remaining work.
3. Accepted mock-up provides visual standard for work.

1.5 DELIVERY, STORAGE AND HANDLING

A. Color Additives: Comply with manufacturer's instructions. Deliver color additives to job site or batch plant in original, unopened packaging. Store in dry conditions.

PART 2 - PRODUCTS

2.1 COLORED ADDITIVES FOR INTEGRALLY COLORED CONCRETE

A. Basis-of-Design Product: Subject to compliance with requirements, provide Davis Colors, www.daviscolors.com or approved equal product by Architect prior to bidding.

1. Materials: Colored additives shall contain pure, concentrated mineral pigments specially processed for mixing into concrete and complying with ASTM C979.
2. Packaging: If color additives are to be added to mix at site, furnish color additives in premeasured Mix-Ready® disintegrating bags to minimize job site waste.
3. Admixtures: Do not use calcium chloride admixtures.
4. Concrete Color: Custom color.

a. Dosage: 1/2 to 7 lbs. per 94 lbs. of cement content.
1) Dosage rate of color additive shall not exceed 10% of weight of cementitious materials in mix.
b. Finish: Broomed.

2.2 FORMS

A. Form Facing Material: Provide non-porous surface such as steel, plastic, or high-density overlaid plywood with watertight joint seals to prevent leakage.

B. Form Ties: Fiberglass rods tinted to match concrete.

C. Form Release: Non-staining and minimizes formation of “bug-holes in surface of concrete”.

2.3 ACCESSORIES

A. Curing Compound for Colored Concrete: Curing compound shall comply with ASTM C309 and be approved by color additive manufacturer for use with colored concrete.

B. Supports for Reinforcing Bars: Use corrosion-resistant types at locations in contact with exposed surfaces.

C. Cleaning Agents: Use products known to be compatible with colored concrete.

2.4 MIXES

A. General: As recommended by manufacturer. Provide low water-cement ratio to promote rich, dark concrete color.

B. Color Additives: Mix in accordance with manufacturer’s instructions. Mix until color additives are uniformly dispersed throughout mixture and disintegrating bags, if used, have disintegrated.

C. Do not re-temper mix by adding water in field.

PART 3 - EXECUTION

3.1 GENERAL

A. Comply strictly with manufacturer's written instructions for color additive. Coordinate with Section 321313 “Concrete Paving”.

B. Fill holes and defects in concrete surface within 48 hours of form removal.

C. Use the same patching materials and techniques that were approved on mock-up.

1. Make patches with a stiff mortar made with materials from the same sources as the concrete. Adjust mortar mix proportions so dry patch matches dry adjacent concrete. Follow manufacturer's recommendations strictly.

D. Curing: Maintain concrete between 65 deg. and 85 deg. F during curing.

1. Colored Concrete: Apply curing compound in accordance with manufacturer's instructions. Apply curing compound at consistent time for each pour to maintain close color consistency.

E. Tolerances: Minor variations in appearance of colored concrete, which are similar to natural variations in color and appearance of uncolored concrete, are acceptable.

3.2 PAVING FINISH

A. Broom Finish: Coordinate with Architect for texture of broom finish.

3.3 CLEANING

A. Efflorescence: Remove efflorescence as soon as they appear. Use least aggressive cleaning techniques possible as recommended by manufacturer.

1. Test cleaner in a small area to make sure cleaner will not etch or discolor the surface.
2. Do not use muriatic acid on colored concrete.

END OF SECTION 32 1316

SECTION 32 1373 - CONCRETE PAVING JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Cold-applied joint sealants.
2. Hot-applied joint sealants.

1.2 PRECONSTRUCTION TESTING

A. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, eight, Samples of materials that will contact or affect joint sealants. Use ASTM C 1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.

1.3 SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. Samples: For each kind and color of joint sealant required.

C. Pavement-Joint-Sealant Schedule: Include the following information:
1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

D. Product certificates.

E. Product test reports.

F. Preconstruction compatibility and adhesion test reports.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021.

B. Preinstallation Conference: Conduct conference at Project site.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and

application, as demonstrated by joint-sealant manufacturer based on testing and field experience.

B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 COLD-APPLIED JOINT SEALANTS

A. Single-Component, Nonsag, Silicone Joint Sealant for Concrete: ASTM D 5893, Type NS.
1. Products: Subject to compliance with requirements, provide one of the following:
   a. Crafco Inc., an ERGON company; RoadSaver Silicone.
   b. Dow Corning Corporation; 888.
   c. Pecora Corporation; 301 NS.

B. Single-Component, Self-Leveling, Silicone Joint Sealant for Concrete: ASTM D 5893, Type SL.
1. Products: Subject to compliance with requirements, provide one of the following:
   a. Crafco Inc., an ERGON company; RoadSaver Silicone SL.
   b. Dow Corning Corporation; 890-SL.
   c. Pecora Corporation; 300 SL.

C. Multicomponent, Pourable, Traffic-Grade, Urethane Joint Sealant for Concrete: ASTM C 920, Type M, Grade P, Class 25, for Use T.
1. Products: Subject to compliance with requirements, provide one of the following:
   a. Pecora Corporation; Urexpan NR-200.
2.

2.3 HOT-APPLIED JOINT SEALANTS

A. Hot-Applied, Single-Component Joint Sealant for Concrete: ASTM D 3406.
1. Products: Subject to compliance with requirements, provide one of the following:
   a. Crafco Inc., an ERGON company; Superseal 444/777.

B. Hot-Applied, Single-Component Joint Sealant for Concrete and Asphalt: ASTM D 6690, Types I, II, and III.
1. Products: Subject to compliance with requirements, provide one of the following:
   a. Meadows, W. R., Inc.; Sealtight Hi-Spec or Sealtight 3405.
   b. Right Pointe; D-3405 Hot Applied Sealant.
2.

2.4 JOINT-SEALANT BACKER MATERIALS

A. Round Backer Rods for Cold- and Hot-Applied Joint Sealants: ASTM D 5249, Type 1, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.

B. Round Backer Rods for Cold-Applied Joint Sealants: ASTM D 5249, Type 3, of diameter and density required to control joint-sealant depth and prevent bottom-side adhesion of sealant.

C. Backer Strips for Cold- and Hot-Applied Joint Sealants: ASTM D 5249; Type 2; of thickness and width required to control joint-sealant depth, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.

2.5 PRIMERS

A. Primers: Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated unless more stringent requirements apply.

B. Cleaning of Joints: Clean out joints immediately before installing joint sealants.

C. Joint-Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

D. Install joint-sealant backings of kind indicated to support joint sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
   1. Do not leave gaps between ends of joint-sealant backings.
   2. Do not stretch, twist, puncture, or tear joint-sealant backings.
   3. Remove absorbent joint-sealant backings that have become wet before sealant application and replace them with dry materials.

E. Install joint sealants using proven techniques that comply with the following and at the same time backings are installed:
   1. Place joint sealants so they directly contact and fully wet joint substrates.
   2. Completely fill recesses in each joint configuration.
   3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

F. Tooling of Nonsag Joint Sealants: Immediately after joint-sealant application and before skinning or curing begins, tool sealants according to the following requirements to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint:
   1. Remove excess joint sealant from surfaces adjacent to joints.
   2. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.

G. Provide joint configuration to comply with joint-sealant manufacturer's written instructions unless otherwise indicated.

H. Clean off excess joint sealant or sealant smears adjacent to joints as the Work progresses, by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

END OF SECTION

SECTION 32 3113 - CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Chain-Link Fences: Industrial.
2. Gates: Swing and rolling.

B. Related Sections include the following:

1. Division 03 Section “Cast-in-Place Concrete” for concrete.
2. Division 31 Section “Earth Moving” for site excavation, fill, and backfill where chain link fences and gates are located.

1.3 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for chain-link fences and gates.

1. Fence and gate posts, rails, and fittings.
2. Chain-link fabric (regular and vinyl bonded/coated), reinforcements, and attachments.
3. Gates and hardware.

B. Shop Drawings: Show locations of fences, gates, posts, rails, tension wires, details of extended posts, extension arms, gate swing, or other operation, hardware, and accessories. Indicate materials, dimensions, sizes, weights, and finishes of components. Include plans, gate elevations, sections, details of post anchorage, attachment, bracing, and other required installation and operational clearances.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer who has at least three years' experience and has completed at least five chain link fence projects with same material and of similar scope to that indicated for this Project with a successful construction record of in-service performance. Western Fence Company is a pre-approved fence installer.

B. Single-Source Responsibility: Obtain chain link fences and gates, including accessories, fittings, and fastenings, from a single source.

1.5 PROJECT CONDITIONS

A. Field Measurements: Verify layout information for fences and gates shown on the Drawings in relation to the property survey and existing structures. Verify dimensions by field measurements.

PART 2 - PRODUCTS

2.1 INDUSTRIAL FENCE

A. Selvage: Knuckled on both ends.

B. Steel Chain-Link Fence Fabric: Fabricated in one-piece widths for fencing 12 feet and less in height to comply with Chain Link Fence Manufacturers Institute (CLFMI) "Product Manual" and with requirements indicated below:

1. Mesh and Wire Size: 2-inch mesh, 0.148-inch diameter (9 guage).
2. Coating:
   a. For regular non vinyl coated fencing: ASTM A 817, Type 2, Class 1, zinc-coated (galvanized) applied after weaving.
   b. For vinyl coated fencing: Colorbond™ Heavy Mil Vinyl Bonded over Galvanized Steel as manufactured by an approved manufacturers by Architect, prior to bidding, must meet specification criteria.

2.2 FRAMING

A. Round member sizes for Sch. 40 posts as follows:
1. 6’ tall fencing: 2-3/8” line post, 2-7/8” corner and gate post with 1-5/8” top rail.
2. 4’ tall fencing: 1 -7/8” line post, 2-3/8” corner and gate post with 1-5/8” top rail.

B. Type I Round Posts: Standard weight (schedule 40) galvanized-steel pipe conforming to ASTM F 1083, according to heavy industrial requirements of ASTM F 669, Group IA, with minimum yield strength of 25,000 psi, not less than 1.8 oz. of zinc per sq. ft. Type A coating inside and outside according to ASTM F 1234, as determined by ASTM A 90, and weights per foot.

C. Roll-Formed Steel: Rolled form steel shapes produced from structural-quality steel conforming to ASTM A 570, grade 45, or ASTM A 446, grade D, galvanized, conforming to heavy industrial requirements of ASTM F 669, Group II, with a minimum yield strength of 45,000 psi. Protective coating system according to ASTM F 1234, Type A, hot-dip galvanized with a minimum of 2.0 oz. of zinc per sq. ft. according to ASTM A 123, 4.0 oz. of zinc per sq. ft. according to ASTM A 525.

D. Top Rail: Manufacturer's longest lengths (10 feet) with swedged-end or expansion-type coupling, approximately 6 inches long for joining. Provide rail ends or other means for attaching top rail securely to each gate corner, pull, and end post.

1. Round Steel: 1-5/8” Type I or II steel pipe.

E. Steel posts for fabric heights 6 feet and higher:

1. Round Line or Intermediate Posts: 2-3/8” Type I or II steel pipe.

2. Round End, Corner, and Pull Posts: 2-7/8” Type I or II steel pipe.

F. Material: Comply with ASTM F 626. Mill-finished aluminum or galvanized iron or steel to suit manufacturer's standards.

G. Post and Line Caps: Provide weathertight closure cap for each post. Provide line post caps with loop to receive or top rail.

H. Post Brace Assembly: Manufacturer's standard adjustable brace. Use material specified below for brace, and truss to line posts with 3/8-inch-diameter rod and adjustable tightener. Provide manufacturer's standard galvanized-steel, for each end.

1. Round Steel: 1.660-inch OD Type I or II steel pipe.

I. Tension Wire: 0.177-inch-diameter metallic-coated steel marcelled tension wire conforming to ASTM A 824 with finish to match fabric. (If shown on plans.)

1. Coating Type II zinc in the following class as determined by ASTM A 90.

a. Class 2, with a minimum coating weight of 1.20 oz. per sq. ft. of uncoated wire surface.

J. Tie Wires: 0.106-inch-diameter (12-guage) galvanized steel with a minimum of 0.80 oz. per sq. ft. of zinc coating according to ASTM A 641, or equal, to match fabric wire.

2.3 INDUSTRIAL SWING GATES

A. General: Comply with ASTM F 900 for single or double swing gate types.

1. Metal Pipe and Tubing: Galvanized steel. Comply with ASTM F 1043 and ASTM F 1083 for materials and protective coatings.

B. Frames and Bracing: Fabricate members from round, galvanized steel tubing with outside dimension and weight according to ASTM F 900 and the following:

1. Gate Fabric Height: 2 inches (50 mm) less than adjacent fence height.
2. Leaf Width: As indicated.
3. 4’ Gate Posts: 2-3/8” O.D. DQ-40 pipe, 3.12 lbs per foot.
4. 6’ Gate Posts: 2-7/8” O.D. DQ-40 pipe, 3.12 lbs per foot.
5. 6’ Rolling Gate Posts: 2-7/8” O.D. DQ-40 pipe, 4.64 lbs per foot.
6. Frame Members: Tubular Steel 1-5/8” round.

C. Frame Corner Construction:

1. Welded 3/8-inch diameter, adjustable truss rods for panels 5 feet (1.52 m) wide or wider.

D. Hardware: All hardware shall be commercial standard. Latches permitting operation from both sides of gate, hinges, center gate stops and keepers for each gate leaf more than 5 feet wide.

1. Single: Fork Latch.
2. Double: Plunger type drop rod.

E. Angle Bracing: Install as needed.

2.4 CONCRETE

A. Concrete: Provide concrete consisting of portland cement per ASTM C 150, aggregates per ASTM C 33, and potable water. Mix materials to obtain concrete with a minimum 28-day compressive strength of 3000 psi. Use at least four sacks of cement per cu. yd., 1-inch maximum size aggregate, 3-inch maximum slump.

B. Packaged Concrete Mix: Mix dry-packaged normal-weight concrete conforming to ASTM C 387 with clean water to obtain a 2- to 3-inch slump.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for site clearing, earthwork, pavement work, and other conditions affecting performance.

1. Do not begin installation before final grading is completed, unless otherwise permitted by Architect.
2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. General: Install fence to comply with ASTM F 567. Do not begin installation and erection before final grading is completed, unless otherwise permitted.

1. Apply fabric to outside of framework. Install fencing per plans.

3.3 CHAIN LINK FENCE INSTALLATION

A. Excavation: Drill or hand-excavate (using post-hole digger) holes for posts to diameters and spacings indicated, in firm, undisturbed or compacted soil.

1. If not indicated on Drawings, excavate holes for each post to minimum diameter recommended by fence manufacturer, but not less than four times the largest cross section of post.
2. Unless otherwise indicated, excavate hole depths approximately 3 inches lower than post bottom, with bottom of posts set not less than 36 inches below finish grade surface.

B. Setting Posts: Center and align posts in holes 3 inches above bottom of excavation. Space a maximum of 10 feet o.c., unless otherwise indicated.

1. Protect portion of posts above ground from concrete splatter. Place concrete around posts and vibrate or tamp for consolidation. Check each post for vertical and top alignment, and hold in position during placement and finishing operations.

a. Unless otherwise indicated, extend concrete footings 2 inches above grade and trowel to a crown to shed water.

C. Top Rails: Run rail continuously through line post caps, bending to radius for curved runs and at other posts terminating into rail end attached to posts or post caps fabricated to receive rail. Provide expansion couplings as recommended by fencing manufacturer.

D. Brace Assemblies: Install braces at end and gate posts and at both sides of corner and pull posts. Locate horizontal braces at midheight of fabric on fences with top rail and at two thirds fabric height on fences without top rail. Install so posts are plumb when diagonal rod is under proper tension. (If shown on plans.)

E. Bottom Tension Wire: Install tension wire within 6 inches of bottom of fabric before stretching fabric and tie to each post with not less than same gage and type of wire. Pull wire taut, without sags. Fasten fabric to tension wire with 0.120-inch-diameter (11-guage) hog rings of same material and finish as fabric wire, spaced a maximum of 24 inches o.c.

F. Fabric: Leave approximately 2 inches between finish grade and bottom selvage unless otherwise indicated. Pull fabric taut and tie to posts, rails, and tension wires. Install fabric on security side of fence, and anchor to framework so that fabric remains under tension after pulling force is released.

G. Tie Wires: Use wire of proper length to secure fabric firmly to posts and rails. Bend ends of wire to minimize hazard to persons or clothing.

1. Maximum Spacing: Tie fabric to line posts 12 inches o.c. and to rails and braces 24 inches o.c.

H. Fasteners: Install nuts for tension bands and carriage bolts on the side of the fence opposite the fabric side. Peen ends of bolts or score threads to prevent removal of nuts for added security.

I. Privacy Slats: (not included for this project) Install slats in direction indicated, securely locked in place.

J. Mowcurb: Install mowcurb under fence per details and per School District Standards. Install expansion joints with expansion material and elastomeric sealant and control joints.

3.4 GATE INSTALLATION

A. Install gates according to manufacturer’s written instructions, level, plumb, and secure for full opening without interference. Attach fabric same as for fencing. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary.

3.5 ADJUSTING

A. Gate: Adjust gate to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

END OF SECTION 32 3113

SECTION 32 8423 - UNDERGROUND IRRIGATION

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install planting irrigation system as described in Contract Documents complete with accessories/fittings necessary for proper installation and function.

1.2 SUBMITTALS

A. Product Data: Some irrigation materials specified are manufacturer specific however each bidding contractor may request substitutes for any parts of the irrigation system. This submittal shall be made during the bid process as per specs. All materials different than what is specified shall be approved in writing prior to bid submission. If submittals are not provided and approved per specs, the contractor shall use the specified manufactures for all irrigation components.
   1. Manufacturer's cut sheets for each element of system.
   2. Parts lists for operating elements of system.
   3. Manufacturer's printed literature on operation and maintenance of operating elements of system.
   4. Cut sheets shall be submitted electronically via email in PDF format.

B. Quality Assurance / Control:
   1. Results of static pressure test at existing point of connection before beginning work on system. Static pressure at point of connection shall be at least 95 psi. If static pressure is not at least 95 psi, some re-design may be necessary. Consult with the Landscape Architect after the pressure test has been completed to determine any changes. If Landscape Architect is not consulted in writing before installation begins, the contractor assumes all liability and cost associated with installing a system (and re-design costs if necessary) that will work properly and provide adequate coverage of all lawn and landscape areas.
   2. The irrigation contractor shall verify that there is sufficient flow (110 gpm) and 95 psi where the new mainline joins the existing mainline. This information shall be given to In-Site Design Group in writing prior to any work beginning on the system. If this is not done, then the landscape contractor assumes all liability and associated costs in getting the system to function as designed.

C. Closeout:
   1. Record Drawings:
      a. As installation occurs, contractor shall prepare accurate CAD record drawings which will be given to the Landscape Architect at the substantial completion meeting. The Landscape Architect will review the record drawing and give it to the Owner. The following needs to be included on the CAD record drawing produced by the contractor:
         1) Detail and dimension changes made during construction.
         2) Significant details and dimensions not shown in original Contract Documents.
         3) Field dimensioned locations of valve boxes, manual drains, quick-coupler valves, isolation valves, control wire runs not in mainline ditch, and both ends of sleeves.

4) Take dimensions from permanent constructed surfaces or edges located at or above finish grade.
5) Take and record dimensions at time of installation.
6) In addition to the CAD record drawing, all valves, heads, both ends of sleeves, all boxes, wire conduit path, drains, etc. shall have a recorded GPS point. An electronic copy and hard copy of this GPS information shall be given to the Owner at the substantial completion meeting. Consult the Owner for the exact format/file type for the electronic version. In-Site Design Group cannot provide this service so if the contractor does not have the ability to do this themselves, they will need to hire a surveyor to perform this task.

b. If the landscape contractor installing the irrigation system does not have CAD capabilities, they may contact In-Site Design Group at 801-756-5043 for a bid to convert their redlined as-built into a CAD record drawing. The contractor may also solicit bids for this service from other Landscape Architects or CAD drafters. The landscape contractor is responsible for paying the fee for this service as part of their base landscape/irrigation bid.

c. The Contractor shall reduce copy of the record drawings to half-size, color all circuits, and laminate both sides with 5 mil thick or heavier plastic and give to Owner at project close-out.

2. Operations And Maintenance Manual Data:
   a. Provide the following:
      1) Instruction manual that contains complete instructions for system operation and maintenance, including spring start-up and winterizing.
      2) Complete instructions on how to drain entire system including all aspects of the new/modified system to prevent freezing.
      3) At Owners request Contractor shall provide complete watering schedule for grow-in and long term watering. This shall be part of the base bid.

1.3 QUALITY ASSURANCE

A. Qualifications:
   1. Use only trained personnel familiar with required irrigation system installation procedures.
   2. Perform installation under direction of foreman or supervisor with five years minimum experience in sprinkling system installations.

B. Regulatory Requirements: Work and materials shall be in accordance with latest rules and regulations, and other applicable state or local laws. Nothing in Contract Documents is to be construed to permit work not conforming to these codes. Contractor shall apply for all permits and pay for the same. Please check all necessary building codes and other local codes and ordinances for proper installation of all project components including electrical work for controller(s). Provide documentation from governing authority as required by Architect.

C. Pre-Installation Conference: Schedule pre-installation conference before irrigation system installation begins. Demonstrate or describe method to be used to maintain head spacing from concrete walks, curbs etc. and to stabilize heads.

D. Weekly (or as deemed necessary by Landscape Architect) job site inspections and/or coordination meetings will be held throughout the construction process. Contractor is required to attend all site construction meetings with Owner and Architect.

E. Do not cut or trench through any roots 1-1/2” and larger. Hand excavate within the dripline of all existing trees and other plants noted to remain.

F. Insert a dielectric union wherever a copper-based metal (copper, brass, bronze) and an iron-based metal (iron, galvanized steel, stainless steel) are joined together.

G. Contractor shall perform pressure test at irrigation point of connection prior to installation of irrigation system. If static pressure is higher or lower than 95 psi for the system, then Landscape Architect shall be notified immediately to determine if some redesign of the system is necessary.

1.4 DELIVERY, STORAGE, AND HANDLING

A. During delivery, installation, and storage protect materials from damage and prolonged exposure to sunlight.

1.5 SEQUENCING

A. Install sleeves before installation of cast-in-place concrete site elements, paving, walls, etc.

1.6 WARRANTY

A. Standard one year guarantee shall include:
   1. Filling and repairing depressions and replacing plantings due to settlement of irrigation system trenches.
   2. Adjusting system to supply proper coverage of areas to receive water. Remove or add (even though these additions or deletions may not be shown on the plans) additional sprinklers, rotor, valves, piping, tubing and emitters as may required so that over or under watering does not occur.
   3. Provide at least monthly visual inspections (during the 1 year warranty period) of project during normal growing season to monitor and make sure plants are not being over or under watered. Prepare and file a monthly report of findings to Architect and Owner. Make adjustments to system based on findings at no additional cost to Owner including reprogramming of controller(s) and adjusting quantity and size of emitters each month during the first year (growing season only) if necessary.
   4. Repair and replace any damaged and/or malfunctioning part of the irrigation system.
   5. Ensuring system can be adequately drained and winterized including freezing pumps, filters, backflow preventor, etc.
   6. Provide winterization and spring start-up of entire system during the first year of operation.
   7. Provide hand watering of all trees (with a water truck) at least 3 times during the first winter (Nov-March). See the maintenance spec. for additional information. The contractor is liable for plants drying out the first year during the warranty period.

1.7 OWNER'S INSTRUCTIONS

A. After system is installed and approved, instruct Owner's designated personnel in complete operation and maintenance procedures. Program each new station for valves modified within scope of work.

1.8 MAINTENANCE

A. Extra Materials:
   1. Furnish the following items before Final Closeout Review:
      a. Two heavy-duty keys for isolation valves.
      b. Two heavy-duty keys for manual drains.

c. Two quick coupler keys with brass hose swivel.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Rock-Free Soil:
1. Backfill soil around PVC pipe.
2. Soil shall have rocks no larger than 1/2 inch in any dimension.
3. Can be on-site or imported material.

B. Pea Gravel:
1. For use around drains, valves, quick couplers, and rotor heads.
2. 1/2 inch maximum dimension, washed rock.

C. Sand: Fine granular material naturally produced by rock disintegration and free from organic material, mica, loam, clay, and other deleterious substances.

D. Native Material: Soil native to project site free of wood and other deleterious materials and rocks over 1/2 inches.

E. Topsoil: Imported topsoil material meeting the specified requirements. Remove rocks, roots, sticks, clods, debris, and other foreign matter over 1/2 inches longest dimension encountered during trenching and prior to installing topsoil.

2.2 COMPONENTS

A. Pipe, Pipe Fittings, And Connections:

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

C. Piping: Provide pipe fittings and accessories of same material and weight/class as pipes, with joining method as indicated.

D. Ductile Fittings:
1. Provide all labor, material, and related items for Leemco fittings and joint restraint connections for irrigation system for mainline fittings 3” and larger.
a. All ductile iron fittings and joint restraints shall have a fusion bonded epoxy coating on interior and exterior of the product surface, average of 10-12mm thickness. Epoxy coating shall conform to the requirements of CSA Z245.20-20 and NSF 61 for water services. Tar/bitumen coating will not be approved.
b. All ductile iron fittings, joint restraints, lateral isolation valves and mainline isolation gate valves shall carry a 10-Year warranty on products and replacement labor costs. Prior to install, Manufacture shall provide documentation stating the above warranty information. Contractor shall be responsible to facilitate this warranty for the Owner.

c. All ductile iron pipe fittings, joint restraints, lateral isolation valves and mainline isolation gate valves shall be of the same manufacture.
d. All rubber gaskets and O-rings shall be constructed of EPDM high grade rubber. SB rubber gaskets and O-rings will not be approved.
e. All ductile iron joint restraints shall have blunt cast serrations. Machine threaded joint restraints will not be approved.
f. Install Leemco fittings with LH Series pipe to fitting joint restraint per manufacturers specs. See details for more information.
g. Mechanical fittings and joint restraints shall be as specified.

E. Pipe, Pipe Fittings and Connections:
1. Pipe shall be continuously and permanently marked with Manufacturer's name, size, schedule, type, and working pressure.
2. Pipe sizes shown on Drawings are minimum. Larger sizes may be substituted if at no additional cost to Owner.
3. Pipe:
a. Pressure Lines: Sch. 40 Mainline per plans for all piping 3” and smaller.
b. Lateral Lines: Schedule 40 PVC.
c. Quick Coupler Piping: Galvanized steel for blow-out areas or sch. 80 PVC per plans and details.
4. Fittings: Install Leemco fittings and joint restraints for mainline 3” and larger. Mainline fittings smaller than 3”, if any, shall be Schedule 80 fittings except where detailed otherwise.
5. Use a dielectric union wherever a copper-based metal (copper, brass, bronze) is joined to an iron-based metal (iron, galvanized steel, stainless steel).
6. Sleeves for mainline and lateral lines:
a. Under Parking Area and Driveway Paving: Schedule 40 PVC Pipe for sizes up to 3” and then Class 200 for all sleeving greater than 3”.
b. All Other: Class 200 PVC Pipe.
c. Sleeve diameter shall be two times larger than pipe installed in sleeve.
7. Sleeves for control wiring:
a. Schedule 40 PVC grey electrical conduit shall be used for all sleeving of control wires under hardscape surfaces as well as between all valve boxes.
b. Sleeve diameter shall be two times larger than wire bundle installed in sleeve.

F. Sprinkler Heads:
1. Each type of head shall be the product of a single manufacturer.
2. Spray Heads in Lawn Areas:
a. Use the following:
1) Rainbird: 1806-PRS Series with MPR nozzles as noted on plans and legend for new lawn areas.
2) Equal as approved by Landscape Architect before bidding.
3. Gear Driven Rotor Pop-ups:
a. Use the following:
1) Rainbird: 5006+ stainless steel series rotors with PRS and flow stop options and with 25’, 30’ and 35’ MPR nozzles as noted in Legend.
2) Rainbird: Falcon 6504 (stainless steel with nozzles noted in legend).
3) Equal as approved by Landscape Architect before bidding.

G. Sprinkler Risers:
1. Pop-up rotor sprinkler heads shall have adjustable riser assembly consisting of a marlex street ell, a 12” nipple, another two additional marlex street ells. These swing joint fittings shall be of schedule 40 PVC plastic and nipples schedule 80 gray PVC unless otherwise designated on Drawings. Horizontal nipple parallel to side of lateral line shall be 12 long minimum. All other nipples on swing joint riser shall be of length required for proper installation of sprinkler heads.

2. Pop-up sprinkler heads (including rotary nozzles) shall have risers made up one of the following ways:
   a. Risers for sprinkler heads 14 inches long minimum and 24 inches maximum.
      1) Rainbird: Swing Pipe with barbed fittings.
      2) Equal as approved by Landscape Architect before bidding.

H. Automatic Irrigation Control Wiring and Controller:
1. Control wire shall be UF-UL listed, Insulated 2-wire cable (compatible with Calsense controllers). New 2-wire shall be installed in Sch. 40 grey electrical conduit between all valve boxes.
2. Waterproof Wire Connectors:
   a. Type Two Acceptable Products:
      1) 2-wire connectors as approved/recommended by CalSense only.
3. Automatic controllers:
   a. The existing 2-wire controller shall remain in place. Existing decoders shall be re-used. Install new grounding per CalSense specs for all new and relocated valves along the new 2-wire path. Each bidding contractor shall field verify how many valves exist in the project limit area (old, new and relocated valves) in order to determine how many decoders they need to salvage and reinstall. Turn over existing valves and extra decoders to the school district at project completion.

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I. Valves:
1. Manual Drain Valves: Bronze or Brass ball valve (Ford Curb Stop Valve) on main lines at isolation valve locations.
2. Automatic Valves:
   a. Category Approved Products.
      1) Rainbird: PEB-PRSD valves (size per plans). Install PRS-D option if required. If not required, provide a credit to the Owner.
      2) Rainbird: XCZ-075-PRF, XCZ-100-PRB-COM control zone kits as noted in the legend.
      3) Equal as approved by Landscape Architect before bid submission.
3. Isolation/shut off valves:
   a. Category Approved Products:.
      1) 2” Leemco manifold isolation valve and 3” Leemco mainline isolation valve.
      2) Equal as approved by Landscape Architect before bidding.
4. Pressure Reducer: Not required for this project.
5. Quick Coupling Valves and Keys:
   a. Category Approved Products.
      1) Rainbird: 44NP per plans and details with SH-1 Swivel, (2) 44K Valve Keys and (2) 2049 Cover Keys.
      2) Equal as approved by Landscape Architect before bidding.

J. Valve Accessories:
1. Valve manifolds:
   a. Pre-manufactured manifolds are not acceptable. Manifolds shall be custom built with schedule 80 toe nipples, couplers, pipe and misc. fittings as necessary.
2. Plastic Valve Boxes And Extensions:
   a. Acceptable Products:
      1) Rainbird.
      2) Carson-Brookes.
      3) Plymouth Products, Div Ametek.
      4) Equal as approved by Architect before bidding.
3. Valve ID tags:
   a. Acceptable Products:

1) Christy. Tags must be pre-printed. Consult with Landscape Architect for more information prior to ordering tags.
2) Equal as approved by Landscape Architect before bidding.

4. Valve Box Supports: Standard size fired clay paving bricks without holes. If Rainbird valve boxes are used, clay bricks are not required.

K. Thrust Blocks (only required for valve manifolds per details).
1. Thrust blocks for fittings on mainline pipe 3” and larger diameter.
2. Use 3,000 PSI concrete.
3. Use 2 mil plastic.
4. Use no. 4 Rebar wrapped or painted with asphalt tar based mastic coating.
5. Thrust blocks must be installed on native undisturbed soil.

L. Joint Restraint Harness (Required for 3” and larger mainline piping):
1. Use a Leemco joint restraint harness wherever joints are not positively restrained by flanged fittings or threaded fittings.
2. Use a joint restraint harness with transition fittings between metal and PVC pipe, where weak trench banks do not allow the use of thrust blocks or where extra support is required to retain a fitting or joint (such as near a sleeve).
3. Use bolts, nuts, retaining clamps, all-thread, or other joint restraint harness materials which are zinc plated or galvanized.
4. Use on mainline pipe 3 inch and greater or any diameter rubber gasketed pipe. Install Leemco fittings with LH Series pipe to fitting joint restraint per manufacturers specs.

M. Other Components:
1. Provide all other components necessary to complete irrigation system and make it operational.

2.3 MANUFACTURERS

A. Contact Information:
1. Carson Industries LLC, Glendora, CA www.carsonind.com.
2. Hunter Industries, San Marcos, CA www.hunterindustries.com.
3. King Safety Products, St Charles, MO www.kingsafety.com.
4. Nibco Inc, Elkhart, IN www.nibco.com.
5. Orbit Irrigation Products, Bountiful, UT www.orbitonline.com.
6. Plymouth Products, Div Ametek, Sheboygan, MI www.plymouthwater.com.
7. Rain Bird Sprinkler Manufacturing Corp, Glendora, CA www.rainbird.com.
8. 3M, Austin, TX www.3m.com/elpd.
9. Watertronics, Omaha, Nebraska www.watertronics.com
10. Equal as approved by Landscape Architect before bidding.

PART 3 - EXECUTION

3.1 INSTALLERS

A. To be pre-approved by the Owner before bidding.

3.2 EXAMINATION

A. Site Verification of Conditions: Perform pressure test at point of connection. Notify Landscape Architect of existing pressure and flow to determine if some re-design of system is necessary before beginning work on system.

B. Contractor shall field verify all existing and proposed utilities, trees, plants, buildings, structures, roads, curb and gutter, sidewalks, irrigation system, utilities, easements, setbacks, Right-of-ways, etc. to make sure no conflicts exist between existing conditions and proposed plans. Contractor shall be responsible to make on-site field adjustments as may be required due to discrepancies found during construction. Contractor and Owner agrees to hold In-Site Design Group harmless for any and all such discrepancies including costs associated with such discrepancies including repair, replacement or anything related to such discrepancies.

3.3 PREPARATION

A. Protection:
1. Repair or replace work of this Section damaged during course of the Work at no additional cost to Owner. If damaged work is new, installer of original work shall perform repair or replacement.
2. Do not cut existing tree roots measuring over 1-1/2 inches in diameter in order to install irrigation lines. Route main and lateral lines around existing trees and other obstacles such as fire hydrants, light poles, etc. as necessary. Hand dig all trenches within the dripline of any existing trees to minimize harming the tree.
3. All utilities shall be blue staked before digging. Any damage to utilities shall be repaired at expense of the contractor with no additional cost to the owner.\

B. Layout of Irrigation Heads:
1. Location of heads and piping shown on Drawings is approximate. Actual placement may vary slightly as is required to achieve full, even coverage without spraying onto buildings, sidewalks, fences, etc. Contractor shall install additional pipe as necessary for complete and proper installation of system.
2. During layout, consult with Landscape Architect to verify proper placement and make recommendations, where revisions are advisable.
3. Minor adjustments in system layout will be permitted to avoid existing fixed obstructions.
4. Make certain changes from Contract Documents are shown on record drawings.

3.4 INSTALLATION

A. Trenching And Backfilling:
1. Pulling of pipe is not permitted.
2. Excavate trenches to specified depth. Remove rocks larger than 1-1/2 inch in any direction from bottom of trench. Separate out rocks larger than 1-1/2 inch in any direction uncovered in trenching operation from excavated material and remove from areas to receive landscaping and then remove from site at no additional cost to the Owner. All extra excavated material from irrigation installation shall be hauled off-site at no additional cost to the Owner.
3. Cover main line pipe with 2” of sand on top, bottom and sides of pipe as noted in Contract Documents. If excavated soil is acceptable to Landscape Architect, the sand will not need to be installed and a credit shall be issued to the Owner. Contractor shall bid a separate line item for sand bedding all irrigation mainline piping with initial bid submission. If this is not done, sand will be required regardless of the soil type on-site. Remainder of backfill to within 4 or 12 inches in lawn areas shall be rock-free soil as specified under PART 2 PRODUCTS. Top 4 to 12 inches of backfill in lawn areas shall be imported topsoil as specified in Section 329113.
4. Do not cover pressure main, irrigation pipe, or fittings until Landscape Architect or Owner has inspected and approved system.
5. Hand trenching is required for all areas within the dripline of any existing tree. Do not cut any root 1-1/2” or greater.

B. Sleeving:
   1. Sleeve water lines and control wires under walks and paving. Extend sleeves 18 inches minimum beyond walk or pavement edge. Cover sleeve ends until pipes and wires are installed to keep sleeve clean and free of dirt and debris.
   2. Position sleeves with respect to buildings and other obstructions so pipe can be easily removed.
   3. Patch and repair asphalt and concrete damaged (if any) during sleeving installation including excavation, backfill, compaction, road base or gravel, concrete, asphalt, cutting and/or boring, etc. These costs shall be part of the base bid.

C. Grades And Draining:
   1. Winterization is required for this project. The irrigation system has been designed to be blown out with an air compressor; however, manual drains shall be installed at mainline isolation/gate valve locations and other areas as directed by the Owner. Perform the following:
      a. Slope pipe to drain to isolation valve locations.
      b. At these locations install manual drain per detail and the following:
         1) 1” bronze or brass ball valve (Ford Curb Stop) for manual drain. Do not use automatic drain valves.
         2) Install 2 inch Class 200 PVC pipe over top of drain and cut at finish grade.
         3) Provide rubber valve cap marker.
         4) Provide two cubic foot pea gravel sump at outlet of each drain.
      c. Slope pipes under parking areas or driveways to drain outside these areas.
      d. Provide and install quick-coupling valves per plan for easy blowout of entire system.

D. Installation of Pipe:
   1. Install pipe in manner to provide for expansion and contraction as recommended by Manufacturer.
   2. Shield pipe from direct sunlight so that expansion and contraction do not affect the integrity of glued fittings. Temperature swings from daytime to night time can cause pipe to completely pull out of glued fittings. Consult with the manufacturer for proper shielding of PVC pipe before installation and provide the Owner with the proposed method for shielding the piping.
   3. Ensure that mainline and lateral lines don’t conflict with proposed utilites, fire hydrants, light poles, underground sumps or storm drain and downspout piping or other utilities. Refer to civil and electrical plans for locations of these utilities. Re-route mainline and lateral lines as necessary to avoid these and all other utilities as may be required or requested by Owner, Architect, Civil Engineer, Electrical Engineer or Landscape Architect.
   4. Unless otherwise indicated on Drawings, install 3” main lines with minimum of 24” of cover based on finished grade and mainlines smaller than 3” shall have a minimum of 18” of cover based on finished grade. All other lateral lines connecting pop-up rotor and pop-up sprays with minimum of 12 inches of cover based on finish grade.
   5. Trench bottoms shall be flat and not have a lot of ups and downs where water could get trapped in low spots. The contractor shall ensure trenches are uniform, have uniform slopes and have the high and low spots removed prior to laying pipe in trenches.
   6. Install pipe and wires under driveways or parking areas in specified sleeves 24” below finish grade or as shown on Drawings.
   7. Locate no sprinkler head closer than 6 inches from building foundation. Heads immediately adjacent to mow strips, walks, or curbs shall be one inch below top of mow strip, walk, or curb and have 3 inches clearance between head and mow strip, walk, or curb.
   8. Insert a dielectric union wherever a copper-based metal (copper, brass, bronze) and an iron-based metal (iron, galvanized steel, stainless steel) are join
   9. Cut plastic pipe square. Remove burrs at cut ends before installation so unobstructed flow will result.

10. Make solvent weld joints as follows:
    a. Do not make solvent weld joints if ambient temperature is below 45 deg F.
    b. Clean mating pipe and fitting with clean, dry cloth and apply one coat of P-70 primer to each.
    c. Apply uniform coat of 711 solvent to outside of pipe.
    d. Apply solvent to fitting in similar manner.
    e. Give pipe or fitting a quarter turn to insure even distribution of solvent and make sure pipe is inserted to full depth of fitting socket.
    f. Allow joints to set at least 24 hours before applying pressure to PVC pipe.
11. Tape threaded connections with teflon tape.

E. Thrust Blocks and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water-cementitious materials ratio.
1. Install thrust blocks per details and for 3” manifold fittings.
2. Use a form to provide the appropriate amount and shape of concrete for the thrust block. Do not cover the fitting with concrete. The entire fitting must be serviceable when the thrust block is installed.

F. Joint Restraint Harness:
1. Install joint restraint harness in the manner recommended by the manufacturer, in accordance with the drawings these specifications and in accordance with accepted industry practices. Install joint restraints for all mainline pipe fittings 3” and larger.

G. Control Valves And Controller
1. Install valves in plastic boxes with reinforced heavy duty plastic covers. Locate valve boxes within 12 inches of sidewalks and shrub bed edges with tops at finish grade. Do not install more than two valves in single box.
2. Valve boxes placed in planter areas shall be brown or tan in color. Valve boxes placed in lawn areas shall be green in color. Valve boxes shall be capable of being bolted closed after installation. Round valve boxes are not allowed on the project even if shown in the details. Use standard or jumbo boxes.
3. Place 3 inches minimum of pea gravel below bricks supporting valve boxes to drain box. Set valve boxes over valve so all parts of valve can be reached for service. Set cover of valve box even with finish grade. Valve box cavity shall be reasonably free from dirt and debris.
4. Arrange valve stations to operate in an easy-to-view progressive sequence around project site. Tag valves with waterproof labels showing final sequence station assignments.
5. Wiring:
    a. Enclose all wiring in Sch. 40 grey PVC electrical conduit per specs.
    b. Use waterproof wire connectors at splices and locate all splices within valve boxes.
    c. Use wire as noted on contract documents or an approved equal.
6. Connect new and relocated vales to new 2-wire path and run new 2-wire to existing controller (field verify exact location).
7. See manufacturer’s specs for grounding and surge protections information. Install grounding for surge protection for irrigation decoders and new 2-wire path within the project limit lines, etc. per manufacturers written instructions. Contractor shall adhere to the manufacturer’s specs and/or electrical specifications for grounding installation.

H. Sprinkler Heads:
1. Before installation of sprinkler heads, open control valves and use full head of water to flush out system.
2. Set sprinkler heads and quick-coupling valves perpendicular to finish grade.
3. Do not install sprinklers using side inlets. Install using base inlets only, unless approved otherwise in writing by Landscape Architect.

4. Set sprinkler heads 3” away from existing walks, curbs, and other paved areas and to grade by using specified components or other method demonstrated in Pre-Construction Conference.

3.5 PIPE JOINT CONSTRUCTION

A. Basic pipe joint construction is specified in Division 33 Section "Common Work Results for Utilities." Where specific joint construction is not indicated, follow piping manufacturer's written instructions.

B. Join pressure piping according to the following:

1. Join ductile-iron pressure piping according to AWWA C660 or AWWA M41 for push-on joints.
2. Join ductile-iron special fittings according to AWWA C660 or AWWA M41 for push-on joints.
3. Join PVC pressure piping according to AWWA M23 for gasketed joints.
4. Join PVC water-service piping according to ASTM D 2855 for solvent-cemented joints.

C. Join dissimilar pipe materials with pressure-type couplings.

3.6 FIELD QUALITY CONTROL

A. Site Tests: Before backfilling main line, conduct piping tests before joints are covered, and after thrust blocks have sufficiently hardened (or mechanical joint restraints are in place). Fill pipeline with water 24-hrs prior to testing, and apply hydrostatic test pressure to stabilize system. Test pressure at 150 psi minimum for 2 hours minimum and make certain there are no leaks. Notify Landscape Architect 3 working days minimum before conducting test.

B. Operational Test:

1. Activate each remote control valve in sequence from controller using both the remote control device and the controller. The Construction Project Representative will visually observe operation, water application patterns, and leakage.
2. Replace defective remote control valve, solenoid, wiring, or appurtenances to correct operational deficiencies.
3. Replace, adjust, or move water emission devices to correct operational or coverage deficiencies.
4. Replace defective pipe, fitting, joint, valve, sprinkler, or appurtenance to correct leakage problems. Cement or caulking to seal leaks is prohibited.
5. Repeat test(s) until each lateral passes all tests. Repeat tests, replace components, and correct deficiencies at no additional cost to the Owner.

C. Inspections: A full audit may be required for new irrigation lawn rotor and spray zones at Owners request. Contractor shall pay for this water audit and any necessary repairs/modifications needed to the system based on the report. Contractor shall provide a price for this water audit as an alternate to their irrigation base bid. A DU of 70 for rotors and 65 for sprays shall be achieved. Contractor’s base bid shall include any needed modifications to system based on comments from Water Audit.

3.7 ADJUSTING

A. Adjust sprinkler heads to proper grade when turf is sufficiently established to allow walking on it without appreciable harm. Such lowering and raising of sprinkler heads shall be part of original contract with no additional cost to Owner.

B. Adjust sprinkler heads for proper distribution and trim so spray does not fall on buildings. Adjust sprinkler heads for proper distribution and trim so spray is minimized on sidewalks or parking areas. Install He-Van nozzles where necessary.

C. Adjust watering time of valves to provide proper amounts of water to lawn and trees.

3.8 CLEANING

A. Upon completion of work, remove from the site all machinery, tools, excess materials, excess excavated soils, rock and other debris and rubbish at no additional cost to the Owner. In addition, contractor shall sweep, clean, power wash, etc. all areas of construction as may be required to leave the site clean.

3.9 FINAL INSPECTION

A. At the end of the 1 year guarantee period, when the lawn and landscaping have been approved, the Contractor shall call for a final inspection of the sprinkler irrigation system. There shall be five (5) days notice given, in writing, to the Owner, prior so that the appropriate people may attend.

B. Prior to that time, all heads shall have been adjusted to their proper pattern, radii, and height. Additional sprays or rotors shall be installed or removed as necessary at this time to ensure that over or under watering does not occur. The system will have been flushed out, checked for operation, and any defects corrected. A final list of items found in need or correction (if any), will be made and the Contractor shall correct them. Upon acceptance of the system, the Owner shall assume all responsibility for the system.

END OF SECTION 32 8423

SECTION 32 9001 - COMMON PLANTING REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Common procedures and requirements for landscaping work.

B. Related Sections:
   1. Section 328423: Underground Irrigation.

1.2 QUALITY ASSURANCE

A. Qualifications:
   1. Trained personnel familiar with required planting procedures and Contract Documents shall perform planting.
   2. Planting shall be performed under direction of foreman or supervisor with minimum five years experience in landscape installations.

B. Pre-Installation Conferences:
   1. Participate in pre-installation conference.
   2. Schedule planting pre-installation conference after completion of Fine Grading specified in Section 312216, but before beginning landscape work. In addition to these requirements:
      a. Establish responsibility for maintenance of new landscaping during all phases of construction period.
      b. Prepare three typical landscape planting excavations (at different locations around the site) and conduct percolation test to verify that water drains away within two hours. Discuss results of percolation tests with Landscape Architect and Owner's representative prior to proceeding with planting. If this is not done, Contractor assumes all liability for planting in soils that do not drain properly and all plants including trees will be required to have a 2 year warranty from time of final acceptance by Owner.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Deliver packaged materials in containers showing weight, analysis, and name of Manufacturer. Protect materials from deterioration during delivery and while stored at site. A minimum of 25% of all plant material shall be labeled with the Botanical Name of the plant as well as the plant/pot size.

B. Deliver sod and trees in healthy and vigorous condition and store in location on site where they will not be endangered and where they can be adequately watered and kept in healthy and vigorous condition.

1.4 SEQUENCING

A. Do not plant trees until major construction operations are completed. Do not commence landscaping work until work of Sections 312216 and 328423 has been completed and approved.

B. Coordinate installation of planting materials during normal planting seasons for each type of plant material required.

PART 2 - PRODUCTS: Not Used

PART 3 - EXECUTION

3.1 INSTALLERS

A. To be pre-approved by Owner before bidding.

3.2 EXAMINATION

A. Inspect site and Contract Documents to become thoroughly acquainted with locations of existing and proposed utilities on site. Repair damage to these and other items adjacent to landscaping caused by work of this Section or replace at no additional cost to Owner. Contractor shall call Blue Stakes prior to commencing work on the project and shall keep the Blue Staking up to date as required. Any damage to existing Utilities, landscaping and irrigation shall be repaired at the expense of the Contractor with no additional costs to the Owner.

3.3 PREPARATION

A. Before proceeding with work, verify dimensions and quantities. Report variations between Drawings and site to Landscape Architect before proceeding with landscape work.
   1. Plant and all other landscape totals are for convenience of Contractor only and are not guaranteed. Verify amounts shown on Drawings prior to submitting bid and notify Architect of any discrepancies.
   2. All planting and other landscaping indicated on Drawings is required unless indicated otherwise.

B. Contractor shall field verify all existing and proposed utilities, trees, plants, buildings, structures, roads, curb and gutter, sidewalks, irrigation system, utilities, easements, setbacks, right-of-ways, etc. to make sure no conflicts exist between existing conditions and proposed plans. Contractor shall be responsible to make on-site field adjustments as may be required due to discrepancies found during construction. Contractor and Owner agrees to hold In-Site Design Group, harmless for any and all such discrepancies including costs associated with such discrepancies including repair, replacement or anything related to such discrepancies.

C. Protection:
   1. Take care in performing landscaping work to avoid conditions that will create hazards. Post signs or barriers as required.
   2. Provide adequate means for protection from damage through excessive erosion, flooding, heavy rains, etc. Repair or replace damaged areas.

3. Keep site well drained and landscape excavations dry.

3.4 INSTALLATION

A. All excavation with-in the dripline of any trees or plants to remain (if any) shall be done by hand.

B. Maintain grade stakes until parties concerned mutually agree upon removal.

C. When conditions detrimental to plant growth are encountered, such as rubble fill or adverse drainage conditions, notify Landscape Architect before planting.

3.5 FIELD QUALITY CONTROL

A. Inspection:
   1. Landscape Architect, Architect and/or Owner will inspect landscaping installation approximately before Substantial Completion. Contractor shall replace landscaping that is dead or appears dead as directed by Landscape Architect within 3 days of notification and before Final Completion.

3.6 ADJUSTING

A. Replace damaged plantings at no additional cost to Owner.

3.7 CLEANING

A. Immediately clean up soil or debris spilled onto pavement and dispose of deleterious materials at no additional cost to the Owner.

3.8 PROTECTION

A. Protect planted areas against traffic or other use immediately after planting is completed by placing adequate warning signs, barricades etc. as approved by Owner.

B. Provide adequate protection of planted areas against trespassing, erosion, and damage of any kind. Remove this protection after Landscape Architect and Owner has accepted planted areas.

END OF SECTION 32 9001

SECTION 32 9113 - FINISH GRADING AND SOIL PREPARATION

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Perform finish grading and soil preparation work required to prepare site for installation of landscaping as described in Contract Documents.
   2. Furnish and apply imported topsoil, soil amendments and conditioners as described in Contract Documents.
   3. Excavate existing landscape areas in order to implement new lawn, trees artificial turf, decorative rock, topsoil and amendments, etc.

B. Related Sections:
   1. Section 32 9223: Sodding
   2. Section 31 2216: Fine Grading.
   3. Section 31 1000: Site Clearing.

1.2 REFERENCES

A. American Society For Testing And Materials:
   1. ASTM 1557-02, 'Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort.'

1.3 SUBMITTALS

A. Product Data:
   1. Product literature and chemical / nutrient analysis of soil amendments, conditioners and fertilizers.

B. Provide PDF copies of all submittals for this project including irrigation submittals, soils and amendments submittals, etc. Submittals shall be received and approved by Landscape Architect and Owner prior to Contractor beginning construction activities.

C. Samples: Sample of soil amendments and conditioner for approval before delivery to site. Include product analysis list. Samples are only needed for these items if requested by Owner. Landscape Architect only needs analysis and data cut sheets in order to approve the materials.

D. Quality Assurance / Control:
   1. Delivery slips indicating amount of soil amendments and conditioner delivered to Project site upon request of Owner or Landscape Architect.
   2. All imported topsoil shall meet minimum specified requirements and be approved by Landscape Architect before use. Provide topsoil test showing topsoil meeting the criteria listed herein. Once a topsoil has been found that meets the specs, soil amendments (as noted below) shall be installed.

1.4 QUALITY ASSURANCE

A. Pre-Installation Conference: Participate in pre-installation conference.

PART 2 - **PRODUCTS**

2.1 MATERIALS

A. Topsoil:
1. Imported topsoil used in landscaped areas shall be fertile, loose, friable soil meeting following criteria:
   a. Chemical Characteristics:
      1) Acidity / alkalinity range: pH 5.5 to 8.0
      2) Soluble Salts: less than 3.0 mmhos/cm
      3) Sodium Absorption Ratio (SAR): less than 6.0
      4) Organic Matter: greater than two percent
   b. Physical Characteristics:
      1) Gradation as defined by USDA triangle of physical characteristics as measured by hydrometer.
         a) Sand: 15 to 60 percent.
         b) Silt: 10 to 60 percent.
         c) Clay: 5 to 30 percent.
      2) Clean and free from toxic minerals and chemicals, noxious weeds, rocks larger than 1-1/2 inch in any dimension, and other objectionable materials.
      3) Soil shall not contain more than 5 percent by volume of rocks measuring 4.75mm to 12mm in largest size.
      4) All rocks greater than 12mm shall be screened and removed from the on-site topsoil prior to use. All roots, plants and any other material over ½ inch in any dimension shall be screened out of the topsoil prior to reuse in lawn and landscape areas.
2. When calculating quantities for topsoil and amendments, a compaction factor of 10% should be added therefore instead of adding just 4” of topsoil in lawn areas for example, the contractor will really be responsible for spreading 4.4” of topsoil in lawn areas. The same rule applies for soil and soil amendments in lawn and planter areas.
3. Incorporate following soil amendments/conditioners into imported topsoil meeting the above specifications:
   a. Acceptable Fertilizers And Application Rates:
      1) Type(s) and rate(s) as necessary based on Topsoil Testing Report of imported topsoil. If phosphorus or potassium are recommended to be installed as a result of the soils test, this fertilizer shall be tilled into the top 4” of soil prior to planting. Follow manufacturers instructions for proper application of fertilizer
      2) “Composted Bark Fines (acceptable bark fine products are available from Thompson Logging – 435-640-3694 or Soil Prep from Miller Companies) & MagmaLite Soil Conditioner:

         ~ In new lawn areas (not artificial turf areas), spread 4” depth of amended topsoil consisting of 80% imported topsoil, 10% MagmaLite soil conditioner and 10% Composted Bark Fines. Backfill deeper than 4” in tree pits in lawn areas to be 20% “Composted Bark Fines”, 20% MagmaLite soil conditioner and 60% excavated native soil from planter pit.

         ~ In top 12” of new planter beds, mix at a rate of 15% “Composted Bark Fines, 15% MagmaLite Soil Conditioner and 70% imported topsoil. Backfill 12” and deeper in tree pits to be 15% “Composted Bark Fines”,

15% MagmaLite Soil Conditioner and 70% excavated native soil from planter pit.
~ All native soil, imported topsoil and amendments shall be thoroughly mixed so as to prevent “soil interfacing”. Consult with the Landscape Architect on-site prior to planting any trees.
~ Since plantings are sparse in some areas and some areas have no plants at all, there will be some areas that do not need to have amended topsoil and therefore will not need to have as much excavation. Where no plants area proposed then no topsoil or amendments will be required. Where trees are close together, the entire planter area shall have 12” depth of amended and imported topsoil but where trees are sparse over excavate to the mature size of the tree and amend with 12” depth of topsoil/amendments. The trees in the planter and lawn areas shall have 10x or up to 20’ diameter planter pit excavated (or to the mature dripline of the tree) per plans and then be amended with 70% imported topsoil, 15% Magmalite Soil Conditioner and 15% Composted Bark Fines.
~ Where existing trees are to remain, topsoil depths will be 1-4”. Contractor shall install enough topsoil to create smooth and uniform transitions between new and existing lawn areas.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Do not commence work of this Section until grading tolerances specified in Section 312216 are met.

B. Contractor shall field verify all existing and proposed utilities, trees, plants, buildings, structures, roads, curb and gutter, sidewalks, irrigation system, utilities, easements, setbacks, right-of-ways, etc. to make sure no conflicts exist between existing conditions and proposed plans. Contractor shall be responsible to make on-site field adjustments as may be required due to discrepancies found during construction. Contractor and Owner agrees to hold In-Site Design Group harmless for any and all such discrepancies including costs associated with such discrepancies including repair, replacement or anything related to such discrepancies.

3.2 PREPARATION

A. Protection: Protect utilities and site elements from damage.

B. Surface Preparation:
1. Haul-off and removal of tree stumps, shrubs, concrete, excavated soils and other materials shall be a lump sum price and shall be part of the base bid.
2. After excavation of lawn and planter areas has occurred, disk, till, or aerate with approved agricultural aerator to a depth of 6 inches in lawn areas and 12” in planter areas. Cross rip or till subgrade before placing topsoil and amendments in all areas.
3. Contractor shall be responsible for removing all unused soils and/or excavated soils and other materials (including excavated rock, cobble, wood mulch, tree stumps, shrubs and other plant material, concrete, etc.) from the site at no additional cost to the Owner. Owner shall approve removal of all extra stripped topsoil (if any) prior to removal from the site. Owner retains ownership if they so desire otherwise the contractor will be responsible for removing excess soils from the site.

4. Seven days maximum before beginning planting:
   a. Loosen area 4 inches deep, dampen thoroughly, and cultivate to properly break up clods and lumps.
   b. Rake area to remove clods, rocks, weeds, roots, and debris.
   c. Grade and shape landscape area to bring surface to true uniform planes free from irregularities and to provide drainage and proper slope to catch basins.
5. Limit use of heavy equipment to areas no closer than 6 feet from building or other permanent structures. Use hand held tillers for preparation of subsoil in areas closer than 6 feet.

3.3 PERFORMANCE

A. Site Tolerances:
   1. Total Topsoil Depth:
      a. New Lawn Planting Areas: 4 inches including amendments (plus the 10% for compaction) except where existing tree roots are exposed then install 1-4” depth as necessary.
      b. New Tree Planting Areas: 12 inches including amendments (plus the 10% for compaction) for tree root area. Excavate to the proposed mature dripline of all trees or 20’ diameter min. for large trees.
      c. New Plant Free Rock Areas: No topsoil or amendments are required therefore excavation only needs to be done to a depth to allow for installation of rock per plans. Topsoil and amendments are still required for the trees where they are located in groups or individually even though plantings may be sparse. In these areas, the depth shall be as 12 inches as indicated above.
   2. Finish grade of planting areas before planting and after addition of topsoil and soil additives shall be specified distances below top of adjacent pavement of any kind:
      a. Sodded Areas: Approx. 1inch below (from top of pavement to top of sod, not bottom of sod).
      b. Shrub Areas: 7 to 7-1/2 inches below in 6 inch deep decorative rock areas.

B. Do not expose or damage existing shrub or tree roots. See section 322216 and tree protection plan for more information.

C. Distribute approved imported topsoil and amendments outlined above. Remove organic material, rocks and clods greater than 1/2 inch in any dimension, and other objectionable materials from topsoil and remove from site as part of the base bid and at no additional cost to the Owner.

D. Water settle topsoil in lawn, and planter areas as may be required so that lawn, plants and irrigation components do not settle and sink. Ensure proper compaction so that irrigation components do no settle.

E. Where topsoil depth is 12 inches or greater, place topsoil in layers not to exceed 12 inches and, to prevent settling, compact to 85 percent relative density in accordance with ASTM D 1557. Do not place topsoil whose moisture content makes it prone to compaction during placement process.

F. Slope grade away from building for 12 feet minimum from walls at slope of 1/2 inch in 12 inches minimum unless otherwise noted. Direct surface drainage in manner indicated on Drawings by molding surface to facilitate natural run-off of water. Fill low spots and pockets with topsoil and grade to drain properly.

G. Add specified soil amendments at specified rates to lawn and planter areas. Roto-till amendments evenly into top 4 inches of topsoil in lawn areas and into top 12 inches in other planter areas (or mix amendments off-site in a rotary trammel to incorporate and mix amendments with topsoil). Incorporate and leach soil amendments which require leaching, such as gypsum, within such time limits that soil is sufficiently dry to allow proper application of fertilizer, soil amendments and conditioners.

H. After landscape areas have been prepared, take no heavy objects over them except lawn rollers. Immediately before planting lawn and with topsoil in semi-dry condition, roll areas that are to receive lawn in two directions at approximately right angles with water ballast roller weighing 100 to 300 lbs, depending on soil type. Rake or scarify and cut or fill irregularities that develop as required until area is true and uniform, free from lumps, depressions, and irregularities.

END OF SECTION 32 9113

SECTION 32 9223 - SODDING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install sodded lawn as described in Contract Documents.

B. Related Sections:
   1. Section 329001: Common Planting Requirements.
   2. Section 329113: Finish Grading and Soil Preparation.

1.2 SUBMITTALS

A. Quality Assurance / Control:
   1. Written certification confirming lawn seed quality and mix.
   2. Provide a sample piece of sod to the Owner on-site to ensure the color matches closely with the existing grass.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Harvest, deliver, store, and handle sod in accordance with requirements of 'American Sod Producers (ASPA) Specifications for Turfgrass Sod Materials and Transplanting / Installing.'

B. Cut and lift sod by method acceptable to Landscape Architect. Cut sod in pieces approx. 3/4 to 1 inch thick. Roll or fold sod so it may be lifted and handled without breaking or tearing and without loss of soil.

C. Schedule deliveries to coincide with topsoil operations and laying. Keep storage at job site to minimum without causing delays.
   1. Deliver, unload, and store sod on pallets within 24 hours of being lifted.
   2. Do not deliver small, irregular or broken pieces of sod.

D. During wet weather, allow sod to dry sufficiently to prevent tearing during lifting and handling. During dry weather, protect sod from drying before installation. Water as necessary to insure vitality and to prevent excess loss of soil in handling. Sod that dries out before installation will be rejected.

1.4 SEQUENCING

A. Do not commence work of this Section until work of Sections 329113 and 329300 have been completed and approved.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Certified Sod:

1. Superior sod grown from certified, high quality, seed of known origin or from plantings of certified grass seedlings or stolons:
   a. Assure satisfactory genetic identity and purity.
   b. Assure over-all high quality and freedom from noxious weeds or an excessive amount of other crop and weedy plants at time of harvest.
2. Sod shall be composed of 100% Kentucky Bluegrass (three varieties minimum and shall be 100% free of Poa Annua grass.
3. If Poa Annua grass is found in the sod, the entire sodded areas will have to be removed at the contractors expense and have new sod installed.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Site Tolerances: Final grade of soil (the top of the sod) after sodding of lawn areas is complete shall be approx. one inch below top of adjacent curb, sidewalk or pavement of any kind. Consult with Landscape Architect and Owner on-site to determine final finished grade of lawn areas prior to installing sod.

B. Laying of Sod:
   1. Roll sod areas prior to laying sod per Section 329113.
   2. Lay sod during growing season. Sodding during dry summer period, at freezing temperatures, or over frozen soil is not acceptable.
   3. Lay sod within 36 hours of being lifted.
   4. Lay sod in rows with joints staggered. Butt sections closely without overlapping or leaving gaps between sections. Cut out irregular or thin sections with a sharp knife.
   5. Lay sod flush with adjoining existing sodded surfaces.
   6. Do not sod slopes steeper than 3:1. Consult with Landscape Architect for alternate treatment.

C. After Sodding Is Complete:
   1. Roll horizontal surface areas in two directions perpendicular to each other.
   2. Repair and re-roll areas with depressions, lumps, or other irregularities. Heavy rolling to correct irregularities in grade will not be permitted.
   3. Water sod immediately after laying to obtain moisture penetration into top 4” of topsoil.

3.2 FIELD QUALITY CONTROL

A. Inspection:
   1. Sodded areas will be accepted at final inspection if:
      a. Sodded areas are properly established.
      b. Sod is free of bare and dead spots and is without weeds.
      c. No surface soil is visible when grass has been cut to height of 2 inches.
      d. Sodded areas have been mowed a minimum of twice by Contractor. Sod shall still be maintained min. 60 days from final completion and not substantial completion.
   2. Areas sodded after September 15 will be accepted the following spring (May 1st) approximately one month after start of growing season if specified conditions have been met.

END OF SECTION 32 9223

SECTION 32 9300 - PLANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install landscaping plants as described in Contract Documents.

B. Related Sections:
   1. Section 329001: Common Planting Requirements.

1.2 REFERENCES

A. American Nursery & Landscape Association / American National Standards Institute:
   1. ANLA / ANSI Z60.1-2004, 'American Standard for Nursery Stock.'

1.3 SUBMITTALS

A. Samples: Decorative rock and colored wood mulch for approval before delivery to site. Owner and Landscape Architect shall approve samples prior to delivery to site.

B. Cut sheets and manufacturer information for weed barrier fabric and stakes, tree staking materials, herbicide and pre-emergent herbicide.

C. Submittals shall be received and approved by Landscape Architect and Owner prior to Contractor beginning construction activities.

D. Cut sheets shall be submitted electronically via email in PDF format.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver healthy and vigorous trees, shrubs and other plant material.
   1. Do not prune before delivery, except as approved by Landscape Architect.
   2. Protect bark, branches, and root systems from sun scald, drying, whipping, and other handling and tying damage.
   3. Do not bend or bind-tie trees in such a manner as to destroy natural shape.
   4. Provide protective covering during delivery.

B. Handle balled stock by root ball or container. Do not drop trees and shrubs during delivery.

C. Deliver trees after preparations for planting have been completed and install immediately.
   1. If planting is delayed more than six hours after delivery, set planting materials in shade and protect from weather and mechanical damage.
   2. Set balled stock on ground and cover ball with soil, saw dust, or other acceptable material approved by Landscape Architect. Do not place on pavement.
   3. Do not remove container-grown stock from containers before time of planting.
   4. Water root systems of trees stored on site with fine mist spray. Water as often as necessary to maintain root systems in moist condition.

1.5 SEQUENCING

A. Do not commence work of this Section until work of Section 329113 has been completed and approved.

1.6 WARRANTY:

A. Provide written warranties confirming following:
   1. Furnished trees guaranteed to live and remain in strong, vigorous, and healthy condition for 1 year from date landscape installation is accepted as 100% complete. If tree pit drainage test is not completed and documented before tree planting, the warranty for all trees shall increase to two years from 100% completion.
   2. Any trees that die or are seriously stressed as determined by Owner or Landscape Architect only need to be replaced one time during the warranty period if the tree pit drainage tests have been performed as required. If the same plant or trees dies twice within the 1 year warranty period, the Owner will be responsible for replacement at Owner's cost however the contractor shall amend the soils, modify the irrigation or implement other methods to ensure the survival of any tree that has to be replaced a second time. The contractor shall document the cause of the plant mortality and consult with the Landscape Architect and Owner for recommendations prior to plant replacement.
   3. Contractor shall document clearly on as-built plans all plants and trees that are replaced during warranty period. If contractor fails to document this immediately after replacement (within 3 days of replacement) and provide written documentation to Architect and Owner within 5 days, Contractor will be liable for a second replacement if plant dies a second time during the 1 year warranty period.
   4. 1 year warranty on all mowcurb, fencing and any other landscape related items.

1.7 OWNER'S INSTRUCTIONS

A. Provide written instructions covering maintenance requirements by Owner for first 60 days of guarantee period beyond Contract maintenance period specified in Section 320101.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Plants:
   1. Conform to requirements of Plant List and Key on Drawings and to ANSI Z60.1.
   2. Nomenclature: Plant names used in Plant List conform to 'Standardized Plant Names' by American Joint Committee on Horticultural Nomenclature except in cases not covered. In these instances, follow custom of nursery trade. Plants shall bear a tag showing the genus, species, and variety of at least 25 percent of each species delivered to site. All plants shall be approved by Landscape Architect prior to planting. Min. 72 hour notice shall be given to Landscape Architect for requested inspection.

   3. Quality:
      a. Plants shall be sound, healthy, vigorous, free from plant disease, insect pests or their eggs, noxious weeds, and have healthy, normal root systems. Container stock shall be well established and free of excessive root-bound conditions.
      b. Do not prune plants or top trees prior to delivery.

c. Plant materials shall be subject to approval by Landscape Architect as to size, health, quality, and character.
d. Bare root trees are not acceptable.
e. Provide plant materials from licensed nursery or grower.

4. Measurements:
   a. Measure height and spread of specimen plant materials with branches in their normal position as indicated on Drawings or Plant List.
   b. Measurement should be average of plant, not greatest diameter. For example, plant measuring 15 inches widest direction and 9 inches in narrowest would be classified as 12 inch stock.
   c. Plants properly trimmed and transplanted should measure same in every direction.
   d. Measure caliper of trees 6 inches above surface of ground.
   e. Where caliper or other dimensions of plant materials are omitted from Plant List, plant materials shall be normal stock for type listed.
   f. Plant materials larger than those specified may be supplied, with prior written approval of Landscape Architect, and:
      1) If complying with Contract Document requirements in all other respects.
      2) If at no additional cost to Owner.
      3) If sizes of roots or balls are increased proportionately.
5. Shape and Form:
   a. Plant materials shall be symmetrical or typical for variety and species and conform to measurements specified in Plant List.
   b. Well grown material will generally have height equal to or greater than spread. However, spread shall not be less than 2/3's of height.

B. Planting Mix in Tree and Other Plant Pits in planter areas: The top 12” shall be 70% imported topsoil meeting the topsoil requirements of section 329113, 15% Magmalite Soil Conditioner and 15% Composted Bark Fines (acceptable bark fine product is available from Thompson Logging – 435-640-3694 or Soil Prep from Miller Companies) thoroughly mixed prior to back-filling per specs. Backfill 12” and deeper shall be 70% native soil excavated from planting pit, 15% Magmalite Soil Conditioner and 15% Composted Bark Fines thoroughly mixed prior to back-filling. See finish grading and soil preparation spec. for additional information. Topsoil and amendments are not required for rock areas where no plants are to be planted however topsoil may be used as fill material in these rock areas at the contractor’s option and with approval of the civil engineer. Fill material under concrete and other paving shall still comply with civil and structural engineer plans and specs. See plans for more information.

C. Planting Mix in Tree Pits in lawn areas: The top 12” (out to the mature dripline of the new trees or 20’ diameter min. for large trees) shall be imported and amended topsoil per specs. Backfill deeper than 12” shall be 70% native soil excavated from planting pit, 15% Magmalite Soil Conditioner and 15% Composted Bark Fines (acceptable bark fine product is available from Thompson Logging – 435-640-3694 or Soil Prep from Miller Companies) thoroughly mixed prior to back-filling per specs. See finish grading and soil preparation spec. for additional information. Depending on the civil engineers’ recommendations, fill deeper than 12” may be imported topsoil as well (however, amendments will still be required for the tree planter pit areas as described herein).

D. Planting Tablets: Do not use.

E. Tree Stakes:
1. Acceptable Products:
   a. 2 inch diameter Lodgepole Pine.
   b. Equal as approved by Landscape Architect before bidding.

F. Tree Staking Ties:
   1. Type Two Acceptable Products:
      a. As indicated on plans.
      b. Equal as approved by Landscape Architect before bidding.

G. Pre-Emergent Herbicide:
   1. Contractor shall ensure that all plants noted in the planting plan will not be harmed by the selected pre-emergent herbicide. Contractor shall provide documentation to Landscape Architect showing acceptable use of selected herbicide. Contractor shall select the Pre-Emergent Herbicide and provide manufacture cut sheet or letter certifying that the Herbicide won't harm any of the proposed plantings.

H. Herbicide:
   1. Contractor shall ensure that all plants noted in the planting plan will not be harmed by any residual effects of using the selected herbicide. Contractor shall provide documentation to Landscape Architect showing acceptable use of selected herbicide. Contractor shall select the Herbicide and provide manufacture cut sheet to Landscape Architect for approval. Once topsoil is stripped, any residual plant material shall be killed using a herbicide per manufacture specs. Contractor shall provide a report from a licensed herbicide applicator that all remaining vegetation has been sprayed and killed prior to topsoil and amendment installation.

I. Weed Barrier:
   1. DeWitt #5 20 year woven polypropylene weed barrier with staples at 5' O.C. triangular spacing and as per details.
   2. Equal as approved by Landscape Architect before bidding.

H. Wood Mulch:
   1. Colored wood mulch spread at 3" depth in tree well areas for trees located in lawn areas or other planting areas per plan or per Owners request. Color of wood mulch shall be chocolate.

I. Rock Mulch:
   1. Acceptable Products:
      a. Install double washed rock per plans. Landscape contractor shall be responsible to wash cobble rock if manufacturer does not wash the rock before delivery. See plans for depths.
      b. Equal as approved by Owner and Landscape Architect before bidding.

K. Decorative Landscape Boulders: (not used on this project)
   1. Acceptable Products:
      a. Landscape boulders shall be used in groupings per plans. Boulders shall be pressure washed by landscape contractor prior to placement.
      b. Equal as approved by Landscape Architect before bidding.

L. Landscape Mowcurb:
   1. Acceptable Products:
      a. Fence curb, artificial turf curb, lawn mowcurb, etc. shall be 6" deep x (width noted on plans) flat formed and cast-in-place concrete curb per plans for areas between lawn and rock mulch and between artificial turf and lawn or rock mulch areas. Mowcurb will not be installed around tree wells in lawn areas. Tree wells shall be shovel cut.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Before proceeding with work, check and verify dimensions and quantities. Report variations between Drawings and site to Landscape Architect before proceeding with work of this Section.

B. Plant and landscape totals are for convenience only and are not guaranteed. Verify amounts shown on Drawings. All planting and landscaping indicated on Drawings is required unless indicated otherwise by Owner or Landscape Architect.

C. Contractor shall field verify all existing and proposed utilities, trees, plants, buildings, structures, roads, curb and gutter, sidewalks, irrigation system, utilities, easements, setbacks, right-of-ways, etc. to make sure no conflicts exist between existing conditions and proposed plans. Contractor shall be responsible to make on-site field adjustments as may be required due to discrepancies found during construction. Contractor and Owner agrees to hold In-Site Design Group harmless for any and all such discrepancies including costs associated with such discrepancies including repair, replacement or anything related to such discrepancies.

3.2 PREPARATION

A. Layout individual tree locations and areas for multiple plantings. Stake locations and outline areas. Secure Landscape Architect's acceptance before planting. Make minor adjustments as may be requested.

3.3 INSTALLATION

A. Excavation:
   1. If underground construction work or obstructions are encountered in excavation of planting holes, Landscape Architect will select alternate locations.
   2. Plant Excavation Size:
      Diameter: Trees in lawn areas shall have 20’ diameter (or min. of mature dripline) of root ball or container minimum hole over excavated. Rock areas with no trees will not need over excavation as no topsoil or amemendments are required. Excavate as required for rock mulch only. See Section 329113 for more information.
      a. Depth:
         1) Trees: Depth of rootball in burlap or container (see detail).
   3. Roughen sides and bottoms of excavations.

B. Planting:
   1. Before planting, test three typical planting excavations (in different areas of the site as approved by the Landscape Architect) with water and verify that water drains away within two hours. Inform Landscape Architect in writing if water does not drain properly. Do not plant trees in holes or areas that do not properly drain. If documentation is not given to Landscape Architect, the contractor will be liable for plants that die due to poor drainage including costs to further amend the soils and make plant replacements. The warranty will also extend to two years as noted.
   2. Removing Binders And Containers:
      a. Remove entire wire basket and burlap binders.
      b. Remove plastic and twine binders from around root ball and tree trunk.

c. Remove wood boxes from around root ball. Remove box bottoms before positioning plant in hole. After plant is partially planted, remove remainder of box without injuring root ball.

3. Plant immediately after removing binding material and containers. Place trees in holes so, after watering and settling, top of root ball shall be approximately one inch higher than finished grade. See details for more information.
4. Properly cut off broken or frayed roots.
5. Center plant in hole and backfill with specified planting mix. Except in heavy clay soils, make ring of mounded soil around hole perimeter to form watering basin.
6. Fill landscape excavations tamped planting mix. Settle by firming and watering to ensure top of ball one inch higher than surrounding soil.
7. Do not use muddy soil for backfilling.
8. Make adjustments in positions of plants as directed by Landscape Architect.
9. Thoroughly water trees immediately after planting.
10. At base of each tree in lawn areas, leave min. 48-72 inch diameter circle free of any grass or plants. Shovel cut edge of grass. See details for more information.

C. Supports for New Trees:
1. Provide new supports for trees noted on Drawings to be staked.
a. Remove nursery stakes delivered with and attached to trees.
b. Support shall consist of at least three tree stakes driven into hole base before backfill so roots are not damaged. Place stakes vertically and run parallel to tree trunk. Install stakes so 3 feet of stake length is below finish grade.
c. Place tree ties 6 to 12 inches below crotch of main tree canopy. Second set of tree ties may be required 18 to 24 inches above finish grade, if directed by Architect.
d. Remove tops of tree stakes so top of stake is 6 inches below main tree canopy to prevent damage to tree branches and canopy growth.
e. Tree staking will be part of the base bid.

D. Weed Barrier Fabric:
1. Before placing rock, apply a granular pre-emergent herbicide to top of fabric. After placing plants and rock, rake rock smooth, wet rock to entire depth, allow to dry, then apply a secondary application of pre-emergent herbicide to top of rock.
2. Before planting and after application of herbicide in shrub beds, apply covering of specified weed barrier fabric.
3. Achieve 100 percent coverage over ground areas.
4. Overlap seams 6 inches minimum and fold over as per Contract Documents.
5. Staple at 5 feet on center each way with two at each corner.
6. Staple fabric at 12 inches on center along seams.
7. Fabric is not required in tree well areas where wood mulch will be installed.

E. Post Planting Weed Control:
1. Apply specified pre-emergent herbicide to rock mulch bed areas and grass-free areas at tree bases (in wood mulch areas) after completion of planting.
2. Areas shall be free of existing weed growth prior to application of herbicide.

F. Mulching:
1. After initial application of pre-emergent herbicide, mulch tree planting areas with layer of colored wood mulch as specified. Apply a secondary pre-emergent herbicide application once trees, wood mulch and rock mulch have been installed as noted above.
2. Cover grass-free area at tree bases with 3 inch depth of colored wood mulch.
3. Place top dressing mulch to uniform depth for a neat finished appearance.

G. Landscape Fence Curb and Mowcurb:
1. Compact subgrade and soil under mowcurb to a minimum of 85%.

2. Install cast-in-place concrete mowcurb per plans.
3. Provide control joints at 10’ O.C.
4. Provide expansion joints with expansion material at 30’ O.C. and where curb meets other hard surface areas such as sidewalks, curb and gutter, etc.
5. Install rebar per details and ensure rebar is centered in the curb. Provide rebar supports as necessary to keep rebar min. 3” from outside of concrete edge.

END OF SECTION 32 9300

DIVISION 33 - UTILITIES

SECTION 33 4100 - STORM DRAINAGE SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. The extent of work is indicated on the Drawings and includes the following:

1. New Boxes and inlets and Piping.

B. The work includes but is not limited to:

Perform trenching and backfilling required for work of this Section.

1.2 RELATED SECTIONS

A. Procedures and quality of excavating, backfilling, and compacting are specified in Division 31 Section “Earthwork”.

B. Concrete requirements related to this work are specified in Division 32 Section “Site Concrete.”

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firms regularly engaged in manufacturing of products of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years. Products are limited to those of domestic manufacturers.

B. Installer Qualifications: Firm with at least 3 years of successful installation experience on projects of similar scope.

C. Codes and Standards: Comply with all applicable codes and requirements, including amendments and modifications by local jurisdictions, related to the performance of this work including, but not necessarily limited to the following:
International Building Code, International Plumbing Code, International Mechanical Code, American National Standards Institute (ANSI), American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) , Welding: Qualify Welding procedures, welders, and operators in accordance with ASME b31.1, or ASME B31.9 or ANSI and ASTM as applicable, for shp and project site welding of piping work. Utah Safety Standards (OSHA), Utah State Industrial Council

1.4 SUBMITTALS

A. Product Data: Submit manufacturers’ technical data and installation instructions for each type of material precast items and product furnished.

B. Record Drawings: At project closeout, submit Record Drawings of installed utility service lines in accordance with Division 1 Requirements.

1.5 PROJECT CONDITIONS

A. Interruption of Existing Storm Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
   1. Notify Owner and Architect no fewer than two days in advance of proposed interruption of service.
   2. Do not proceed with interruption of service without Construction Manager's written permission.

PART 2 - PRODUCTS

2.1 STORM DRAINAGE SYSTEM COMPONENTS

A. For pipe 12" diameter or larger HDPE, Corrugated PE Pipe and Fittings AASHTO M 294, Type S, with smooth waterway for coupling joints.

-Watertight Joints: Watertight joints in accordance with ASTM D 3212 and AASHTO M 252. Bell and spigot with gaskets, ASTM F477.

B. For pipe 8" diameter or smaller, PVC Pipe: ASTM D - 3035 SDR 35, with bell and spigot type joints and elastomeric seals.

2.2 CATCH BASIN/CLEANOUT BOXES

1. Pipe Connectors: ASTM C 923, resilient, of size required, for each pipe connecting to base section.

A. Designated Precast Concrete Catch Basins: ASTM C 913, precast, reinforced concrete; designed according to ASTM c 890 for A-16, heavy-traffic, structural loading; of depth, shape, and dimensions indicated, with provision for sealant joints.
   1. Joint Sealants: ASTM C 990, bitumen or butyl rubber.
   2. Grade Rings: Include 2 or 3 reinforced-concrete rings, of 6- to 9-inch total thickness, that match 24-inch-diameter frame and grate.
   3. Pipe Connectors: ASTM C 923, resilient, of size required, for each pipe connecting to base section.

B. Frames and Grates: as specified on plans.

PART 3 - EXECUTION

3.1 GENERAL:

A. Excavate and backfill as specified in Section 312000.
B. Locate lines as close as possible to those shown on Drawings.
C. For sloped lines, grade to obtain fall required.
D. Remove debris from trench prior to laying of pipe.
E. Do not cut trenches near footings without consulting Architect.
F. Backfill only after pipe lines have been inspected and approved by Architect.
G. Failure to install joints properly shall be cause for rejection and replacement of piping system.

3.2 INSTALLATION OF STORM DRAINAGE SYSTEM

A. General: Backfill only after pipe lines have been inspected and approved by Architect.

B. Install cleanout boxes to grade as indicated on plans. Provide concrete collar around new and existing boxes. Use 4,000 psi concrete collars around inlets and cleanout boxes to grade.

C. Install materials in accordance with Manufacturer's instructions.

D. Grout smooth with non-shrink grout all inlet box joints, piping connections or ledges.

3.3 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.
   1. Submit separate reports for each system inspection.
   2. Defects requiring correction include the following:
      a. Alignment: Less than full diameter of inside of pipe is visible between structures.
      b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
      c. Crushed, broken, cracked, or otherwise damaged piping.
      d. Infiltration: Water leakage into piping.
      e. Exfiltration: Water leakage from or around piping.
   3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
   4. Reinspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
   1. Do not enclose, cover, or put into service before inspection and approval.
   2. Test completed piping systems according to authorities having jurisdiction.
   3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours advance notice.
   4. Submit separate report for each test.

C. Leaks and loss in test pressure constitute defects that must be repaired.

E. Replace leaking piping using new materials and repeat testing until leakage is within allowances specified.

3.4 CLEANING

A. Clean interior of piping and storm drain boxes of dirt and superfluous materials.

END OF SECTION