TECHNICAL SPECIFICATIONS

GLENWOOD-PEDLAR RANGER OFFICE ADDITION AND RENOVATIONS

95% SUBMISSION
June 2, 2017

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SECTION 02230 - SITE PREPARATION AND CLEARING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Protecting existing trees and vegetation to remain.
2. Removing trees and other vegetation.
3. Clearing and grubbing.
4. Topsoil stripping.
5. Removing above-grade site improvements.
6. Disconnecting, capping or sealing, and abandoning site utilities in place.
7. Disconnecting, capping or sealing, and removing site utilities.

1.2 MATERIALS OWNERSHIP

A. Except for materials indicated to be stockpiled or to remain Owner's property, cleared materials shall become Contractor's property and shall be removed from the site.

1.3 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.

B. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where advised by Owner.

C. Notify utility locator service for area where Project is located before site clearing.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. Satisfactory Soil Materials: As specified in Division 2 Section "Earthwork."

1. Obtain approved borrow soil materials off-site when satisfactory soil materials are not available on-site.

PART 3 - EXECUTION

3.1 PREPARATION

A. Provide erosion-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

B. Where indicated 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 TREE PROTECTION (where indicated if applicable)

A. Erect and maintain a temporary fence around drip line of individual trees or around perimeter drip line of groups of trees to remain. Remove fence when construction is complete.

B. Do not excavate within drip line of trees, unless otherwise indicated.

C. Where excavation for new construction is required within drip line of trees, hand clear and excavate to minimize damage to root systems. Use narrow-tine spading forks, comb soil to expose roots, and cleanly cut roots as close to excavation as possible.

D. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations, in a manner approved by Architect.

3.3 UTILITIES

A. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed.

B. Do not interrupt utilities serving facilities occupied by Owner or others unless permitted. Arrange to provide temporary utility services.

C. Excavate for and remove underground utilities indicated to be removed.

3.4 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, grass, and other vegetation to permit installation of new construction. Removal includes digging out stumps and obstructions and grubbing roots.

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 8-inch (200-mm) loose depth, and compact each layer to a density equal to adjacent original ground.

3.5 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to whatever depths are encountered in a manner to prevent intermingling with underlying subsoil or other waste materials.

C. Stockpile topsoil materials away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust.

3.6 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and as necessary to facilitate new construction.

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.

END OF SECTION 02230

SECTION 02300 - EARTHWORK

PART 1 - GENERAL

1.1 RELATED SECTIONS

A. Section: 02930 Exterior Planting
B. Section: 02230 Site Preparation and Clearing

1.2 SUMMARY

A. This Section includes the following:

1. Preparing subgrades.
2. Excavating and backfilling.
3. Subbase course for concrete walks and pavements.

1.3 DEFINITIONS

A. Backfill: Soil materials used to fill an excavation.

B. Base Course: Layer placed between the subbase course and asphalt paving.

C. Bedding Course: Layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow: Satisfactory soil imported from off-site for use as fill or backfill.

E. Drainage Course: Layer supporting slab-on-grade used to minimize capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations.

1. Additional Excavation: Excavation below subgrade elevations as directed by Architect. Additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated 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. 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.

I. Subbase Course: Layer placed between the subgrade and base course for asphalt paving, or layer placed between the subgrade and a concrete pavement or walk.

J. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.

K. Utilities include on-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.4 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.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: ASTM D 2487 Soil Classification Groups [GW, GP, GM, SW, SP, and SM], or a combination of these group symbols; free of rock or gravel larger than 3 inches (75 mm) in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

C. Backfill and Fill: Satisfactory soil materials.

D. Subbase: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2- inch (38-mm) sieve and not more than 12 percent passing a No. 200 (0.075-mm) sieve.

E. Base: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 95 percent passing a 1-1/2-inch (38-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) sieve.

F. Bedding: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch (25-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) sieve.

G. Drainage Fill: Washed, narrowly graded mixture of crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2- inch (38-mm) sieve and 0 to 5 percent passing a No. 8 (2.36-mm) sieve.

H. Detectable Warning Tape: Polyethylene film warning tape encasing a metallic core, minimum 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, freezing temperatures or frost, and other hazards created by earthwork operations. Provide protective insulating materials as necessary.

B. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, as indicated in plan.

C. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

D. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

3.2 EXCAVATION

A. Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered, including rock, soil materials, and obstructions.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

B. Excavate for structures, pavements, and walks to indicated elevations and dimensions. Extend excavations for placing and removing concrete formwork, for installing services and other construction, and for inspections. Trim bottoms to required lines and grades to leave solid base to receive other work.

C. Excavate utility trenches to indicated gradients, lines, depths, and invert elevations of uniform widths to provide a working clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches (300 mm) higher than top of pipe or conduit.

1. Excavate trenches deeper than bottom of pipe elevation, 6 inches (150 mm) deeper in rock, 4 inches (100 mm) deeper elsewhere, to allow for bedding course. Hand excavate for bell of pipe.

D. Proof roll subgrades, before filling or placing aggregate courses, with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof roll wet or saturated subgrades.

E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities.

F. 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 may be used when approved by Architect.

G. Stockpile borrow materials and satisfactory soil materials, without intermixing, in shaped, graded, drained, and covered stockpiles. Stockpile soil materials away from edge of excavations and outside drip line of remaining trees.

3.3 BACKFILLS AND FILLS

A. Utility Trench Backfill: Place, compact, and shape bedding course to provide continuous support for pipes and conduits over rock and other unyielding bearing surfaces and to fill unauthorized excavations.

1. Place and compact initial backfill of satisfactory soil material or subbase material, free of particles larger than 1 inch (25 mm), to a height of 12 inches (300 mm) over the utility pipe or conduit. Place and compact final backfill of satisfactory soil material to final subgrade.
2. Install warning tape directly above utilities, 12 inches (300 mm) below finished grade, except 6 inches (150 mm) below subgrade under pavements and slabs.

B. Fill: Place and compact fill material in layers to required elevations.

C. Uniformly moisten dry soil subgrades or aerate damp soil subgrades and each subsequent fill or backfill layer before compaction.

1. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that is too wet to compact.

D. Compaction: Place backfill and fill materials in layers not more than 8 inches (200 mm) in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches (100 mm) in loose depth for material compacted by hand-operated tampers.

E. Grading: Uniformly grade areas to a smooth surface, free from irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated. Grade lawns, walks, and unpaved subgrades to tolerances of plus or minus 1 inch (25 mm) and pavements and areas within building lines to plus or minus 1/2 inch (13 mm).

F. Subbase and Base Courses: Under pavements and walks, place subbase course on prepared subgrade. Place base course material over subbase. Compact to required grades, lines, cross sections, and thickness.

G. Under slabs-on-grade, place drainage course on prepared subgrade. Compact to required cross sections and thickness.

3.4 PROTECTION AND DISPOSAL

A. 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.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

D. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

END OF SECTION 02300

SECTION 02410 - EROSION AND SEDIMENT CONTROL

1. GENERAL

1.1 THE CONTRACT DOCUMENTS APPLY TO THIS SECTION.

1.2 RELATED WORK SPECIFIED ELSEWHERE INCLUDES THE FOLLOWING:

A. SECTION 02200 - EARTHWORK

1.3 SPECIFICATIONS ARE REFERRED TO BY ABBREVIATION AS FOLLOWS:

A. AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS ---------- AASHTO

B. AMERICAN SOCIETY OF TESTING AND MATERIALS ---------- ASTM

C. VIRGINIA DEPARTMENT OF TRANSPORTATION ---------- VDOT

D. VIRGINIA DEPARTMENT OF CONSERVATION & RECREATION ---------- VDCR

E. VIRGINIA EROSION & SEDIMENT CONTROL HANDBOOK-- VE&SCH

1.4 SCOPE OF WORK

A. GENERAL: ALL PHASES OF THE CONSTRUCTION WORK SHALL COMPLY OR EXCEED THE MINIMUM STATE REQUIREMENTS FOR CONTROLLING EROSION AND SEDIMENTATION FROM "LAND DISTURBING ACTIVITIES" AS OUTLINED IN THE "VIRGINIA EROSION AND SEDIMENT CONTROL HANDBOOK" - LATEST EDITION, THE APPROVED EROSION AND SEDIMENT CONTROL PLAN FOR THIS PROJECT, AND ALL REVISIONS AND ADDENDUMS THERETO.

B. STABILIZATION OF DENUDED AREAS AND SOIL STOCKPILES: PERMANENT OR TEMPORARY SOIL STABILIZATION SHALL BE APPLIED TO DENUDED AREAS WITHIN 15 DAYS AFTER FINAL GRADE IS REACHED ON ANY PORTION OF THE SITE. SOIL STABILIZATION SHALL ALSO BE APPLIED WITHIN 15 DAYS TO DENUDED AREAS WHICH MAY NOT BE AT FINAL GRADE, BUT WILL REMAIN DORMANT (UNDISTURBED) FOR LONGER THAN 60 DAYS (VE&SCH STANDARDS AND SPECIFICATIONS 3.31, 3.32).

1. SOIL STABILIZATION IS NECESSARY TO PROTECT SOIL FROM THE EROSIVE FORCES OF RAINDROP IMPACT AND FLOWING

WATER. APPLICABLE PRACTICES INCLUDE VEGETATIVE ESTABLISHMENT, MULCHING, AND THE EARLY APPLICATION OF GRAVEL BASE ON AREAS TO BE PAVED.

2. SOIL STOCKPILES SHALL BE STABILIZED OR PROTECTED WITH SEDIMENT TRAPPING MEASURES TO PREVENT SOIL LOSS (VE&SCH STANDARDS AND SPECIFICATIONS 3.13, 3.14).

C. ESTABLISHMENT OF PERMANENT VEGETATION: A PERMANENT VEGETATIVE COVER SHALL BE ESTABLISHED ON DENUDED AREAS NOT OTHERWISE PERMANENTLY STABILIZED. PERMANENT VEGETATION SHALL NOT BE CONSIDERED ESTABLISHED UNTIL A GROUND COVER IS ACHIEVED WHICH, IN THE OPINION OF THE ENGINEER, IS MATURE ENOUGH TO CONTROL SOIL EROSION SATISFACTORILY AND TO SURVIVE SEVERE WEATHER CONDITIONS (VE&SCH STANDARDS AND SPECIFICATIONS 3.32).

D. PROTECTION OF ADJACENT PROPERTIES: PROPERTIES ADJACENT TO THE SITE OF LAND DISTURBANCE SHALL BE PROTECTED FROM SEDIMENT DEPOSITION. THIS SHALL BE ACCOMPLISHED BY INSTALLING PERIMETER CONTROLS SUCH AS SEDIMENT BARRIERS, SILT FENCES, FILTERS OR DIKES, OR SEDIMENT BASINS, OR BY A COMBINATION OF SUCH MEASURES AS INDICATED ON THE APPLICABLE EROSION CONTROL PLAN OUTLINED IN THE SPECIFICATIONS AND VE&SC HANDBOOK.

2. EXECUTION

2.1 PROCEDURES

A. GENERAL: THE FOLLOWING MINIMUM EROSION AND SEDIMENT CONTROLS SHALL BE INCORPORATED INTO THE CONSTRUCTION PROJECT. ADDITIONAL CONTROLS REQUIRED BY THE VE&SC HANDBOOK TO PROTECT EXISTING AND ADJACENT PROPERTIES, AND PROTECT HUMAN LIFE, SHALL BE INCLUDED.

2.2 SILT FENCE: SEDIMENT BARRIER SHALL UTILIZE EXTRA STRENGTH SYNTHETIC FILTER FABRICS (VE&SCH PLATE 3.05-1).

A. CONSTRUCTION: HEIGHT OF SILT FENCE SHALL NOT EXCEED 36 INCHES.

1. FILTER FABRIC SPLICE JOINTS SHALL OCCUR ONLY AT SUPPORT POST, MINIMUM 6-INCH OVERLAP, AND SECURELY SEALED.

2. POSTS SHALL BE SPACED A MAXIMUM OF 10 FEET ON CENTERS AT THE BARRIER LOCATION AND DRIVEN SECURELY INTO THE GROUND (MINIMUM OF 12 INCHES). WHEN EXTRA STRENGTH FABRIC IS USED WITHOUT THE WIRE SUPPORT FENCE, POST SPACING SHALL NOT EXCEED 6 FEET ON CENTERS.

3. TRENCH SHALL BE EXCAVATED APPROXIMATELY 4 INCHES WIDE AND 4 INCHES DEEP ALONG THE LINE OF POSTS AND UPSLOPE FROM THE BARRIER.

4. FOR EXTRA STRENGTH FILTER FABRIC INSTALLATION UTILIZING CLOSER POST SPACING, THE WIRE MESH SUPPORT FENCE MAY BE ELIMINATED. IN SUCH CASE, THE FABRIC IS ATTACHED TO THE UPSLOPE SIDE OF THE POSTS USING HEAVY-DUTY WIRE STAPLES, MINIMUM 1-INCH LONG OR TIE WIRES. EIGHT INCHES OF THE FABRIC SHALL BE EXTENDED INTO THE TRENCH. FILTER FABRIC SHALL NOT BE STAPLED TO THE EXISTING TREES.

5. THE TRENCH SHALL BE BACKFILLED AND THE SOIL COMPACTED OVER THE FILTER FABRIC.

6. SILT FENCES SHALL BE REMOVED WHEN THEY HAVE SERVED THEIR USEFUL PURPOSE, BUT NOT BEFORE THE UP-SLOPE AREA HAS BEEN PERMANENTLY STABILIZED.

B. MAINTENANCE: SILT FENCES AND FILTER BARRIERS SHALL BE INSPECTED IMMEDIATELY AFTER EACH RAINFALL AND AT LEAST DAILY DURING PROLONGED RAINFALL. ANY REQUIRED REPAIRS SHALL BE MADE IMMEDIATELY.

1. DECOMPOSED OR INEFFECTIVE SILT FENCE OR FILTER BARRIERS SHALL BE REPLACED PROMPTLY.

2. SEDIMENT DEPOSITS SHALL BE REMOVED WHEN DEPOSITS REACH APPROXIMATELY ONE-QUARTER THE HEIGHT OF THE

BARRIER. SEDIMENT SHALL BE REMOVED FROM THE SITE AND DISPOSED OF AT AN APPROVED WASTE AREA.

3. ANY SEDIMENT DEPOSITS REMAINING IN PLACE AFTER THE SILT FENCE OR FILTER BARRIER IS NO LONGER REQUIRED SHALL BE DRESSED TO CONFORM WITH THE EXISTING GRADE, PREPARED AND SEEDED.

C. INLET PROTECTION: INLET PROTECTION SHALL BE PROVIDED FOR EACH DROP INLET AND CULVERT INLET. INLET PROTECTION FOR ALL STRUCTURES SHALL CONFORM TO VE&SCH STANDARDS AND SPECIFICATIONS 3.07 PLATE 3.07-1 SHALL APPLY TO INLET STRUCTURES.

2.3 CUT AND FILL SLOPES

A. GENERAL: CUT AND FILL SLOPES SHALL BE CONSTRUCTED IN A MANNER WHICH WILL MINIMIZE EROSION. ALL SLOPES SHALL REQUIRE SURFACE ROUGHENING, EITHER STAIR-STEP GRADING, GROOVING, FURROWING, OR TRACKING IF STABILIZED WITH VEGETATION (VE&SCH STANDARDS AND SPECIFICATIONS 3.29).

B. AREAS WITH GRADES LESS THAN 3:1 SHALL HAVE THE SOIL SURFACE LIGHTLY ROUGHENED AND LOOSENED TO A DEPTH OF 4-INCHES PRIOR TO SEEDING.

C. AREAS WHICH HAVE BEEN GRADED AND WILL NOT BE STABILIZED IMMEDIATELY SHALL BE ROUGHENED TO REDUCE RUNOFF VELOCITY UNTIL SEEDING TAKES PLACE.

D. SLOPES WITH A STABLE ROCK FACE DO NOT REQUIRE ROUGHENING OR STABILIZATION.

2.4 CUT SLOPE APPLICATION FOR AREAS WHICH WILL NOT BE MOWED: CUT SLOPES WITH A GRADIENT STEEPER THAN 2:1 SHALL BE STAIR-STEP GRADED OR GROOVED (VE&SCH PLATE 3.29-1 AND 3.29-2).

A. STAIR-STEP GRADING SHALL BE CARRIED OUT ON ANY MATERIAL SOFT ENOUGH TO BE RIPPED WITH A BULLDOZER.

B. THE RATIO OF THE VERTICAL CUT DISTANCE TO THE HORIZONTAL DISTANCE SHALL BE LESS THAN 1:1 AND THE HORIZONTAL

PORTION OF THE "STEP" SHALL SLOPE TOWARD THE VERTICAL WALL.

C. INDIVIDUAL VERTICAL CUTS SHALL NOT BE MORE THAN 30-INCHES ON SOFT SOIL MATERIALS AND NOT MORE THAN 40-INCHES IN ROCKY MATERIALS.

D. GROOVING UTILIZING APPROPRIATE MACHINERY SHALL CREATE A SERIES OF RIDGES AND DEPRESSIONS WHICH RUN PERPENDICULAR TO THE SLOPE ON CONTOUR.

E. GROOVES SHALL BE MADE WITH APPROPRIATE EQUIPMENT WHICH CAN BE SAFELY OPERATED ON THE SLOPE AND WHICH WILL NOT CAUSE UNDUE COMPACTION. SUGGESTED IMPLEMENTS INCLUDE DISCS, TILLERS, SPRING HARROWS, AND THE TEETH ON A FRONT-END LOADER BUCKET. GROOVES SHALL NOT BE LESS THAN 3-INCHES DEEP, MAXIMUM 15-INCHES ON CENTER.

2.5 FILL SLOPE APPLICATIONS FOR AREAS WHICH WILL NOT BE MOWED: FILL SLOPES WITH A GRADIENT STEEPER THAN 3:1 SHALL BE GROOVED OR ALLOWED TO REMAIN ROUGH AS THEY ARE CONSTRUCTED. EITHER OF THE FOLLOWING METHODS MAY BE USED:

A. GROOVE AS SPECIFIED ABOVE.

B. AS LIFTS OF THE FILL ARE CONSTRUCTED, SOIL AND ROCK MATERIALS MAY BE ALLOWED TO FALL NATURALLY ON THE SLOPE SURFACE.

C. AT NO TIME SHALL SLOPES BE BLADED OR SCRAPED TO PRODUCE A SMOOTH, HARD SURFACE.

2.6 ROUGHENING WITH TRACKED MACHINERY (VE&SCH PLATE 3.29-4): TRACKING MACHINERY SHALL BE OPERATED UP AND DOWN THE SLOPE TO LEAVE HORIZONTAL DEPRESSIONS IN THE SOIL. AS FEW PASSES OF THE MACHINERY SHALL BE MADE AS POSSIBLE TO MINIMIZE COMPACTION.

2.7 SEEDING: ROUGHENED AREAS SHALL BE SEEDED AND MULCHED AS SOON AS POSSIBLE TO OBTAIN SEED GERMINATION AND SEEDING GROWTH. SEED MIXTURE SHALL BE AS INDICATED IN THE EROSION CONTROL NARRATIVE.

2.8 CONSTRUCTION ACCESS ROUTES

A. CONSTRUCTION ENTRANCES: WHEREVER CONSTRUCTION VEHICLE ACCESS ROUTES INTERSECT PAVED PUBLIC ROADS, PROVISIONS MUST BE MADE TO MINIMIZE THE TRANSPORT OF SEDIMENT (MUD) BY RUNOFF OR VEHICLE TRACING ONTO THE PAVED SURFACE (VE&SCH STANDARDS AND SPECIFICATIONS 3.02 AND 3.03). WHERE SEDIMENT IS TRANSPORTED ONTO A PUBLIC ROAD SURFACE, THE ROADS SHALL BE CLEANED THOROUGHLY AT THE END OF EACH DAY. SEDIMENT SHALL BE REMOVED FROM ROADS BY SHOVELING OR SWEEPING AND BE TRANSPORTED TO A SEDIMENT CONTROLLED DISPOSAL AREA. STREET WASHING SHALL BE ALLOWED ONLY AFTER SEDIMENT IS REMOVED IN THIS MANNER.

2.9 DISPOSITION OF TEMPORARY MEASURES

A. GENERAL: ALL TEMPORARY EROSION AND SEDIMENT CONTROL MEASURES SHALL BE DISPOSED OF WITHIN 30 DAYS AFTER FINAL SITE STABILIZATION IS ACHIEVED OR AFTER THE TEMPORARY MEASURES ARE NO LONGER NEEDED, UNLESS OTHERWISE AUTHORIZED BY THE LOCAL PROGRAM ADMINISTRATOR. TRAPPED SEDIMENT AND OTHER DISTURBED SOIL AREAS RESULTING FROM THE DISPOSITION OF TEMPORARY MEASURES SHALL BE PERMANENTLY STABILIZED TO PREVENT FURTHER EROSION AND SEDIMENTATION.

END OF SECTION

SECTION 2741 - HOT-MIX ASPHALT PAVEMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Asphaltic Concrete Paving: surface/wearing course and base/binder course.

B. Surface sealer, primer/tack coat.

C. Aggregate Base Course; depth and compaction.

1.2 RELATED SECTIONS

A. Section 1310-Project management and coordination

B. Section 01330- Submittal Procedures

C. Section 01400-Quality Requirements: Aggregate and asphalt testing. Compaction testing. Geotechnical Engineer.

D. Section 01500-Temporary Facilities and Controls.

E. Section 02300-Earthwork.

F. Section 02750-Pavement marking & Signage.

G. Section 02400-Site Storm Drainage.

H. Section 02923- Finish Grading: Adjacent surface rough grade.

1.3 DEFINITIONS

A. Local Governing Authority (LGA)- The state agency municipal department or other entity which legally has jurisdiction over the referenced work or activity. This usually means the field official who makes or controls onsite inspections of the work.

1.4 REFERENCE STANDARDS

A. Virginia Department of Transportation " Road & Bridge Standards and Specifications" latest edition. VDOT section numbers referenced herein refer to sections in these Road & Bridge Specifications. The provisions therein for method of measurement and payment do not apply.

B. Manual of Uniform Traffic Control Devices (MUTCD, including Virginia supplement) latest edition.

C. Americans With Disabilities Act (ADA): 28 CFR Part 36, Nondiscrimination on the Basis of Disability by Public Accommodations and in Commercial Facilities. Final Rule dated July 26, 1991.

D. Local Governing Authority Regulations pertaining to work of this section (i.e. handicapped parking marking and signage requirements, fire lane marking and signage requirements, etc.).

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with requirements of Reference Standards above. Refer to ACI 304 for any concrete related item not covered in Reference Standard.

B. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with industry standards, the specified requirements and the methods for proper performance of the work of this section.

C. Asphalt Mixing Plant: VDOT Certified.

D. Obtain materials from the same source throughout.

1.6 SUBMITTALS FOR INFORMATION

A. Submit certification from Asphalt batch plant for proposed mix design of each class of mix for information prior to beginning of work.

1.7 ENVIROMENTAL REQUIREMENTS

A. Do not produce or place asphalt when the weather is rainy or foggy, when the base course is frozen or has excess moisture, or when the ambient temperature is less than 40 degrees F in the shade away from artificial heat.

B. Other material shall be placed or installed per manufacturer's recommendation.

1.8 BARRICADES AND SIGNALS

A. Within public right-of-way, provide and maintain signs, signals, lighting devices, markings, barricades, and channeling and hand signaling devices in accordance with DOT D-6.1 to protect personnel and new construction from damage by equipment and vehicles until the surface is approved by the Architect/Engineer, as applicable.

B. On-site, provide and maintain temporary signs, signals, lighting devices, markings, and barricades to protect personnel and new construction from damage by equipment and vehicles until the surface is approved by the Architect/Engineer.

1.9 REGULATORY REQUIREMENTS

A. Testing per VDOT Stds. made by Geotechnical Engineer.

PART 2 PRODUCTS

2.1 AGGREGATE BASE COURSE

A. Aggregate Base under asphalt Pavement Coarse Aggregate Type A4 in accordance with Section 02300- Earthwork (see Pavement Sections on Drawings).

2.2 ASPHALTIC CONCRETE PAVING

A. Primer, Tack & Seal Coats: In accordance with VDOT Section 210, Asphalt Materials.

B. Asphalt Surface Course: In accordance with VDOT Section 212.17, Type SM-2A bituminous concrete.

2.3 SOURCE QUALITY CONTROL AND TESTS

A. Have required tests made by Geotechnical Engineer (in lieu of VDOT) per Reference Standard. Test asphalt samples for depth and density.

B. Section 01400- Quality Requirements Aggregate and asphalt testing. Compaction testing. Geotechnical Engineer.

PART 3 EXECUTION

3.1 EXAMINATION

A. Coordinate the work and verify base conditions under provisions of Div. 1. Verify that all pre-requisite work (subsurface utilities, ect) has been completed and is ready to receive the work of this section. Verify that compacted subgrade is dry and ready to support paving/surfacing and imposed loads. Verify that gradients and elevations of base are correct.

3.2 PLACING AGGREGATE BASE COURSE

A. For Asphalt pavement. Begin spreading base material at the point nearest the source of supply. Permit traffic and hauling over the base. Fill ruts formed by traffic and reroll. After base course placement, continue machining and rolling until surface is smooth, compacted, well bonded, and true to the designed cross section. Compact to 100 percent ASTM D-698 maximum dry density. Maintain the base smooth and true to grade and cross section until asphaltic concrete placement.

3.3 PREPARATION

A. Protect finished surfaces adjacent to asphalt work from overspray, damage by equipment, ect.

B. For repair work, cut existing surfaces to result in smooth transitions and uniform, sections.

C. Butt new work to existing surfaces to result in smooth transitions and uniform sections.

D. Before placing surface, inspect the subgrade and base for conformity with the specified section. If necessary, remove or add material to bring all portions of the subgrade and base to proper section and correct elevation. Thoroughly compact and inspect the adjusted section after correcting.

E. Asphalt Pavement-Primer
   1. Apply a prime coat on the finished stone base course at a rate of 0.25 gallon residual asphalt per square yard. Allow prime coat to cure for a minimum of 48 hours prior to placing asphaltic concrete. Apply cutback asphalts when the stone base course is dry. Lightly spray stone base with water immediately prior to application of emulsified asphalts. During prime coat placement, minimum ambient temperature shall be 50

degrees F and rising. Maintain and protect primed surfaces from damage until asphalitic concrete placement.

2. Apply primer in accordance with VDOT Section 311-Prime Coat
3. Apply primer to contact surfaces of curbs and gutters.
4. Use clean sand to blot excess primer.

F. Asphalt Pavement-Tack Coat

1. Apply tack coat on existing pavement to be overlaid at a rate of 0.10 gallon residual asphalt per square yard. Thoroughly clean surfaces to receive the tack coat immediately prior to application of tack coat. Tack coat shall be tacky at the time of asphalitic concrete placement.
2. Apply tack coat in accordance with VDOT Standards.
3. Apply tack coat to contact surfaces of curbs and gutters.
4. Coat surfaces of manhole and drainage structure frames with oil to prevent bond with asphalt pavement. Do not tack coat these surfaces.

G. Asphalt Pavement-Seal Coats

1. Apply asphalt and cover material in accordance with VDOT Section 312-Seal Coat

3.4 PLACING ASPHALT PAVEMENT-SINGLE COURSE

A. Install Work in accordance with VDOT standards.

B. Place to compacted thickness identified in detail on Drawings.

C. Install drainage tops/frames in correct position and elevation.

D. Compact pavement by rolling to specified density. Do not displace or extrude pavement from position. Hand compact in areas inaccessible to rolling equipment.

E. Perform rolling with consecutive passes to achieve even and smooth finish without roller marks.

3.5 PLACING ASPHALT PAVEMENT-DOUBLE COURSE

A. Place base/binder course to compacted thickness identified in details on Drawings.

B. Place surface/wearing course within two (2) hours of placing and compacting binder course.

C. Place surface/wearing course to compact thickness identified in details on Drawings.

D. Install drainage tops/frames in correct position and elevation.

E. Compact pavement by rolling to specified density. Do not displace or extrude pavement from position. Hard compact in areas inaccessible to rolling equipment.

F. Perform rolling with consecutive passes to achieve even and smooth finish, without roller marks.

3.6 TOLERANCES

A. Flatness: Maximum variation of 1/4 inch (6 mm) measured with 10 foot (3 m) straight edge.

B. Scheduled Compacted Thickness. Within 1/4 inch(6 mm).

C. Variation from True Elevation: Within 1/2 inch (12 mm).

D. Assure that drainage swales over pavement function as designed.

3.7 FIELD QUALITY CONTROL

A. Field testing methods shall be as determined by the Geotechnical Engineer.

3.8 PROTECTION OF ASPHALT

A. Immediately after placement protect pavement from premature drying and excessive hot or cold temperatures. Also, protect pavement from mechanical injury for one (1) day or until surface temperature is less than 140 degrees F (60 degrees C).

B. Do not permit pedestrian traffic over pavement for 7 days minimum after finishing.

3.9 SCHEDULES

A. Refer to notes and details on the Drawings.

END OF SECTION 02741

SECTION 2750 - PAVEMENT MARKING & SIGNAGE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pavement Marking & Related Signage.

1.2 RELATED SECTIONS

A. Section 1310-Project Management & Coordination.

B. Section 01330-Submittal Procedures.

C. Section 01400-Quality Requirements.

D. Section 01700-Execution Requirements.

1.3 DEFINITIONS

A. Local Governing Authority (LGA)- The state agency, municipal department or other entity which legally has jurisdiction over the reference work or activity. This usually means the field official who makes or controls onsite inspections of the work.

1.4 REFERENCE STANDARD

A. Virginia Department of Transportation "Road & Bridge Standards & Specifications", latest edition. VDOT section numbers referenced herein refer to sections in these Road & Bridge Specifications. The provisions therein for method of measurement and payment do not apply.

B. Manual of Uniform Traffic Control Devices (MUTCD, including Virginia supplement), latest edition.

C. Americans With Disability Act (ADA): 28 CFR Part 36, Nondiscrimination on the Basis of Disability by Public Accommodations and in Commercial Facilities. Final Rule dated July 26, 1991.

D. Local Governing Authority Regulations pertaining to work of this section (i.e. handicapped parking marking and signage requirements, fire lane marking and signage requirements, ect.).

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with requirements of Reference Standards above. Refer to ACI 304 for any concrete related item not covered in Reference Standard. Maintain one copy of the reference utilized onsite with Contact Documents.

B. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with industry standards, the specified requirements and the methods for proper performance of the work of this section.

C. Obtain materials from the same source throughout.

1.6 SUBMITTALS FOR INFORMATION

A. Product Data: Provide data on paint materials.

B. Submit certification from sign supplier for all signage provided that they meet applicable standards above.

1.7 DELIVERY, STORAGE, AND PRODUCTION

A. Deliver products to site in Manufacturer's sealed and labeled containers, inspect to verify acceptability.

B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Paint Materials: Store all paint materials in a single location at minimum ambient temperature of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by Manufacturer's instructions. Protect from danger of combustion.

1.8 ENVIROMENTAL REQUIREMENTS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.

B. Do not apply exterior coatings during rain or snow, or when relative humidity is outside the humidity ranges by the paint product manufacturer.

1.9 EXTRA MATERIALS

A. Section 01700- Execution Requirements.

B. Supply Owner with 1-gallon (4L) of each color, type, and surface texture of paint materials used in the work; store where directed.

C. Label each container with color, type, texture, and locations where used in addition to the manufacturer's label.

PART 2 PRODUCTS

2.1 PAVEMENT MARKING AND SIGNAGE

A. Provide all identification, fire lane, traffic control and ADA signage indicated on Drawings and per schedule this section. Signs shall meet minimum standards of local fire department/marshall; ADA and Manual of Uniform Traffic Control Devices (MUTCD, including Virginia supplement) for all components. Sign posts shall meet VDOT Stds. & Specs. Unless modified herein or on Drawings.

B. Plans have been reviewed and approved by the local governing authority (LGA) If, upon construction compliance inspection by LGA building inspector, any signage is lacking per requirements of VDOT, ADA or local code, the Contractor shall provide and place such signs as necessary for compliance at no additional cost to the Owner.

C. For work within public right-of-way, provide pavement marking in accordance with local jurisdiction requirements.

D. Provide pavement marking paint in accordance with VDOT Section 231 No. 44 White (No. 45 yellow, as applicable) traffic zone paint for work within right-of way. For traffic lane marking on-site use same with omission of glass beads. For parking lot stripping use "Ultra Hide" water reducible acrylic latex traffic paint as manufactured by Gibben, Benjamin Moore, Devoe, PPG or Sherwin-Williams or approved equal. Use white for pavement markings, and direction arrows on asphalt (OSHA yellow on concrete) unless otherwise required by reference standards.

E. Reference ADA requirements and local regulations for handicapped space marking configuration and colors.

2.2 SOURCE QUALITY CONTROL AND TESTS

A. Section 01400 – Quality Requirements Aggregate and asphalt testing. Compaction testing. Geotechnical Engineer.

PART 3 EXECUTION

3.1 EXAMINATION

A. Coordinate the Work and verify pavement conditions under provisions of Div. 1. Verify that all pre-requisite work (subsurface utilities, ect) has been completed and is ready to receive the work of this section. Verify that pavement is ready to support paving/surfacing and imposed loads. Verify that finish grade of lawn areas are correct.

B. Verify that surfaces or substrate conditions, as applicable, are ready to receive Work as instructed by product manufacturer.

C. Examine surfaces scheduled to be finished prior to commencement of work.. Report any condition that may potentially affect proper application.

D. Verify locations, requirements, and extent of work.

3.2 PREPARATION

A. Surface Appurtenances: Remove or mask any adjacent or attached items which are not to receive applied material prior to preparing surfaces or finishing.

B. Surfaces: Correct defects and clean surfaces which affect work of this section. Remove or repair existing coatings that exhibit surface defects.

3.3 APPLICATION

A. Protection: Protect work of other trades, whether being painted or not, against damage by painting. Provide “Wet Paint” signs to protect newly painted surfaces.

B. Procedures: Apply products in accordance with manufacturer’s instructions.

C. Dry Receiving Surface: Do not apply finishes to surfaces that are not dry. Allow applied coats to dry thoroughly before next coat is applied.

D. Minimum Coating Thickness: Apply no thinner that manufacturer’s recommended spreading rate. Provide the total dry film thickness of the entire system as recommended by the manufacturer.

E. Appearance: Apply each coat to uniform appearance. Apply each coat of paint slightly darker than preceding coat unless otherwise approved.

F. Sand wood and metal surfaces lightly between coats to achieve required finish.

G. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

H. Where clear finishes are required, tint fillers to match wood. Work fillers into the grain before set. Wipe excess from surface.

I. Prime concealed surfaces of woodwork with primer paint.

J. Acceptance: Owner’s representative shall determine quality and consistency of coverage, color and finishes. Remove, refinish or repaint not complying with requirements.

3.4 PAVEMENT MARKINGS

A. Unless indicated otherwise, provide painted lines four 4 inches wide. Apply paint after asphaltic concrete has cured for a minimum of seven (7) days, and minimum ambient temperature is 40 degrees F. Apply paint to clean, dry surfaces, protect adjacent surfaces from overspray and protect surfaces from traffic until dry. Provide uniform paint film of sufficient thickness to completely conceal base material.

B. Roadway improvements within public right-of-way shall be marked in accordance with VDOT Spec. Section 704 – Pavement Markings & Markings. Replace any markings damaged by construction.

C. Place required pavement marking and signage in accordance with ADA or Manual of Uniform Traffic Control Devices (MUTCD including Virginia Supplement) as applicable. See schedule this section. See pavement marking and Exterior Handicap Sign detail on the Drawings.

D. Travel lane stop bars shall be painted, white lines, twenty-four (24) inches in width and across the entire indicated lane width.

3.5 SIGNAGE

A. Relocated Town signage shall be core drilled and sleeved in accordance with Town requirements.

B. New Sigmage: Provide Sleeves in accordance with Town requirements.

C. Confirm the location of all signage within public right-of-way with Town Streets and Traffic.

3.6 FIELD QUALITY CONTROL

A. Section 01400 – Quality Requirements: Field inspection and testing

B. The owner reserves the right to engage the services of an independent testing agency to sample the paint material being used. Samples of material delivered to the project may be taken, identified, sealed and certified in the presence of the contractor. The testing agency will perform appropriate tests as required by the Owner. If test show material being used does not comply with specified requirements, the contractor shall remove non-complying paint from the site, pay for the testing, and repaint surfaces previously coated with the rejected paint. If necessary, the contractor may be required to remove rejected paint from those surfaces if, on repainting with specified paint, the two coatings are incompatible.

3.7 CLEANING

A. Section 01770 – Closeout Procedures: Cleaning installed work.

B. At the end of each workday, collect empty cans, rags, rubbish, and other discarded paint materials, place in closed metal containers, and remove daily from the site.

C. After completing painting, clean all paint-splattered surfaces being careful not to cause harm to adjacent finished surfaces. Correct damage caused by painting to the satisfaction of the Owner's representative.

D. At the completion of construction activities of all other trades, touch up and restore damaged or defaced painted surfaces.

3.8 SCHEDULES

A. Pavement Marking:

1. LGA's Standard handicapped parking space and isle pavement marking in each handicapped space indicated by symbol on Drawings.

B. Signage

1. LGA's Standard handicapped parking space signage at the head of each space and handicapped access signs as detailed on the drawings.
2. Parking Space Signage as indicated in Section 01020 – Allowances.

END OF SECTION 02750

SECTION 02751 - CONCRETE PAVEMENT

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes cement concrete pavement for walkways:

1.2 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening steel reinforcement. Manufacture bar supports according to CRSI's "Manual of Standard Practice.

B. Joint Dowel Bars: plain steel bars, ASTM A 615/A 615M, Grade 60. Cut bars true to length with ends square and free of burrs.

2.2 CONCRETE MATERIALS

A. Portland Cement: ASTM C 150, Type I or II, gray.

1. Fly Ash: ASTM C 618, Class F or C.
2. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

B. Aggregate: ASTM C 33, uniformly graded, from a single source.

C. Water: ASTM C 94.

D. Synthetic Fiber: Fibrillated or monofilament polypropylene fibers engineered and designed for use in concrete pavement, complying with ASTM C 1116, Type III, 1/2 to 1-1/2 inch (13 to 38 mm) long.

1. Available Products:
   a. Fibrillated Fibers:
      1. Axim Concrete Technologies, Fibrasol F.
      2. FORTA Corporation, Forta

3. Euclid Chemical Company (The); Fiberstrand F.
4. Grace, W.R. & Co. – Conn., Grace Fibers.
5. SI Concrete Systems, Fibermesh.

E. Admixtures: Certified by manufacturer to contain not more than 0.1 percent water-soluble chloride ions by mass of cement and to be compatible with other admixtures, as follows:

1. Air-Entraining Admixture: ASTM C 260.
2. Water-Reducing Admixture: ASTM C 494, Type A.
3. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.
4. Water-Reducing and Accelerating Admixture: ASTM C 494, Type E.
5. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.

F. Curing Materials:

1. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) dry.
2. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
3. Water: Potable.
4. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
5. Clear Waterborne Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.

G. Related Materials:

1. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber, or ASTM D 1752, cork or self-expanding cork.

2.3 CONCRETE MIXES AND MIXING

A. Concrete Mixes: Prepare design mixes, proportioned according to ACI 211.1 and ACI 301, with the following properties:

1. Compressive Strength (28 Days): 3500 psi (24.1 MPa).
2. Maximum Water-Cementitious Materials Ratio: comply with VDOT 217.
3. Slump Limit: comply with VDOT 217.
4. Air Content: 6 percent plus or minus 2.0 percent for 1 inch nominal maximum aggregate size.

B. Synthetic Fiber: Uniformly disperse in concrete mix at manufacturer's recommended rate, but not less than 1.5 lb/cu. yd. (0.60 kg/cu. m).

C. Ready-Mixed Concrete: Comply with requirements and with ASTM C 94 and ASTM C 1116.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Surface Preparation: Proof-roll prepared subbase, and remove loose material from surface.

B. Forms: Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for pavement to required lines, grades, and elevations.

C. Joints: Locate and install construction, isolation, contraction, and expansion joints as indicated.

D. Concrete Placement: Comply with recommendations in ACI 304R for measuring, mixing, transporting, and placing concrete. Place concrete in a continuous operation within planned joints or sections.

1. Moisten subbase to provide a uniform dampened condition at time concrete is placed.
2. Consolidate concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping according to recommendations in ACI 309R.
3. Screed and initial-float concrete surfaces with darby or bull float before excess moisture or bleed water appears on the surface.
4. Protect concrete from cold or hot weather during mixing, placing, and curing.

D. Evaporation Retarder: Apply to concrete surfaces if hot, dry, or windy conditions cause moisture loss before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

3.2 FINISHES AND CURING

A. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and the concrete surface has stiffened sufficiently to permit operations. Float surfaces to true planes with gaps below 10-foot- (3-m-) long, unleveled straightedge not to exceed 1/4 inch (6 mm). 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.

B. Curing: Begin curing after finishing concrete, but not before free water has disappeared from concrete surface. Cure concrete by one or a combination of the following methods:

1. Moisture cure concrete by water, continuous fog spray, continuously wet absorptive cover, or by moisture-retaining-cover curing. Keep surfaces continuously moist for not less than seven days.
2. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

3.3 REPAIRS AND PROTECTION

A. Remove and replace concrete pavement that is broken, damaged, or defective, or does not meet 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 02751

SECTION 02922 - PERMANENT SEEDING

PART 1 - GENERAL

1.1 Description: As follows:

A. The work of this section consists of seeding, fertilizing, and mulching of lawn areas.

1.2 Submittals:

A. As specified in Division 1. Submit one cubic foot mulch sample of mulch, if commercial mulch is used. Provide labels of grass seed bags of each type used.

1.3 Product Handling:

A. Seed: Deliver in acceptable condition in original, unopened containers with seed label attached to each container.

B. Limestone: Deliver in original, unopened containers with identifying mark and analysis attached.

C. Fertilizer: Deliver in original, unopened containers with analysis, type, and trade name attached.

D. Deliver all materials to the site with their labels intact and legible. Replace materials that become wet or damaged at no additional expense to the Owner. Store in weatherproof storage area, free from the affects of the weather.

1.4 Project Conditions:

A. Seed during recommended planting period or as approved.

1. All areas of this contract are to be permanently seeded within three (3) days of finish grading, and shall be seeded within 7 days with temporary seeding if they are to be left idle in a disturbed state more than thirty (30) days.

1.5 Guarantee:

A. The Contractor shall produce dense, vigorous, well established lawns and shall maintain lawn areas until final acceptance of the work by the A/E. Any areas which fail to show a uniform stand of grass shall be reworked, and reseeded at the Contractor's expense with the same seed as originally used thereon, and such reseeding shall be replaced until all required areas are covered with a satisfactory stand of grass. A satisfactory stand of grass shall be defined as a cover of living grass in which gaps larger than 2 inches are not occurring at final acceptance.

1.6 Quality Assurance:

A. Provide only quality seeds as approved and certified by the Commonwealth of Virginia.

PART 2 - PRODUCTS

2.1 TOPSOIL: As specified in Division 31.

2.2 Lime: As required by soil test.

A. Agricultural limestone containing minimum of 85 percent carbonates. Minimum gradation: 100 percent passing a 10 mesh sieve; 98 percent a 20 mesh sieve; 55 percent a 60 mesh sieve; and 40 percent a 10 mesh sieve.

2.3 Fertilizer:

A. FS O-F-241D, granular, or pelleted; complete commercial type with 50 percent of the nitrogen in slowly available form. All fertilizer shall be a commercial balanced formula with at best 25 percent organic material, and shall conform to applicable state fertilizer laws. It shall be uniform in composition, in granular form dry and free-flowing. For all grass and lawn areas it shall have a minimum guaranteed analysis of 15 percent nitrogen, 30 percent phosphorus, and 15 percent potash. Fertilizer, unless otherwise specified shall be delivered mixed as specified, in standard size, unopened containers, showing weight, analysis, and name of manufacturer.

B. Store in weatherproof place and in a manner that will be dry and its effectiveness unimpaired.

2.4 Seed:

A. FS JJJ-S-181B. All permanent Grass seed and Temporary seed specified in this section will be manufactured by a seed company that can guarantee all seed shall be free of noxious weed seeds, cleaned Grade A recent crop seed. Seed company shall provide guaranteed germination of 80 percent.

2.5 Permanent Grass Seed:

A. Seed mixture below is proportioned by weight.

1. Seed mixture shall consist of: 25% Kentucky Bluegrass (Mix of 3 varieties), 75% Turf Type Tall Fescure (Rebel 3D, Titan 2, Shenandoan, Finelawn 88, Anthem) complying with minimum germination, purity, weed content as specified in Virginia Seed and Sod laws, VDOT Standards. Kentucky 31 is NOT acceptable. Percentages determined by weight. All seed shall be certified seed.

2.6 Mulch:

A. Clean wheat or barley straw, free from noxious weed seed and other harmful material. Commercial products may be used with approval.

2.7 Binder:

A. Fiber mulch based tack binder such as “Enviro-Blend” by Conwed or equal. Apply at 25 lbs. per thousand square feet according to manufacturer’s recommendations.

PART 3 - EXECUTION

3.1 Preparation:

A. General: The Contractor shall prior to seeding operations, repair any ruts, depressions, eroded areas, as directed.

3.2 Grass Area Preparation:

A. Loosen soil to a depth of three inches in all areas by approved method of scarification, by either pulverizing or disking the seedbed. Remove stones or foreign matter over 2 inch in diameter from soil surface.

B. Lime deficiency of soil in grass areas shall be tested to a depth of 6 inches by a Soil Science Lab through seed contractor to determine whether lime is needed. Send results of tests to A/E.

C. Spread Fertilizer at a rate of 4 pounds per thousand square feet on grass seed areas. Fertilizer shall be distributed evenly, by mechanical spreader, over all areas to be seeded. Fertilizer shall be applied not more than one week prior to seeding. Fertilizer to be uniformly distributed in the top 2 inches to 4 inches of seed bed.

D. Finish Grade - immediately prior to seeding the bed shall be prepared by breaking, disking, harrowing, blading, dragging or other approved methods. The soil shall be thoroughly pulverized to minimum depth of approximately three inches and smoothed by means of raking or other approved methods. Raking shall be done by hand adjacent to structures, walks, curbing, and trees.

E. Final seed bed preparation shall be performed at such time that the seeding work will follow within three days, weather permitting.

3.3 Seeding:

A. General: Seeding and straw cover shall be done during sunny weather conditions and when wind is five miles per hour or less.

B. Method: Within three days of when the finish grading operations are performed (with no rain between operations) and after approved by the A/E the seed shall be applied at the rate specified above by means of an approved mechanical seed spreader which will provide a seeding depth of 1/8 inch to 1/4 inch. Seed in two directions perpendicular to each other, using half of the specified amount in each application. Seeding shall be done using a Drill Seeder or a Brillion Seeder or approved equal.

3.4 Mulching:

A. Immediately after rolling, apply mulch uniformly to a depth of 2 inches. Application by mechanical methods is preferred; however, mulch chopped or cut into short pieces will not be acceptable. Secure mulch in place by staking and tying or by spraying with binder. Apply binder at the rate of 6 to 10 gallons per 1,000 square feet.

3.5 Watering:

A. After mulching, water with a mist spray soaking ground to minimum depth of 2 inches. Water as necessary until final inspection.

3.6 Clean-Up

A. Upon completion of work, remove debris and leave area in clean, acceptable condition.

3.7 Maintenance and Protection:

A. Maintain lawn including the preparation and reseeding of any bare areas, proper watering, refilling of rain-washed gullies and rutted areas, refertilizing, mowing, cultivation, weeding, disease and insect control, protective spraying, and all other procedures necessary to produce a normal healthy and vigorous lawn. Maintain lawn until final acceptance.
B. At least three mowings shall be completed in grass areas before the work will be accepted. Mower blades shall be set 2 1/2 inches to 3 inches high.
C. Water all areas which have been seeded except when natural precipitation has provided the necessary moisture as determined by the A/E. Watering shall be done in a manner which will prevent erosion due to the application of excessive quantities, and the watering equipment shall be of a type that will not damage the finished surface. A minimum amount of rainfall would be two one inch rains per week.
D. Protect seeded areas against traffic or other use by placing warning signs as approved by the A/E and protective fencing as specified.
E. Should an area receive excessive run-off and become eroded, protect area long enough to establish grass. Use jute or excelsior mat.

3.8 Inspection:

A. Contractor shall maintain grass by watering, weeding, fertilizing and re-seeding as necessary until lawn area is established and accepted. If grass and erosion mix areas are being readied for inspection, no individual area of any lawn shall have bare spots to cover more than 5 percent of individual lawn areas.
B. Re-seed gaps larger than 2 inches in lawn area prior to final acceptance. This shall be accomplished through mechanical means using a slit-seeder or a core aerator.

END OF SECTION 329220

SECTION 02923 – FINISH GRADING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Providing, placing on previously prepared subgrade, and grading topsoil to finish grade.

1.2 RELATED SECTIONS

A. Division 1 – GENERAL CONDITIONS: Including but not limited to:

1. Coordination of Work,
2. Submittals; Procedure for submittals, and
3. Protection of the finished Work.

B. Section 02230 – Site Preparation and Clearing: Preparation for land disturbance, protection of the Work, and stripping and stockpiling topsoil.

C. Section 02300 – Earthwork.

D. Section 02410 – Erosion & Sediment Control.

E. Section 02930 – Exterior Planting; Planting soil depths.

1.3 SUBMITTALS FOR INFORMATION

A. Comply with applicable section of Div. 1: Submittals; Procedures for submittals.

PART 2 PRODUCTS

2.1 MATERIAL

A. Topsoil: Fill Type T1 as specified in Section 02300 – Earthwork and Section 02921 – Topsoil.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that building, utility and miscellaneous backfilling have been inspected.

B. Verify that subgrade has been contoured and compacted and that uneven areas, low spots, and stockpiles have been eliminated.

3.2 SUBGRADE PREPARATION

A. Remove debris, roots, branches, stones, in excess of ½ inch (13 mm) in size. Remove subsoil contaminated with petroleum products.

B. Scarify subgrade to depth of 3 inches (75 mm) where topsoil is scheduled. Re-scarify in areas where equipment used for hauling and spreading topsoil has compacted subsoil.

3.3 PLACING TOPSOIL

A. Establish limits.

B. Coordinate placing topsoil with exterior planting operations and planting soil extents defined in Section 02930.

C. Use only imported topsoil in accordance with Section 02921. Do not deliver or place topsoil in frozen, wet or muddy condition.

D. Place topsoil in areas where seeding to thickness as scheduled. Manually spread topsoil site improvements, and buildings to prevent damage. Place topsoil during dry weather.

E. Fine grade topsoil eliminating rough or low areas. Maintain profiles and contour of subgrade.

F. Remove roots, weeds, rocks and foreign material while spreading.

G. Lightly compact placed topsoil.

H. Unless otherwise noted or indicated, compacted surface of placed topsoil shall be ½" below top of header boards, walks, pavements, and utility structures. Where upslope and against curb, flush with top of curb to allow positive drainage.

3.4 SCHEDULE

A. All required topsoil (per schedule) shall be in place prior to any landscaping activities within the area to immediately receive landscaping.

3.5 TOLERANCES

A. Top of Topsoil: Plus or minus ½ inch (13 mm) adjacent to improvements; 1 inch (25 mm) within 100 feet of buildings; and 2 inches (50 mm) on surrounding fields and slopes.

3.6 PROTECTION

A. Comply with applicable section of Div. 1: Temporary Controls; Protection of the Work.

B. Comply with Section 02230 – Site Preparation and Clearing: Protection.

C. Protect landscaping and other features remaining as final work.

D. Protect any/all existing site improvements including structures, fences, sidewalks, utilities, paving and curbs.

3.7 SCHEDULES

A. Refer to Section 02921 – Topsoil.

END OF SECTION 02923

SECTION 02930 - EXTERIOR PLANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Trees
2. Shrubs
3. Groundcover
4. Perennials/Grasses
5. Planting Soil

B. Related Sections include the following:

1. Division 31 Section "Site Clearing" for protection of existing trees and planting, topsoil stripping and stockpiling, and site clearing.
2. Division 31 Section "Earthwork" for excavation, filling, and rough grading and for subsurface aggregate drainage and drainage backfill materials.
3. Division 33 Section "Subdrainage" for below-grade drainage of landscaped areas, paved areas, and wall perimeters.
4. Division 32 Section “Permanent Seed”

1.3 DEFINITIONS

A. Balled and Burlapped Stock: Exterior plants dug with firm, natural balls of earth in which they are grown, with ball size not less than diameter and depth recommended by ANSI Z60.1 for type and size of tree or shrub required; wrapped, tied, rigidly supported, and drum-laced as recommended by ANSI Z60.1.

B. Balled and Potted Stock: Exterior plants dug with firm, natural balls of earth in which they are grown and placed, unbroken, in a container. Ball size is not less than diameter and depth recommended by ANSI Z60.1 for type and size of exterior plant required.

C. Container-Grown Stock: Healthy, vigorous, well-rooted exterior plants grown in a container with well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for kind, type, and size of exterior plant required.

D. Finish Grade: Elevation of finished surface of planting soil.

E. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.

F. Planting Soil: Native or imported topsoil, manufactured topsoil, or surface soil modified to become topsoil; mixed with soil amendments.

G. Subgrade: Surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill, before placing planting soil.

1.4 SUBMITTALS

A. Material Test Reports: For existing surface soil and imported topsoil.

B. Planting Schedule: Indicating anticipated planting dates for exterior plants.

C. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of exterior plants during a calendar year. Submit before expiration of required maintenance periods.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful establishment of exterior plants.

1. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when exterior planting is in progress.

B. Soil-Testing Laboratory Qualifications: An independent laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.

C. Topsoil Analysis: Furnish soil analysis by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; deleterious material; pH; and mineral and plant-nutrient content of topsoil.

1. Report suitability of topsoil for plant growth. State recommended quantities of nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce a satisfactory topsoil.

D. Provide quality, size, genus, species, and variety of exterior plants indicated, complying with applicable requirements in ANSI Z60.1, "American Standard for Nursery Stock."

E. Tree and Shrub Measurements: Measure according to ANSI Z60.1 with branches and trunks or canes in their normal position. Do not prune to obtain required sizes. Take caliper measurements 6 inches above ground for trees up to 4-inch caliper size, and 12 inches above

ground for larger sizes. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip-to-tip.

F. Observation: Landscape Architect may observe trees and shrubs either at place of growth or at site before planting for compliance with requirements for genus, species, variety, size, and quality. Landscape Architect retains right to observe trees and shrubs further for size and condition of balls and root systems, insects, injuries, and latent defects and to reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.

1. Notify Landscape Architect of sources of planting materials no less than seven days in advance of delivery to site.

G. Preinstallation Conference: Attend conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver exterior plants freshly dug.

1. Immediately after digging up bare-root stock, pack root system in wet straw, hay, or other suitable material to keep root system moist until planting.

B. Do not prune trees and shrubs before delivery, except as approved by Landscape Architect. Protect bark, branches, and root systems from sun scald, drying, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of exterior plants during delivery. Do not drop exterior plants during delivery.

C. Handle planting stock by root ball.

D. Deliver exterior plants after preparations for planting have been completed and install immediately. If planting is delayed more than six hours after delivery, set exterior plants and trees in shade, protect from weather and mechanical damage, and keep roots moist.

1. Heel-in bare-root stock. Soak roots in water for two hours if dried out.
2. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
3. Do not remove container-grown stock from containers before time of planting.
4. Water root systems of exterior plants stored on-site with a fine-mist spray. Water as often as necessary to maintain root systems in a moist condition.

E. In the event of damage or rejection, immediately make all replacements necessary to the approval of the Landscape Architect and at no additional cost to the Owner.

1.7 COORDINATION

A. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion.

1. Spring Planting: Recommended April 15 – June 15
2. Fall Planting: Recommended September 15 – November 15
3. No Planting shall be done in frozen ground, when snow covers ground or when site is muddy.

B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit.

C. Coordination with Lawns: Plant trees and shrubs after finish grades are established and before planting lawns, unless otherwise acceptable to Landscape Architect.

1. When planting trees and shrubs after lawns, protect lawn areas and promptly repair damage caused by planting operations.

D. Utilities:

1. The exact location of all existing and proposed underground and overhead utilities shall be verified by the Contractor and he shall conduct his work so as to prevent interruption of service and damage to any system. The Contractor shall protect existing structures and utility services and be responsible for their replacement if damaged by him or to make necessary adjustment in their location if required in order to complete the work of this contract.
2. Should the Contractor damage any utility during his work, he shall replace and/or repair the utility as it existed prior to the damage at his own expense.

1.8 WARRANTY

A. Special Warranty: Warrant the following exterior plants, for the warranty period indicated, against defects including death and unsatisfactory growth.

1. Warranty Period for Trees and Shrubs: One year from date of Substantial Completion.
2. Warranty Period for Ground Cover and Plants: One year from date of Substantial Completion.
3. Remove dead exterior plants immediately. Replace immediately unless required to plant in the succeeding planting season.
4. Replace exterior plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
5. A limit of one replacement of each exterior plant will be required, except for losses or replacements due to failure to comply with requirements.

1.9 MAINTENANCE

A. Trees and Shrubs: Maintain for the following maintenance period by pruning, cultivating, watering, weeding, fertilizing, restoring planting saucers, tightening and repairing stakes and

guy supports, and resetting to proper grades or vertical position, as required to establish healthy, viable plantings. Spray as required to keep trees and shrubs free of insects and disease. Restore or replace damaged tree wrappings.

1. Maintenance Period: 12 months from date of Substantial Completion.

B. Ground Cover and Perennials: Maintain for the following maintenance period by watering, weeding, fertilizing, and other operations as required to establish healthy, viable plantings:

1. Maintenance Period: 12 months from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 TREE AND SHRUB MATERIAL

A. General: Furnish nursery-grown trees and shrubs complying with ANSI Z60.1, with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock free of disease, insects, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.

B. Grade: Provide trees and shrubs of sizes and grades complying with ANSI Z60.1 for type of trees and shrubs required. Trees and shrubs of a larger size may be used if acceptable to Landscape Architect, with a proportionate increase in size of roots or balls.

C. Label at least one tree and one shrub of each variety and caliper with a securely attached, waterproof tag bearing legible designation of botanical and common name.

D. If formal arrangements or consecutive order of trees or shrubs is shown, select stock for uniform height and spread, and number label to assure symmetry in planting.

2.2 SHADE AND FLOWERING TREES

A. Shade Trees: Single-stem trees with straight trunk, well-balanced crown, and intact leader, of height and caliper indicated, complying with ANSI Z60.1 for type of trees required.

1. Provide balled and burlapped trees.
2. Branching Height: One-third to one-half of tree height.

B. Small Spreading Trees: Branched or pruned naturally according to species and type, with relationship of caliper, height, and branching according to ANSI Z60.1; stem form as follows:

1. Stem Form: Single stem.
2. Provide balled and burlapped trees.

C. Multistem Trees: Branched or pruned naturally according to species and type, with relationship of caliper, height, and branching according to ANSI Z60.1; stem form as follows:

1. Stem Form: Clump with 2 or more main stems.
2. Provide balled and burlapped trees.

2.3 DECIDUOUS SHRUBS

A. Form and Size: Deciduous shrubs with not less than the minimum number of canes required by and measured according to ANSI Z60.1 for type, shape, and height of shrub.

2.4 CONIFEROUS EVERGREENS

A. Form and Size: Normal-quality, well-balanced, coniferous evergreens, of type, height, spread, and shape required, complying with ANSI Z60.1.

B. Form and Size: Specimen-quality, exceptionally heavy, tightly knit, symmetrically shaped coniferous evergreens and the following grade:

2.5 BROADLEAF EVERGREENS

A. Form and Size: Normal-quality, well-balanced, broadleaf evergreens, of type, height, spread, and shape required, complying with ANSI Z60.1.

2.6 GROUNDCOVER PLANTS

A. Groundcover: Provide ground cover of species indicated, established and well rooted in pots or similar containers, and complying with ANSI Z60.1.

2.7 PERENNIALS / ORNAMENTAL GRASSES

A. Perennials: Provide healthy, field-grown plants from a commercial nursery, of species and variety shown or listed.

2.8 ORGANIC SOIL AMENDMENTS

A. Compost: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 3/4-inch sieve; soluble salt content of 5 to 10 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:

1. Organic Matter Content: 50 to 60 percent of dry weight.
2. Feedstock: Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.

B. Peat: Sphagnum peat moss, partially decomposed, finely divided or granular texture, with a pH range of 3.4 to 4.8.

C. Peat: Finely divided or granular texture, with a pH range of 6 to 7.5, containing partially decomposed moss peat, native peat, or reed-sedge peat and having a water-absorbing capacity of 1100 to 2000 percent.

D. Wood Derivatives: Decomposed, nitrogen-treated sawdust, ground bark, or wood waste; of uniform texture, free of chips, stones, sticks, soil, or toxic materials.

1. In lieu of decomposed wood derivatives, mix partially decomposed wood derivatives with at least 0.15 lb (2.4 kg) of ammonium nitrate or 0.25 lb (4 kg) of ammonium sulfate per cubic foot (cubic meter) of loose sawdust or ground bark.

E. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, and material harmful to plant growth.

2.9 ORGANIC FERTILIZER

A. Bonemeal: Commercial, steamed, finely ground (1-13-0).

B. Blood meal: containing 13% nitrogen.

B. Potash: containing 51% soluble material.

2.10 MULCHES

A. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:

1. Type: Shredded hardwood.

2.11 STAKES AND GUYS

A. Upright and Guy Stakes: Rough-sawn, sound, new hardwood, redwood, free of knots, holes, cross grain, and other defects, 2 by 2 inches by length indicated, pointed at one end.

B. Arbor Tie: ¾" wide, 900 lb break strength, manufactured by Deep Root, 81 Longton Street, Suite 4, San Francisco, CA 94103, Tel: 800-458-7668, or Approved equal.

2.14 PLANTING SOIL MIX

A. Planting Soil Mix: Mix topsoil with the following soil amendments and fertilizers in the following quantities:

1. Add amendments and fertilizers per recommendations from soil testing agency.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive exterior plants for compliance with requirements and conditions affecting installation and performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities, and lawns and existing exterior plants from damage caused by planting operations.

B. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

C. Lay out individual tree and shrub locations and areas for multiple exterior plantings. Stake locations, outline areas, adjust locations when requested, and obtain Landscape Architect's acceptance of layout before planting. Make minor adjustments as required.

D. Lay out exterior plants at locations directed by Landscape Architect. Stake locations of individual trees and shrubs and outline areas for multiple plantings.

3.3 PLANTING BED ESTABLISHMENT

A. Loosen subgrade of planting beds to a minimum depth as follows:

Area	Depth of Planting Soil Mix
For Flowers and Ground Cover Beds	6” Deep for entire bed
For Shrubbery Plant Beds	12” Deep for entire bed
For Tree Pits and Shrub Pits	12” Deep by 2.5 time ball dia.

Remove stones larger than 1 inch in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

1. Apply fertilizer directly to subgrade before loosening.
2. Thoroughly blend planting soil mix off-site before spreading

    a. Delay mixing fertilizer with planting soil if planting will not proceed within a few days.
    b. Mix lime with dry soil before mixing fertilizer.

3. Spread planting soil mix to a depth as indicated above but not less than required to meet finish grades after natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.

    a. Spread approximately one-half the thickness of planting soil mix over loosened subgrade. Mix thoroughly into top 4 inches of subgrade. Spread remainder of planting soil mix.

B. Finish Grading: Grade planting beds to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

C. Restore planting beds if eroded or otherwise disturbed after finish grading and before planting.

3.4 TREE AND SHRUB EXCAVATION

A. Pits and Trenches: Excavate circular pits with sides sloped inward. Trim base leaving center area raised slightly to support root ball and assist in drainage. Do not further disturb base. Scarify sides of plant pit smeared or smoothed during excavation.

1. Excavate approximately three times as wide as ball diameter for balled and burlapped and container-grownstock.
2. Excavate at least 12 inches (300 mm) wider than root spread and deep enough to accommodate vertical roots for bare-root stock.
3. If drain tile is shown or required under planted areas, excavate to top of porous backfill over tile.

B. Subsoil removed from excavations may be used as backfill.

C. Obstructions: Notify Landscape Architect if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.

1. Hardpan Layer: Drill 6-inch- (150-mm-) diameter holes into free-draining strata or to a depth of 10 feet (3 m), whichever is less, and backfill with free-draining material.

D. Drainage: Notify Landscape Architect if subsoil conditions evidence unexpected water seepage or retention in tree or shrub pits.

E. Fill excavations with water and allow to percolate away before positioning trees and shrubs.

F. Install root barrier where indicated.

3.5 TREE AND SHRUB PLANTING

A. Set balled and burlapped stock plumb and in center of pit or trench with top of root ball 2-4” above adjacent finish grades.

1. Remove burlap and wire baskets from tops of root balls and partially from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
2. Place planting soil mix around root ball in layers, tamping to settle mix and eliminate voids and air pockets. When pit is approximately one-half backfilled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed. Water again after placing and tamping final layer of planting soil mix.

B. Set container-grown stock plumb and in center of pit or trench with top of root ball 1 inchadjacent finish grades.

1. Carefully remove root ball from container without damaging root ball or plant.
2. Place planting soil mix around root ball in layers, tamping to settle mix and eliminate voids and air pockets. When pit is approximately one-half backfilled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed. Water again after placing and tamping final layer of planting soil mix.

3.6 TREE AND SHRUB PRUNING

A. Prune, thin, and shape trees and shrubs only as directed by Landscape Architect.

3.7 GUYING AND STAKING

A. Upright Staking and Tying: Stake trees of 2- through 5-inch caliper. Stake trees of less than 2-inch caliper only as required to prevent wind tip-out. Use a minimum of 2 stakes of length required to penetrate at least 18 inches below bottom of backfilled excavation and to extend at least 72 inches above grade. Set vertical stakes and space to avoid penetrating root balls or root masses. Support trees with guying material as indicated. Allow enough slack to avoid rigid restraint of tree. Use the number of stakes as follows:

1. Use 2 stakes for trees up to 12 feet (3.6 m) high and 2-1/2 inches (63 mm) or less in caliper; 3 stakes for trees less than 14 feet (4.2 m) high and up to 4 inches (100 mm) in caliper. Space stakes equally around trees.

B. Guying and Staking: Guy and stake trees exceeding 14 feet in height and more than 3 inches in caliper, unless otherwise indicated. Securely attach no fewer than 3 guys to stakes 30 inches long, driven to grade.

1. For trees more than 6 inches (150 mm) in caliper, anchor guys to deadmen 8 inches (200 mm) in diameter and 48 inches (1200 mm) long buried at least 36 inches (900 mm) below grade.

3.8 EDGING INSTALLATION

A. Aluminum Edging: Install aluminum edging where indicated according to manufacturer's written instructions. Anchor with aluminum stakes spaced approximately 36 inches apart, driven below top elevation of edging.

3.9 GROUNDCOVER AND PLANT PLANTING

A. Set out and space groundcover, perennials, and ornamental grasses as indicated.

B. Dig holes large enough to allow spreading of roots, and backfill with planting soil.

C. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.

D. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.

E. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.10 PLANTING BED MULCHING

A. Mulch backfilled surfaces of planting beds and other areas indicated.

1. Organic Mulch: Apply 3-inch average thickness of organic mulch, and finish level with adjacent finish grades. Do not place mulch against plant stems.

3.11 CLEANUP AND PROTECTION

A. During exterior planting, keep adjacent pavings and construction clean and work area in an orderly condition.

B. Protect exterior plants from damage due to landscape operations, operations by other contractors and trades, and others. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged exterior planting.

3.12 DISPOSAL

A. Disposal: Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off Owner's property.

3.13 FINAL INSPECTION

A. Contractor shall notify the Owner and Landscape Architect upon completion of warrenty period. Contractor shall request final inspection prior to end of warrenty period.

B. Should any plant material be dead, or in an unhealthy state of growth as determined by the Landscape Architect at the end of the one year period, Contractor shall make all work acceptable and request a reinspection by the Owner and Landscape Architect. Any replaced plant material is warrenteed one year from the replacement plants' planting date.

END OF SECTION 329305

SECTION 03300 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes cast-in-place concrete, including reinforcement, concrete materials, mix design, placement procedures, and finishes.

1.2 SUBMITTALS

A. Product Data: For each manufactured material and product indicated.

B. Design Mixes: For each concrete mix indicated.

C. Shop Drawings: Include details of steel reinforcement placement including material, grade, bar schedules, stirrup spacing, bent bar diagrams, arrangement, and supports.

D. Material certificates.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.

B. Comply with ACI 301, "Specification for Structural Concrete," including the following, unless modified by the requirements of the Contract Documents.

1. General requirements, including submittals, quality assurance, acceptance of structure, and protection of in-place concrete.
2. Formwork and form accessories.
3. Steel reinforcement and supports.
4. Concrete mixtures.
5. Handling, placing, and constructing concrete.
6. Lightweight concrete.

C. Preinstallation Conference: Conduct conference at Project site.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Formwork: Furnish formwork and form accessories according to ACI 301.

B. Steel Reinforcement:

1. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.

2. Plain-Steel Welded Wire Fabric: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.

C. Concrete Materials:

1. Portland Cement: ASTM C 150, Type I or II.
2. Normal-Weight Aggregate: ASTM C 33, uniformly graded, not exceeding 1-1/2-inch (38-mm) nominal size.
3. Water: Complying with ASTM C 94.
4. Synthetic Fiber: Fibrillated or monofilament polypropylene fibers engineered and designed for use in concrete, complying with ASTM C 1116, Type III, 1/2 to 1-1/2 inches (13 to 38 mm) long.

D. Admixtures:

1. Air-Entraining Admixture: ASTM C 260.
2. Water-Reducing Admixture: ASTM C 494, Type A.
3. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.
4. Water-Reducing and Accelerating Admixture: ASTM C 494, Type E.
5. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.

E. Vapor Retarder: Multi-ply reinforced polyethylene sheet, ASTM E 1745, Class C, not less than 7.8 mils (0.18 mm) thick; or polyethylene sheet, ASTM D 4397, not less than 10 mils (0.25 mm) thick.

1. Fine-Graded Granular Material: Clean mixture of crushed stone, crushed gravel, and manufactured or natural sand; ASTM D 448, Size 10, with 100 percent passing a No. 4 (4.75-mm) sieve and 10 to 30 percent passing a No. 100 (0.15-mm) sieve; complying with deleterious substance limits of ASTM C 33 for fine aggregates.

F. Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.

G. Curing Materials:

1. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
2. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf.
3. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
4. Water: Potable.
5. Clear,Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.

2.2 CONCRETE MIXES

A. Comply with ACI 301 requirements for concrete mixtures.

B. Prepare design mixes, proportioned according to ACI 301, for normal-weight concrete determined by either laboratory trial mix or field test data bases, as follows:

1. Compressive Strength (28 Days): 4000 psi (27.6 MPa).
2. Slump: 4 inches (100 mm).

a. Slump Limit for Concrete Containing High-Range Water-Reducing Admixture: Not more than 8 inches (200 mm) after adding admixture to plant- or site-verified, 2- to 3-inch (50- to 75-mm) slump.

C. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content of 2.5 to 4.5 percent

1. Air content of trowel-finished interior concrete floors shall not exceed 3.0 percent.

D. Synthetic Fiber: Uniformly disperse in concrete mix at manufacturer's recommended rate, but not less than [1.0 lb/cu. yd. (0.60 kg/cu. m)] [1.5 lb/cu. yd. (0.90 kg/cu. m)].

2.3 CONCRETE MIXING

A. Ready-Mixed Concrete: Comply with ASTM C 94.

1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For mixer capacity of 1 cu. yd. (0.76 cu. m) or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
2. For mixer capacity larger than 1 cu. yd. (0.76 cu. m), increase mixing time by 15 seconds for each additional 1 cu. yd. (0.76 cu. m).

C. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mix type, mix time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Formwork: Design, construct, erect, shore, brace, and maintain formwork according to ACI 301.

B. Vapor Retarder: Install, protect, and repair vapor-retarder sheets according to ASTM E 1643; place sheets in position with longest dimension parallel with direction of pour.

1. Lap joints 6 inches (150 mm) and seal with manufacturer's recommended tape.
2. Cover vapor retarder with fine-graded granular material, moisten, and compact with mechanical equipment to elevation tolerances of plus 0 inch (0 mm) or minus 3/4 inch (19 mm).

C. Steel Reinforcement: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

D. Joints: Construct joints true to line with faces perpendicular to surface plane of concrete.

1. Construction Joints: Locate and install so as not to impair strength or appearance of concrete, at locations indicated or as approved by Architect.
2. Isolation Joints: Install joint-filler strips at junctions with slabs-on-grade and vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

a. Extend joint fillers full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.

3. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows:

a. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with groover tool to a radius of 1/8 inch (3 mm). Repeat grooving of contraction joints after applying surface finishes. Eliminate groover marks on concrete surfaces.
b. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3-mm-) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

E. Tolerances: Comply with ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

3.2 CONCRETE PLACEMENT

A. Comply with recommendations in ACI 304R for measuring, mixing, transporting, and placing concrete.

B. Do not add water to concrete during delivery, at Project site, or during placement.

C. Consolidate concrete with mechanical vibrating equipment.

3.3 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defective areas repaired and patched, and fins and other projections exceeding 1/4 inch (6 mm) in height rubbed down or chipped off.

1. Apply to concrete surfaces not exposed to public view.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defective areas. Completely remove fins and other projections.

1. Apply to concrete surfaces exposed to public view or to be covered with a coating or covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, or painting.
2. Do not apply rubbed finish to smooth-formed finish.
3. Apply smooth-rubbed finish, defined in ACI 301, to smooth-formed finished concrete.

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

3.4 FINISHING UNFORMED SURFACES

A. General: Comply with ACI 302.1R for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Screed surfaces with a straightedge and strike off. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane before excess moisture or bleedwater appears on the surface.

1. Do not further disturb surfaces before starting finishing operations.

C. Scratch Finish: Apply scratch finish to surfaces to receive concrete floor topping or mortar setting beds for ceramic or quarry tile, portland cement terrazzo, and other bonded cementitious floor finish, unless otherwise indicated.

D. Float Finish: Apply float finish to surfaces indicated, to surfaces to receive trowel finish, and to floor and slab surfaces to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.

E. Trowel Finish: Apply a hard trowel finish to surfaces indicated and to floor and slab surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin film-finish coating system.

F. Trowel and Fine-Broom Finish: Apply a partial trowel finish, stopping after second troweling, to surfaces indicated and to surfaces where ceramic or quarry tile is to be installed by either thickset or thin-set methods. Immediately after second troweling, and when concrete is still plastic, slightly scarify surface with a fine broom.

G. Nonslip Broom Finish: Apply a nonslip broom finish to surfaces indicated and to exterior concrete platforms, steps, and ramps. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.

3.5 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection, and follow recommendations in ACI 305R for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions occur before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Begin curing after finishing concrete, but not before free water has disappeared from concrete surface.

D. Cure formed and unformed concrete for at least seven days as follows:

1. Moisture Curing: Keep surfaces continuously moist with absorptive cover, water saturated and kept continuously wet.
2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to sample materials, perform tests, and submit test reports during concrete placement. Tests will be performed according to ACI 301.

1. Testing Frequency: One composite sample for each day's pour of each concrete mix exceeding 5 cu. yd. (4 cu. m), but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.
2. Testing Frequency: At least one composite sample for each 100 cu. yd. (76 cu. m) or fraction thereof of each concrete mix placed each day.

END OF SECTION 03300

SECTION 04850 – STONE VENEER SYSTEM

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Portland cement based manufactured stone veneer and trim.

B. Related Sections:
   1. 076200–Sheet Metal Flashing and Trim
   2. 07900–Joint Sealants.

1.02 REFERENCES

A. American National Standards Institute (ANSI):
   1. ANSI A118.4 Specifications for Latex-Portland Cement Mortar.

B. American Society for Testing and Materials (ASTM):
   1. ASTM C1329 Standard specification for Portland cement

C. Underwriter's Laboratory (UL): Building Materials Directory.

1.03 SUBMITTALS

A. Reference Section Submittal Procedures; submit following items:
   1. Product Data.
   2. Samples:
      a. Standard sample board consisting of small-scale pieces of veneer units showing full range of textures and colors.
      b. Full range of mortar colors.
   3. Verification Samples: Following initial sample selection submit “laid-up” sample board using the selected stone and mortar materials and showing the full range of colors expected in the finished Work; minimum sample size: 3 by 3 feet (1 by 1 m).
   4. Quality Assurance/Control Submittals:
      a. Qualifications:
         1) Proof of manufacturer qualifications.
         2) Proof of installer qualifications.
      b. Regulatory Requirements: Evaluation reports.
      c. Veneer manufacturer’s installation instructions.
      d. Installation instructions for other materials.

B. Closeout Submittals: Reference Section Closeout Submittals; submit following items:
   1. Maintenance Instructions.
   2. Special Warranties.

1.04 QUALITY ASSURANCE

A. Qualifications:
    1. Manufacturer Qualifications: Eldorado Stone LLC is the basis of design. Stone Veneer System to be provided by Eldorado Stone, LLC or equal.
    2. Installer Qualifications: Experienced mason familiar with installation procedures and related local, state and federal codes masonry.

B. Field Sample:
    1. Prepare 4 by 4 foot (1200 by 1200 mm) sample at a location on the structure as selected by the Architect. Use approved selection sample materials and colors. Include corner, wall and water table pieces.
    2. Obtain Architect's approval.
    3. Protect and retain sample as a basis for approval of completed manufactured stone work. Approved sample may be incorporated into completed work.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Reference Section Product Storage and Handling Requirements.

B. Follow manufacturer's instructions.

1.06 PROJECT/SITE CONDITIONS

A. Environmental Requirements: When air temperature is 40 degrees F (4.5 degrees C) or below, consult local building code for Cold-Weather Construction requirements.

1.07 WARRANTY

A. Special Warranty: Manufacturer's standard warranty coverage against defects in materials when installed in accordance with manufacturer's installation instructions.

PART 2 - PRODUCTS

2.01 MANUFACTURER

A. Eldorado Stone LLC is the basis of design. Stone Veneer System to be provided by Eldorado Stone, LLC or equal.

2.02 MATERIALS

A. Stone Veneer:
    1. Profile: Bluffstone. Include matching corner pieces and water table.

B. Veneer Unit properties: Precast veneer units consisting of portland cement, lightweight aggregates, and mineral oxide pigments.
    1. Compressive Strength: ASTM C 192 and ASTM C 39, 5 sample average: greater than 1,800 psi (12.4MPa).
    2. Shear Bond: ASTM C 482: 50 psi (345kPa), minimum.
    3. Freeze-Thaw Test: ASTM C 67: Less than 3 percent weight loss and no disintegration.
    4. Thermal Resistance: ASTM C 177: 0.473 at 1.387 inches thick

5. Weight per square foot: 2012 IBC and 2012 IRC, ASTM C1670, 15 pounds, saturated.

C. Weather Barrier: ICC AC-38, synthetic house wrap

D. Reinforcing: ASTM C 847, 2.5lb/yd^2 (1.4kg/m^2) galvanized expanded metal lath complying with code agency requirements for the type of substrate over which stone veneer is installed.

E. Mortar:
   1. Cement: Portland cement complying with ASTM C 1329.
   2. Lime: ASTM C 207.
   3. Sand: ASTM C 144, natural or manufactured sand.
   4. Water: Potable.

F. Bonding Agent: Exterior integral bonding agent meeting ASTM C 932

2.03 MORTAR MIXES

A. Standard Installation (Grouted Joints):
   1. Mix mortar in accordance with ASTM C 270,
   2. Polymer modified mortar complying with ANSI A118.4

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates upon which work will be installed.

B. Coordinate with responsible entity to perform corrective work on unsatisfactory substrates.

C. Commencement of work by installer is acceptance of substrate.

3.02 PREPARATION

A. Protection: Protect adjacent work from contact with mortar.

B. Surface Preparation: Prepare substrate in accordance with manufacturer's installation instructions for the type of substrate being covered.

3.03 INSTALLATION

A. Install and clean stone in accordance with manufacturer's installation instructions for Standard Installation (Grouted Joint) as specified above.

3.04 FIELD QUALITY CONTROL

A. Manufacturer's Field Services: Manufacturer’s Field Service Representative shall make one site visit review of on-going installation process but is not responsible for any errors or omissions that are not observed or are previously completed.

3.05 CLEANING

A. Remove protective coverings from adjacent work.

B. Cleaning Veneer Units:
   1. Wash with soft bristle brush and water/granulated detergent solution
   2. Rinse immediately with clean water

C. Removing Effloresence:
   1. Allow veneer to dry thoroughly
   2. Scrub with soft bristle brush and clean water
   3. Rinse immediately with clean water; allow to dry
   4. If efflorescence is still visible, contact ES Customer Service for assistance

END OF SECTION

SECTION 05500 - METAL FABRICATIONS

PART 1 - GENERAL

1.01 SUMMARY

A. Provide miscellaneous metal items fabricated from heavy gage ferrous metals and not provided with structural steel system:

1. Miscellaneous framing and supports as needed.

1.02 SUBMITTALS

A. Submit shop drawings and product data for new metal products

1.03 QUALITY ASSURANCE

A. Comply with governing codes and regulations. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Materials:

1. Steel plates, angles, shapes, and bars: ASTM A 36.
2. Bolts: ASTM A 325.
3. Fasteners: Zinc coated fasteners designed for loading and use.
4. Grout: Non-shrink non-metallic grout, Euco NS by Euclid Chemical Co or approved equal.
5. Concrete inserts: Galvanized ferrous castings.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Take field measurements prior to preparation of shop drawings and fabrication. Do not delay job; allow for cutting and fitting if field measurement not practical.

B. Form work true to line with sharp angles and edges. Weld continuously, grind flush and make smooth on exposed surfaces.

C. Install work plumb and level with hairline joints and ground flush welds.

D. Lintels: Provide sizes indicated with 8" bearing at each end.

E. Touch-up damaged coatings with shop primer and galvanize repair paint.

F. Paint items scheduled in accordance with painting section.

END OF SECTION

SECTION 06100 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Wood framing.
2. Wood supports.
3. Wood blocking.
4. Wood nailers.
5. Wood furring.
6. Wood grounds.
7. Wood sheathing.
8. Wood subflooring.
9. Wood underlayment.
10. Plywood backing panels.

1.2 SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product indicated.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that materials comply with requirements.

B. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses.

C. Research/Evaluation Reports: For the following:

1. Treated wood.
2. Engineered wood products.
3. Foam-plastic sheathing.
4. Power-driven fasteners.
5. Powder-actuated fasteners.
6. Expansion anchors.
7. Metal framing anchors.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.

2.2 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of lumber grading agencies certified by the American Lumber Standards Committee Board of Review.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. For exposed lumber indicated to receive stained or natural finish, mark grade stamp on end or back of each piece, or omit grade stamp and provide certificates of grade compliance issued by grading agency.
3. Provide dressed lumber, S4S, unless otherwise indicated.
4. Provide dry lumber with 19 percent maximum moisture content at time of dressing for 2-inch nominal (38-mm actual) thickness or less, unless otherwise indicated.

B. Engineered Wood Products: Acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.

1. Allowable Design Stresses: Meet or exceed those indicated per manufacturer's published values determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

C. Wood Structural Panels:

1. Plywood: Either DOC PS 1 or DOC PS 2, unless otherwise indicated.
2. Oriented Strand Board: DOC PS 2.
3. Comply with "Code Plus" provisions in APA Form No. E30K, "APA Design/Construction Guide: Residential & Commercial."

2.3 WOOD-PRESERVATIVE-TREATED MATERIALS

A. Preservative Treatment by Pressure Process: AWPA C2 (lumber) and AWPA C9 (plywood), except that lumber that is not in contact with the ground and is continuously protected from liquid water may be treated according to AWPA C31 with inorganic boron (SBX).

B. Kiln-dry material after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.

C. Mark each treated item with treatment quality mark of an inspection agency approved by the American Lumber Standards Committee Board of Review.

D. Application: Treat items indicated on Drawings, and the following:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
3. Wood framing members less than 18 inches (460 mm) above grade.

4. Wood floor plates that are installed over concrete slabs directly in contact with earth.

2.4 FIRE-RETARDANT-TREATED MATERIALS

A. General: Where fire-retardant-treated materials are indicated, provide materials that comply with performance requirements in AWPA C20 (lumber) and AWPA C27 (plywood). Identify fire-retardant-treated wood with appropriate classification marking of UL, U.S. Testing, Timber Products Inspection, or another testing and inspecting agency acceptable to authorities having jurisdiction.

1. Use treatment for which chemical manufacturer publishes physical properties of treated wood after exposure to elevated temperatures, when tested by a qualified independent testing agency according to ASTM D 5664, for lumber and [ASTM D 5516, for plywood.
2. Use treatment that does not promote corrosion of metal fasteners.
3. Use Exterior type for exterior locations and where indicated.
4. Use Interior Type A High Temperature (HT), unless otherwise indicated.

2.5 DIMENSION LUMBER

A. General: Of grades indicated according to the American Lumber Standards Committee National Grading Rule provisions of the grading agency indicated.

B. Framing Load-Bearing Conditions: Construction or No. 2 grade and any of the following species:

1. Douglas fir-larch, Douglas fir-larch (north), or Douglas fir-south; NLGA, WCLIB, or WWPA.
2. Hem-fir or Hem-fir (north); NLGA, WCLIB, or WWPA.
3. Southern pine; SPIB.
4. Spruce-pine-fir (south) or Spruce-pine-fir; NELMA, NLGA, WCLIB, or WWPA.

C. Exposed Framing: Hand select material for uniformity of appearance and freedom from characteristics that would impair finish appearance.

1. Species and Grade: As indicated above for load-bearing construction of same type.
2. Species and Grade: Hem-fir or Hem-fir (north), Select Structural grade; NLGA, WCLIB, or WWPA.
3. Species and Grade: Southern pine, [Select Structural] [No. 1] grade; SPIB.
4. Species and Grade: Spruce-pine-fir or Spruce-pine-fir (south), [Select Structural] [No. 1] grade; NELMA, NLGA, WCLIB, or WWPA.

2.6 MISCELLANEOUS LUMBER

A. Provide miscellaneous lumber for support or attachment of other construction, including the following:

1. Rooftop equipment bases and support curbs.
2. Blocking.
3. Cants.
4. Nailers.

5. Furring.
6. Grounds.

B. For items of dimension lumber size, provide Construction, Stud, or No. 2 grade lumber with 19 percent maximum moisture content of any species.

C. For concealed boards, provide lumber with 19 percent maximum moisture content and any of the following species and grades:

1. Mixed southern pine, No. 2 grade; SPIB.
2. Eastern softwoods, No. 2 Common grade; NELMA.
3. Northern species, No. 2 Common grade; NLGA.
4. Western woods, Construction or No. 2 Common grade; WCLIB or WWPA.

2.7 ENGINEERED WOOD PRODUCTS

A. Laminated-Veneer Lumber: Composite of wood veneers with grain primarily parallel to member lengths, manufactured with exterior-type adhesive complying with ASTM D 2559. Allowable design values determined according to ASTM D 5456.

1. Manufacturers:
   a. Boise Cascade Corporation.
   b. Georgia-Pacific Corporation.
   c. Louisiana-Pacific Corporation.
   d. Pacific Woodtech Corp.
   e. Trus Joist MacMillan.
   f. Union Camp Corp.; Building Products Division.
   g. Willamette Industries, Inc.
   h. or equal

2. Extreme Fiber Stress in Bending, Edgewise: 2850 psi (19.7 MPa) for 12-inch nominal- (286-mm actual-) depth members.
3. Modulus of Elasticity, Edgewise: 2,000,000 psi (13 800 MPa).

2.8 SUBFLOORING AND UNDERLAYMENT

A. Plywood Combination Subfloor-Underlayment: DOC PS 1, Exterior, Structural I, C-C Plugged single-floor panels.
B. Oriented-Stand-Board, Combination Subfloor-Underlayment: Exposure 1 single-floor panels.
C. Plywood Subflooring: Exterior, Structural I.
D. Oriented-Strand-Board Subflooring: Exposure 1, Structural I sheathing.
E. Plywood Underlayment for Resilient Flooring: DOC PS 1, Exterior A-C with fully sanded face.

F. Plywood Underlayment for Carpet: DOC PS 1, Exterior, C-C Plugged.

2.9 PLYWOOD BACKING PANELS

A. Telephone and Electrical Equipment Backing Panels: DOC PS 1, Exposure 1, C-D Plugged, fire-retardant treated, in thickness indicated or, if not indicated, not less than 1/2 inch (12.7 mm) thick.

2.10 MISCELLANEOUS MATERIALS

A. Fasteners:

1. Where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
2. Power-Driven Fasteners: CABO NER-272.
3. Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers.

B. Metal Framing Anchors: Made from hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 (Z180) coating designation.

1. Manufacturers:

a. Alpine Engineered Products, Inc.
b. Cleveland Steel Specialty Co.
c. Harlen Metal Products, Inc.
d. KC Metals Products, Inc.
e. Silver Metal Products, Inc.
f. Simpson Strong-Tie Company, Inc.
g. Southeastern Metals Manufacturing Co., Inc.
h. United Steel Products Company, Inc.
i. or equal

2. Research/Evaluation Reports: Provide products acceptable to authorities having jurisdiction and for which model code research/evaluation reports exist that show compliance of metal framing anchors, for application indicated, with building code in effect for Project.
3. Allowable Design Loads: Meet or exceed those indicated per manufacturer's published values determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

C. Sheathing Tape: Pressure-sensitive plastic tape for sealing joints and penetrations in sheathing and recommended by sheathing manufacturer for use with type of sheathing required.

D. Sill-Sealer Gaskets: Glass-fiber-resilient insulation, fabricated in strip form, for use as a sill sealer; 1-inch (25-mm) nominal thickness, compressible to 1/32 inch (0.8 mm); selected from manufacturer's standard widths to suit width of sill members indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.

B. Apply field treatment complying with AWPA M4 to cut surfaces of preservative-treated lumber and plywood.

C. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. CABO NER-272 for power-driven fasteners.
2. Published requirements of metal framing anchor manufacturer.
3. Table 23-II-B-1, "Nailing Schedule," and Table 23-II-B-2, "Wood Structural Panel Roof Sheathing Nailing Schedule," in the Uniform Building Code.
4. Table 2305.2, "Fastening Schedule," in the BOCA National Building Code.
5. Table 2306.1, "Fastening Schedule," in the Standard Building Code.
6. Table 602.3(1), "Fastener Schedule for Structural Members," and Table 602.3(2), "Alternate Attachments," in the International One- and Two-Family Dwelling Code.

D. Use finishing nails for exposed work, unless otherwise indicated. Countersink nail heads and fill holes with wood filler.

E. Framing Standard: Comply with AFPA's "Manual for Wood Frame Construction," unless otherwise indicated.

F. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.

G. Comply with applicable recommendations contained in APA Form No. E30K, "APA Design/Construction Guide: Residential & Commercial," for types of structural-use panels and applications indicated.

1. Comply with "Code Plus" provisions in above-referenced guide.

H. Fastening Methods:

1. Combination Subfloor-Underlayment: Glue and nail to wood framing.
2. Subflooring: Glue and nail to wood framing.
3. Sheathing: Nail to wood framing.
4. Underlayment: Nail to subflooring.
5. Plywood Backing Panels: Nail or screw to supports.

I. Apply sheathing tape to joints between sheathing panels and at items penetrating sheathing. Apply at upstanding flashing to overlap both flashing and sheathing.

END OF SECTION 06100

SECTION 06120 – STRUCTURAL INSULATED PANELS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes Structural Insulated Panels (SIP).

B. Related Sections include the following:

1. Section 06100 – Rough Carpentry

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide SIPs capable of withstanding design loads including dead load, live loads, wind loads and seismic loads. Design loads shall be in compliance with the requirements of the local Building Code.

1.4 SUBMITTALS

A. Product Data: SIP manufacturer's product literature including structural properties and installation instructions.

B. Shop Drawings: Show fully dimensioned fabrication and installation details for SIPs. Shop drawings shall be prepared under the supervision of a Professional Engineer.

1.5 QUALITY ASSURANCE

A. SIP Manufacturer shall be a member of the Structural Insulated Panel Association (SIPA).

B. Structural Design: A Professional Engineer shall perform a structural analysis and design of the SIP assemblies in accordance with the design loads. And shall provide sealed drawings depicting the solid wood posts and LVL beams in accordance with the design loads

C. Installation Contractor must have experience on projects of similar size and scope. Lead installer / supervisor shall have a minimum of 3 years experience installing SIPs or have completed a certifying curriculum at a dedicated SIP training program such as those provided by the United Brotherhood of Carpenters and Joiners of America or equivalent.

1.6 DELIVERY, STORAGE, AND HANDLING

A. SIPs shall be kept dry and protected with waterproof covering during transportation and storage.

B. Exercise care to prevent crushing of SIP edges with cargo hold down straps during transportation.

C. Carefully load and unload SIPs from trucks to prevent damage to the panels.

D. Store SIPs elevated off of the ground on sleepers.

E. Take care in handling SIPs to prevent delamination. Do not lift panels by the top skin.

1.7 COORDINATION

A. Time delivery and installation of SIPs to avoid extended on-site storage and to avoid delaying progress of other trades whose work must follow the installation of SIPs.

PART 2 – PRODUCTS

2.1 STRUCTURAL INSULATED PANELS (SIP)

A. Oriented Strand Board (OSB): 7/16” thick minimum.

B. Core: Expanded Polystyrene (EPS) shall comply with ASTM C578 and shall have a minimum density of 0.9. pcf

C. Adhesive: ASTM D2559

2.2 LUMBER

A. Grade and Species: Visually graded dimension lumber No. 2 or better of any of the following species:

1. Spruce-Pine-Fir; NLGA
2. Hem-Fir (North); WCLIB or WWPA
3. Douglas Fir – Larch; WCLIB or WWPA
4. Southern Pine; SPIB

B. Lumber shall be kiln dried to not more than 19% moisture content

C. Lumber shall be clearly marked with grade stamp of grading agency.

D. Engineered wood products shall be used where required for structural adequacy.

1. Laminated Veneer Lumber (LVL)
2. Parallel Strand Lumber (LSL)
3. Laminated Strand Lumber (LSL)

2.3 FASTENERS

A. Common Nails: ASTM F1667.

B. Panel Screws: screws with pancake head, minimal thread diameter 0.255 inches, minimum shank diameter 0.190 inches and a minimum head diameter 0.625 inches.

2.4 FABRICATION

A. Cut SIPs to accurate lengths, angles, and sizes to produce close fitting joints.

B. Remove foam as required to accommodate wood blocking and splines.

C. Provide electrical wiring chases in foam core where required.

PART 3 – EXECUTION

3.1 PREPARATION

A. Examine foundations, sills, framing and other surfaces to receive SIPs and verify that conditions are suitable for the installation of SIPs. Report any unsatisfactory conditions to the Contractor. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Hoist SIPs in place by lifting equipment suited to size of panels. Exercise care to prevent damage to SIPs.

B. Install SIPs plumb, square and true to line.

C. Fill all panel joints with expanding urethane foam or seal by other approved method..

D. Repair or replace all damaged SIPs.

E. Remove debris from project site and legally dispose of debris.

END OF SECTION

SECTION 06176 - METAL-PLATE-CONNECTED WOOD TRUSSES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Wood roof trusses.
2. Wood floor trusses
3. Truss accessories.

B. See Division 6 Section "**Rough Carpentry**" for supplementary framing and permanent bracing.

1.2 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide metal-plate-connected wood trusses capable of withstanding design loads for this location without exceeding TPI 1 deflection limits.

1.3 SUBMITTALS

A. Product Data: For metal-plate connectors, metal framing anchors, bolts, and fasteners indicated.

B. Shop Drawings: Show location, pitch, span, camber, configuration, and spacing for each type of truss required; species, sizes, and stress grades of lumber; splice details; type, size, material, finish, design values, orientation, and location of metal connector plates; and bearing details.

1. Include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Qualification Data: For the following:

1. Metal-plate manufacturer.
2. Fabricator.

1.4 QUALITY ASSURANCE

A. Metal Connector-Plate Manufacturer Qualifications: A manufacturer that is a member of TPI and that complies with TPI quality-control procedures for manufacture of connector plates published in TPI 1.

1. Manufacturer's responsibilities include preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.

B. Fabricator Qualifications: Shop that participates in a recognized quality-assurance program that involves inspection by SPIB, Timber Products Inspection, TPI, or other independent testing and inspecting agency acceptable to Architect and authorities having jurisdiction.

C. Comply with TP1 1, "National Design Standard for Metal Plate Connected Wood Truss Construction," and TPI HIB, "Commentary and Recommendations for Handling, Installing & Bracing Metal Plate Connected Wood Trusses."

D. Wood Structural Design Standard: Comply with applicable requirements in AFPA's "National Design Specifications for Wood Construction" and its "Supplement."

PART 2 - PRODUCTS

2.1 DIMENSION LUMBER

A. Lumber: DOC PS 20 and applicable rules of lumber grading agencies certified by the American Lumber Standards Committee Board of Review.

B. Grade and Species: Any species for truss chord and web members, graded visually or mechanically, and capable of supporting required loads without exceeding allowable design values according to AFPA's "National Design Specifications for Wood Construction" and its "Supplement."

2.2 METAL PRODUCTS

A. Metal Connector Plates: Fabricate connector plates to comply with TPI 1 from hot-dip galvanized steel sheet complying with ASTM A 653/A 653M, G60 (Z180) coating designation; Designation SS, Grade 33, and not less than 0.036 inch (0.9 mm) thick.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Fasteners: Where trusses are exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.

1. Nails, Wire, Brads, and Staples: FS FF-N-105.
2. Power-Driven Fasteners: CABO NER-272.
3. Wood Screws: ASME B18.6.1.
4. Lag Bolts: ASME B18.2.1. (ASME B18.2.3.8M).
5. Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers.

C. Metal Framing Anchors: Provide framing anchors made from hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 (Z180) coating designation.

1. Allowable Design Loads: Meet or exceed those per manufacturer's published values determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

2.3 FABRICATION

A. Assemble truss members in design configuration indicated; use jigs or other means to ensure uniformity and accuracy of assembly with joints closely fitted to comply with tolerances in TPI 1. Position members to produce design camber indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install and brace trusses according to TPI recommendations and as indicated. Install trusses plumb, square, and true to line and securely fasten to supporting construction.

B. Anchor trusses securely at bearing points; use metal framing anchors. Install fasteners through each fastener hole in metal framing anchor according to manufacturer's fastening schedules and written instructions.

C. Securely connect each truss ply required for forming built-up girder trusses. Anchor trusses to girder trusses as indicated.

D. Install and fasten permanent bracing during truss erection and before construction loads are applied. Anchor ends of permanent bracing where terminating at walls or beams.

1. Install and fasten strongback bracing vertically against vertical web of parallel-chord floor trusses at centers indicated.

E. Install wood trusses within installation tolerances in TPI 1.

F. Do not cut or remove truss members.

G. Return wood trusses that are damaged or do not meet requirements to fabricator and replace with trusses that do meet requirements.

END OF SECTION 06176

SECTION 06200 - FINISH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Standing and running trim.

1.2 SUBMITTALS

A. Product Data: For each type of factory-fabricated product and process indicated.

B. Samples: For the following:

1. Each type of finish required.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Lumber Standards: Comply with DOC PS 20, "American Softwood Lumber Standard," for lumber and with applicable grading rules of inspection agencies certified by the American Lumber Standards Committee Board of Review.

B. Softwood Plywood: Comply with DOC PS 1, "U.S. Product Standard for Construction and Industrial Plywood."

C. Hardwood Plywood: Comply with HPVA HP-1, "Interim Voluntary Standard for Hardwood and Decorative Plywood."

D. Preservative Treatment: Comply with NWWDA I.S. 4 for exterior finish carpentry to receive water-repellent preservative treatment.

E. Fire-Retardant Treatment: Where indicated, use materials impregnated with fire-retardant chemicals per AWPA C20; exterior type or interior Type A as required.

2.2 STANDING AND RUNNING TRIM

A. Exterior Standing and Running Trim: Finished lumber and moldings.

1. Clear STK, smooth Douglas Fir

B. Interior Standing and Running Trim: Finished lumber and moldings.

1. Species and Grade or Cut: C Select, eastern white pine; NELMA or B & Btr. Select or Supreme, Idaho white, lodgepole, ponderosa, or sugar pine; WWPA.

2.3 MISCELLANEOUS MATERIALS

A. Fasteners for Exterior Finish Carpentry: Provide nails of stainless steel, hot-dip galvanized steel, or noncorroding aluminum. Fasteners shall be hidden as per best practices applicable to specific finish work; e.g. puttied and painted, counter sunk and plugged; blind to view; biscuited.

PART 3 - EXECUTION

3.1 PREPARATION

A. Condition finish carpentry to average prevailing humidity conditions in installation areas before installation, for a minimum of 24 hours.

B. Prime and backprime lumber for painted finish exposed on the exterior. Comply with requirements for surface preparation and application in Division 9 Section "Painting."

3.2 INSTALLATION

A. Install finish carpentry level, plumb, true, and aligned with adjacent materials. Use concealed shims where required for alignment. Scribe and cut finish carpentry to fit adjoining work. Refinish and seal cuts.

B. Standing and Running Trim: Install with minimum number of joints practical, using full-length pieces from maximum lengths of lumber available. Stagger joints in adjacent and related trim. Cope at returns and miter at corners.

C. Paneling: Install according to manufacturer's written recommendations. Select and arrange units on each wall for best match of adjacent units where grain character or color variations are noticeable. Install with uniform tight joints between units.

E. Repair damaged or defective finish carpentry where possible to eliminate functional or visual defects. Where not possible to repair, replace finish carpentry. Adjust joinery for uniform appearance.

END OF SECTION 06200

SECTION 07200 - INSULATION

PART 1 - GENERAL

1.01 SUMMARY

A. Provide building insulation of board and blanket types as applicable:

1. Attics (interior), loose fill cellulose.
2. Exterior stud walls existing, spray moisture added, cellulose.
3. Exterior stud walls new, batt insulation
4. Slabs on grade in treated areas; 2”thick under slab.
5. 3 1/2” sound batts in interior walls where scheduled.
6. Provide 2” deep baffles at eaves.
7. Air infiltration blankets on building’s perimeter walls.

B. Provide vapor barrier below concrete floor slab areas.

C. Provide air infiltration blanket at exterior face of all new exterior wall sheathing.

1.02 SUBMITTALS

A. Submit for approval shop drawings, product data, test reports.

1.03 QUALITY ASSURANCE

A. Comply with governing codes and regulations. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Loose fill cellulose insulation: (R-38) in attic, Class I fire retardant minimum

B. Sprayed (moisture added, cellulose insulation: (R-15) in exterior walls, Class I fire retardant minimum

C. Unfaced, fiberglass batts in floors above crawlspaces(R-19).

D. Polyisocyanurate insulation boards at underside of floor joists in crawl space

E. Unfaced fiberglass sound batts, 3-1/2” in interior walls and ceilings at dwelling separations and where indicated on Drawings. Owens Corning Fiberglass Corp or approved equal.

F. Vapor barrier: 6 mil clear polyethylene sheet under slab on grade.

1. Provide crushed stone ballasting at crawlspace areas.

G. 2” baffles at roof eaves.

H. Air Infiltration blankets to be installed on all exterior wall surfaces; Tyvek by Dupont or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install insulation materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials and systems in proper relation with adjacent construction. Coordinate with work of other sections. Provide full thickness in one layer over entire area, tightly fitting around penetrations.

B. Install vapor barrier over entire area of inside face of exterior walls and elsewhere as indicated. Install air infiltration blankets over entire area of exterior wall. Seal all seams and around perimeter and penetrations with approved tape to form a continuous barrier free of holes.

C. Protect installed insulation, air infiltration blankets, and vapor barrier.

END OF SECTION

SECTION 07311 – COMPOSITE SHINGLE SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes asphalt shingles for steep roofs.

1.2 SUBMITTALS

A. Product Data: For each product indicated.

B. Samples: Two full-size units for each asphalt shingle indicated and for each color and texture required.

1.3 QUALITY ASSURANCE

A. Fire-Test-Exposure Classification: Identify each bundle of shingles or shakes with appropriate markings indicating fire-test-exposure classification of testing and inspecting agency acceptable to authorities having jurisdiction.

B. Wind-Resistance-Test Characteristics: Identify each bundle of asphalt shingles with appropriate markings indicating wind-resistance-test characteristics determined by a qualified testing and inspecting agency.

1.4 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to furnish replacement shingles or refund pro-rata portion of amount originally paid for shingles that fail due to original product defects within 50 years from date of Substantial Completion. Failures include, but are not limited to, leaks or deformation or deterioration of asphalt shingles beyond normal weathering.

PART 2 - PRODUCTS

2.1 COMPOSITE SHINGLE SYSTEM

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

B. Products: Subject to compliance with requirements, provide one of the following:
   1. Acceptable Manufacturer: Provide products manufactured by the CertainTeed Corporation. Contact Sales Support Group P.O. Box 860 Valley Forge, PA 19482 Toll Free 800-233-8990 or equal
   2. CertainTeed XT30 Shingles: Conforming to ASTM D 3018 Type I – Self-Sealing; UL Certification of ASTM D3462, ASTM D 3161/UL 997 80-mph Wind Resistance and UL Class A Fire

Resistance; glass fiber mat base, Ceramically colored/UV resistant mineral surface granules across entire face of shingle; square three tab type or equal

3. Weight: 215 pounds per square (100 square feet) (12.0 kg/sq m).
4. Color: As selected by Architect from manufacturer's standards.

2.2 SHEET MATERIALS

A. Eaves Protection: CertainTeed "WinterGuard";ASTM D1970 sheet barrier of self-adhering rubberized asphalt membrane shingle underlayment having internal reinforcement and "split" back plastic release film; provide material warranty equal in duration to that of shingles being applied.

1. CertainTeed WinterGuard Sand or equal

B. Underlayment: CertainTeed "Roofers' Select", ASTM D 6757 or equal; asphalt-impregnated fiberglass-reinforced organic felt designed for use on roof decks as a water-resistant layer beneath roofing shingles

C. Underlayment: ASTM D 4869, Asphalt saturated felt.

2.3 FLASHING MATERIALS

A. Sheet Flashing: ASTM A 361/A361M; 26 Guage (0.45 mm) steel with minimum G115/Z350 galvanized coating

B. Sheet Flashing: ASTM B 209; 0.025 (0.63mm) thick aluminum, mill finish.

C. Sheet Flashing: ASTM B 370; cold rolled copper; 16 ounces per square foot (0.55mm), natural finish.

D. Bitumious Paint: Acid and alkali resistant type; black color.

E. Tinner's Paint: Color as selected by Architect to coordinate with shingle color.

2.4 ACCESSORIES

A. Nails: Standard round wire type roofing nails, corrosion resistant; hot dipped zinc coated steel, aluminum or chormated steel; minimum 3.8 inch (9.5mm) head diameter; minimum 11 or 12 gage (2.5mm) shank diameter; shank to be sufficient length to penetrate through the roof sheathing or ¾ inch (19mm) into solid wood, plywood or non-veneer wood decking.

B. Asphalt Roofing Cement: ASTM D 4586, Type I or II

C. Metal Drip Edge: Brake-formed sheet metal with at least 2-inch (50-mm) roof deck flange and 1-1/2-inch (38-mm) fascia flange with 3/8-inch (9.6-mm) drip at lower edge. Furnish in lengths of 8 or 10 feet (2.5 or 3 m).

2.5 FLASHING FABRICATION

A. Form flashing to profiles indicated on Drawings and to protect roofing materials from physical damage and shed water.

B. Form sections square and accurate to profile, in maximum possible lengths, free from distortion or defects detrimental to appearance or performance.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify existing site conditions.

B. Verify that roof penetrations and plumbing stacks are in place and flashed to deck surfaces.

C. Verify deck surfaces are dry and free of ridges, warps or voids.

3.2 ROOF DECK PREPARATION

A. Follow shingle manufacturer's recommendations for acceptable roof deck material

B. Broom clean deck surfaces under eave protection and underlayment prior to their application

3.3 INSTALLATION – EAVE ICE DAM PROTECTION

A. Place eave edge and gable metal edge flashing tight with fascia boards. Weather-lap joints 2 inches (50mm). Secure flange with nails spaced 8 inches (200 mm) on center.

B. Apply CertainTeed "WinterGuard" Waterproofing Shingle Underlayment as eave protection in accordance with manufacturer's instructions.

C. Extend eave protection membrane minimum 24 inches (640 mm) up slope beyond interior face of exterior wall.

3.4 INSTALLATION – PROTECTIVE UNDERLAYMENT

A. Roof Slopes 4:12 or Greater: Install one layer of asphalt felt shingle underlayment perpendicular to slope of roof and lap minimum 4 inches (100 mm) over eave protection.

B. Weather-lap and seal watertight with asphalt roofing cement items projecting through or mounted on roof. Avoid contact or solvent-based cements with WinterGuard and Diamond Deck

C. Install asphalt shingles, beginning at roof's lower edge, with starter strip of roll roofing or inverted asphalt shingles with tabs removed. Fasten asphalt shingles in desired weather exposure pattern; use number of fasteners per shingle as recommended by manufacturer. Use vertical and horizontal chalk lines to ensure straight coursing.

1. Cut and fit asphalt shingles at valleys, ridges, and edges to provide maximum weather protection. Provide same weather exposure at ridges as specified for roof. Lap asphalt shingles at ridges to shed water away from direction of prevailing wind.
2. Use fasteners at ridges of sufficient length to penetrate sheathing as specified.

D. Hip ridge Shingles: Install according to manufacturer's written instructions.

END OF SECTION 07311

SECTION 07411 – METAL ROOF PANELS

1.01 SUMMARY

A. Section includes: Pre-finished, prefabricated, roll formed, 24 ga. 5v crimp overlapping Galvalume roof panels with exposed fasteners.

B. Related Sections:

1. Rough carpentry, plywood, and underlayment
2. Flashing and sheet metal
3. Joint sealers: sealants and caulk

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM)

1. ASTM A 653: Steel Sheet, Zinc-Coated by the Hot Dip Process
2. ASTM A 792: Steel Sheet, Aluminum-Zinc Alloy Coated by the Hot Dip Process.
3. ASTM B 209: Aluminum and Aluminum Alloy Sheet and Plate.
4. ASTM E 283: Air leakage
5. ASTM E 331: Water penetration
6. ASTM E 1646-95 Water Penetration
7. ASTM E 1680-95 Air Infiltration and Exfiltration

B. Underwriters Laboratory

1. UL Building Materials Directory
2. Underwriters Laboratories Construction No. 274, 274a, and 369 for Uplift Test 580 Class 90.

C. Sheet Metal and Air Condition Contractors National Association, Inc. (SMACNA)

1. SMACNA Architectural Sheet Metal Manual, 1993 Edition.

D. American Iron and Steel Institute (AISI)

1. AISI Cold Formed Steel Design Manual

E. Aluminum Association

1. Aluminum Design Manual

F. Metal Construction Association (MCA)

1. Preformed Metal Wall Guidelines

G. Code references

1. IBC International Building Code

1.03 SYSTEM DESCRIPTION

A. Performance Requirements: Provide factory formed, pre-finished, Galvalume roof panels with exposed fasteners metal roof system, that has been pre-tested and certified by manufacturer to comply with specified requirements under installed conditions.

1. Provide UL2218 rated roofing system.
2. Structural: ASTM E330, E1592 Steel panels.
3. ASTM E1680 No air penetration @ 20 psf ASTM E283 0.09 cfm/ft2 @ 1.57 psf, 0.21 cfm/ft2 @ 6.24 psf
4. Wind Uplift: ASTM E1592 Test results vary depending on gauge and panel width UL580 Class 90, UL 1897
5. Class 4 impact: UL2218
6. Class A fire: UL790 .

B. Structural Requirements: Engineer panels for structural properties in accordance with latest edition of American Iron and Steel Institute Cold Formed Steel Design Manual using “effective width" concept and Aluminum Association’s Aluminum Design Manual.

1.04 SUBMITTALS

A. Product Data: submit manufacturer's specifications, standard profile sheet, product data brochure and finish warranty.

B. Shop Drawings: shop drawings showing roof plan with layout of panels underlayment and sections of each flashing/trim condition shall be submitted for approval prior to fabrication. Drawings shall contain material type, metal thickness and finish. Drawings shall distinguish between factory and field fabrication.

C. Samples:

1. Submit sample 12" long x full width panel showing complete profile.
2. Submit manufacturers standard colors for Architect's selection.

D. Test Reports:

1. Submit the test reports prepared by Underwriters Laboratory indicating wind uplift rating of proposed roof system. The manufacturer must be listed by name in the UL Directory.
2. Air leakage per ASTM E 1680 and Water penetration per ASTM E 1646 (Actual independent laboratory certified test results must be submitted).

E. Certification: Submit manufacturer's certification that materials and finishes meet specification requirements.

1.05 QUALITY ASSURANCE

A. Panel manufacturer shall have a minimum of ten (10) years of experience in manufacturing architectural roofing in a permanent stationary indoor facility.

B. Panel installer shall have a minimum of two (2) years experience in the installation of concealed clip architectural standing seam metal roofing and show evidence of successful completion of at least three (3)

projects of similar size, scope, and complexity.

1.06 DELIVERY, STORAGE, and HANDLING

A. Panels and flashings shall be protected and properly packaged to protect against transportation damage in transit to the jobsite.

B. Upon delivery, exercise care in unloading, stacking, moving, storing, and erecting panels and flashings to prevent twisting, bending, scratching, or denting.

C. Store panels and flashings in a safe, dry environment under a waterproof covering to prevent water damage. Allow for adequate ventilation to prevent condensation. Panels and flashings with strippable film shall not be stored in direct sunlight.

D. Upon installation immediately remove strippable film from panels and flashings. Protect panels and flashings from foot traffic and from all other trades.

1.07 PROJECT CONDITIONS

A. Field dimensions shall be taken prior to fabrication to verify jobsite conditions.

1.08 WARRANTIES

A. Panel manufacturer shall provide a twenty (20) year warranty on the paint finish covering chalking, cracking, checking, chipping, blistering, peeling, flaking, and fading.

B. Applicator shall furnish written warranty for a two (2) year period from date of substantial completion of building covering repairs required to maintain roof and flashings in watertight conditions.

2.01 PRODUCT DESCRIPTION

A. Basis of design and specification: Firestone Unaclad 5 v crimp roof panel.

2.02 PRODUCT SUBSTITUTIONS

A. Requests to use alternate systems shall be submitted in writing to the project designer at least ten (10) days prior to bid date. Request shall demonstrate proposed substitution meets or exceeds specified performance requirements. Certified statements, samples and descriptive data shall be included in this submittal request.

2.03 MATERIALS AND FINISHES

A. Panel materials

1. 24 gauge, Grade 50 (50 ksi yield strength) structural steel with G90 (0.90 oz./ft.^{2}) “Galvalume” finish system per manufacturer’s specification and warranty for a complete finish.

B. Texture: panels shall be smooth.

C. Finish: Refer to manufacturer's standard color card to determine appropriate finish and color. All panels

shall receive a factory-applied complete finish per manufacturer's "Galvalume" specification and product warranty.

2.04 ACCESSORIES

A. Fasteners:

1. Fasteners shall be minimum of #10x1.5" hex head with banded neoprene washer, non-corrosive type.

B. Underlaymensts
1. Non-asphaltic fiberglass-based underlayment meeting ASTM D146, D1922 and D4869.
2. Waterproof Membrane: ASTM D1970, self-adhering rubberized sheet membrane.
Use "Ice & Water Shield" be used in areas subject to moisture infiltration, e.g. eaves, valleys and similar areas.

C. Flashings

1. All flashing and trim shall be of the same material, gauge, finish, and color as the roof panels and fabricated in accordance with standard SMACNA procedure and details.
2. Provide transition rib covers where roofing changes pitch.
3. Fabricate gutters and downspouts in the same gauge, material, finish, and color as the roof panels.

D. Sealants

1. Shall not contain oil, asbestos, or asphalt.
2. Factory applied sealant shall be applied in the seam and designed for metal to metal concealed joints.
3. Field applied panel end sealant shall be mastic tape sealant.
4. Exposed sealant shall be one-part polyurethane joint sealant. Coordinate color with roof panels.

E. Closures

1. Ridge and hip closures shall be protected and supported by a formed metal closure manufactured from the same material, color, and finish as the panels.
2. Metal closures shall be factory fabricated and field-cut as needed.

2.05 RELATED MATERIALS

A. Refer to other sections listed in Related Sections paragraph for related materials.

2.06 FABRICATION

A. Form roofing panels in longest practical lengths, true to shape, accurate in size, square, and free from distribution or manufacturing defects.
1. Panels are only available 22.5 inches wide with a coverage area of 20.5 inches.

2.07 SOURCE QUALITY

A. Source Quality: obtain metal panels and accessories from a single manufacturer.

B. Fabrication tolerances: follow tolerances in MCA's Preformed Metal Wall Guidelines.

C. Tests and inspections

D. Verification of performance

3.01 MANUFACTURER'S INSTRUCTIONS

A. Compliance: Comply with manufacturer's product data, including product technical bulletins, product catalog installation instructions, and product cartons for installation.

3.02 EXAMINATION

A. Installer shall:

1. Inspect roof deck and/or purlins to verify that it complies with shop drawings and is smooth, even, sound, and free of depressions.

2. Report variations and potential problems in writing to the architect.

3.03 INSTALLATION

A. Conform to the standard set forth in the SMACNA architectural sheet metal manuals and the approved shop drawings detailed for the project.

B. Install panels plumb, level, and straight with the seams parallel, conforming to the design as indicated

C. Install panel system so it is watertight, without waves, warps, buckles or distortions, and allow for thermal movement considerations.

D. Abrasive devices shall not be used to cut on or near roof panel system.

E. Apply sealant tape or caulking as necessary at flashing and panel joints to prevent water penetration.

F. Remove any strippable film immediately upon exposure to direct sunlight.

3.04 CLEANING

A. Dispose of excess materials and debris from jobsite.

B. Remove filings, grease, stains, marks, or excess sealants from roof panel system to prevent staining.

C. Protect work from damage from other trades until final acceptance.

.

END OF SECTION 07411

SECTION 07460 – EXTERIOR SIDING AND TRIM

PART 1 - GENERAL

1.01 SUMMARY

A. Provide Exterior Siding and Trim where indicated on Drawings.

1. Provide exterior cement-reinforced lap siding.
2. Provide exterior trim, constructed of cement-reinforced components.
3. Provide exterior panels, constructed of cement-reinforced components.

1.02 SUBMITTALS

A. Submit for approval samples, product data.

1.03 QUALITY ASSURANCE

A. Comply with governing codes and regulations. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Exterior siding shall be cement-reinforced exterior siding panels, Hardieplank Lap Siding, smooth finish with 5” exposure as manufactured by James Hardie or approved equal, painted.

B. Exterior trim components for window trim and siding corner boards shall be cement-reinforced components, 5/4 HardieTrim Boards, Smooth as manufactured by James Hardie or approved equal, painted.

1. 3.5” x 1“at corner boards, window/door jamb trim.

C. Porch entablature (beam) trim and column trim components shall be cement-reinforced components, 4/4 HardieTrim Boards, Smooth as manufactured by James Hardie or approved equal, painted. Widths shall be as indicated on Drawings.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install all siding materials in strict accordance with James Hardie instructions or approved equal and approved submittals. Install materials and systems in proper relation with adjacent construction and with uniform appearance. Coordinate with work of other sections.

B. Restore damaged components. Clean and protect work from damage.

END OF SECTION

SECTION 07620 - FLASHING AND SHEET METAL

PART 1 - GENERAL

1.01 SUMMARY

A. Provide flashing and sheet metal components for building construction.

1. Metal counter-flashing.
2. Continuous gutters and downspouts.
3. Miscellaneous sheet metal accessories.

1.02 SUBMITTALS

A. Submit for approval samples, shop drawings, product data.

1.03 QUALITY ASSURANCE

A. Comply with governing codes and regulations. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Flashing:

1. Aluminum Sheet: 20 gage alloy 3003 clear anodized aluminum, ASTM B 209.

B. Gutters and downspouts:

1. Aluminum, prefinished: 0.040" thick.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Follow recommendations of SMACNA "Sheet Metal Manual". Allow for expansion. Isolate dissimilar materials.
B. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials and systems in proper relation with adjacent construction and with uniform appearance. Coordinate with work of other sections.
C. Restore damaged components and finishes. Clean and protect work from damage.

END OF SECTION

SECTION 07720 - ROOF ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Equipment supports.
2. Roof hatches.
3. Snow guards.

1.2 SUBMITTALS

A. Product Data: For each product indicated.

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

C. Coordination Drawings: Roof plans drawn to scale and coordinating penetrations and roof-mounted items.

D. Samples: For each exposed finish.

1.3 QUALITY ASSURANCE

A. Standards: Comply with the following:

1. SMACNA's "Architectural Sheet Metal Manual" details for fabrication of units, including flanges and cap flashing to coordinate with type of roofing indicated.
2. NRCA's "Roofing and Waterproofing Manual" details for installing units.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aluminum:

1. Sheet: ASTM B 209 (ASTM B 209M) for alclad alloy 3005H25 or alloy and temper required to suit forming operations, with mill finish, unless otherwise indicated.
2. Extrusions: ASTM B 221 (ASTM B 221M) alloy 6063-T52 or alloy and temper required to suit structural and finish requirements, with mill finish, unless otherwise indicated.

B. Galvanized Steel Sheet: ASTM A 653/A 653M with G90 (Z275); commercial steel, unless otherwise indicated.

1. Structural Quality: Grade 40 (Grade 275), where indicated or as required for strength.

C. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M with Class AZ-50 (AZ-150) coating, structural quality, Grade 40 (Grade 275), or as required for strength.

D. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, complying with AWPA C2; not less than 1-1/2 inches (38 mm) thick.

E. Fasteners: Same metal as metals being fastened, or nonmagnetic stainless steel or other noncorrosive metal as recommended by manufacturer. Match finish of exposed fasteners with finish of material being fastened.

F. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, or PVC; or flat design of foam rubber, sponge neoprene, or cork.

G. Bituminous Coating: SSPC-Paint 12, solvent-type bituminous mastic, nominally free of sulfur and containing no asbestos fibers, compounded for 15-mil (0.4-mm) dry film thickness per coating.

H. Mastic Sealant: Polyisobutylene; nonhardening, nonskinning, nondrying, nonmigrating sealant.

I. Elastomeric Sealant: Recommended by unit manufacturer that is compatible with joint surfaces; ASTM C 920, Type S, Grade NS, Class 25.

J. Roofing Cement: ASTM D 4586, nonasbestos, fibrated asphalt cement designed for trowel application or other adhesive compatible with roofing system.

2.2 ROOF CURBS AND EQUIPMENT SUPPORTS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

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

1. AES Industries, Inc.
2. Colony Custom Curbs.
3. Commodity Products Company, Inc.
4. Conn-Fab Sales, Inc.
5. Curbs Plus, Inc.
6. Custom Curb, Inc.
7. Gieske Custom Metal Fabricators.
8. Goeller Enterprises.
9. LMCurbs.
10. Loren Cook Company.
11. Metallic Products Corporation.

12. Pate Co. (The).
13. Roof Products & Systems Corp.
14. ThyCurb, Inc.
15. Uni-Curb, Inc.
16. Vent Products Co., Inc.
17. or equal

C. General: Units capable of supporting superimposed live and dead loads, including equipment loads and other construction to be supported. Coordinate dimensions with equipment to be supported.

1. Provide preservative-treated wood nailers at tops of units and formed flange at perimeter bottom for mounting to roof.
3. Fabricate units to minimum height of 8 inches (200 mm), unless otherwise indicated.
4. Where slope of roof deck exceeds 1/4 inch per foot (1:48), fabricate support units with height tapered to match slope to level tops of units.

D. Equipment Supports: Capable of supporting superimposed live and dead loads, including equipment loads and other construction to be supported. Coordinate dimensions with equipment to be supported.

1. Fabrication: Unless otherwise indicated or required for strength, fabricate units from minimum 0.0747-inch- (1.9-mm-) thick, structural-quality, hot-dip galvanized or aluminum-zinc alloy-coated steel sheet; factory primed and prepared for painting with welded or sealed mechanical corner joints.

2.3 ROOF HATCHES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

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

1. Babcock-Davis Hatchways, Inc.
2. Bilco Company.
3. Bristolite Skylights.
4. Custom Curb, Inc.
5. Dur-Red Products, Inc.
6. Goeller Enterprises.
7. Hi Pro International, Inc.
8. J. L. Industries, Inc.
9. Metallic Products Corporation.
10. Milcor, Inc.
11. Nystrom Products Co.
12. O'Keeffe's Inc.
13. Precision Stair Corporation.
14. Roof Products & Systems Corp.
15. ThyCurb, Inc.
16. Trimco, Inc.
17. Wasco Products, Inc.
18. or equal

C. General: Frame with minimum 9-inch- (225-mm-) high, integral-curb, double-wall construction with 1-1/2-inch (38- mm) insulation, formed cants and cap flashing (roofing counterflashing), with welded or sealed mechanical corner joints. Provide double-wall cover (lid) construction with 1- inch- (25-mm-) thick insulation core. Provide gasketing and equip with corrosion-resistant or hot-dip galvanized hardware including pintle hinges, hold-open devices, interior padlock hasps, and both interior and exterior latch handles.

1. Fabricate units to withstand 40-lbf/sq. ft. (1.9-kPa) external and 20-lbf/sq. ft. (0.95-kPa) internal loading pressure.

D. Single-Leaf Personnel Hatches:

1. Size: 30 by 36 inches (750 by 900 mm) for ladder access.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Coordinate installation of roof accessories with installation of roof deck, roof insulation, flashing, roofing membranes, penetrations, equipment, and other construction to ensure that combined elements are waterproof and weathertight. Anchor roof accessories securely to supporting structural substrates so they are capable of withstanding lateral and thermal stresses, and inward and outward loading pressures.

B. Install roof accessory items according to construction details in NRCA's "Roofing and Waterproofing Manual," unless otherwise indicated,

C. Separation: Separate metal from incompatible metal or corrosive substrates, including wood, by coating concealed surfaces, at locations of contact, with bituminous coating or providing other permanent separation.

D. Flange Seals: Unless otherwise indicated, set flanges of accessory units in a thick bed of roofing cement to form seal.

E. Cap Flashing: Where required as component of accessory, install cap flashing to provide waterproof overlap with roofing or roof flashing (as counterflashing). Seal overlap with thick bead of mastic sealant.

F. Operational Units: Test-operate units with operable components. Clean and lubricate joints and hardware. Adjust for proper operation.

G. Clean exposed surfaces according to manufacturer's written instructions. Touch up damaged metal coatings.

END OF SECTION 07720

SECTION 07900 - JOINT SEALERS

PART 1 - GENERAL

1.01 SUMMARY

A. Provide sealants at intersection of building components and at control and expansion joints.

1.02 SUBMITTALS

A. Submit for approval samples, product data.

1.03 QUALITY ASSURANCE

A. Comply with governing codes and regulations. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Joints designed for expansion and movement conditions at site:

1. Exterior joints on vertical surfaces: Non-sag polyurethane; Pecora Dynatrol II or Tremco Dymeric or approved equal.
2. Horizontal paving joints, interior and exterior: Self-leveling polyurethane; Tremco THC 900 or approved equal.
3. Toilet fixture joints: Silicone rubber; Tremco Proglaze or Dow 786 or approved equal.
4. Interior joints: Acrylic latex; Tremco Acrylic Latex or approved equal.
5. Precompressed expanding sealant tape; Emseal PC-SA or approved equal.
6. Pavement joint filler: Resilient, premolded asphalt impregnated fiberboard.
7. Primers, bond breakers, and backer rods compatible with sealant and adjacent surfaces.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Examine substrate; report unsatisfactory conditions in writing. Beginning work means acceptance of substrates.

B. Provide sealants in colors as selected from manufacturer's standards.

C. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials and systems in proper relation with adjacent construction and with uniform appearance. Coordinate with work of other sections. Clean and prime joints, and install bond breakers, backer rods and sealant as recommended by manufacturers.

D. Depth shall equal width up to 1/2" wide; depth shall equal 1/2 width for joints over 1/2" wide.

E. Cure and protect sealants as directed by manufacturers. Replace or restore damaged sealants. Clean adjacent surfaces to remove spillage.

END OF SECTION

SECTION 08110 - STEEL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes Insulated hollow flush seam steel doors and steel frames.

1.2 SUBMITTALS

A. Product Data: For each product indicated. Include door designation, type, level and model, material description, label compliance, fire-resistance ratings, and finishes.

B. Door Schedule. Use same reference designations indicated on Drawings.

1.3 QUALITY ASSURANCE

A. Steel Door and Frame Standard: Comply with ANSI A 250.8, unless more stringent requirements are indicated.

B. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 252.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

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

1. Amweld Building Products, Inc.
2. Benchmark Commercial Doors; a division of General Products Co., Inc.
3. Ceco Door Products; a United Dominion Company.
4. Copco Door Co.
5. Curries Company.
6. Deansteel Manufacturing, Inc.
7. Kewanee Corporation (The).
8. Mesker Door, Inc.
9. Pioneer Industries Inc.
10. Republic Builders Products.

11. Steelcraft; a division of Ingersoll-Rand.
12. or equal

2.2 MATERIALS

A. Hot-Rolled Steel Sheets: ASTM A 569/A 569M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

B. Cold-Rolled Steel Sheets: ASTM A 366/A 366M, Commercial Steel (CS), or ASTM A 620/A 620M, Drawing Steel (DS), Type B; stretcher-leveled standard of flatness.

C. Metallic-Coated Steel Sheets: ASTM A 653/A 653M, Commercial Steel (CS), Type B, with an A40 (ZF120) zinc-iron-alloy (galvannealed) coating; stretcher-leveled standard of flatness.

D. Electrolytic Zinc-Coated Steel Sheet: ASTM A 591/A 591M, Commercial Steel (CS), Class B coating; mill phosphatized; suitable for unexposed applications; stretcher-leveled standard of flatness where used for face sheets.

2.3 DOORS

A. Exterior and interior Doors: Complying with ANSI A250.8 for level and model and ANSI A250.4 for physical-endurance level indicated.

1. Level 4 and Physical Performance Level A, Model 1 (Full Flush).

2.4 FRAMES

A. General: ANSI A250.8; conceal fastenings, unless otherwise indicated.

B. Frame Steel Sheet Thickness:

1. 0.093-inch- (2.3-mm-) for level 4 steel doors and wood doors.

C. Door Silencers: Three silencers on single-door frames and two silencers on double-door frames.

D. Plaster Guards: 0.016-inch- (0.4-mm-) thick, steel sheet plaster guards or mortar boxes to close off interior of openings.

E. Supports and Anchors: Not less than 0.042-inch- (1.0-mm-) thick zinc-coated steel sheet.

1. Masonry Wall Anchors: 0.177-inch- (4.5-mm-) diameter, steel wire complying with ASTM A 510 (ASTM A 510M) may be used in place of steel sheet.

F. Inserts, Bolts, and Fasteners: Manufacturer's standard units. Zinc-coat items that are to be built into exterior walls according to ASTM A 153/A 153M, Class C or D as applicable.

2.4 ACCESSORIES

A. Manufqacturer’s head and jamb weather sealing.

B. Manufacture’s brush seal continuous along bottom of door.

C. Door Silencers: Three silencers on single-door frames and two silencers on double-door frames.

D. Plaster Guards: 0.016-inch- (0.4-mm-) thick, steel sheet plaster guards or mortar boxes to close off interior of openings.

E. Supports and Anchors: Not less than 0.042-inch- (1.0-mm-) thick zinc-coated steel sheet.

1. Masonry Wall Anchors: 0.177-inch- (4.5-mm-) diameter, steel wire complying with ASTM A 510 (ASTM A 510M) may be used in place of steel sheet.

F. Inserts, Bolts, and Fasteners: Manufacturer's standard units. Zinc-coat items that are to be built into exterior walls according to ASTM A 153/A 153M, Class C or D as applicable.

2.5 FABRICATION

A. General: Fabricate steel door and frame units to comply with ANSI A250.8 free from defects including warp and buckle. Where practical, fit and assemble units in manufacturer's plant.

B. Exterior Doors: Fabricate doors, panels, and frames from metallic-coated steel sheet. Close top and bottom edges of doors flush as an integral part of door construction or by addition of 0.053-inch- (1.3-mm-) thick, metallic-coated steel channels with channel webs placed even with top and bottom edges.

D. Core Construction: Manufacturer's standard solid urethene core construction that produces a door complying with SDI standards.

E. Clearances for Non-Fire-Rated Doors: Not more than 1/8 inch (3.2 mm) at jambs and heads, except not more than 1/4 inch (6.4 mm) between pairs of doors. Not more than 3/4 inch (19 mm) at bottom.

F. Clearances for Fire-Rated Doors: As required by NFPA 80.

G. Door-Edge Profile: Square edge, unless beveled edge is indicated.

H. Tolerances: Comply with SDI 117.

I. Prepare doors and frames to receive mortised and concealed hardware according to final door hardware schedule and templates provided by hardware supplier. Comply with applicable requirements in ANSI A250.6 and ANSI A115 Series specifications for door and frame preparation for hardware.

J. Frame Construction:

1. Fabricate frames with mitered or coped and continuously welded corners and seamless face joints. Provide temporary spreader bars.
2. Provide terminated stops.

K. Reinforce doors and frames to receive surface-applied hardware. Drilling and tapping for surface-applied hardware may be done at Project site.

L. Locate hardware as indicated or, if not indicated, according to ANSI A250.8.

2.6 FINISHES

A. Prime Finish: Manufacturer's standard, factory-applied coat of rust-inhibiting primer complying with ANSI A250.10 for acceptance criteria.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Placing Frames: Comply with provisions in SDI 105, unless otherwise indicated. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders, leaving surfaces smooth and undamaged.

1. Wall Anchors: Provide at least three anchors per jamb. For openings 90 inches (2286 mm) or more in height, install an additional anchor at hinge and strike jambs.
2. Fire-Rated Frames: Install according to NFPA 80.

B. Door Installation: Comply with ANSI A250.8. Shim as necessary to comply with SDI 122 and ANSI/DHI A115.1G.

1. Fire-Rated Doors: Install within clearances specified in NFPA 80.
2. Smoke Control Doors: Install to comply with NFPA 105.

C. After installation, remove protective wrappings from doors and frames and touch up prime coat with compatible air-drying primer.

END OF SECTION 08110

SECTION 08210 – WOOD DOORS AND FRAMES

PART 1 - GENERAL

1.01 SUMMARY

A. Provide prehung interior door assemblies where scheduled.

1.02 SUBMITTALS

A. Submit for approval samples, shop drawings, product data, and warranty.

1.03 QUALITY ASSURANCE

A. Comply with governing codes and regulations. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Solid core prehung door units, where scheduled for interior use factory primed for field painting; 1 3/8” thick custom grade.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Comply with NWMA I.S.-1 and AWI quality standard. Prefit doors to frames. Premachine doors for hardware listed on final schedules. Factory bevel doors.

B. Install doors with not more than 1/8" clearance at top and sides, 1/4" at bottom. Comply with NFPA 80 for rated assemblies.

C. Shop Finish: Sand and provide first coat of finish system specified in painting section. Wrap and protect.

D. Adjust, clean, and protect.

END OF SECTION

SECTION 08305 - ACCESS DOORS

PART 1 - GENERAL

1.01 SUMMARY

A. Provide access doors for access to valves, controls, and concealed items requiring maintenance.
B. Provide attic access doors in roof-ceiling assemblies as indicated on Drawings

1.02 SUBMITTALS

A. Submit for approval shop drawings, product data.

1.03 QUALITY ASSURANCE

A. Comply with governing codes and regulations. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Doors: 14 gage for non-fire-rated units, 20 gage for fire-rated units; recessed steel panel doors to accept field finish of drywall or tile; cam locks except key locks at public areas.
B. Frames: 16 gage with concealed flanges for drywall and tile; and 1" exposed flanges for installation into concrete or masonry.
C. Primed finish for field finish.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Comply with manufacturer's installation instructions. Install plumb, level and square.
B. Install fire-rated units to comply with fire-resistance rating required. Coordinate installation and field finishing with work of other trades.
C. Adjust hardware and operation. Repair or replace damaged units.

END OF SECTION

SECTION 08610 – WINDOWS

PART 1 - GENERAL

1.01 SUMMARY

A. Provide Aluminum clad wood windows, with screens and window locks, as scheduled on the Drawings.

B. Window types:

1. Fixed windows where scheduled.
2. Casement windows where scheduled
3. Double-hung windows where scheduled.

1.02 SUBMITTALS

A. Submit for approval window samples, shop drawings, product data, warranty, test reports, maintenance data.

1.03 QUALITY ASSURANCE

A. Comply with governing codes and regulations. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Units: Aluminum clad wood, window units with insulated glass (Energy Star) and screens, fixed window units with insulated glass (Energy Star). Manufacturer shall be the same as or equal to Jeldwen Premium Operable and Fixed Pane Windows.

1. Exterior color: White.
2. Integral vinyl interlock with dual weather-stripping.
4. 3/4” double pane insulating glass, Low E glazing
5. Pre-punched 1 1/4 inch nailing fin.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials and systems in proper relation with adjacent construction and with uniform appearance. Coordinate with work of other sections.

1. Securely fasten windows in place, plumb, level and square without distortion, twisting, bowing, or springing of frame members.

2. Head and sill members shall be properly supported and leveled along entire length.
3. Caulk windows with good grade non-hardening caulk around perimeter of the window and frame opening.

B. Restore damaged finishes and test for proper operation. Clean and protect work from damage.

END OF SECTION

SECTION 08700 - FINISH HARDWARE

PART 1 - GENERAL

1.01 SUMMARY

A. Provide finish hardware for all interior and exterior doors.

1.02 SUBMITTALS

A. Submit for approval samples, product data, hardware schedule proposed for use based on Hardware Schedule and notes and Owner's requirements.

1.03 QUALITY ASSURANCE

A. Comply with governing codes and regulations. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.01 MATERIALS

A. See Door Hardware notes in the Construction drawings.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Follow guidelines of DHI "Recommended Locations for Builder's Hardware for Standard Steel Doors and Frames" and hardware manufacturers' instructions.

B. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials and systems in proper relation with adjacent construction and with uniform appearance. Coordinate with work of other sections.

C. Adjust operation, clean and protect.

END OF SECTION

SECTION 09260 - GYPSUM BOARD ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Interior gypsum wallboard.
2. Tile backing panels.
3. Non-load-bearing steel framing.

1.2 SUBMITTALS

A. Product Data: For each product indicated.

B. Samples: For each textured finish indicated and on same backing indicated for Work.

1.3 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: For gypsum board assemblies with fire-resistance ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.

B. Sound Transmission Characteristics: For gypsum board assemblies with STC ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by a qualified independent testing agency.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products specified, or equal products accepted.

2.2 STEEL FRAMING

A. Steel Framing, General: Comply with ASTM C 754 for conditions indicated.

1. Steel Sheet Components: Metal complying with ASTM C 645 requirements.

    a. Protective Coating:

        1) Interior and Exterior Applications: ASTM A 653/A 653M, hot-dip galvanized zinc coating.

B. Suspended Ceiling and Soffit Framing:

1. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch- (1.59-mm-) diameter wire, or double strand of 0.0475-inch- (1.21-mm-) diameter wire.
2. Hanger Attachments to Concrete:

    a. Anchors: Fabricated from corrosion-resistant materials with holes or loops for attaching hanger wires and capable of sustaining, without failure, a load equal to [5] <Insert number> times that imposed by construction as determined by testing according to ASTM E 488 by a qualified independent testing agency.

        1) Type: Postinstalled, expansion anchor.

    b. Powder-Actuated Fasteners: Suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, a load equal to 10 times that imposed by construction as determined by testing according to ASTM E 1190 by a qualified independent testing agency.

3. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.162-inch (4.12-mm) diameter.
4. Carrying Channels: Cold-rolled, commercial-steel sheet with a base metal thickness of 0.0538 inch (1.37 mm), a minimum 1/2-inch- (12.7-mm-) wide flange, and in depth indicated.
5. Furring Channels (Furring Members):

    a. Cold Rolled Channels: 0.0538-inch (1.37-mm) bare steel thickness, with minimum 1/2-inch- (12.7-mm-) wide flange, 3/4 inch (19.1 mm) deep.
    b. Steel Studs: ASTM C 645, in depth indicated.

        1) Minimum Base Metal Thickness: 0.0312 inch (0.79 mm).

    c. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch (22.2 mm) deep.

        1) Minimum Base Metal Thickness: 0.0312 inch (0.79 mm).

    d. Resilient Furring Channels: 1/2-inch- (12.7-mm-) deep members designed to reduce sound transmission, and asymmetrical with single leg or hat shaped with two legs.

C. Grid Suspension System for Interior Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.

1. Products:

a. Armstrong World Industries, Inc.; Furring Systems/Drywall.
b. USG Interiors, Inc.; Drywall Suspension System.
c. or equal

D. Partition and Soffit Framing:

1. Steel Studs and Runners: ASTM C 645, in depth indicated.

a. Minimum Base Metal Thickness: 0.0312 inch (0.79 mm).

2. Deep-Leg Deflection Track: ASTM C 645 top runner with 2-inch- (50.8-mm-) deep flanges.

3. Proprietary Firestop Track: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.

a. Products:

1) Fire Trak Corp.; Fire Trakattached to studs with Fire Trak Slip Clip.
2) Metal-Lite, Inc.; The System.
3) or equal

4. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.

a. Minimum Base Metal Thickness: 0.0312 inch (0.79 mm).

5. Cold-Rolled Channel Bridging: 0.0538-inch (1.37-mm) bare steel thickness, with minimum 1/2-inch- (12.7-mm-) wide flange, and in depth indicated.

a. Clip Angle: 1-1/2 by 1-1/2 inch (38.1 by 38.1 mm), 0.068-inch- (1.73-mm-) thick, galvanized steel.

6. Hat-Shaped, Rigid Furring Channels: ASTM C 645, in depth indicated.

a. Minimum Base Metal Thickness: 0.0312 inch (0.79 mm).

7. Resilient Furring Channels: 1/2-inch- (12.7-mm-) deep, steel sheet members designed to reduce sound transmission. Asymmetrical or hat shaped, with face attached to single flange by a slotted leg (web) or attached to two flanges by slotted or expanded metal legs.
8. Cold-Rolled Furring Channels: 0.0538-inch (1.37-mm) bare steel thickness, with minimum 1/2-inch- (12.7-mm-) wide flange, and in depth indicated.

a. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum bare steel thickness of 0.0312 inch (0.79 mm).
b. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch- (1.59-mm-) diameter wire, or double strand of 0.0475-inch- (1.21-mm-) diameter wire.

9. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches (31.8 mm), wall attachment flange of 7/8 inch (22.2 mm), minimum bare metal thickness of 0.0179 inch (0.45 mm), and depth required to fit insulation thickness indicated.
10. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

2.3 PANEL PRODUCTS

A. Panel Size, General: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.

B. Gypsum Wallboard: ASTM C 36.

1. Regular Type: In thickness indicated and with long edges tapered and featured (rounded or beveled).
2. Type X: In thickness indicated and with long edges tapered and featured (rounded or beveled).

C. Flexible Gypsum Wallboard: ASTM C 36, manufactured to bend to fit tight radii and to be more flexible than standard regular-type panels of the same thickness, 1/4 inch (6.4 mm) thick, and with long edges tapered. Apply in double layer at curved assemblies.

D. Sag-Resistant Gypsum Wallboard: ASTM C 36, manufactured to have more sag resistance than regular-type gypsum board, 1/2 inch (12.7 mm) thick, and with long edges tapered. Apply on ceiling surfaces.

E. Proprietary, Special Fire-Resistive Type: ASTM C 36, having improved fire resistance over standard Type X, complying with requirements of fire-resistance-rated assemblies indicated, in thickness indicated, and with long edges tapered.

F. Foil-Backed Gypsum Wallboard: ASTM C 36, with core type and in thickness indicated, and with long edges tapered.

G. Proprietary Abuse-Resistant Gypsum Wallboard: ASTM C 36, manufactured to produce greater resistance to surface indentation and through-penetration than standard gypsum panels, with core type and in thickness indicated, and with long edges tapered.

1. Products:

a. National Gypsum Company; Gold Bond Hi-Abuse Wallboard.
b. United States Gypsum Co.; SHEETROCK Brand Abuse-Resistant Gypsum Panels.
c. or equal

H. Exterior Gypsum Panels for Ceilings and Soffits:

1. Exterior Gypsum Soffit Board: ASTM C 931/C 931M, with core type and in thickness indicated and with manufacturer's standard edges.
2. Glass-Mat Gypsum Sheathing Board: ASTM C 1177/C 1177M, with core type and in thickness indicated.

a. Product: G-P Gypsum Corp; Dens-Glass Gold.

I. Tile Backing Panels:

1. Water-Resistant Gypsum Backing Board: ASTM C 630/C 630M, with core type and in thickness indicated.
2. Glass-Mat, Water-Resistant Backing Board: ASTM C 1178/C 1178M, with core type and in thickness indicated.

a. Product: G-P Gypsum Corp.; Dens-Shield Tile Backer.

3. Cementitious Backer Units: ANSI A118.9, in thickness indicated.

2.4 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

2.5 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475.

B. Joint Tape:

1. Interior Gypsum Wallboard: Paper.
2. Exterior Gypsum Soffit Board: Paper.
3. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
4. Tile Backing Panels: As recommended by panel manufacturer.

C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints, rounded or beveled panel edges,] and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, flanges of trim accessories, and fasteners, use drying-type, all-purpose compound.

a. Use setting-type compound for installing paper-faced metal trim accessories.

3. Fill Coat: For second coat, use setting-type, sandable topping compound.
4. Finish Coat: For third coat, use setting-type, sandable topping compound.
5. Skim Coat: For final coat of Level 5 finish, use setting-type, sandable topping compound.

E. Joint Compound for Tile Backing Panels:

1. Water-Resistant Gypsum Backing Board: Use setting-type taping and setting-type, sandable topping compounds.
2. Glass-Mat, Water-Resistant Backing Panel: As recommended by manufacturer.

3. Cementitious Backer Units: As recommended by manufacturer.

2.6 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

B. Acoustical Sealant for Exposed and Concealed Joints: Nonsag, paintable, nonstaining, latex sealant complying with ASTM C 834 that effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

1. Products:

a. Pecora Corp.; AC-20 FTR Acoustical and Insulation Sealant.
b. United States Gypsum Co.; SHEETROCK Acoustical Sealant.
c. or equal

C. Acoustical Sealant for Concealed Joints: Nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant recommended for sealing interior concealed joints to reduce airborne sound transmission.

1. Products:

a. Ohio Sealants, Inc.; Pro-Series SC-170 Rubber Base Sound Sealant.
b. Pecora Corp.; BA-98.
c. Tremco, Inc.; Tremco Acoustical Sealant.
d. or equal

D. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.
2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

E. Isolation Strip at Exterior Walls:

1. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No. 15 asphalt felt), nonperforated.
2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch (3.2 mm) thick, in width to suit steel stud size.

F. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.

1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.

PART 3 - EXECUTION

3.1 NON-LOAD-BEARING STEEL FRAMING INSTALLATION

A. General: Comply with ASTM C 754, and ASTM C 840 requirements that apply to framing installation.

B. Suspended Ceiling and Soffit Framing:

1. Suspend ceiling hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or ceiling suspension system. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with the location of hangers required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
3. Attach hangers to structural members. Do not support ceilings from or attach hangers to permanent metal forms, steel deck tabs, steel roof decks, ducts, pipes, or conduit.
4. Screw furring to wood framing.
5. Wire-tie or clip furring channels to supports, as required to comply with requirements for assemblies indicated.
6. Grid Suspension System: Attach perimeter wall track or angle where grid suspension system meets vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

C. Partition and Soffit Framing:

1. Where studs are installed directly against exterior walls, install isolation strip between studs and wall.
2. Extend partition framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing over frames for doors and openings and frame around ducts penetrating partitions above ceiling to provide support for gypsum board.
3. Frame door openings to comply with GA-600 and with gypsum board manufacturer's applicable written recommendations, unless otherwise indicated. Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.

    a. Install two studs at each jamb, unless otherwise indicated.
    b. Extend jamb studs through suspended ceilings and attach to underside of floor or roof structure above.

4. Frame openings other than door openings the same as required for door openings, unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.

D. Z-Furring Members: Erect insulation vertically and hold in place with Z-furring members.

1. Until gypsum board is installed, hold insulation in place with 10-inch (250-mm) staples fabricated from 0.0625-inch- (1.59-mm-) diameter, tie wire and inserted through slot in web of member.

E. Polyethylene Vapor Retarder: Install to comply with requirements specified in Division 7 Section "Building Insulation."

3.2 PANEL PRODUCT INSTALLATION

A. Gypsum Board: Comply with ASTM C 840 and GA-216.

1. Space screws a maximum of 12 inches (304.8 mm) o.c. for vertical applications.
2. Space fasteners in panels that are tile substrates a maximum of 8 inches (203.2 mm) o.c.
3. On ceilings, apply gypsum panels before wall/partition board application to the greatest extent possible and at right angles to framing, unless otherwise indicated.
4. On partitions/walls, apply gypsum panels horizontally (perpendicular to framing), unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.

    a. Stagger abutting end joints not less than one framing member in alternate courses of board.
    b. At stairwells and other high walls, install panels horizontally, unless otherwise indicated or required by fire-resistance-rated assembly.

5. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
6. Single-Layer Fastening Methods: Apply gypsum panels to supports with steel drill screws.
7. Multilayer Fastening Methods: Fasten base layers and face layers separately to supports with screws.
8. Laminating to Substrate: Comply with gypsum board manufacturer's written recommendations and temporarily brace or fasten gypsum panels until fastening adhesive has set.

B. Exterior Ceilings and Soffits: Apply exterior gypsum panels perpendicular to supports, with end joints staggered and located over supports.

1. Fasten with corrosion-resistant screws.

C. Tile Backing Panels:

1. Water-Resistant Gypsum Backing Board: Install with 1/4-inch (6.4-mm) gap where panels abut other construction or penetrations.
2. Glass-Mat, Water-Resistant Backing Panel: Install with 1/4-inch (6.4-mm) gap where panels abut other construction or penetrations.
3. Cementitious Backer Unit Application: ANSI A108.11.

3.3 FINISHING

A. Installing Trim Accessories: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Finishing Gypsum Board Panels: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration.

1. Prefill open joints, rounded or beveled edges, and damaged surface areas.
2. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.
3. Glass-Mat Gypsum Sheathing Board: Finish according to manufacturer's written instructions for use as exposed soffit board.
4. Glass-Mat, Water-Resistant Backing Panels: Finish according to manufacturer's written instructions.

C. Cementitious Backer Units: Finish according to manufacturer's written instructions.

END OF SECTION 09260

SECTION 09512 - ACOUSTICAL TILE CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes acoustical tiles and concealed suspension systems for ceilings.

1.2 SUBMITTALS

A. Product Data: For each product indicated.

B. Coordination Drawings: Drawn to scale and coordinating penetrations and ceiling-mounted items. Show the following:

1. Ceiling suspension assembly members.
2. Method of attaching hangers to building structure.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

C. Samples: For each acoustical tile, for each concealed suspension system member, and for each color and texture required.

D. Product test reports.

E. Research/evaluation reports.

F. Maintenance data.

1.3 QUALITY ASSURANCE

A. Acoustical Testing Agency Qualifications: An independent testing laboratory or an NVLAP-accredited laboratory.

B. Fire-Test-Response Characteristics:

1. Fire-Resistance Ratings: Where indicated, provide acoustical tile ceilings identical to those of assemblies tested for fire resistance per ASTM E 119 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Ratings are indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another testing and inspecting agency.

a. Identify materials with appropriate markings of applicable testing and inspecting agency.

2. Surface-Burning Characteristics: Acoustical tiles complying with ASTM E 1264 for Class A materials, when tested per ASTM E 84.

   a. Smoke-Developed Index: 450 or less.

C. Seismic Standard: Comply with the following:

1. ASTM E 580.
2. CISCA's "Recommendations for Direct-Hung Acoustical Tile and Lay-in Panel Ceilings--Seismic Zones 0-2."
3. CISCA's "Guidelines for Seismic Restraint of Direct-Hung Suspended Ceiling Assemblies--Seismic Zones 3 & 4."
4. UBC Standard 25-2.

1.4 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Acoustical Ceiling Units: Full-size units equal to 2.0 percent of quantity installed, but not fewer than one box.
2. Suspension System Components: Quantity of each concealed grid and exposed component equal to 2.0 perent of quantity installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products specified.
2. Products: Subject to compliance with requirements, provide one of the products specified.

2.2 GENERAL

A. Acoustical Tile Standard: Comply with ASTM E 1264.

B. Metal Suspension System Standard: Comply with ASTM C 635.

C. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated.

D. Wire Hangers, Braces, and Ties: Zinc-coated carbon-steel wire; ASTM A 641/A 641M, Class 1 zinc coating, soft temper.

1. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch- (2.69-mm-) diameter wire.

E. Seismic struts and seismic clips.

F. Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that fit acoustical tile edge details and suspension systems indicated; formed from sheet metal of same material and finish as that used for exposed flanges of suspension system runners.

2.3 ACOUSTICAL TILES

A. Products: as indicated or equal.

2.4 METAL SUSPENSION SYSTEM

A. Products: Suprafine ML 16 Exposed T by Armstrong or equal

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install acoustical tile ceilings to comply with ASTM C 636 and seismic requirements indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

B. Measure each ceiling area and establish layout of acoustical tiles to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width tiles at borders.

C. Suspend ceiling hangers from building's structural members, plumb and free from contact with insulation or other objects within ceiling plenum. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers, use trapezes or equivalent devices.

1. Do not support ceilings directly from permanent metal forms or floor deck; anchor into concrete slabs.
2. Do not attach hangers to steel deck tabs or to steel roof deck.

D. Install edge moldings and trim at perimeter of acoustical tile ceiling area and where necessary to conceal edges of acoustical units. Screw attach moldings to substrate with concealed fasteners at intervals not more than 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3.2 mm in 3.66 m). Miter corners accurately and connect securely.

E. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

F. Install acoustical tiles in coordination with suspension system and exposed moldings and trim. Place splines or suspension system flanges into kerfed edges so tile-to-tile joints are closed by double lap of material. Fit adjoining tile to form flush, tight joints. Scribe and cut tile for accurate fit at borders and around penetrations through tile. Hold tile field in compression by inserting leaf-type, spring-steel spacers between tile and moldings, spaced 12 inches (305 mm) o.c.

END OF SECTION 09512

SECTION 09681 - CARPET TILE

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes carpet tile and installation.

1.2 SUBMITTALS

A. Product Data: For each product indicated.

B. Shop Drawings: Include the following:

1. Pattern of installation.
2. Pattern type, location, and direction.
3. Pile direction.
4. Transition and other accessory strips.
5. Transition details to other flooring materials.

C. Samples: For each carpet tile and exposed accessory and for each color and pattern required.

D. Product Schedule: Use same room and product designations indicated on Drawings and in schedules.

E. Maintenance data.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who is certified by the Floor Covering Installation Board or who can demonstrate compliance with its certification program requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Comply with CRI 104, Section 5, "Storage and Handling."

1.5 PROJECT CONDITIONS

A. General: Comply with CRI 104, Section 6.1, "Site Conditions; Temperature and Humidity."

B. Environmental Limitations: Do not install carpet tile until wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

C. Do not install carpet tile over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.

D. Where demountable partitions or other items are indicated for installation on top of carpet tile, install carpet tile before installing these items.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to replace carpet tile that does not comply with requirements or that fails within 10 years from date of Substantial Completion.

1. Warranty does not include deterioration or failure of carpet tile from unusual traffic, failure of substrate, vandalism, or abuse. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, and delamination.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd. (8.3 sq. m).

PART 2 - PRODUCTS

2.1 CARPET TILE

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

B. Products: Subject to compliance with requirements, provide one of the following:

1. As indicated

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with CRI 104, Section 13, "Carpet Modules (Tiles)."

B. Install borders parallel to walls.

END OF SECTION 09681

SECTION 09912 - PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes surface preparation and field painting of exposed exterior and interior items and surfaces.

1.2 SUBMITTALS

A. Product Data: For each product indicated.

B. Samples: For each type of finish-coat material indicated.

1.3 QUALITY ASSURANCE

A. Benchmark Samples (Mockups): Provide a full-coat benchmark finish sample for each type of coating and substrate required. Comply with procedures specified in PDCA P5.

1. Wall Surfaces: Provide samples on at least 100 sq. ft. (9 sq. m).
2. Small Areas and Items: Architect will designate items or areas required.
3. Final approval of colors will be from benchmark samples.

1.4 PROJECT CONDITIONS

A. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F (7 deg C). Maintain storage containers in a clean condition, free of foreign materials and residue.

B. Apply waterborne paints only when temperatures of surfaces to be painted and surrounding air are between 50 and 90 deg F (10 and 32 deg C).

C. Apply solvent-thinned paints only when temperatures of surfaces to be painted and surrounding air are between 45 and 95 deg F (7 and 35 deg C).

D. Do not apply paint in snow, rain, fog, or mist; or when relative humidity exceeds 85 percent; or at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

1.5 EXTRA MATERIALS

A. Furnish extra paint materials from the same production run as the materials applied and in the quantities described below. Package with protective covering for storage and identify with labels describing contents. Deliver extra materials to Owner.

1. Quantity: 3 percent, but not less than 1 gal. (3.8 L) or 1 case, as appropriate, of each material and color applied.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in other Part 2 articles.

B. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles.

C. Manufacturers' Names: Basis of Design is as indicated in the drawings. Or equal manufactures can be accepted. Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:

1. Benjamin Moore & Co. (Benjamin Moore).
2. Coronado Paint Company (Coronado).
3. ICI Paint Stores, Inc. (Dulux Paint).
4. Kelly-Moore Paint Co. (Kelly-Moore).
5. M. A. Bruder & Sons, Inc. (M. A. B. Paint).
6. PPG Industries, Inc. (Pittsburgh Paints).
7. Sherwin-Williams Co. (Sherwin-Williams).
8. or equal

2.2 PAINT MATERIALS, GENERAL

A. Material Compatibility: Provide block fillers, primers, and finish-coat materials that are compatible with one another and with the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

B. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint-material containers not displaying manufacturer's product identification will not be acceptable.

C. Colors: As selected from manufacturer's full range.

2.3 PREPARATORY COATS

A. Exterior Primer: Exterior alkyd or latex-based primer of finish coat manufacturer and recommended in writing by manufacturer for use with finish coat and on substrate indicated.

1. Ferrous-Metal and Aluminum Substrates: Rust-inhibitive metal primer.
2. Zinc-Coated Metal Substrates: Galvanized metal primer.
3. Where manufacturer does not recommend a separate primer formulation on substrate indicated, use paint specified for finish coat.

B. Interior Primer: Interior latex-based or alkyd primer of finish coat manufacturer and recommended in writing by manufacturer for use with finish coat and on substrate indicated.

1. Ferrous-Metal Substrates: Quick drying, rust-inhibitive metal primer.
2. Zinc-Coated Metal Substrates: Galvanized metal primer.
3. Where manufacturer does not recommend a separate primer formulation on substrate indicated, use paint specified for finish coat.

2.4 EXTERIOR FINISH COATS

A. Exterior Full-Gloss Acrylic Enamel for Ferrous and Other Metals:

1. Benjamin Moore; Moore's IMC Acrylic Gloss Enamel M28.
2. Coronado; 80 Line Rust Scat Acrylic Latex High Gloss Enamel.
3. Dulux Paint; 3028-XXXX Dulux Interior/Exterior Acrylic Gloss Finish.
4. Kelly-Moore; 5780 DTM Acrylic Gloss Enamel.
5. M. A. B. Paint; Rust-O-Lastic Gloss Acrylic (DTM) Maintenance Finish 043 Line.
6. Pittsburgh Paints; 90-300 Series Pitt-Tech One Pack Interior/Exterior High Performance Waterborne High Gloss DTM Industrial Enamels.
7. Sherwin-Williams; DTM Acrylic Coating Gloss (Waterborne) B66W100 Series.
8. or equal

2.5 INTERIOR FINISH COATS

A. Interior Flat Acrylic Paint:

1. Benjamin Moore; Moorecraft Super Spec Latex Flat No. 275.
2. Coronado; 28 Line Super Kote 5000 Latex Flat Paint.
3. Dulux Paint; 1200-XXXX Dulux Professional Velvet Matte Interior Flat Latex Wall & Trim Finish.
4. Kelly-Moore; 450 Pro-Wall Interior Flat Latex Wall Paint.
5. M. A. B. Paint; Fresh Kote Latex Flat 402 Line.
6. Pittsburgh Paints; 6-70 Line SpeedHide Interior Wall Flat-Latex Paint.
7. Sherwin-Williams; ProMar 200 Interior Latex Flat Wall Paint B30W200 Series.
8. or equal

B. Interior Semigloss Acrylic Enamel:

1. Benjamin Moore; Moorcraft Super Spec Latex Semi-Gloss Enamel No. 276.
2. Coronado; 32-Line Super Kote 5000 Latex Semi-Gloss Enamel.
3. Dulux Paint; 1406-XXXX Dulux Professional Acrylic Semi-Gloss Interior Wall & Trim Enamel.
4. Kelly-Moore; 1649 Acrylic-Latex Semi-Gloss Enamel.
5. Kelly-Moore; 1685 Dura-Poxy Semi-Gloss Acrylic Enamel.
6. M. A. B. Paint; Fresh Kote Latex Semi-Gloss 410 Line.
7. Pittsburgh Paints; 6-500 Series SpeedHide Interior Semi-Gloss Latex.
8. Sherwin-Williams; ProMar 200 Interior Latex Semi-Gloss Enamel B31W200 Series.
9. or equal

C. Interior Full-Gloss Alkyd Enamel for Wood and Metal Surfaces:

1. Benjamin Moore; Moore's IMC Urethane Alkyd Enamel No. M22.
2. Coronado; 123 Line Super Kote 5000 High Gloss Alkyd Enamel.
3. Dulux Paint; 4308-XXXX Devguard Alkyd Industrial Gloss Enamel.
4. Kelly-Moore; 1630--Kel-Cote Interior Alkyd Semi-Gloss Enamel.
5. M. A. B. Paint; Rich Lux Architectural Bright White Enamel 026-127 Line.
6. Pittsburgh Paints; 7-814 Series Pittsburgh Paints Industrial Gloss-Oil Interior/Exterior Enamel.
7. Sherwin-Williams; ProMar 200 Alkyd Gloss Enamel B35W200 Series.
8. or equal

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with procedures specified in PDCA P4 for inspection and acceptance of surfaces to be painted.

B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.

C. Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of size or weight of the item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.

D. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.

1. Provide barrier coats over incompatible primers or remove and reprime.

2. Wood: Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand surfaces exposed to view smooth and dust off.

a. Scrape and clean small, dry, seasoned knots, and apply a thin coat of white shellac or other recommended knot sealer before applying primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.
b. Prime, stain, or seal wood to be painted immediately on delivery. Prime edges, ends, faces, undersides, and back sides of wood, including cabinets, counters, cases, and paneling.
c. If transparent finish is required, backprime with spar varnish.
d. Backprime paneling on interior partitions where masonry, plaster, or other wet wall construction occurs on back side.
e. Seal tops, bottoms, and cutouts of unprimed wood doors with a heavy coat of varnish or sealer immediately on delivery.

4. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with SSPC's recommendations.

a. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
b. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with same primer as the shop coat.

5. Galvanized Surfaces: Clean galvanized surfaces with nonpetroleum-based solvents so surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.

E. Material Preparation:

1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.

F. Exposed Surfaces: Include areas visible when permanent or built-in fixtures, grilles, convector covers, covers for finned-tube radiation, and similar components are in place. Extend coatings in these areas, as required, to maintain system integrity and provide desired protection.

1. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
2. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
3. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
4. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
5. Finish interior of wall and base cabinets and similar field-finished casework to match exterior.

G. Sand lightly between each succeeding enamel or varnish coat.

H. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

1. Omit primer over metal surfaces that have been shop primed and touchup painted.
2. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance.

I. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.

J. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate. Provide total dry film thickness of the entire system as recommended by manufacturer.

K. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in equipment rooms and occupied spaces.

L. Block Fillers: Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores filled.

M. Prime Coats: Before applying finish coats, apply a prime coat, as recommended by manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn-through or other defects due to insufficient sealing.

N. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.

O. Transparent (Clear) Finishes: Use multiple coats to produce a glass-smooth surface film of even luster. Provide a finish free of laps, runs, cloudiness, color irregularity, brush marks, orange peel, nail holes, or other surface imperfections.

P. Stipple Enamel Finish: Roll and redistribute paint to an even and fine texture. Leave no evidence of rolling, such as laps, irregularity in texture, skid marks, or other surface imperfections.

3.2 CLEANING AND PROTECTING

A. At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from Project site.

B. Protect work of other trades, whether being painted or not, against damage from painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Architect.

C. Provide "Wet Paint" signs to protect newly painted finishes. After completing painting operations, remove temporary protective wrappings provided by others to protect their work.

1. After work of other trades is complete, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

A. Ferrous Metal:

1. Acrylic Finish: Two finish coats over a rust-inhibitive primer.

   a. Primer: Exterior ferrous-metal primer (not required on shop-primed items).
   b. Finish Coats: Exterior full-gloss acrylic enamel for ferrous and other metals.

2. Alkyd-Enamel Finish: Two finish coats over a rust-inhibitive primer.

   a. Primer: Exterior ferrous-metal primer (not required on shop-primed items).
   b. Finish Coats: Exterior full-gloss alkyd enamel.

3.4 INTERIOR PAINT SCHEDULE

A. Gypsum Board:

1. Acrylic Finish: Two finish coats over a primer.

   a. Primer: Interior gypsum board primer.
   b. Finish Coats: Interior low-luster acrylic enamel.

2. Alkyd-Enamel Finish: Two finish coats over a primer.

   a. Primer: Interior gypsum board primer.
   b. Finish Coats: Interior semigloss alkyd enamel for gypsum board and plaster.

B. Wood and Hardboard:

1. Acrylic-Enamel Finish: Two finish coats over a primer.

   a. Primer: Interior wood primer for acrylic-enamel and semigloss alkyd-enamel finishes.
   b. Finish Coats: Interior semigloss acrylic enamel.

2. Alkyd-Enamel Finish: Two finish coats over a primer.

   a. Primer: Interior wood primer for acrylic-enamel and semigloss alkyd-enamel finishes.
   b. Finish Coats: Interior semigloss alkyd enamel for wood and metal surfaces].

C. Ferrous Metal:

1. Acrylic Finish: Two finish coats over a primer.

   a. Primer: Interior ferrous-metal primer.
   b. Finish Coats: Interior semigloss acrylic enamel.

2. Alkyd-Enamel Finish: Two finish coats over a primer.

    a. Primer: Interior ferrous-metal primer.
    b. Finish Coats: Interior semigloss alkyd enamel for wood and metal surfaces].

F. Zinc-Coated Metal:

1. Acrylic Finish: Two finish coats over a primer.

    a. Primer: Interior zinc-coated metal primer.
    b. Finish Coats: Interior semigloss acrylic enamel.

2. Alkyd-Enamel Finish: Two finish coats over a primer.

    a. Primer: Interior zinc-coated metal primer.
    b. Finish Coats: Interior semigloss alkyd enamel for wood and metal surfaces.

END OF SECTION 09912

SECTION 09930 – CONCRETE COLOR FLOOR

PART 1 – GENERAL

1.1 DESCRIPTION

A. This specification describes Smith's Color Floor application, or equal, to properly prepared interior and exterior, horizontal porous substrates including, but not limited to concrete, terra cotta, stucco and plaster.

1.2 SUBMITTALS

A. Manufacturer's technical information and instructions for surface preparation, product application, material storage and handling.

B. Color: Smith's Color Floor is manufactured in 33 colors. Color matches are available with predetermined order size and surcharge. Color Charts are available in the following forms:

1. Stain on 2 x 2.5 inch concrete chips (sold via distribution outlets).
2. Printed color chart (free).

1.3 QUALITY ASSURANCE

A. Applicator Qualifications: Experienced applicator as well as successful installation of Smith's Color Floor or similar waterborne stains.

B. Dilution: When diluting color concentrate, use only distilled, de-ionized or reverse osmosis water. For application to concrete, the use of Smith's Base Boost is recommended.

C. Color:

1. Apply stain to intended substrate or a sample of substrate with similar characteristics (color, porosity and texture).
2. Apply stain to sample area with same application method as intended for application area.

D. Pre-installation: Before the start of stain application, require that all parties/trades working in or around intended application surface are in full understanding of surface preparation, application, and protection of subsequently stained and sealed area.

1.4 DELIVERY, STORAGE AND HANDLING

A. Product is not freeze thaw stable in liquid state.

B. Packing: Deliver materials in manufacturer's original, unopened packages and containers, with labels identifying manufacturer, product name, product number and stain color.

C. Storage and Protection: Store materials not in use in tightly covered containers, out of direct sunlight in an ambient temperature between 40 – 115 degrees F. Store diluted stain in clean, carefully sealed containers.

D. Handling: Protect materials from freezing and/or contamination during handling and application.

1.6 PROJECT CONDITIONS

A. Temperature Conditions: Apply stain only when temperature of substrate and surrounding air temperatures is between 45 and 110 degrees F.

B. Weather Conditions: Do not apply stain on exterior surfaces during precipitation or at a temperature that is less than 5 degrees F above the dew point.

1.7 SEQUENCING

A. Application of stain shall begin following substrate cleaning.

B. In ideal curing conditions (70° F, 50% Relative Humidity) schedule application of protective sealer 24 hours after stain is applied.

PART 2 – PRODUCTS

2.1 MANUFACTURER

A. Provide Smith Paint Products, or equal, 2200 Paxton Street, Harrisburg, PA 17111. Telephone Number (717) 233-8781. Facsimile (717) 232-5199. Web Site www.smithpaints.com. Email: info@smithpaints.com.

2.2 WATERBORNE STAIN

A. Waterborne Stain: Smith's Color Floor

1. Description: Water-based, modified acrylic and pigments
2. Concentrate Percent Solids: 29.4 – 36 percent
3. VOC: Diluted 9.14 – 11.11 g/l
4. Color: please refer to Smith's Color Floor color chart

B. Cleaner: Smith's Green Clean or equal. Clean surface in accordance with manufacturer's written application instructions.

C. A clear, film-forming sealer or "top coat" is required for installation longevity and durability.

1. Compatible Sealers: Smith's Royal Seal, Smith's Seal WB, Smith's Polyurethane Solvent Based (SB) and Smith's Polyurethane Water-Based (WB). Generic terms for sealers are as follows; solvents and water based acrylics, 2 component epoxies and poly-urethanes.
2. Incompatible Clear Systems: penetrating sealers including lithium, potassium and sodium silicates as well s methyl methacrylate sealers (a.k.a. MMA's).

PART 3 – INSTALLATION

3.1 EXAMINATION

A. Examine substrate and conditions, with application contractor present, to determine compliance with application requirements.

B. Notify Architect in writing of anticipated problems and/or unsatisfactory conditions.

C. Do not begin surface preparation or stain application until unsatisfactory conditions have been corrected.

3.2 PREPERATION

A. Remove or mask fixtures and areas that are not to be stained.

1. Ensure concrete has cured a minimum of 28 days.

B. Prepare surfaces in accordance with manufacturer's instructions.

1. Remove loose concrete, dirt, dust, oil, grease, and other contaminants.
2. Apply Smith's Green Clean according to the product's Application Instructions.
3. Alternative surface preparation includes the use of grinding equipment to remove contaminants found in the intended application surface.

C. Surface

1. Surface must be free of all contaminants and appear dry. Follow manufacturer's instruction for "tape test" to verify proper surface preparation resulting in optimal adhesion.

3.3 APPLICATION

A. Dilute products concentrate to achieve desired appearance. Recommended dilution ration is 1 part concentrate to 4 parts distilled, de-ionized or reverse osmosis water.

1. Decreased dilution ratio (amount of water): increases color intensity and opacity.
2. Increased dilution ratio: decreases color intensity and opacity.
3. For application to concrete substrates, the use of Smith's Base Boost is recommended. Dilute Smith's Color Floor Concentrate; 1 part concentrate with 2 parts Smith's Base Boost along with 2 parts distilled, de-ionized or reverse osmosis water.

B. Apply stain to prepared substrate according to manufacturer's written instructions.

END OF SECTION 09930

SECTION 10431 - SIGNS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Panel signs.
2. Dimensional characters (letters and numbers) for exterior use.
3. Signage accessories.

1.2 SUBMITTALS

A. Product Data: For each product indicated.

B. Shop Drawings: Include plans, elevations, sections, details, wiring diagrams, and attachments to other Work.

1. Verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings.
2. Provide message list for each sign, including large-scale details of wording, lettering, and braille layout.

C. Samples: For each sign material indicated that involves color selection.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with the Americans with Disabilities Act (ADA) and with code provisions as adopted by authorities having jurisdiction.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.

2.2 PANEL SIGNS

A. General: Provide panel signs that comply with requirements indicated for materials, thicknesses, finishes, colors, designs, shapes, sizes, and details of construction.

B. Manufacturers:

1. Allenite Signs; Allen Marking Products, Inc.
2. American Graphics Inc.
3. Andco Industries Corp.
4. APCO Graphics, Inc.
5. ASI Sign Systems, Inc.
6. Best Manufacturing Co.
7. Grimco, Inc.
8. Innerface Sign Systems, Inc.
9. Kaltech Industries Group, Inc.
10. Mills Manufacturing, Inc.
11. Mohawk Sign Systems.
12. Seton Identification Products.
13. Signature Signs, Inc.
14. Supersine Company (The).
15. or equal

C. Cast-Acrylic Sheet: Manufacturer's standard and as follows:

1. Color: As selected from manufacturer's full range.

D. Unframed Panel Signs: Fabricate signs with edges mechanically and smoothly finished to comply with the following requirements:

1. Edge Condition: Square cut.
2. Corner Condition: Square.

E. Brackets: Fabricate brackets and fittings for bracket-mounted signs from extruded aluminum to suit panel sign construction and mounting conditions indicated.

F. Tactile and Braille Copy: Manufacturer's standard process for producing copy complying with ADA Accessibility Guidelines and ICC/ANSI A117.1. Text shall be accompanied by Grade 2 braille. Produce precisely formed characters with square cut edges free from burrs and cut marks.

1. Panel Material: Clear acrylic sheet with opaque color coating, subsurface applied.
2. Raised-Copy Thickness: Not less than 1/32 inch (0.8 mm).

2.3 DIMENSIONAL CHARACTERS

A. Manufacturers:

1. American Graphics Inc.
2. A.R.K. Ramos.
3. ASI Sign Systems, Inc.

4. Charleston Industries, Inc.
5. Gemini Incorporated.
6. Grimco, Inc.
7. Innerface Sign Systems, Inc.
8. Kaltech Industries Group, Inc.
9. Metal Arts; Div. of L&H Mfg.
10. Mills Manufacturing, Inc.
11. Mohawk Sign Systems.
12. Signature Sign Signs, Inc.
13. Southwell Co. (The).
14. or equal

B. Aluminum Castings: Provide aluminum castings of alloy and temper recommended by sign manufacturer for casting process used and for type of use and finish indicated.

2.4 ACCESSORIES

A. Mounting Methods: Use concealed fasteners fabricated from materials that are not corrosive to sign material and mounting surface.

B. Anchors and Inserts: Provide nonferrous-metal or hot-dip galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel or lead expansion-bolt devices for drilled-in-place anchors. Furnish inserts, as required, to be set into concrete or masonry work.

C. Note Holders: Manufacturer's standard aluminum paper sheet holders.

2.5 ALUMINUM FINISHES

A. Clear Anodic Finish: Manufacturer's standard clear anodic coating, 0.018 mm or thicker, over a satin (directionally textured) mechanical finish.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Locate signs and accessories where indicated, using mounting methods of types described and in compliance with manufacturer's written instructions.

1. Install signs level, plumb, and at heights indicated, with sign surfaces free from distortion and other defects in appearance.
2. Interior Wall Signs: Install signs on walls adjacent to latch side of door where applicable. Where not indicated or possible, such as double doors, install signs on nearest adjacent walls. Locate to allow approach within 3 inches (75 mm) of sign without encountering protruding objects or standing within swing of door.

B. Wall-Mounted Panel Signs: Attach panel signs to wall surfaces using methods indicated below:

1. Vinyl-Tape Mounting: Use double-sided foam tape to mount signs to smooth, nonporous surfaces. Do not use this method for vinyl-covered or rough surfaces.
2. Hook-and-Loop Tapes: Use hook-and-loop tapes to mount signs to smooth, nonporous surfaces.
3. Magnetic Tape: Use magnetic tape to mount signs to smooth, nonporous surfaces.
4. Silicone-Adhesive Mounting: Use liquid-silicone adhesive recommended in writing by sign manufacturer to attach signs to irregular, porous, or vinyl-covered surfaces. Use double-sided vinyl tape where recommended in writing by sign manufacturer to hold sign in place until adhesive has fully cured.
5. Shim Plate Mounting: Provide 1/8-inch- (3-mm-) thick, concealed aluminum shim plates with predrilled and countersunk holes, at locations indicated, and where other mounting methods are not practicable. Attach plate with fasteners and anchors suitable for secure attachment to substrate. Attach panel signs to plate using method specified above.
6. Mechanical Fasteners: Use nonremovable mechanical fasteners placed through predrilled holes. Attach signs with fasteners and anchors suitable for secure attachment to substrate as recommended in writing by sign manufacturer.
7. Where panel signs are scheduled or indicated to be mounted on glass, provide matching plate on opposite side of glass to conceal mounting materials.

C. Dimensional Characters: Mount characters using standard fastening methods recommended in writing by manufacturer for character form, type of mounting, wall construction, and condition of exposure indicated. Provide heavy paper template to establish character spacing and to locate holes for fasteners.

1. Projected Mounting: Mount characters at projection distance from wall surface indicated.

END OF SECTION 10431

SECTION 10801 - TOILET ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Toilet accessories.
2. Underlavatory guards.

1.2 SUBMITTALS

A. Product Data: For each product indicated.

B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required. Use room designations indicated on Drawings.

1.3 WARRANTY

A. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace mirrors that develop visible silver spoilage defects within 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Provide same or similar to Bobrick Washroom Equipment, Inc. The design for toilet accessories described in Part 2 are based on products indicated. Subject to compliance with requirements, provide the named product or a comparable product by one of the following:

1. Toilet Accessories:

a. A & J Washroom Accessories, Inc.
b. American Specialties, Inc.
c. Bradley Corporation.
d. General Accessory Manufacturing Co. (GAMCO).
e. McKinney/Parker Washroom Accessories Corp.

2.2 MATERIALS

A. Stainless Steel: ASTM A 666, Type 304, No. 4 finish (satin), 0.0312-inch (0.8-mm) minimum nominal thickness, unless otherwise indicated.

B. Brass: ASTM B 19, ASTM B 16 (ASTM B 16M), or ASTM B 30 castings.

C. Steel Sheet: ASTM A 366/A 366M, 0.0359-inch (0.9-mm) minimum nominal thickness.

D. Galvanized Steel Sheet: ASTM A 653/A 653M, G60 (Z180).

E. Chromium Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).

F. Baked-Enamel Finish: Factory-applied, gloss-white, baked-acrylic-enamel coating.

G. Mirror Glass: ASTM C 1036, Type I, Class 1, Quality q2, nominal 6.0 mm thick, with silvering, electroplated copper coating, and protective organic coating complying with FS DD-M-411.

H. Galvanized Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.

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

J. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

2.3 TOILET AND BATH ACCESSORIES

A. Grab Bars: B-6806 Series Concealed Mounting Grab Bar – 1-1/2 inch diameter.

B. ADAMirror: B-290 Series Angle-Frame Mirror.
C. Toilet paper dispenser: B-2888 Surface Mounted Multi-Roll Toilet Tissue Dispenser
D. Paper towel dispenser: b-2621 Surface Mount paper Towel Dispenser
G. Soap dispenser: B-155 Liquid Soap Dispenser
H. TA-7 Underlavatory Guard:
   1. Same or similar to: Brocar Products, Inc., Truebro, Inc.
   2. Insulating Piping Coverings: White, antimicrobial, molded-vinyl covering for supply and drain piping assemblies intended for use at accessible lavatories to prevent direct contact with and burns from piping. Provide components as required for applications indicated with flip tops at valves that allow service access without removing coverings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install accessories using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

1. Install grab bars to withstand a downward load of at least 250 lbf (1112 N), when tested according to method in ASTM F 446.

B. Adjust accessories for unencumbered, smooth operation and verify that mechanisms function properly. Replace damaged or defective items. Remove temporary labels and protective coatings.

END OF SECTION 10801

SECTION 12500 - WINDOW TREATMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Provide window coverings.

1. Horizontal blinds.

1.02 SUBMITTALS

A. Submit for approval samples, shop drawings, product data, mock-ups, warranty, extra stock.

1.03 QUALITY ASSURANCE

A. Comply with governing codes and regulations. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Horizontal 1” wide vinyl blinds with raising and tilting capabilities, wand and cord (manual) operation the same as or equal to Levelor:

PART 3 - EXECUTION

3.01 INSTALLATION

A. Take field measurements prior to fabrication to ensure fit.

B. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials and systems in proper relation with adjacent construction and with uniform appearance. Coordinate with work of other sections.

C. Restore damaged finishes and test for proper operation. Clean and protect work from damage.

END OF SECTION

SECTION 230010 - HVAC GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

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

B. Work Included:
Every item of labor, materials, equipment and appurtenances for installing complete new Heating, Ventilating and Air Conditioning Systems included in Division 23 of the Specifications.

1.2 DRAWINGS

A. The mechanical Drawings are diagrammatic in nature and show the general arrangement of all ductwork, piping, equipment and appurtenances and shall be followed as closely as actual building construction and the work of other trades will permit. Because of the small scale of the mechanical Drawings, it is not feasible to indicate all offsets, fittings and accessories that may be required. The Contractor shall investigate the construction conditions affecting the work and provide fittings and accessories as required to meet actual conditions.

B. Where discrepancies in scope of work as to which Trade provides specific items, such as starters, disconnects, flow switches, electrical control components, etc. exist, such conflicts shall be reported to the Engineer. If such action is not taken, the Contractor, as applicable, shall furnish such items as part of his work, for complete and operable systems and equipment, as determined by the Engineer.

1.3 REGULATIONS AND STANDARDS

A. The completed installation and all materials and equipment shall conform to local ordinances and codes, other regulations and standards listed herein or in related sections. These are intended as a minimum and shall be exceeded if required by the specifications or the Drawings. In the event of conflict between the codes, standards, or regulations, and information contained in the Contract Documents, the applicable code, standards, or regulation shall take precedence.

B. Refer to Division 1 and Supplementary Instructions to Bidders for construction permitting requirements.

1.4 INSPECTION CERTIFICATES

A. The Contractor shall furnish three copies of certificates of final acceptance to the Engineer from all inspection authorities having jurisdiction.

1.5 SUBSTANTIAL COMPLETION INSPECTION

A. The Engineer will visit the site for the purpose of conducting a substantial completion inspection once the following items have been met by the Contractor:

1. All HVAC systems shall be complete, operational and under automatic control.
2. HVAC systems cleaning, balancing, and testing as described in Section 23 05 93 shall be complete and the final report shall be approved by the Engineer.
3. Letters, signed by representatives of the manufacturer, for the heat pump, and air conditioning unit shall be provided attesting that their respective equipment has been started, tested, and set to operate safely and at the control points required as an integral part of the systems in which they are installed.
4. The Contractor shall provide certification from an authorized official of the equipment manufacturer(s) stating that all refrigerant piping as described in Section 23 20 00 and specialties have been installed in accordance with the manufacturer's recommendations.
5. The noise and vibration control supplier as described in Section 23 05 48 shall provide a letter stating that all items have been installed properly and that all equipment is adequately isolated and/or restrained.
6. The Contractor shall attest by letter that all equipment has been wired and tested to verify that the indicated sequence of motor control is established, that all safety controls function properly, that all motor protective devices are sized correctly, and that the systems are operating at the proper set points.

B. All discrepancies noted in the substantial completion report shall be corrected prior to the final inspection. The Contractor shall provide a detailed item-by-item description of all corrections made for each item on the substantial completion discrepancy list prior to scheduling final inspection by the Engineer. Additional visits required after the final inspection, for the reason that previously documented discrepancies had not been corrected at the time of the final inspection, will be made at the Contractor's expense.

1.6 ASBESTOS

A. Asbestos Free Materials: The intention of these Drawings and specifications is that there are no asbestos-containing materials installed on this project. To the best of the Architects and Engineers knowledge, none of the material or equipment specified herein or shown on the Drawings contains asbestos. The Contractor shall make every effort to prevent any asbestos materials from being installed in or used on the construction of the project. At the completion of the project, the Contractor shall certify by letter that to the best of his knowledge, no asbestos-containing materials were used for or in the construction of this project.

B. Existing Materials:

1. Contractor shall review the Owners asbestos management plan to ensure suspected asbestos containing materials are under surveillance.
2. Discovery: If during the construction of this project, work involving friable asbestos is suspected, or encountered, all work in this area shall be discontinued and the Owner or the Owner's representative, shall be notified immediately and the Owner with his own forces or by separate contract shall be responsible for complete investigation, removal, and disposition of the friable asbestos hazard in accordance with applicable laws and regulations. If the Contractor claims that

delay or additional cost is involved because of such action by the Owner, he shall make such claim as provided elsewhere in the Contract Documents.

3. Removal: All work involving the removal of friable asbestos will be done under a separate contract.

1.7 MATERIALS AND WORKMANSHIP

A. Equipment and material used in the project shall be new and undamaged. The mechanical installation shall fit into the space allotted and shall allow adequate and acceptable clearances for entry, servicing and maintenance. Similar types of equipment shall be the products of the same manufacturer unless specified otherwise. Work shall be performed by mechanics or tradesmen skilled in the trade involved.

B. All ductwork, piping and conduit shall be installed in a neat and organized manner, parallel to other work and the nearest building elements, unless specifically shown otherwise on the Drawings.

C. Equipment and materials shall be suitable for use in the environment in which they are installed. Equipment exposed to outside conditions shall be adequately protected from the weather, manufactured from materials suitable for outdoor use, and designed specifically for use in outdoor environments.

1.8 SUBMITTALS

A. Submit shop drawings, product data and samples in accordance with Division 1 for all items as specified in related sections of these specifications. Eight (8) copies of the submittal shall be submitted. Five (5) copies of the submittal will be returned to the Contractor. If additional copies are required, they will be the responsibility of the Contractor. All submittal data shall be correctly identified to show project name, and the exact model, style or size of item being submitted. Improperly identified submittals will not be reviewed by the Engineer. Each item submitted for review shall bear the Subcontractor's stamp which states that they have reviewed the submission, that it is complete, and that in their opinion it meets the contract requirements. Contractor's stamp shall identify the specification section, paragraph and page number for which the submittal is being made. Shop drawings will be reviewed only for general compliance with the Contract Documents. Review will not include correctness of details, proper configuration, utility connections, dimensions, sizes, quantities, and the like. Any submission which has not been reviewed and stamped by the M/E Subcontractor will not be reviewed be the Engineer. No reviews prior to award of Contract will be considered or accepted. Re-submissions of shop drawings, product data and samples shall include the entire original submittal. **Partial submittals will not be reviewed by the Engineer.**

B. Submissions will be stamped by the Engineer in one of the following ways:

"No Exceptions Taken"	No exceptions are taken and subject to compliance\ with the Contract Documents.
"Make Corrections Noted"	Minor corrections are noted and a re-submittal is not required subject to compliance with the corrections and the Contract Documents.
"Correct and Resubmit "	The submitted material, method or system meets the intent of the specifications, yet has insufficient data to determine compliance with the Contract Documents. Re-submittal is required.

"No Exceptions Taken"	No exceptions are taken and subject to compliance\ with the Contract Documents.
"Rejected"	The submitted material, method or system does not meet the intent of the specifications, or has insufficient data to determine compliance with the Contract Documents.

C. Submission Procedures:

1. If a submission is satisfactory to the Engineer, the Engineer will annotate the submission, "No Exceptions Taken" or "Make Corrections Noted" and transmit five (5) copies to the Contractor. If a resubmission is required, the Engineer will annotate the submission “Correct and Resubmit” or "Rejected" and transmit five (5) copies to the Contractor for appropriate action.
2. The Contractor shall revise and resubmit submissions as required by the Engineer until submissions are acceptable to the Engineer.
3. Approval of a working and/or shop drawings by the Engineer will constitute acceptance of the subject matter for which the drawing was submitted and not for any other structure, material, equipment or appurtenances indicated as shown.
4. The Engineer's review of the Contractor's submissions shall in no way relieve the Contractor of any of his responsibilities under the Contract. An approval of a submission shall be interpreted to mean that the Engineer has no specific objections to the submitted material, subject to conformance with the Contract Documents.
5. Where as-built drawings, record drawings and specifications are available and when provided to the Contractor for use in performing the work, the Contractor shall verify the content of such drawings and specifications, the suitability of their use in performing the work and their accuracy for the purposes in which the Contractor intends to use any record or historical documents which may be obtained. In no case shall the Contractor assume that such documents reflect a true and accurate record of the construction. Acceptance of any such materials, records, and/or drawings shall in no way result in additional cost to the Owner should an error and/or omission in these documents result in additional costs to the Contractor.

D. Equivalents: Manufacturers, trade names, and model numbers indicated herein and on Drawings shall be interpreted as establishing a standard of quality and shall not be construed as limiting competition. Unless definitely stated otherwise and upon complying with Division 1, the Contractor may use any article which, in his judgment is equal to that specified and is accepted by the Engineer. Where three (3) or more manufacturers are named in the specifications for any item, the Contractor shall use one of the named manufacturers. No others will be reviewed or accepted. Manufacturers listed first in these specifications and on Drawings were used as a basis of design. It will be the responsibility of the Contractor to verify all connections, physical sizes, capacities, etc. of all other manufacturer’s items, both named or proposed. If the equipment necessitates changes in ductwork, piping, wiring or other building systems from that indicated on the Drawings, the Contractor shall be responsible for all additional costs included and notify other trades. Where such changes are required, detail drawings indicating all required changes shall be submitted for review at the same time the manufacturers drawings are submitted for approval.

E. Shop drawings, diagrams, catalog data and such other data necessary to fully describe and substantiate compliance with these specifications shall be submitted for all equipment and materials where specifically required by specification and all items identified with an [S] behind the product title. Submittals not required by the Contract Documents will not be reviewed.

F. Shop Drawing manual(s) shall be submitted in accordance with Division 1 and shall include a complete product index, a copy of all approved shop drawings, and the name, address and telephone number of supplier or nearest representative. The manual(s) shall be presented to the Engineer for review and transmittal to the Owner before final payment is recommended.

G. Operation and Maintenance manual(s) shall be submitted in accordance with Division 1 and Section 23 01 00 and shall include a complete product index in each volume, installation and maintenance data, sequence of controls, parts lists, a copy of all approved shop drawings and the name, address and telephone number of supplier or nearest representative. All mechanical devices, equipment and systems marked [O/M] in these specifications shall be included and all other such mechanical items that will require servicing before the duration of its useful life has been reached. Manual(s) shall be presented to the Engineer for review and transmittal to the Owner before final payment is recommended.

1.9 WARRANTY

A. The Contractor shall provide a warranty for a period of one year for all work provided under the Contract to include, but not necessarily limited to, all systems, equipment, materials, and workmanship. This shall not be construed to limit any extended warranty periods of longer than one year for specific items or systems specified elsewhere in the Contract Documents.

B. The warranty period shall commence on the date of acceptance by the Owner and shall cover all parts and labor as required to fulfill the warranty at no cost to the Owner.

C. Refer to Division 1 for additional warranty requirements.

D. Information on all warranties shall be included in the O&M Manuals specified herein to be provided to the Owner.

1.10 EXCAVATION AND BACKFILLING

A. General: Excavation and backfilling shall be as specified in Division 31. Backfilling shall not commence until all tests have been performed and all utility systems conform to the Contract Documents.

B. Protection of Existing Utilities: Existing utility lines to be retained, whether known or unknown and uncovered during excavation operations, shall be protected from damage during excavation and backfilling, and if damaged, shall be restored to original condition.

1.11 COORDINATION OF WORK

A. General: The Contract Documents indicate the extent and general arrangement of the mechanical systems. The Contractor shall be responsible for the coordination and proper relation of the mechanical work to the building structure and to the work of other trades. No additional compensation or extension of completion time will be granted for extra work caused by the lack of coordination.

B. Cooperation: The Contractor shall provide dimensions and locations of all openings, shafts and similar items to the proper trades and install work as required so as not to interfere with, or delay, the building construction.

C. Locations of lines and equipment shall be determined from actual field measurements. The outlines of the building shown on the mechanical Drawings are intended only as a guide to indicate relative locations of the mechanical work. Refer to architectural and structural Drawings for building construction details. The Contractor shall determine the exact routing and location of his systems prior to fabrication or installation of any system component. Accurate measurements and coordination shall be completed to verify dimensions and characteristics for the installation of each system.

D. Unless necessitated by equipment access or otherwise indicated in the Contract Documents, all piping, ductwork, and conduit concealed above ceilings and in finished or utility spaces shall be routed as high as possible.

E. Offsets, transitions and changes of direction in all systems shall be made as required to maintain proper headroom and pitch of sloping lines whether or not indicated on the drawings. The Contractor shall provide manual air vents and drains as required for his work to affect these offsets, transitions and changes in direction, as applicable.

F. Cutting and Patching: See Division1.

G. Roughing-In: Verify the locations of other buildings machines, door swings, block coursing, alignment of tile end and other similar features before roughing-in for mechanical equipment components and/or controls.

H. Damage to Other Work: Each Contractor is responsible for damage to other work caused by his work or workmen. Repairing of damaged work shall be done by the Contractor who installed the work, and as directed by the Architect-Engineer; the cost of which shall be paid for by the Contractor responsible for the damage.

1.12 EQUIPMENT INSTALLATION

A. General: Equipment shall be installed in accordance with manufacturer's instructions to conform with the details and application indicated. Where manufacturer's recommendations or installation instructions require options or accessories not specified, they shall be included and installed by the Contractor.

B. Supports: Provide necessary supports for all equipment and appurtenances as required; this includes but is not limited to frames or supports for items such as tanks, compressors, boilers, plumbing fixtures, pumps, valves, fans, and other similar items requiring supports. Floor mounted equipment in Equipment Rooms shall be set on 4-inch high concrete foundation pads unless shown otherwise. All pads shall be poured such that the top of the pad is level. Foundation drawings, bolt setting information and foundation bolts shall be furnished by the subcontractors furnishing the equipment for all equipment required to have concrete foundations. Concrete for foundations shall be provided by mechanical subcontractor unless indicated otherwise. Except where indicated in Section 23 05 48, all equipment shall be anchored to concrete pads. Provide additional structural steel supports under air handlers where required to achieve correct elevation for cooling coil condensate drains. Structural supports shall be firmly anchored to concrete housekeeping pads. Air handler or vibration isolators shall be firmly anchored to structural supports. Rooftop equipment, ductwork, and piping shall be set on pre-manufactured curbs anchored to the roof and flashed into the roofing system. Rooftop equipment, ductwork, piping, etc. shall be anchored to the curb except where vibration isolation is installed between the curb and the equipment.

C. Service Area: All equipment and appurtenances shall be located to permit adequate service clearance in accordance with manufacturer's recommendations and as otherwise required. Service clearance shall include but not be limited to service and removal of filters, coils, motors, controls and removal of equipment sections. Service clearance shall include adequate space for rodding and removing tubes from boilers, chillers, and heat exchangers. All piping, ductwork, and other equipment shall be located outside of the service area or shall be flanged for easy removal to facilitate equipment service. All equipment shall be located with sufficient distance from building features, structural components, and the equipment of other trades. Service clearance in front of electrical panels shall be minimum as required by National Electric Code (NEC) where applicable.

D. Temporary Requirements: Temporary filters shall be provided for all fans that are operated during construction. Return openings, grilles, and registers shall be provided with temporary filters to prevent the intrusion of dust and particulate into the return air ductwork. Temporary filter shall have a minimum efficiency of MERV 8 in accordance with ASHRAE 52.2. Openings in equipment shall be kept plugged at all times until connection is made to the system. The ends of all pipes, ducts and equipment openings shall be kept plugged or capped properly with approved devices. Approved devices are items such as specially molded plastic caps, pipe plugs, test plugs and sheet metal caps.

E. All equipment indicated to be installed exposed within finished spaces shall be installed such that all conduit, piping, and appurtenances are concealed. Air conditioning units utilizing gravity condensate drains shall be installed at an elevation necessary for the specified pipe slope.

1.13 EXISTING EQUIPMENT

A. General: Care shall be exercised to protect all existing equipment to be reused. The Contractor shall remove from operation all equipment that is shown to be reused and provide adequate protection including but not limited to prevention of corrosion, protection of seals, prevention of leaking, and prevention of internal/external contamination. All electronic components shall be protected from weather and moisture, deterioration and loss of programming.

1.14 SLEEVES AND INSERTS

A. General: Sleeves and inserts shall be provided and correctly located in the structure, as require for the work.

B. Inserts shall be steel and proper size for loads encountered.

C. Sleeves shall be provided for all pipes passing through concrete or masonry walls, partitions, concrete beams or slabs installed during construction of the wall, partition, beam or slab. Sleeves through existing concrete walls and slabs may be omitted if wall or slab can be core drilled and properly sealed in a manner acceptable to the Engineer. Sleeves placed horizontally in walls or in any position in beams shall be standard weight ASTM A53 steel pipe of length equal to thickness of wall or beam. Those placed vertically in non-waterproof floors shall be 20 gauge galvanized sheet steel of length equal to thickness of slab, flared and nailed to the form, or fastened to reinforcing fabric and filled with sand during pouring to prevent deformation. Sleeves occurring in floors of rooms where hose bibs or floor drains occur, and in pipe spaces, shall be standard weight steel pipe projecting 2" above the finished floor except in Equipment Rooms they shall project four (4) inches above floor. Sleeves in floors with waterproof membrane shall be provided with flanges or flashing rings and shall be clamped or flashed into membrane. All sleeves (and core drilled openings) shall be of sufficient diameter to clear bare or

covered pipes by 1/4" all around except sleeves on lines subject to movement by expansion which shall clear the bare pipe or insulation on insulated pipe at least one inch all around. Pipes through exterior walls below grade and above footings shall be installed in sleeves having a minimum size of two larger pipe diameters and sealed watertight with flexible synthetic rubber seals. Sleeve shall have anchor and water stop plate. The entire assembly shall be tightened and adjusted and made watertight. Sleeves for pipes and conduit, penetrating fire (and smoke) rated partitions, walls and floors shall be sealed in accordance with the terms of U.L. Listed Through-Penetration Firestop Systems XHEZ as published in the U.L. Fire Resistance Directory. Penetrations shall exactly conform to details of the Firestop System indicated for the type of partition, wall and floor construction encountered. All penetrations through nonfireresistance rated floor assemblies and through the ceiling membrane of nonfireresistance rated roof assemblies shall be fireblocked with tightly packed mineral-wool insulation secured in place. All penetrations through equipment room walls and other areas of noise or heat generation shall be tightly sealed with mineral fiber rope. All penetrations through draftstop partitions shall be sealed to maintain the integrity of the partition. All firestopping and draftstopping of sleeves for mechanical work shall be provided under Division 23.

1.15 WOODEN STRUCTURE

A. Where piping, ductwork and conduit are supported from wooden structure, all connections shall be made in strict accordance with this Section. For spacing of piping and ductwork supports, see Section 23 05 00.

B. Engineered wooden trusses shall not be drilled or cut under any circumstances. Where equipment or piping is supported from trusses, the Contractor shall provide steel supports bearing at panel points and spanning a minimum of two trusses. Any wooden blocking shall be fire retardant lumber in accordance with ASTM E-84 and shall bear the mark of an approved testing agency.

C. All connections to wooden framing shall be made thru shear hangers at the face of wooden members. All connections shall be made by screws.

D. Hangers for multiple pipes or ducts shall be staggered to distribute weight on trusses as evenly as possible.

1.16 PREMANUFACTURED LIGHT GUAGE METAL STRUCTURE

A. Where piping, ductwork and conduit are supported from the light gauge structure, all connections shall be made in strict accordance with this Section and with details indicated on the Drawings. For spacing of piping and ductwork supports, see Section 23 05 00.

B. Piping 4" or larger shall not be supported by light gauge metal roof framing, but rather shall be supported only by the designated steel channels shown on the structural drawings. Any connections to the light gauge metal roof framing shall be limited to 150 pounds per connection and to a maximum of two such connections to any individual light gauge member.

C. All connections to the light gauge roof framing shall be made thru shear hangers at the face of the light gauge members. No clamps or eccentric connections shall be used that will induce twisting of the light gauge members. All connections shall be made by screws. No welding to the light gauge members will be allowed.

D. Hangers for multiple pipes or ducts shall be staggered to distribute weight on light gauge framing as evenly as possible.

1.17 ESCUTCHEONS

A. Where pipes pass through floors, walls or ceilings in finished rooms, they shall be fitted with chromium plated escutcheons of suitable pattern to effectively cover the rough opening. Where sleeves project above floors, special deep type escutcheons shall be provided.

1.18 ACCESS DOORS

A. Provide for all concealed valves, controls, dampers, junction boxes, equipment, or any item requiring access. Doors shall be of sufficient size and so located that the concealed items may be serviced or completely removed and replaced. Doors required for Mechanical work shall be furnished as a part of this Division to the General Contractor for installation. The Mechanical Contractor shall provide locations of all access doors such that service may be safely performed from a ladder, lift, or platform without the need for support from the ceiling system. Doors in acoustic tile ceilings shall be furnished in multiples of tile sizes. Doors are not required in exposed grid type ceilings where tiles are removable. Doors shall be metal access doors with cam lock, style to match ceiling or wall construction. Doors occurring in rated construction shall be fire rated U.L. labeled access doors correlated to preserve the integrity of the rated construction. Doors leading to concealed spaces shall be provided with means to open from the inside. Doors shall be prime finish steel except those in toilets, shower rooms, locker rooms, kitchens and other similar areas shall be stainless steel with brushed finish.

1.19 ELECTRICAL WIRING AND EQUIPMENT

A. Wiring, low voltage (100 volts or less) control wiring shall be provided as a part of (Section 23 09 00 Instrumentation and Control for HVAC) (Division 23) in strict accordance with Division 26 and shall be in accordance with manufacturer's recommendations to comply with the sequence of control indicated. Verify that wiring of all motors and controls required by equipment furnished is accomplished for the correct sequence of operation.

B. Wiring, line voltage (101 volts or higher) power or control wiring shall be furnished and installed under Division 26.

C. Disconnects shall be provided for each item of equipment under Division 26 unless specified otherwise in other sections.

D. Miscellaneous manual or automatic control and protective or signal devices required for the sequence of operation indicated for mechanical equipment shall be provided under the section of the specifications where the item of equipment is specified unless indicated otherwise.

1.20 PROTECTION FROM MOVING PARTS

A. Belts, pulleys, chains, gears, shafts, couplings and other rotating or moving parts located so that any person may come in close proximity thereto shall be fully enclosed or properly guarded.

1.21 RECORD OF UNDERGROUND LINES

A. On completion of the project, the Contractor shall prepare and submit to the Engineer a drawing on tracing paper and one blue line print to show the location of any underground lines installed in locations different from those on the Architect-Engineer's Drawings. The location of cleanouts, and the distance from the building to outside sewers, mains, and manholes shall be dimensioned.

1.22 CHARTS AND DIAGRAMS

A. General: Material as listed below shall be provided by the Contractor and shall be mounted in separate hardwood frames where directed in the field or folded and stored in a plastic document folder and located in the control cabinets. All charts, diagrams and schemes shall be photographic positives prepared from original tracings. A copy of charts and diagrams shall be included with O/M manuals.

B. Automatic Temperature Control Diagrams identified as to name, sequence of operation, location and number of systems. Components of a control system shall be identified as to location, function, temperature setting and manufacturer's part number.

C. Electric Sequence Control Diagrams of entire Mechanical system.

D. Charts for identification of valves.

1.23 INSTRUCTION OF OWNER'S REPRESENTATIVE

A. Contractors shall instruct the representative of the Owner in the proper operation and maintenance of all elements of the Mechanical systems. Competent representatives of the Contractor shall spend such time as necessary to fully prepare the Owner to operate and maintain the Mechanical and Electrical systems.

1.24 COMMISSIONING OF HVAC SYSTEMS:

A. Commissioning of this project will be coordinated and managed by the Owner's Commissioning Agent. Refer to the Commissioning Plan and Division 1 for the scope and requirements for commissioning of mechanical systems.

1.25 CONSTRUCTION STATUS REPORT

A. Each item of discrepancies noted on Construction Status Report prepared by the Engineer shall be answered in detail in writing by the Contractor before payment can be recommended.

1.26 GRAPHICS DATABASE

A. This project's Computer Aided Design & Drafting (CADD) drawing files may be obtained through the Architect/Engineer for use in preparing computer graphics specific to this project. See Appendix A at the end of this Section for Letter of Indemnification and ordering instructions.

1.27 DEMOLITION

A. Contractor shall visit site before bidding to determine extent of demolition.

B. Removal of Ducts, Piping and Equipment: Remove all ductwork and piping connections, plugging outlets, etc., such that are not required for present equipment and fixtures, or are not reused or needed for reconnecting new equipment and fixtures. Remove all equipment, fixtures, etc., indicated to be removed, or not reused or needed after the renovations are complete.

C. Where piping, conduit, ductwork or other similar items passing through rated assemblies are removed; the assemblies shall be patched in accordance with UL so as to maintain the integrity of the assembly.

D. The Owner will select and retain such existing equipment and materials which are indicated to be removed and not reused, as he desires. All other existing equipment and materials indicated to be removed and not reused shall become the property of the Contractor, who shall promptly remove them from the premises. All existing equipment and fixtures indicated to be relocated shall be disconnected, removed, relocated and reconnected. All equipment and fixtures shall be protected from damage during demolition.

E. Miscellaneous: In all altered portions of the buildings, the Contractor shall remove or alter as necessary all existing mechanical work that is not coordinated to operate with the new construction. Demolition shall not begin until the work schedule is approved by the owner. The work shall be scheduled to prevent any disruption to the normal operations of the building.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION – NOT USED

END OF SECTION 230010

APPENDIX A
LETTER OF INDEMNIFICATION

Project Name:

Project Location:

The Contractor may obtain from Ascent Engineering Group a CD-ROM or electronic mail version of the projects Revit / CADD database. All seals, details, schematics, tables, controls, etc. will be deleted. All drawings will be provided in Autocad™ 2014 format.

Ascent Engineering Group reserves all rights to the original drawing files.

The Recipient agrees, to the fullest extent permitted by the law, to hold harmless and indemnify Ascent Engineering Group, as defined in the Bid Documents, from and against all claims, liabilities, losses, damages, and costs, including but not limited to attorney's fees, arising out of or in any way connected with the use, modification, misinterpretation, misuse, or reuse by the Recipient or others of the machine readable information and data provided by Ascent Engineering Group under this Agreement. The foregoing indemnification applies, without limitation, to any use of the project documentation on other projects, for additions to this project, or for completion of this project by others, excepting only such use as may be authorized, in writing, by Ascent Engineering Group.

The electronic drawing files are not part of the Contract Documents for the Project. The Recipient assumes all risks associated with the use of the transmitted files. Ascent Engineering Group will not be responsible for any differences in the information included in the transmitted files and the information shown on the Contract Documents. Modifications to the Contract Documents made before or during construction may or may not be included in the transmitted electronic drawing files.

The Recipient further agrees that the drawing files will only be used in graphics preparation for the above-referenced project.

Company Name of Recipient: _____

Recipient's Designated Representative: _____

Title: _____

Signature: _____

Address: _____

Return to: Ascent Engineering Group
4932 Frontage Road, NW
Roanoke, VA 24019
AEG # 16080

SECTION 230100 - OPERATION AND MAINTENANCE OF HVAC SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

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

B. Work Included:

1. To aid the continued instruction of operating and maintenance personnel, and to provide a source of information regarding the products incorporated into the work, furnish and deliver the data described in this section and in pertinent other sections of these specifications.

C. Related Sections:

1. Section 23 00 10 – HVAC General Requirements
2. Section 23 05 00 – Common Work Results for HVAC
3. Section 23 20 00 – HVAC Piping and Pumps
4. Section 23 30 00 – HVAC Air Distribution
5. Section 23 80 00 – Decentralized HVAC Equipment

1.2 SUBMITTALS

A. Unless otherwise directed in other sections, or in writing by the Engineer, submit three copies of the final manual to the Engineer for approval prior to indoctrination of operation and maintenance personnel.

B. Operation and Maintenance manual(s) shall be submitted in accordance with Division 1 and shall include a complete product index in each volume, installation and maintenance data, sequence of controls, parts lists, a copy of all approved shop drawings and the name, address and telephone number of supplier or nearest representative. All mechanical devices, equipment and systems marked [O/M] in these specifications shall be included and all other such mechanical items that will require servicing before the duration of its useful life has been reached. Motor driven equipment shall include data for the motor. Manual(s) shall be presented to the Engineer for review and transmittal to the Owner before final payment is recommended.

1.3 QUALITY ASSURANCE

A. In preparing data required by this section, use only personnel who are thoroughly trained and experienced in the operation and maintenance of the described items, completely familiar with the requirements of this section, and skilled communicating the essential data.

PART 2 - PRODUCTS

2.1 INSTRUCTION MANUALS

A. Where instruction manuals are required to be submitted under other sections of these specifications, prepare in accordance with the provisions of this section.

B. Format:
Size: 8-1/2" x 11"
Paper: White bond, at least 20 lb. weight.
Text: Typed (Hand printed or written is not acceptable)
Drawings: 11" x 8-1/2" preferable; bind in with text; foldouts are acceptable; larger drawings are acceptable if folded to fit within the manual and provide a drawing pocket inside rear cover or bind in with text.
Fly Sheets: Separate each portion of the manual with neatly prepared Fly Sheets or tabbed index sheets briefly describing the contents of the ensuing portion. Fly sheets or index tabs may be in color.
Binding: Use heavy-duty plastic covers with binding mechanism concealed inside the manual; 3-ring binders are required. All binding is subject to the Engineer's approval.

C. Provide front and back covers for each manual, using durable plastic material approved by the A.E, and clearly identified on the front cover with at least the following information:

OPERATING AND MAINTENANCE INSTRUCTIONS

FOR

(Item/system name and description)

(Name and address of Contractor and sub-contractor)

(General subject of this manual)

(Name and address of Engineer)

(Engineer's approval and date approved)

D. Contents:
Neatly prepared and typewritten detailed table of contents.
Complete instructions regarding operation and maintenance of all equipment involved including lubrication, disassembly, and reassembly.
Complete nomenclature of all parts of all equipment.
Complete nomenclature and part number of all replaceable parts, name and address of nearest vendor, and all other data pertinent to procurement procedures.
Copy of all guarantees and warranties issued.
Manufacturer's bulletin, cuts, and descriptive data, where pertinent, clearly indicating the precise items included in this installation and deleting, or otherwise clearly indicating, all manufacturers' data with which this installation is not concerned.
Such other data as required in pertinent sections of these specifications.

PART 3 - EXECUTION

3.1 INSTRUCTION MANUALS

A. Revisions:

1. Following the indoctrination and instruction of operation and maintenance personnel, review all proposed revisions of the Manual with the Engineer.

END OF SECTION 230100

SECTION 230500 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

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

B. Work Included:

1. Common Motor Requirements for HVAC Equipment
2. Hangers and Supports for HVAC Piping and Equipment

C. Related Sections:

1. Division 01 -- Commissioning
2. Section 23 00 10 – HVAC General Requirements
3. Section 23 01 00 – Operation and Maintenance of HVAC Systems
4. Section 23 05 48 – Vibration and Seismic Controls for HVAC Systems
5. Section 23 05 53 – Identification for HVAC Piping and Equipment
6. Section 23 05 93 – Testing, Adjusting and Balancing for HVAC
7. Section 23 20 00 – HVAC Piping and Pumps
8. Section 23 30 00 – HVAC Air Distribution
9. Section 23 80 00 – Decentralized HVAC Equipment

1.2 REFERENCES

A. General: The following standards or codes form a part of this specification to the extent indicated by the reference thereto.

B. American Society of Mechanical Engineers (ASME):

C. ASME 95 Boiler and Pressure Vessel Code

D. National Electrical Manufacturers Association (NEMA)

E. Underwriters Laboratories, Inc. (UL)

1.3 COMMISSIONING OF HVAC SYSTEMS:

A. The Contractor shall provide contact information to the Commissioning Agent indicated in Division 1 for all major items of Equipment.

B. Provide additional submittal copy of major equipment for Commissioning Agent specified in Division 1.

1.4 SUBMITTALS

A. Submit shop drawings and product data in accordance with Division 1 and Section 23 00 10.

B. Shop drawings, diagrams, catalog data and such other data necessary to fully describe and substantiate compliance with these specifications shall be submitted for all equipment and materials marked with notation set forth in Section 23 00 10.

C. Operation and maintenance data shall be submitted in accordance with Division 1, for all items of equipment and materials marked with notation set forth in Section 23 01 00.

PART 2 - PRODUCTS

2.1 COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

A. Motors shall be provided in place as an integral part of the driven equipment, ready for electrical connections. Motors shall be in accordance with NEMA Standards and of design suitable for the starting and running characteristics of the driven equipment. Motors over 5 HP shall be "premium" efficiency as defined by NEMA MG-1, latest edition.

B. All three phase motors over 5 HP shall be provided with minimum power factor of 90%. Power factor correction capacitors shall be provided if required and shall be furnished to the electrical subcontractor for installation. Shop Drawing submittals for motors over 5 HP shall list efficiency and power factor. Unless specified otherwise, all motors shall have continuous duty classification, 40° Centigrade ambient temperature, shall have enclosure suitable for indicated application and shall be wound for 120 volt, single phase, 60 cycle current, except motors above 1/2 horsepower (unless indicated otherwise) shall be wound for 200V or 230V/460V as required by the secondary voltage specified for main service in Division 26. Each motor shall be selected and rated at the voltage indicated so that the driven load does not exceed the nameplate rating and service factor of the motor. All motors 460V/480V 20 HP and above and 208V/230V 10 HP and above shall be wound for wye-delta (6 or 12 lead) starting with capabilities of being wired for across-the-line starting.

C. Motor starters and motor protective switches shall be provided under Division 26 except where specified to be furnished specifically with the driven equipment. Accessories such as auxiliary contacts, hand-off-automatic switches, start-stop switches, pilot lights, control power transformers and other similar items shall be provided in or on the controllers as required by the control sequence indicated. Starting equipment, unless factory mounted on the equipment, shall be installed under Division 26.

2.2 HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

A. Suspended horizontal piping shall be supported by adjustable wrought steel clevis hangers except that straight runs of hot piping (>100°F) with 40 ft. or more between anchor and expansion device shall be supported on roller type hangers or supports. See Section 23 07 00 for calcium silicate hanger inserts at clevis hangers. All piping connected to motor driven reciprocating or rotating equipment shall have vibration isolation hangers as specified in Section 23 05 48. Protection saddle, welded to pipe, shall be provided at each roller support except on chilled water lines, saddle shall be external metal shield with calcium silicate preformed section as specified in Section 23 07 00, vapor sealed. Calcium silicate

inserts may be omitted for pipe smaller than 2 inches. Where supports bear on copper pipe they shall be copper plated. Chain, strap or other makeshift devices will not be permitted as hangers of supports.

B. Maximum pipe support spacing for steel piping shall be ten feet on center, -copper and brass tubing 1-1/4" and smaller shall be supported six feet on center.

C. Refrigerant piping smaller than 3/4" shall be supported using B-Line Armafix clamps by Cooper Industries or equal.

D. Pipe and suspended equipment hanger rods shall be attached to the top chord only on steel joists and beams by joist or beam clamps without welding. Welding of support rods and connection at any place other than the top chord will not be permitted unless written approval is granted by the Engineer and the Architect. C-clamp hangers shall be limited to 50 lb. or less when used at joists. Threaded rod shall be used through joist chords for loads greater than 50 lb.

E. Duct supports shall consist of not less than 1" by 1/16" galvanized strap iron hangers spaced not over 4 feet on center, except medium and high pressure flat-oval ducts wider than 48 inches shall be supported by trapeze angles. Straps shall be lapped across the bottom ducts a minimum of 1 inch. Ductwork shall be supported from the building structure. Ductwork shall not be supported from the ceiling system or any other building services. Heavy ductwork such as medium or high pressure duct supported by hanger rods, shall be attached to the top chord only on steel joists and beams by joist or beam clamps without welding. Welding of support rods and connection at any place other than the top chord will not be permitted unless written approval is granted by the Engineer and the Architect. All ductwork shall be braced as required to prevent lateral movement.

F. See Section 23 00 10 for special support requirements for Wooden Structure. Connection at any location other than those specified will not be permitted unless written approval is granted by the Engineer and the Architect. Drilling or cutting of wooden trusses shall not be permitted. See Section 23 00 10 for special support requirements for Pre-manufactured Light Gauge Metal Structure. Welding and connection at any location other than those specified will not be permitted unless written approval is granted by the Engineer and the Architect.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's recommendations.

B. Support riser piping independently from the connected horizontal piping.

C. Hangers shall be spaced so that the supported load does not exceed the load recommended by the manufacturer. The supported load shall not overstress the building structural members. Where required hangers for the suspension of heavy items do not correspond with the building structural members, provide supplemental steel members fastened to the building structural members.

D. Where pressure/temperature ports are indicated on the drawings, they shall be provided with full port gauge cocks that allow penetration of instrument probes.

END OF SECTION 230500

SECTION 230548 - VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

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

B. Work Included:

1. Vibration Isolators

C. Related Sections:

1. Section 23 00 10 – HVAC General Requirements
2. Section 23 20 00 – HVAC Piping and Pumps
3. Section 23 30 00 – HVAC Air Distribution
4. Section 23 80 00 – Decentralized HVAC Equipment
5. Division 26 - Electrical

1.2 QUALITY ASSURANCE

A. All vibration control apparatus shall be supplied by a single recognized manufacturer. The supplier of noise and vibration control equipment shall supervise, inspect and approve the installation of their equipment. The supplier shall submit a letter to the Engineer at the conclusion of the project stating that all items have been installed properly and that all equipment is adequately isolated.

1.3 SHOP DRAWINGS

A. Submit shop drawings and product data in accordance with Division 1.

B. Shop drawings, cuts, diagrams, catalog data sheets or such other data necessary to fully describe and substantiate compliance with the specifications shall be submitted for all (seismic restraints,) vibration isolation equipment and materials. The Contractor shall submit drawings for review stating the static deflection, load capacity and location of the isolators, inertia slab dimensions and installation instructions.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Kinetics Noise Control, Vibration Mountings and Control, Inc., Vibration Eliminator Co., Mason Industries, Vibro-Acoustics or Amber/Booth Company.

B. Model numbers used in this specification are those of Kinetics Noise Control and are included to establish a standard of quality.

2.2 ISOLATOR TYPES

A. Floor Mounted Equipment:

1. Type S spring vibration isolators shall be free-standing, unhoused, laterally stabile, steel springs, wound using high strength heat treated spring alloy steel, and shall have a horizontal spring stiffness equal to or greater than 1.0 times the rated vertical spring stiffness. Springs shall be selected to provide the tabulated minimum operating static deflections and shall provide a 50% overload capacity before reaching a solid state. Springs shall be designed to reach a solid state before exceeding the spring steel fatigue point. Springs used to isolate floor mounted equipment shall include a drilled and tapped steel top load plate, and a steel bottom load plate bonded to a 1/4" thick ribbed neoprene noise stop pad. Each spring mount shall include a steel leveling bolt, locknuts, and washers for attachment to supported equipment. Type S units shall be Kinetics Model FDS. Springs shall have the following minimum outside diameters:

Spring Deflection,	Rated Capacities, Lbs.		
Inches	Up to 370	371 to 1600	1601 to 11000
Up to 1.5	1.75" dia.	3.00" dia.	3.00" dia.
1.51 to 2.25	3.50"	5.0"	5.0"

2. Type NIP neoprene isolation pads shall be single rib or crossed, double rib neoprene in shear pads in combination with steel shims. Neoprene pads shall be molded using 2500 psi tensile strength, oil resistant compounds. Type NIP units shall be Kinetics Model NPS, NPD, NGS, or NGD.

B. Suspended Equipment:

1. Type 2 hangers shall consist of a steel spring and a elastomer-in-shear isolator placed in series and encased in a welded steel bracket. The spring element of the hangers shall meet all specified characteristics of a "Type S" spring as previously specified. Springs shall be color coded for ease of load capacity identification and removable for field correction of overloaded hangers. The elastomer noise stop pad shall be selected to operate within the published load range for the pad for each spring capacity when placed in the bracket used. The hanger bracket shall be designed to carry five (5) times overload without failure, and shall allow up to 15° rod misalignment without metal to metal contact. Type 2 units shall be Kinetics Model SRH.
2. Type F hangers shall consist of an elastomer-in-shear isolator encased in a welded steel bracket. The elastomer shall be bonded to the hanger bracket and shall be selected to support the load within its published load rating. The hanger bracket shall be designed to carry a five (5) times overload without failure and allow up to 15° rod misalignment without short circuiting. Type F hanger shall be Kinetics Model RH.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Equipment: All equipment listed hereinafter shall be isolated from the structure and fixed parts by means of resilient vibration and noise isolators. Isolators for floor and roof mounted equipment shall be solidly anchored to the support base or floor and to the supported equipment unless indicated otherwise.

B. Ductwork: Flexible connections shall be incorporated in the ductwork adjacent to all air moving units as part of the sheet metal work.

3.2 MINIMUM VIBRATION ISOLATOR STATIC DEFLECTION

Type of Equipment	Base Type	Isolator Type	Deflection Inches
Air Conditioning Units (Floor Mounted)	N/A	NIP	.25
Air Conditioning Units (Sus-pended)	N/A	2	.5
Fans (Floor Mounted)	N/A	NIP	.25
Fans (Suspended)	N/A	2	.5

3.3 EQUIPMENT WITH INTERNAL ISOLATION

A. Where air handling units have fan and motor assembly internally isolated from the unit casing, using both spring isolators and flexible fan discharge connections, external isolators for the air handling unit shall not be provided.

END OF SECTION 230548

SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

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

B. Work Included:

1. Prepare and paint Division 23 equipment, accessories, ductwork, piping and miscellaneous materials located in Equipment Rooms, Boiler Rooms, pipe trenches and other utility areas housing mechanical equipment and materials.
2. Identification of piping in exposed and accessible locations.
3. Marking and designation of equipment.

C. Work Not Included:

1. Painting of ductwork, piping or equipment located on the building exterior.
2. Painting of ductwork, piping or equipment exposed in finished areas other than those listed under WORK INCLUDED above.
3. Painting of existing equipment, piping or ductwork.

D. Related Sections:

1. Section 09 90 00 – Painting and Coating
2. Section 23 00 10 – HVAC General Requirements
3. Section 23 05 00 – Common Work Results for HVAC
4. Section 23 07 00 – HVAC Insulation
5. Section 23 20 00 – HVAC Piping and Pumps
6. Section 23 30 00 – HVAC Air Distribution
7. Section 23 80 00 – Decentralized HVAC Equipment
8. Division 26 - Electrical

1.2 REFERENCED STANDARDS:

A. General: The following standards or codes (latest edition) form a part of this specification to the extent indicated by the reference thereto.

B. American National Standards Institute (ANSI):

1. ANSI A13.1 Scheme for Identification of Piping Systems

C. American Society for Testing and Materials (ASTM):

1. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials
2. ASTM C 411 Standard Test Method for Hot-Surface Performance of High-Temperature

Thermal Insulation

D. National Fire Protection Association (NFPA):

1. Standard 255 Method of Test of Surface Burning Characteristics of Building Materials

E. Underwriters Laboratories, Inc. (UL)

1. Standard 723 Tests for Surface Burning Characteristics of Building Materials

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. Except as otherwise specified, materials shall be the products of the following manufacturers:

1. Sherwin-Williams
2. Pratt and Lambert
3. Pittsburgh Paints (PPG)
4. Benjamin Moore
5. Porter Paints
6. Seton Identification Products

2.2 MATERIALS:

A. Deliver all paints and materials to the project site in their unopened original containers with all labels intact and legible at the time of use.

B. All coatings exposed to supply and return airstreams and where applied to exposed surfaces in a return air plenum, shall have a composite flame spread rating not exceeding 25, and a smoke developed rating not exceeding 50 as tested under procedure ASTM E-84-75, NFPA 255 and UL 723. Coatings shall not flame, glow, smolder or smoke when tested in accordance with ASTM C411, latest edition.

C. Sherwin-Williams Industrial Maintenance Coatings System 4000 products are listed below to establish color and a standard of quality.

1. All Hangers and Supports: One coat Series 54 Gloss Black Alkyd Enamel.
2. All major items of equipment and equipment supports including boilers, compressors, pumps, tanks, air handling units, condensers, fans and all other similar items shall be painted as follows:

a. Uninsulated hot surfaces on equipment, operating at or above 150°F, shall be painted with two coats of No. B59S8 Heat Resistant Aluminum.
b. Other equipment surfaces of aluminum, iron and steel shall be primed with one coat of No. B50Y1 Zinc Chromate Primer. Galvanized surfaces shall be chemically prepared and primed with one coat of Galvite B50W3 Primer. Field insulated surfaces shall be primed with No. B28W200 Wall Primer. Where equipment is furnished with factory prime or finish coat, only patch priming is required at any damaged areas before finish coats are applied. Finish all equipment with two coats of Series 54 Alkyd Gloss Enamel, No. SW4063 Robotic Blue. Exterior of belt guards and other protective guards shall be

finished with two coats of Series 54 Alkyd Gloss Enamel, No. SW4084 safety yellow color. Interior of and all items covered by belt guards and other protective guards shall be finished with two coats of No. SW4083 safety orange color.

c. Nameplates and Testing Agency Labels on equipment or machinery shall not be painted.

3. Ducts:

a. Interior duct behind all grilles, registers and diffusers shall be painted with one coat of flat black prime or flat black finish paint.

b. Exposed in equipment rooms and other unfinished areas such as storage areas and utility type spaces; uninsulated galvanized steel ducts shall be chemically prepared and primed with one coat of Galvite B50W3 Primer. Aluminum ducts and insulated ducts with aluminum jacket shall be primed with one coat of No. B50Y1 Zinc Chromate Primer. Canvas or paper insulation jacket shall be primed with one coat of No. B28W200 Wall Primer. Finish with Series 54 Alkyd Gloss Enamel, gray No. SW4028 Gypsum applied in sufficient number of coats to effectively cover the prime coat.

D. Each item of equipment such as pumps, air handlers, etc., and equipment control devices such as motor starters, disconnect switches, etc. shall be properly marked with laminated engraved plastic nameplates ([S]) fastened with sheet metal screws, bolts or permanent adhesive. Pressure sensitive tape is not acceptable.

E. All piping, insulated and uninsulated, shall be identified ([S]) with Seton Ultra-Mark or equal wrap around piping system markers and arrow flow directional marker. Markers shall be pre-coiled, semi-rigid plastic or polyester with sealed color graphics. Markers shall be minimum 12 inches long with 1-¼ inch high letters, formed to cover entire circumference of the pipe. Markers shall be attached to piping using plastic tie wraps. Pipe identification shall use the same designations or abbreviations used on the drawings. Marker colors shall be in accordance with ANSI.

PART 3 - EXECUTION

3.1 WORKMANSHIP:

A. The work shall be accomplished by qualified mechanics skilled in the painting trade. Painting of equipment, piping, ductwork and other materials shall not commence until all testing is complete and systems are ready for operation. Materials shall be applied according to manufacturer's directions. All containers shall be securely closed when not in use. Flammable materials shall not be stored on premises. Flammable waste shall be disposed of daily in devices approved for such purposes. Materials shall be evenly spread, and smoothly flowed on without runs or sags. Each coat shall be thoroughly dry before application of succeeding coats.

3.2 PROTECTION OF WORK:

A. The painters shall protect all adjacent surfaces with drop covers during the process of painting. Upon completion, paint spots, if any, shall be removed from all surfaces.

3.3 PREPARATION OF SURFACE:

A. Surfaces to be painted shall be completely dry before applying paint. Metal surfaces shall be cleaned with mineral spirits before applying materials. Rust and scale shall be removed by wire brushing or sanding. Galvanized surfaces shall be chemically pretreated with crystalline (zinc phosphate) phosphate in strict accordance with the manufacturer's recommendations. Surfaces shall not be painted when the temperature is, or is likely to be, near the freezing point, nor when they are exposed to hot sun.

3.4 IDENTIFICATION OF PIPES AND EQUIPMENT:

A. Equipment: After all other painting is completed, each major item of equipment shall be properly identified with nameplates. Identification symbols and designations shall be the same as shown on the Contract Documents. Where equipment is installed above lay-in ceilings (VAV boxes, cabinet unit heaters, fan coil units, or similar), the plastic nameplate shall be adhered to the face of the T-bar support so that it can be identified from within the space.

B. Apply piping system markers after completion of required insulation and finishes on piping systems. Markers shall be applied in the following locations and where identified by the Engineer:

1. At each valve and at connection to equipment.
2. At every tee and branch connection.
3. At each riser including branch risers from mains.
4. At each side of a pipe passage through floors, walls and partitions.
5. Every 15 feet on straight runs of piping mains and branches.
6. Within 6 feet of elbows (each side).
7. At access doors or similar points that permit view of concealed piping.
8. Markers shall be provided on all piping above lay-in ceilings.
9. Provide arrow markers showing direction of flow incorporated into, or adjacent to, each piping system marker.
10. Apply all piping system markers where view is unobstructed, and legends can be read and easily identified.
11. Apply all tags and piping system markers in accordance with the supplier's instructions.

END OF SECTION 230553

SECTION 230593 - TESTING, ADJUSTING AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

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

B. Work Included:

1. Cleaning
2. Adjusting and Balancing

C. Related Sections:

1. Division 01 -- Commissioning
2. Section 23 00 10 – HVAC General Requirements
3. Section 23 05 00 – Common Work Results for HVAC
4. Section 23 07 00 – HVAC Insulation
5. Section 23 20 00 – HVAC Piping and Pumps
6. Section 23 30 00 – HVAC Air Distribution
7. Section 23 80 00 – Decentralized HVAC Equipment

1.2 REFERENCES

A. General: The following publications listed below, form a part of this specification to the extent indicated by the reference thereto.

B. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA):

Balancing and Adjustment Manual

C. Associated Air Balancing Council (AABC):

National Standards for Total System Balance

D. National Environmental Balancing Bureau (NEBB):

Procedural Standards for Testing, Balancing and Adjusting of Environmental Systems.

1.3 QUALIFICATIONS

A. For the air conditioning, heating and ventilation systems the Contractor shall obtain the services of a qualified, independent testing organization specializing in total system air and water testing and balancing. The Contractor shall be responsible for making changes in pulleys, belts and dampers where necessary to obtain the required air volume as determined by the Testing and Balancing Contractor.

The Testing and Balancing Contractor shall provide all labor, engineering and test equipment required to adjust, test and balance all heating, ventilating, air conditioning and exhaust systems as hereinafter specified. All personnel involved in the execution of the work under the balancing contract shall be experienced and factory trained specifically in the total balancing of mechanical systems, as well as being regular employees of the Balancing Contractor. The Test and Balance Contractor shall work in close coordination with the Controls Contractor to ensure that the system is operating as designed and to aid in adjusting setpoints as necessary for proper system operation.

1.4 TAB COORDINATION AND RESPONSIBILITIES

A. The TAB Agent shall provide the following:

1. All instrumentation used in the course of testing and balancing shall be accurate and shall have been calibrated within the six months prior to commencing test and balance work for this project.
2. Where existing air or hydronic systems are to be renovated, the TAB Contractor shall provide a complete measurement of air flow for systems indicated to remain prior to any construction or demolition of existing systems. For air systems, the data shall be taken and recorded for each piece of air handling equipment serving the area of renovation and those indicated on the drawings for ductwork or other mechanical renovations. Data shall be provided as outlined for balancing data hereinafter. Any discrepancies in the data shall be reported to the Architect/Engineer prior to commencing any mechanical work.
3. The TAB Agent shall conduct a pre-TAB inspection two weeks prior to commencing the test and balance. The TAB Agent shall notify the Contractor in writing of any deficiencies that would affect the ability to successfully complete the test and balance or result in an incomplete or unacceptable report.
4. During the course of the test and balance, the TAB Agent shall immediately notify the Contractor of any equipment or system discrepancies discovered that need to be corrected prior to the satisfactory completion of the test and balance procedures.
5. Equipment settings, including damper positions, valve positions, fan speed controls, and similar devices shall be marked to show final settings.

B. The Contractor shall provide the following:

1. Prior to the commencement of testing and balancing, the installation of building systems shall be fully complete. Building controls systems shall be complete, operational, and verified by the Contractor.
2. The Contractor shall resolve any discrepancies noted by the TAB Agent in the Pre-TAB Inspection prior to commencing the test and balance. The Contractor shall provide written confirmation of the corrective action that was taken to correct each deficiency.
3. The Contractor shall make available qualified personnel during the period in which the test and balance is being conducted for the purpose of problem resolution and controls support.
4. The Contractor shall resolve any deficiencies noted by the TAB Agent prior to the submission of the report and prior to any subsequent visits required by the TAB Agent.

1.5 SUBMITTALS

A. Prior to commencing work under this section, the Contractor shall submit the name of the testing organization, a proof of certification by the Associated Air Balance Council or National Environmental Balancing Bureau, and a list of five local projects on which testing and balancing has been completed

for two years, for approval by the Architect/Engineer. The submittal shall include TAB procedures proposed for the systems specific to this project.

B. Heating, Air Conditioning and Ventilation Systems Balance and Performance Data: At a time no later than the Substantial Completion Inspection, the Contractor shall provide the Architect/Engineer with two (2) typewritten copies of schedules containing air and water system balance and performance data.

C. Equipment and System Verification: Letters, signed by representatives of heat pump and air conditioning unit manufacturers, shall attest that their respective equipment installed on this project has been started, tested and set to operate safely and at the control points required as an integral part of the systems specified herein. The Contractor shall attest by letter that all equipment has been wired and tested to see that the indicated sequence of motor control is established, that all safety controls function properly, that all motor protective devices are sized correctly and that the systems are operating at the points set on the controls. The Engineers will not conduct a site visit for the purpose of determining the status of final payment until these letters are received.

D. Test data shall be submitted for all equipment and systems where specifically required by this specification and all items identified with [TD] behind the product data.

1.6 COMMISSIONING OF HVAC SYSTEMS

A. Participate in Commissioning Meetings designated by the Commissioning Agent.

B. Participate in resolving controls issues identified by the Commissioning Agent.

C. Notify Commissioning Agent a minimum of 2 weeks in advance of start-up of Testing, Adjusting and Balancing (TAB) work. Arrange and attend meeting between Commissioning Agent and TAB agency for review of TAB procedures, TAB work plan, and TAB schedule. Refer to Division 1 for complete scope of Commissioning work.

D. Provide Commissioning Agent with a copy of preliminary and final balance reports.

1.7 CONDITIONS

A. Partial Testing: As much as practical, systems shall be tested as complete systems. Tests on portions of a system will be permitted to facilitate proper progress scheduling. When systems are tested in segments, a system diagram indicating portion tested and a separate and complete report including the date of test is required for each segment.

B. Concealed Work:

1. All concealed work shall be tested and approved by the Architect/Engineer prior to the application of insulation or construction of chase walls.
2. Covering shall not be applied to any piping nor shall any piping be concealed or covered until pipes have been tested, all leaks stopped, retested and approved.

PART 2 - PRODUCTS

2.1 GENERAL

A. All equipment, instruments, materials and utilities required for cleaning, testing and balancing of the air and hydronic systems shall be provided by the Contractor.

2.2 INSTRUMENTATION

A. All instruments used by this Contractor shall be accurately calibrated and maintained in good working condition.

2.3 TESTS OF MATERIALS

A. Manufacturers' certificates will be accepted in lieu of tests of materials. If individual laboratory tests are desired by the Architect-Engineer, they will be secured by this Contractor and paid for by the Owner.

PART 3 - EXECUTION

3.1 CLEANING

A. Equipment shall be wiped clean to remove all dust, oil, dirt or paint spots. Trash, plaster, mortar or paint shall be removed from all coils, plenums and end pockets.

B. Ductwork shall be thoroughly blown out or flushed and cleaned of all foreign matter before connections are made to equipment. Temporary bypasses shall be provided around coils, control valves, ice tanks, heat exchangers and other similar items to prevent trash from being flushed into these items. Care shall be taken at time of installation to prevent pipe compound, scale or other objectionable matter from entering the piping systems. After all construction dirt has been removed from the building, new filters shall be installed in all air units.

3.2 ADJUSTING AND BALANCING:

A. Equipment: Before attempting to adjust and balance the air and water systems, the Contractor shall verify that the following items have been completed and are correct.

1. Motor and bearings are properly lubricated.
2. Direction of rotation of motors.
3. Belt tension.
4. Electric current flow in each phase of motors and electric heating elements.
5. Motor protective devices are sized to properly protect installed motors.
6. Thermostats, controls, accessories and other items requiring setting or adjustment shall be set as indicated.

B. Air System Balancing Procedure:

1. Place all related supply, exhaust and return air systems in operation with the fans running at design RPM.
2. Establish system conditions for the maximum demand in airflow; generally, a cooling application. Variable volume systems shall be set and balanced such that the systems are operating at minimum static pressure necessary to maintain proper airflow at the terminal devices.
3. Measure supply air volumes by means of the duct traverse method, making a minimum of sixteen (16) readings. Test holes shall be in straight duct as far as possible downstream from elbows, takeoffs, dampers, etc. Seal duct access holes with metal snap-in plugs. The use of duct tape to seal access holes will not be permitted.
4. Adjust balancing dampers for required branch duct air quantities. Ducts with multiple branches shall have at least one branch with volume damper(s) completely open.
5. Adjust grilles and diffusers to within 10% of individual requirements specified, and also adjust so as to minimize drafts and sound in all areas. Restriction imposed by flow regulating devices in or at terminals shall be minimal. Final measurement of air quantity shall be made after optimum air pattern has been achieved.
6. The total air delivery in any particular fan system shall be obtained by adjustment of the particular fan speed. The drive motor of each fan shall not be loaded over the corrected full load amperage rating of the motor involved. Where belt drive fans are used in conjunction with VFD's, the fan speed shall be adjusted by changing pulleys such that fan speed to achieve design airflow occurs at 60 Hz.
7. Adjust quantity of air on each zone to the values given in the specifications and/or plans.
8. If the supply fan volume is not within plus or minus 10% of the design capacity at design RPM, determine the reason by reviewing all system conditions, procedures and recorded data. Check and record the air pressure drop across filters, coils, eliminators, sound traps, etc., to see if excessive loss is occurring. Particularly study duct and casing conditions at the fan inlet and outlet.
9. Any changes that are required for the final balancing results will be provided for by the respective Contractors who supplied and installed such equipment under their contractual obligations. Such changes may encompass, but are not necessarily restricted to, the changing of pulleys, belts, dampers or adding dampers or access holes.

3.3 BALANCE AND PERFORMANCE DATA REPORT [TD]:

A. General: Each heating, ventilating and air conditioning system shall be operated and tested continuously for at least two consecutive days to verify that the system is operating satisfactorily and safely and that all equipment is producing the required capacity. To be successful, this test must be conducted with all controls in automatic position and all lights on or off to simulate day time or night time use of the building. Submit two typewritten copies of reports covering air and water system balance and performance. Reports must be received by the Architect-Engineer at least one week prior to the Contractor's request for a substantial completion inspection. Reports that contain deficiencies related to incomplete or improper system installation will be rejected by the Engineer without further review.

B. Calibration Data: The report shall include a list of all instrumentation used and the date of the most recent calibration for each instrument.

C. Balance Data: The following balance data shall be provided. Design and actual water and air flows shall be provided in tabular form.

1. All Air Handling and Air Conditioning Equipment Used for Heating, Cooling and Ventilating:

   a. System nomenclature and identification.
   b. Nameplate information: Manufacturer, model and serial number, horsepower, rpm, voltage, phase, maximum amperage.
   c. Fan speed.
   d. Static pressure profile – reading between all components and total external static pressure.
   e. Outside, return, and supply air quantities.
   f. Actual running motor amperage.
   g. For all VAV units, provide location of downstream static pressure sensor, set point (if applicable), and reading.

2. Fans:

   a. System nomenclature and identification.
   b. Nameplate information: Manufacturer, model and serial number, horsepower, rpm, voltage, phase, maximum amperage.
   c. Fan speed.
   d. Total external static pressure.
   e. Air quantity.
   f. Actual running motor amperage.

3. Air Outlet and Inlet:

   a. Room identification.
   b. Manufacturer.
   c. Size.
   d. Free area factor.
   e. Air quantity.
   f. Velocity.

D. Performance Data: The following information shall be recorded twice each day and twice each night during the performance test. Reading shall be taken for each item at a different time each succeeding day at least two hours later than the time the reading was taken on the preceding day.

1. All Air Handling and Air Conditioning Equipment Used for Heating, Cooling and Ventilating (except for unit heaters, VAV boxes, and cabinet unit heaters):

   a. System nomenclature and identification.
   b. Dry bulb and wet bulb temperatures entering and leaving all coils.
   c. Water flow through all coils.
   d. Water temperatures entering and leaving all coils.
   e. Water pressure drop through all coils.
   f. (Test all electric heating coils for operation of low airflow interlock.)

2. Heat pumps:

   a. System nomenclature and identification.

b. Nameplate information: Manufacturer, model and serial number.
c. Dry bulb and wet bulb temperatures entering and leaving indoor and outdoor coils.

3. Space Pressurization:

a. Measure and record space pressurization in corridor served by each major air handling unit.
b. Coordinate with Controls Contactor for fan speed adjustments to achieve space pressurization setpoint of 0.05" w.c. (adjustable).

4. Temperature: Each Room in Building. Temperature measurements shall be taken with the Contractor's calibrated equipment. Trended data from the temperature control system is not acceptable.

E. Control Setting: During the performance and balance tests, control settings may require adjustment, and if so, shall be adjusted to produce the best balanced system operation. The final setting of each operating and safety control shall be recorded. This shall include, but not be limited to, thermostats, limit controls, damper position switches, firestats, freezestats, humidistats, aquastats and other similar items.

3.4 HVAC SYSTEMS FINAL TESTS:

A. Upon completion of the work, in accordance with these drawings and specifications, the Contractor shall make a final test in the presence of the Architect-Engineer. With all equipment energized and all controls in automatic position, the systems and equipment specified herein shall be proven to operate safely and to heat and cool the structure uniformly. If not, adjustments and corrections shall be made until satisfactory operation is achieved.

3.5 HVAC SYSTEM POST ACCEPTANCE TESTS:

A. Should completion of the building occur at such time that the required performance test must be conducted and test data recorded and submitted during a season when both heating and cooling system performance cannot be checked, the Contractor shall perform the tests and record all such data as is available with system operating automatically under the prevailing weather conditions. That part of the system portion which cannot be recorded because of the prevailing weather shall be delayed until the weather is appropriate at which time the remaining part of the required tests shall be conducted and data recorded accordingly. Portions of the tests may not be delayed without written consent of the Engineer.

END OF SECTION 230593

SECTION 230700 - HVAC INSULATION

PART 1 - GENERAL

1.1 SUMMARY

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

B. Work Included:

1. Piping Insulation
2. Ductwork Insulation
3. Equipment Insulation

C. Related Sections:

1. Section 23 00 10 – HVAC General Requirements
2. Section 23 05 00 – Common Work Results for HVAC
3. Section 23 20 00 – HVAC Piping and Pumps
4. Section 23 30 00 – HVAC Air Distribution
5. Section 23 80 00 – Decentralized HVAC Equipment

1.2 SUBMITTALS:

A. Submit shop drawings in accordance with Division 1 and Section 23 00 10.

B. Submit shop drawings and catalog data for each type of material proposed for this project. Indicate thickness of material for individual services, and installation methods.

1.3 REFERENCES:

A. General: The following standards or codes (latest edition) form a part of this specification to the extent indicated by the reference thereto.

B. American Society for Testing and Materials (ASTM):

ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building materials.

ASTM C 411 Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation

C. National Fire Protection Association (NFPA):

Standard 255 Method of Test of Surface Burning Characteristics of Building Materials

D. Underwriters Laboratories, Inc. (UL)

Standard 723 Tests for Surface Burning Characteristics of Building Materials

E. California Department of Health Services

Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers

PART 2 - PRODUCTS:

2.1 GENERAL

A. Acceptable Manufacturers:

1. Manville, Owens Corning, Armstrong, IMCOA, Knauff or Certain-Teed except where specific manufacturer is named.

B. All insulation materials, jackets and fitting covers shall have a composite flame spread rating not exceeding 25, and a smoke developed rating not exceeding 50 as tested under procedure ASTM E-84-75, NFPA 255 and UL 723. Duct coverings and linings shall not flame, glow, smolder or smoke when tested in accordance with ASTM C411.

2.2 MATERIALS

A. Piping:

1. Refrigerant Piping and Interior Condensate Drains: Closed cell flexible elastomeric insulation, 0.28 btu•in./sq.ft./°F/hr. maximum "K" value at 75°F., maximum water vapor transmission rating of 0.1 perms-inch. Insulation located outside the building shall have a selective finish to protect insulation from ultra violet (UV) solar radiation, unless specifically designed to withstand UV radiation.

B. Ductwork:

1. Exposed Rectangular Ducts: Rigid fibrous glass insulation, 3.0 lb. density, 0.24 btu•in./sq.ft./°F/hr. maximum "K" value at 75°F, with factory applied reinforced aluminum foil vapor barrier. (Insulation to be exposed in public, finished areas shall have factory applied reinforced white Kraft all service jacket for painting.)
2. Round Ducts, Flat Oval Ducts and Concealed Rectangular Ducts: Flexible fibrous glass insulation, 1.0 lb. density, 0.27 btu•in./sq.ft./°F/hr. maximum "K" value at 75°F, with factory applied reinforced aluminum foil vapor barrier.

C. Cold Equipment: Rigid fibrous glass insulation molded or fitted to conform to equipment, 0.24 btu•in./sq.ft./°F/hr. maximum "K" value at 75°F.

D. Sealants, Mastics and Adhesives: Products either manufactured by or recommended by the insulation material manufacturer. For field applications within the weatherproofing system, adhesives and sealants shall comply with the requirements of the California Health Services Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers.

PART 3 - EXECUTION:

3.1 PREPARATION

A. Do not install insulation before piping and equipment have been tested and approved.

B. Ensure surface is clean and dry prior to installation. Ensure insulation material is undamaged and dry before application. Finish with system at operating conditions and temperature.

3.2 INSTALLATION

A. General: Ensure insulation is continuous through inside walls and partitions. Insulated piping passing through smoke partitions, fire walls, fire partitions, and fire rated floors shall have insulation of type, thickness and density to match U.L. Through-Penetration Firestop Systems as specified in Section 23 00 10 under Sleeves and Inserts. Insulated piping passing through nonfireresistance rated floors shall be fireblocked as specified in Section 23 00 10 under Sleeves and Inserts. Insulated ducts passing through smoke partitions and fire rated assemblies where a fire damper is not required shall be insulated with calcium silicate for a length equal to twice the thickness of the wall with all voids between the sleeve and duct insulation tightly packed with mineral-wool insulation or U.L. approved packing with sealant. All penetrations through equipment room walls and other areas of noise or heat generation shall be tightly sealed with mineral fiber rope. Finish insulation neatly at hangers, supports and other protrusions.

B. Piping:

1. General:

a. Elastomeric and other foam insulations shall be installed without stretching or compressing individual lengths.

2. Refrigerant Piping: Cover all valves and fittings with equivalent thickness of insulating material. All edges shall be tightly butted. Seal all joints vapor tight.

C. Ductwork:

1. External:

a. Rigid duct insulation shall be secured to rectangular ducts with mechanical fasteners such as metal stick clips or cupped head weld pins located a maximum of 3” from each edge and spaced a maximum of 12” on center each way. All insulation joints shall be tightly butted. All joints, voids and punctures in facing shall be sealed vapor tight with pressure sensitive foil tape or mastic.

b. Flexible duct insulation shall be provided with a minimum 2” facing flap overlapping adjacent and connecting insulation. Seams shall be stapled approximately 6” on center with ½” outward clinching staples. Where rectangular ducts are 24” in width or greater, insulation shall be secured to the bottom of the duct with mechanical fasteners to prevent sagging. All insulation joints shall be tightly butted. All joints, voids and punctures in facing shall be sealed vapor tight with mastic.

2. Internal: The lining shall be applied to cut-to-size pieces fastened to the entire interior of the duct with mastic, stick clips and speed washers. Edges and joints shall be coated with fire resistant mastic. External duct insulation is not required on ducts with internal lining unless noted otherwise. External duct insulation shall be provided on all ducts with, or without internal lining in unheated attic spaces and where exposed to outside conditions.
3. Ductwork exposed to outside conditions shall be insulated as specified herein and covered with minimum .025 inch thick aluminum jacket with seams lapped a minimum 3", sealed with silicon caulk. Covers shall be neatly finished and completely watertight.
4. Where duct mounted heating coils are located downstream from cooling coils and at variable air volume terminal units the coil shall be provided with vapor-sealed external duct insulation on sides, top and bottom.
5. Where ductwork is indicated to have internal acoustic lining, sheet metal drops to diffuser and register necks shall be unlined and shall be externally insulated.

D. Damaged Insulation: All existing thermal coverings that are removed or damaged during construction shall be replaced or repaired to not less than original condition. Repaired sections shall provide equal or better thermal performance and vapor protection.

E. Patching: Where existing control, monitoring or other penetrating devices are removed from ductwork or piping, the insulation shall be patched to match thickness, type and finish of existing insulation.

3.3 INSULATION THICKNESS SCHEDULE

A. Piping:

Type	Size, Inches	Insulation Thickness, Inches
Refrigerant Suction	All	1
Heat Pump Refrigerant Liquid	All	1
Waste Lines Carrying Condensate from A/C Units, Ice Makers, etc.	All	1/2

B. Ductwork:

Type	Insulation Thickness Inches, External
Outside Air Intake and Untempered Supply	2
Supply (Heating and Cooling)	1-1/2
Return (Equip. Room Only)	1-1/2
Plenums	1-1/2
Exhaust (Between MOD & Louver)	2
Supply & Return Exposed to Outside Air Conditions (& in Attic Space)	2

END OF SECTION 230700

SECTION 232000 - HVAC PIPING AND PUMPS

PART 1 - GENERAL

1.1 SUMMARY

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

B. Work Included:

1. Pipe and Pipe Fittings

C. Related Sections:

1. Division 01 -- Commissioning
2. Section 23 00 10 – HVAC General Requirements
3. Section 23 01 00 – Operation and Maintenance of HVAC Systems
4. Section 23 05 00 – Common Work Results for HVAC
5. Section 23 05 48 – Vibration and Seismic Controls for HVAC Equipment and Piping
6. Section 23 05 53 – Identification for HVAC Piping and Equipment
7. Section 23 05 93 – Testing, Adjusting, and Balancing for HVAC
8. Section 23 80 00 – Decentralized HVAC Equipment

1.2 REFERENCES:

A. General: The following standards or codes form a part of this specification to the extent indicated by the reference thereto.

B. American Society for Testing and Materials (ASTM):

A53-88a Pipe, Steel, Black and Hot-dipped, Zinc-coated, Welded and Seamless

A106-88a Seamless Carbon Steel Pipe for High Temperature Service

A120-88a Pipe, Steel Black and Hot-dipped, Zinc-coated, Welded and Seamless for Ordinary Uses

A126-84 Gray Iron Castings for Valves, Flanges and Pipe Fittings

A254-88 Copper Brazed Steel Tubing

A420-88 Piping Fittings of Wrought Iron Carbon Steel and Alloy Steel for Low Temperature Service

A539-88 Electric-Resistance-Welded Coiled Steel Tubing for Gas and Fuel Oil Lines

B32-89 Solder Metal

B42-88 Seamless Copper Pipe, Standard Sizes

B75-86 Seamless Copper Tube

B88-95a Seamless Copper Water Tube

C. American Society of Mechanical Engineers (ASME):

ASME 95 Boiler and Pressure Vessel Code

B16.3 Malleable Iron Threaded Fittings

B16.4 Cast Iron Threaded Fittings

B31.9 Building Services Piping

D. International Ground Source Heat Pump Association (IGSHPA) Installation Manuals.

E. National Electrical Manufacturers Association (NEMA)

F. Underwriters Laboratories, Inc. (UL)

1.3 COMMISSIONING OF HVAC SYSTEMS:

A. The Contractor shall provide contact information to the Commissioning Agent indicated in Division 1 for all major items of Equipment.

B. Provide additional submittal copy of major equipment for Commissioning Agent specified in Division 1.

1.4 SUBMITTALS:

A. Submit shop drawings, product data and samples in accordance with Division 1 and Section 23 00 10.

B. Shop drawings, diagrams, catalog data and such other data necessary to fully describe and substantiate compliance with these specifications shall be submitted for all equipment and materials marked with notation set forth in Section 23 00 10.

C. Operation and maintenance data shall be submitted in accordance with Division 1, for all items of equipment and materials marked with notation set forth in Section 23 00 10.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS:

A. Material Standards:

1. Copper pipe shall be manufactured in accordance with ASTM B88 and shall be so labeled.

B. Cooling coil condensate drain lines shall be type L hard drawn copper tubing. Fittings shall match the piping.

C. Refrigerant piping shall be type "ACR" hard drawn copper tubing, factory cleaned, dehydrated and capped with wrought copper fittings. Provide all accessories including, but not limited to, refrigerant duty ball type shutoff valves, solenoid valves, expansion valves, moisture indicating sight glass, replaceable core filter dryers, access ports with gasketed screw-on covers for charging and measuring subcooling, hot gas bypass valve (where indicated) and other accessories recommended by the refrigeration equipment manufacturer. Expansion valves shall be balanced port, externally equalized type. Provide heat exchangers for subcooling and suction line accumulator as recommended by the manufacturer. All components shall be selected and sized for the lowest pressure drop at the capacities indicated. Prior to offering the system for final acceptance, the Contractor shall submit a written certification from an authorized official of the equipment manufacturer stating the complete system, to include refrigerant piping, has been installed in accordance with the manufacturer's recommendations.

2.2 MISCELLANEOUS PIPING SPECIALTIES:

A. Escutcheons shall be the split pattern chromium plated bronze or steel. Special height escutcheons shall be provided where extended sleeves are used. Escutcheons shall be sized to cover the entire opening.

B. Water seals (Trap) shall be provided on condensate drain from each air handling unit. Seal shall be of sufficient depth to prevent blowout or siphoning of water and shall be configured as indicated on the Drawings.

C. Pipe sleeves shall be installed as outlined in SECTION 23 00 10 HVAC GENERAL REQUIREMENTS.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION:

A. General: Sleeves and sealant shall be provided where pipes pass through floors, partitions or walls as outlined in Section 23 00 10, HVAC GENERAL REQUIREMENTS. Pipe shall be cut accurately to measurements established at the job site and worked into place without springing or forcing, properly clearing all windows, doors and other openings. Pipe in finished areas shall be concealed. Excessive cutting or other weakening of the building structure to facilitate piping installation will not be permitted. Each end of each piece of pipe shall be reamed. Pipe shall be installed to permit free expansion and contraction without damage to joints or hangers. Changes in direction shall be made with fittings. Bushings and all thread nipples will not be allowed.

B. All piping shall be installed with sufficient pitch to insure adequate drainage. Cooling coil condensate drain lines shall slope 1/8" per foot in direction of flow.

C. Escutcheons shall be provided where exposed pipes pass through finished walls or floors.

D. Miscellaneous piping terminating at floor drains or in the air shall be resiliently anchored to protect against fatigue or damage incurred as a result of vibration or abuse.

E. Joints:

1. Copper tubing shall be cut square, ends reamed and all filings and dust wiped from interior of pipe. Joints shall be soldered with solder drawn through the full fitting length. Excess solder shall be wiped from joint before solder hardens. Solder shall be 95/5 composition – 50/50 will not be allowed. All solder joints shall have piping surfaces sanded or brushed. Self-cleaning solder flux as a substitute for sanding or brushing is not acceptable.
2. Threaded joints shall be made with tapered threads properly cut. Joints shall be made tight with a stiff mixture of litharge and glycerin or other approved thread joint compound applied with a brush to the male threads only. Not more than three threads shall show after the joint is made up. The use of thread protectors for pipe couplings is not acceptable. Expanding self-hardening pipe dope ("expando") shall not be used.

3.2 REFRIGERANT PIPING:

A. All refrigerant piping shall be sized, installed, and routed in accordance with the refrigeration equipment manufacturer's recommendations.

B. All piping joints and the inside of all piping shall be clean. Burnish all mating surfaces until all dirt, oxide, or other debris is removed. Using no flux, braze all joints using hard solder equal to Stay-Bright for pipe 2 inches and below or Stay-Silver for pipe larger than 2 inches. Remove all internal components from refrigerant accessories which may be subject to heat damage prior to brazing.

C. Before charging, refrigerant lines shall be thoroughly cleaned and purged. Refrigerant lines shall be pulled down to a vacuum of 500 microns and then pressure tested according to the manufacturer's instructions before charging with refrigerant.

D. All filters from filter dryers shall be replaced after 48 hours of system operation and prior to final acceptance.

E. Refrigerant circuit access ports located outdoors shall be fitted with locking-type tamper resistant caps or shall be otherwise secured to prevent unauthorized access.

END OF SECTION 232000

SECTION 233000 - HVAC AIR DISTRIBUTION

PART 1 - GENERAL

1.1 SUMMARY

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

B. Work Included:

1. HVAC Ductwork
2. Air Duct Accessories
3. HVAC Fans
4. Air Outlets and Inlets

C. Related Sections:

1. Division 01 -- Commissioning
2. Section 23 00 10 – HVAC General Requirements
3. Section 23 01 00 – Operation and Maintenance of HVAC Systems
4. Section 23 05 00 – Common Work Results for HVAC
5. Section 23 05 48 – Vibration and Seismic Controls for HVAC Equipment and Piping
6. Section 23 05 53 – Identification for HVAC Piping and Equipment
7. Section 23 07 00 – HVAC Insulation
8. Section 23 05 93 – Testing, Adjusting, and Balancing for HVAC
9. Section 23 80 00 – Decentralized HVAC Equipment

1.2 REFERENCES:

A. General: The following standards or codes form a part of this specification to the extent indicated by the reference thereto.

B. Air Movement and Comfort Association (AMCA):

Bulletin 210, Standard Test Code for Air Moving Devices

Standard 511, Air Performance and Water Penetration

C. American Society for Testing and Materials (ASTM):

ASTM A 525 General Requirements for Steel Sheet, Zinc Coated (Galvanized) By the Hot-Dip Process

ASTM A 527 Steel Sheet, Zinc Coated (Galvanized) By the Hot-Dip Process, Lock-Forming Quality

ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials

ASTM C 411 Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation

D. Underwriters Laboratories, Inc. (UL)

Standard 723 Tests for Surface Burning Characteristics of Building Materials

E. Sheet Metal and Air Conditioning Contractors' Association (SMACNA)

Duct Construction Standards (Latest Edition)

HVAC Air Duct Leakage Test Manual (Latest Edition)

F. National Fire Protection Association (NFPA):

1. Standard 90A – Standard for the Installation of Air Conditioning and Ventilating Systems
2. Standard 90B – Standard for the installation of Warm Air Heating and Air Conditioning Systems
3. Standard 96 – Standard for the Installation of Equipment for the Removal of Smoke and Grease – Laden Vapors from Commercial Cooking Equipment
4. Standard 255 – Method of Test of Surface Burning Characteristics of Building Materials

G. California Department of Health Services

Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers

1.3 DEFINITIONS:

A. Duct Sizes: Sizes shown on Drawings are actual sheet metal dimensions. For acoustically lined ducts, sizes indicated are actual sheet metal sizes allowing for 1" thick acoustic lining. For double wall ductwork, sizes indicated are inside dimensions.

B. Low Pressure Ductwork: Static pressure rating less than 2" w.g. and velocities less than 2000 fpm.

1.4 COMMISSIONING OF HVAC SYSTEMS:

A. The Contractor shall provide contact information to the Commissioning Agent indicated in Division 1 for all major items of Equipment.

B. Provide additional submittal copy of major equipment for Commissioning Agent specified in Division 1.

1.5 SUBMITTALS:

A. Submit shop drawings, product data and samples in accordance with Division 1 and Section 23 00 10.

B. Shop drawings, diagrams, catalog data and such other data necessary to fully describe and substantiate compliance with these specifications shall be submitted for all equipment and materials marked with notation set forth in Section 23 00 10.

C. Operation and maintenance data shall be submitted in accordance with Division1, for all items of equipment and materials marked with notation set forth in Section 23 01 00.

D. All fans for use with Variable Frequency Drives (VFD) shall have critical speed and multiples of critical speed indicated on each submittal.

1.6 SPARE PARTS

A. Each fan powered terminal box and make-up air fan shall be provided with 3 sets of filters. At end of construction each unit shall be provided with a clean filter and one set shall be turned over to the Owner as spares.

B. Each belt driven piece of equipment shall be provided with one spare set of belts to be turned over to the Owner at the end of construction.

PART 2 - PRODUCTS

2.1 HVAC DUCTWORK

A. Materials:

1. Sheet Metal Ducts: Trademarked galvanized steel, lock forming quality, having zinc coating of 0.90 ounces per square foot for each side (G90, ASTM A 525 and A 527).
2. All ductwork without external insulation, exposed to view in finished, non-utility spaces shall have paint-grip or galvaneal coating to accept field painting.
3. Fasteners: Use rivets and bolts throughout; sheet metal screws may be used on low pressure ducts.
4. Sealants: United McGill “United Duct Sealer” or equal. Water and fire resistant when dry, compatible with mating materials. Where sealants are used on exposed ductwork, composition shall be designed to prevent bleed-through of finish paint, or sealant shall be pre-painted with a coating impervious to bleed-through. For field applications within the weatherproofing system, all adhesives and sealants shall comply with the requirements of the California Health Services Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers.
5. All duct and accessory materials shall have a composite flame spread rating not exceeding 25, and a smoke developed rating not exceeding 50 as tested under procedure ASTM E-84-75, NFPA 255 and UL 723. Duct coverings and linings shall not flame, glow, smolder or smoke when tested in accordance with ASTM C411.

B. Fabrication:

1. All ductwork shall conform accurately to the dimensions indicated on plans and shall be fabricated and installed in accordance with ASHRAE Guide and Data Books and SMACNA Duct Construction Standards, except that sheet metal gauges and zinc coating shall not be lighter than specified under this Section.
2. All rectangular sheet metal ducts over 18” wide shall be cross-broken for rigidity.
3. Reinforcing angles, stiffeners and tie-rods for all sheet metal ducts shall be provided where required to prevent sagging, buckling, and vibration in accordance with the latest SMACNA Duct Construction Standards Publication. Reinforcing for flat oval duct shall be provided as specified for rectangular duct in accordance with the latest SMACNA Duct Construction Standards Publication.

4. Lap metal ducts in direction of air flow. Hammer down edges and slips to leave smooth interior surface.
5. Where square elbows are indicated on the Drawings, curved elbows may be used provided the centerline radius is not less than 1-1/2 times the width of duct and as space allows.
6. Provide turning vanes in all square elbows. Provide air foil type turning vanes on all ducts more than 24" wide.
7. Transitions shall be made with a slope ratio of 4:1, except at equipment divergence and convergence shall not exceed a slope ratio of 3:1.
8. All duct joints and seams shall be mechanically tight, and sealed with sealant or gaskets to provide a substantially airtight system.
9. All duct liners shall be installed using fasteners in strict accordance with SMACNA Duct Construction Standards. Fastener pins shall be clinched pin type or welded pin type. The use of adhesive type pins is not acceptable. All liners shall have transverse edges coated with adhesive, all corners lapped and butted or folded.
10. Duct liners at fan discharges shall be lapped on outside of fan discharge flange or shall have metal nosing on leading edge. Fastening pin length shall be equal to liner thickness.
11. Provide easements where low pressure ductwork conflicts with piping and structure. Where easement exceeds 10% duct area, split into two ducts maintaining original duct area.
12. Plenums and Casings (Site Fabricated Units) [S]: Construct of galvanized steel panels joined by standing seams on outside of casing. Rivet or bolt all seams and joints on approximately 6" centers and seal with sealant. Reinforce with steel angles and provide diagonal bracing. Access doors shall be 36" x 18" with frame welded to plenum, three brass hinges and three brass tension fasteners operable from either side of door.

C. Low Pressure Ducts:

1. Sheet Metal Gauges:

a. Rectangular Ducts:

Max. Dimen., In.	Min. Gauge
Up to 30	24
31 to 54	22
55 to 84	20
85 and Over	18

b. Round Ducts:

Duct Diameter, In.	Min. Gauge
Up to 22	24
23 to 36	22
37 to 50	20
51 to 60	18
61 to 84	16

2. Fittings shall be minimum 20 gauge on flat oval, but not less than 2 gauges heavier than ductwork in which it is installed on round and flat oval. Fittings for duct sizes 5" round and below may be minimum 24 gauge.
3. All take-offs shall be full body pre-manufactured 45° conical lateral type or alternate pre-manufactured fitting with equivalent loss coefficient. The use of field-installed or factory lateral taps or manifolds is not acceptable.

D. Flexible Ducts [S]: Flexible Ducts shall be Flexmaster Type 1M or Thermaflex type M-KE. Duct shall incorporate acoustic rated CPE or PE inner liner, 1" thick fiberglass insulation, and reinforced metalized vapor barrier. Maximum C factor shall be 0.24 btu/hr/sq.ft./°F at 75°F mean temperature. Duct shall have a working pressure of not less than 6 inches w.g. for positive pressure and 1 inch w.g. for negative pressure and suitable for velocities up to 4000 fpm. Vapor transmission shall be less than 0.05 Perm when tested in accordance with ASTM E96, Procedure A. The entire assembly shall be rated and marked as UL 181 Class 1. Flame Spread Rating shall not exceed 25 and Smoke Developed Rating shall not exceed 50 when tested in accordance with ASTM E-84-75, NFPA 255, and UL 723. Minimum duct insertion loss at 2500 fpm for a 10-foot length of straight duct shall be as listed below when tested in accordance with ADC FD-72 R1:

Duct Insertion Loss, dB

Octave Band	2	3	4	5	6
Frequency, Hz	125	250	500	1000	2000
6 inch duct	7	19	34	37	38
8 inch duct	8	13	29	35	36
12 inch duct	20	26	27	33	26

2.2 AIR DUCT ACCESSORIES

A. Access Doors:

1. Doors for low pressure rectangular ductwork shall be galvanized steel, 20 gauge rigid type, 12" X 16" minimum size unless noted otherwise, except where size of duct will not accommodate this size, they shall be as large as possible. Door shall have gasket, two hinges, and two compression latches with outside and inside handles. Provide insulated doors where installed in insulated ductwork.

B. Gravity dampers shall be Airline type CBD counter balanced back draft damper constructed of felt edged aluminum blades. Set to open at .10" H_2O.

C. Dampers:

1. General:

   a. Fabricate of galvanized steel.
   b. Where manual dampers occur behind or above finished portions of hard ceilings or walls, provide a worm gear actuator operated by rotary cable with standard hex drive end. Cable shall be terminated at ceiling or wall with recessed cup and ceiling cap or cover plate. Actuator shall be as manufactured by Metropolitan Air Technology or equal.
   c. Where dampers are located in accessible spaces, operators shall be locking type quadrant operators. Quadrant operators shall be installed on 1-1/2" high 4 bend galvanized steel bracket so that duct insulation may be extended and sealed under the quadrant operator.
   d. End of damper rod on each damper shall be grooved to show damper position.

2. Manual Volume Dampers shall be opposed blade multi-louver construction 16 gauge minimum with molded synthetic or stainless steel bearings, galvanized channel iron frame and maximum

blade width of 8 inches. Axles shall be positively locked into blades to prevent slippage or loosening. Damper blades shall be interlocking type with linkage and control shaft.

D. Rectangular branch take-off connections from mains shall be made using 45 degree entry fittings per SMACNA 1995 figure 2-6. Grille and register connections to mains shall be made using 45 degree entry fittings where space allows. Where diffuser, register or grille is located too close to the main, air deflectors shall be used. Air deflectors shall be factory fabricated. Adjustable deflectors shall be complete with worm gear operator when behind grilles, an extension rod and concealed regulator when above plaster ceilings, or self-locking lever type regulator when accessible.

E. Instrument Test Holes: Holes, with patches, in ducts and plenums shall be provided where directed or necessary for using pitot tubes for taking air measurements for balancing the air systems. At locations where ducts or plenums are insulated and on all medium and high pressure ductwork die cast collars with threaded neoprene caps shall be provided.

F. Apparatus Connections: At points where sheet metal connections are made to fans or where ducts of dissimilar metal are connected, provide a flexible connection of neoprene coated canvas of sufficient length to eliminate transmission of vibration. Flexible connections shall be securely fastened and air tight.

G. Duct Sleeves: All ducts shall have sleeved openings 1" larger than the overall duct dimensions framed in place when the wall is constructed and 1/4" larger when floors are poured. Space between duct or duct insulation and sleeve shall be tightly filled with mineral fiber rope insulation and sealed. All duct penetrations through corridor walls, floors not requiring fire dampers and walls indicated to be smoke partitions shall be sealed with U.L. approved firestopping sealant. In fire partitions or floors requiring fire dampers, the duct sleeve shall be sized to match the fire damper frame with all voids packed tight with mineral fiber rope. All penetrations through draftstop partitions shall be sealed to maintain the integrity of the partition. Flanges, constructed of 20 gauge galvanized sheet metal, not less than 3" wide, shall be installed at each opening in finished areas.

H. Spin-in collar [S] shall be 20 gauge galvanized steel, welded and riveted construction. Each fitting shall have conical bell-mouth duct fitting, locking groove, insulation guard, adjustable damper with 3/8" square shaft, u-bolt, nylon bushings, and standoff locking regulator (Rossi Everlock or equal).

I. All wire mesh, woven metal fabric, bird screens, and similar items shall be constructed from corrosion resistant, galvanized steel or aluminum.

2.3 AIR TERMINAL UNITS [S] [O/M]

A. Variable Volume Zone Damper System

1. General: Variable Volume System shall be Honeywell variable volume variable temperature system complete with all controls including thermostats, bypass dampers, bypass damper controllers, zone dampers, relay packages, transformers and all other miscellaneous devices to provide control indicated on drawings and interconnecting low voltage wiring for system control.
2. Bypass Dampers shall be as specified hereinafter for zone dampers.
3. Zone Dampers shall be constructed of spiral duct with 24 gauge galvanized steel control enclosure and 20 gauge galvanized steel elliptical damper blade with blade seal. Control enclosure shall be capable of housing the relay pack. Stepper motor shall be used to provide modulating control of damper. Relay and outputs shall be provided to control auxiliary heat in

each zone, where indicated on drawings. Each damper shall include a duct temperature sensor located on inlet side of damper.

4. Control panel shall be located as indicated on drawings. The control panel shall be complete with (electronic) timeclock (inputs) to control night set-back times and temperatures (based upon time scheduling from the DDC system specified in Section 23 09 00). Control panel shall coordinate all temperature demand requirements and initialize heating and cooling from the associated air conditioning unit. Monitorstat shall maintain all programmable settings indefinitely and maintain time for a minimum of 8 hours.
5. Thermostats shall be room temperature sensors to control the individual zone dampers and communicate heating and cooling requirements to the control panel.
6. Bypass controller shall be complete with remote mounted airflow sensor to be mounted in the supply air duct.
7. Power disconnect shall be provided for all transformers.
8. Edit Terminal: Terminal shall be provided for editing and monitoring of the system via and RS-232 port and cable at the control panel. Accessible information shall include system and damper status and reports.
9. Control: System shall control to modulate each zone damper to maintain individual room control. The thermostats shall communicate with the control panel to initiate heat or cooling 1st or 2nd stage dependent on demand through the relay pack. Controls for this portion of the system shall be carefully coordinated with the respective air conditioning unit controls specified in Section 23 70 00 to provide a total system.

2.4 AIR OUTLETS AND INLETS [S]:

A. Acceptable Manufacturers:

1. Standard Products: Metal Industries, Krueger, Tuttle and Bailey, Titus and Price.

B. General:

1. All devices shall be commercial grade and shall be constructed of aluminum.
2. Manufacturer shall certify cataloged performance and ensure correct application of each air device to provide air pattern, velocity, pressure drop and sound characteristics NC suitable for space installed. Shop drawings shall include air quantity, size, pressure drop, throw ft, and sound level NC.
3. All devices located in ceilings shall have white baked enamel finish. Devices at other locations shall have prime finish suitable for painting or anodized aluminum unless noted otherwise.
4. Maximum air outlet noise level shall not exceed NC35.
5. Provide sponge rubber seal around edges of all supply registers and grilles.

C. Diffusers:

1. Square ceiling diffusers shall be welded steel, removable core, louver face, square surface mounted type with 1/4” horizontal legs on all sides of inner core, complete with equalizing grid, volume control unit. Diffusers located at heights 9’-0” or more above the floor shall be without horizontal legs to allow air to be directed downward or shall be provided with adjustable vanes for down-discharge pattern.
2. Strip diffusers shall be extruded aluminum adjustable pattern, recessed type complete with volume control, mounting frames, mounting yokes, mounting strips and accessories.

D. Registers and Grilles:

1. Return and exhaust registers shall be aluminum, unless noted otherwise, complete with removable, reversible core and fixed horizontal or longitudinal deflecting vanes at not more than 1/3 inch centers. Provide 1 or 1-1/4 inch margin, 1/8 inch beveled frame or 3/16 to 1/4 inch curved frame with concealed screw holes. Damper shall be opposed blade face operated type with removable key. Units shall be provided with core removal tools which shall be turned over to the Owner. Units on watertight ducts shall be all polished stainless steel or aluminum with baked enamel finish, including damper, linkage, core and frame. Units on watertight duct shall have vanes at not more than 1/2 inch centers.
2. Grilles shall be as specified for registers except without opposed blade dampers.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Duct clearance and lengths shall be established from measurements taken at the job site before any ducts are fabricated.

B. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pitot tube openings where required for testing and balancing of system.

C. Locate ducts with sufficient space around equipment to allow normal passage, and operating and maintenance activity.

D. Locate all ductwork to align with the ceiling grid where connections are to be made to Diffusers, Registers and Grilles. Field verify exact grid location before installing ductwork.

E. Locate all Diffusers, Registers and Grilles as indicated on plans and in accordance with the Reflected Ceiling Plans, if provided.

F. Provide low loss factory fabricated fittings for all round take-off connections to low velocity rectangular ducts.

G. All Flex duct shall be properly supported to prevent any short radius bends or kinks. Connections to diffusers shall be made using long radius bends or elbows with turning vanes to ensure that airflow is distributed evenly across the neck of the diffuser. Conditions that create higher airflows in one quadrant of diffuser throw are not acceptable. Maximum flex duct runout length shall be 5 feet. Flex duct shall not penetrate wall construction of any type.

H. Install duct accessory items in accordance with manufacturers printed instructions.

I. Install volume, smoke and fire dampers where shown on plans.

J. Manual volume dampers shall be installed at all branch connections, divided flow branches, and end-of-run diffuser/register connections for low pressure supply, return, and exhaust duct systems. Manual volume dampers shall be installed within 3 feet of the main duct.

K. Provide access doors at all automatic dampers, fire/smoke dampers, duct heaters, duct mounted coils, thermostats and at all other points requiring inspection or servicing. Duct access doors for fire and

smoke dampers shall be permanently labeled with minimum 1/2 inch high letters reading FIRE DAMPER or SMOKE DAMPER. Labeling shall be as specified for equipment nameplates under Section 23 05 53.

L. Connection of horizontal ducts to rooftop exhaust fans shall be made using radiused elbows or mitered elbows with turning vanes. Duct transitions shall be as hereinbefore specified.

M. Ductwork installed or stored on site shall be protected such that open ends are covered to prevent construction dust and debris and other foreign matter from being introduced into the duct systems. If at any time during construction, dust or debris is discovered within the duct systems or ducts openings are observed to be unprotected, the Contractor will be responsible for properly cleaning all duct systems in accordance with NADCA procedures for the respective type of ductwork.

N. Grille, Register and Diffuser Installation:

1. Boots to diffusers shall fit airtight to diffuser necks and diffusers shall be securely fastened thereto.
2. Where grilles are installed at walls or ceilings, the duct shall be fastened securely to the masonry or panel at each side of the opening and the grille shall be securely fastened snug against the masonry or panel.
3. If flanged grille frames are used on exposed ducts, runout shall be same size as outside dimension of flange and full depth of register assembly.
4. Unless otherwise indicated in the Contract Documents, sidewall grilles and registers to be installed high shall be installed within 6 inches of the ceiling or nearest overhead projection. Unless otherwise indicated in the Contract Documents, sidewall registers and or grilles to be installed low shall be installed within 6 inches of the floor, but shall be coordinated with cove or base molding. Sidewall registers shall also be coordinated with the block coursing where applicable.
5. Air saddles shall be installed on the light fixtures at the time the light fixture is installed. Air passage knockouts in air handling light fixtures, shall be punched out as required. Cooperation with electrical trade is required.
6. Ceiling diffusers shall be installed in and coordinated with the ceiling tile or other ceiling units. Diffusers, Registers and Grilles shall be centered in each ceiling unit, unless shown otherwise. Mounting frames shall be installed as required to support diffusers, registers and grilles. Grilles, registers and diffusers shall not be supported from the ceiling system, conduit, piping or unrelated ductwork.

O. Patching: Where existing control, monitoring or other penetrating devices are removed from ductwork, the opening shall be patched to match thickness, type and finish of existing ductwork, and sealed airtight.

3.2 DUCT SCHEDULE:

A. All ductwork shall be fabricated, installed, sealed, and tested in accordance with the schedule below. All testing shall be in accordance with the latest edition of the SMACNA HVAC Air Duct Leakage Test Manual.

1. Testing shall be conducted and the results approved by the Architect/Engineer prior to the application of insulation.

2. The Architect/Engineer shall be notified one week prior to conducting the test. Unless specifically waived, the Engineer and Owner reserve the right to witness the test. Final, signed and dated test results shall be documented as outlined in SMACNA HVAC Air Duct Leakage Test Manual and submitted to the Architect/Engineer.

B. Supply Ductwork

1. Medium pressure (to include all ductwork upstream of VAV boxes):

   a. Pressure Class: Positive 6" w.g.
   b. Seal Class: A
   c. Leakage Class for Round Duct: 3
   d. Leakage Class for Rectangular Duct: 6
   e. Testing Requirement: 100%

2. Low pressure duct downstream of VAV boxes:

   a. Pressure Class: Positive 2" w.g.
   b. Seal Class: B
   c. Leakage Class for Round Duct: 12
   d. Leakage Class for Rectangular Duct: 12
   e. Testing Requirement: 25%

3. Low pressure duct connected to air handling units, energy recovery units, and rooftop air conditioning units/heat pumps in excess of 5 tons:

   a. Pressure Class: Positive 3" w.g.
   b. Seal Class: B
   c. Leakage Class for Round Duct: 6
   d. Leakage Class for Rectangular Duct: 6
   e. Testing Requirement: 25%

4. Low pressure duct connected to cabinet unit heaters, fan coil units, and heat pumps - 5 tons or less:

   a. Pressure Class: Positive 2" w.g.
   b. Seal Class: B
   c. Leakage Class for Round Duct: 12
   d. Leakage Class for Rectangular Duct: 12
   e. Testing Requirement: N/A

5. Ductwork connected to equipment not listed above:

   a. Pressure Class: Positive 2" w.g.
   b. Seal Class: B
   c. Leakage Class for Round Duct: 12
   d. Leakage Class for Rectangular Duct: 12
   e. Testing Requirement: N/A

C. Return Ductwork:

1. Ductwork located outdoors:

    a. Pressure Class: Negative 2" w.g.
    b. Seal Class: A
    c. Leakage Class for Round Duct: 6
    d. Leakage Class for Rectangular Duct: 6
    e. Testing Requirement: 100%

2. Ductwork located in unconditioned spaces or fully ducted systems located above ceiling:

    a. Pressure Class: Negative 2" w.g.
    b. Seal Class: B
    c. Leakage Class for Round Duct: 12
    d. Leakage Class for Rectangular Duct: 12
    e. Testing Requirement: 10%

3. Ductwork exposed in conditioned spaces or installed in ceiling return plenums:

    a. Pressure Class: Negative 2" w.g.
    b. Seal Class: C
    c. Leakage Class for Round Duct: 24
    d. Leakage Class for Rectangular Duct: 24
    e. Testing Requirement: N/A

4. Ductwork connected to cabinet unit heaters, fan coil units, or heat pumps – 5 tons or less:

    a. Pressure Class: Negative 2" w.g.
    b. Seal Class: B
    c. Leakage Class for Round Duct: 12
    d. Leakage Class for Rectangular Duct: 12
    e. Testing Requirement: N/A

5. Ductwork connected to equipment not listed above:

    a. Pressure Class: Negative 2" w.g.
    b. Seal Class: B
    c. Leakage Class for Round Duct: 12
    d. Leakage Class for Rectangular Duct: 12
    e. Testing Requirement: N/A

D. Exhaust Ductwork:

1. Negative pressure general exhaust:

    a. Pressure Class: Negative 2" w.g.
    b. Seal Class: B
    c. Leakage Class for Round Duct: 12
    d. Leakage Class for Rectangular Duct: 12
    e. Testing Requirement: N/A

2. Positive pressure general exhaust:

a. Pressure Class: Positive 2” w.g.
b. Seal Class: B
c. Leakage Class for Round Duct: 12
d. Leakage Class for Rectangular Duct: 12
e. Testing Requirement: 10%

3. Fume exhaust:

a. Pressure Class: Negative 6” w.g.
b. Seal Class: Welded
c. Leakage Class for Round Duct: 3
d. Leakage Class for Rectangular Duct: 3
e. Testing Requirement: 100%

4. Watertight and dishwasher hood exhaust:

a. Pressure Class: Negative 2” w.g.
b. Seal Class: Welded
c. Leakage Class for Round Duct: 3
d. Leakage Class for Rectangular Duct: 3
e. Testing Requirement: N/A

5. Grease Duct:

a. Pressure Class: Negative 2” w.g.
b. Seal Class: Welded
c. Leakage Class for Round Duct: 3
d. Leakage Class for Rectangular Duct: 3
e. Testing Requirement: 100% Light test (or other test approved by the Code Official in accordance with local and state codes).

3.3 FANS:

A. Coordinate roof opening and locations with structural system.

END OF SECTION 233000

SECTION 238000 - DECENTRALIZED HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY:

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

B. Work Included:

1. Split System Air Conditioning Units
2. Heating and Cooling Coils
3. Electric Wall Heaters
4. Miscellaneous Appurtenances

C. Related Sections:

1. Division 01 -- Commissioning
2. Section 23 00 10 – HVAC General Requirements
3. Section 23 01 00 – Operation and Maintenance of HVAC Systems
4. Section 23 05 00 – Common Work Results for HVAC
5. Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment
6. Section 23 05 53 – Identification for HVAC Piping and Equipment
7. Section 23 05 93 – Testing, Adjusting, and Balancing for HVAC
8. Section 23 20 00 – HVAC Piping and Pumps
9. Section 23 30 00 – HVAC Air Distribution

1.2 REFERENCES:

A. General: The following standards or codes form a part of this specification to the extent indicated by the reference thereto.

B. Air Moving and Conditioning Association, Inc. (AMCA):

Bulletin 210	Standard Test Code for Air Moving Devices

C. Air Conditioning and Refrigeration Institute (ARI):

Standard 210	Standard for Unitary Air Conditioning Equipment
Standard 240	Standard for Unitary Heat Pump
Standard 310	Standard for Packaged Terminal Air Conditioners
Standard 410	Standard for Forced Circulation Air Cooling and Heating Coils
Standard 440	Standard for Room Fan Coil Air Conditioners

D. American National Standards Institute (ANSI):

Standard B31.1	Code for Pressure Piping

E. American Society of Heating, Refrigeration and Air Conditioning Engineers (ANSI/ASHRAE):

Standard 15	Safety Code for Mechanical Refrigeration

F. National Fire Protection Association (NFPA):

Standard 90A	Air Conditioning and Ventilating Systems of other than Residence Type

G. National Electrical Manufacturers Association (NEMA)

H. Sheet Metal and Air Conditioning Contractors' Association (SMACNA)

Duct Construction Standards (Latest Edition)

I. Underwriters Laboratories, Inc. (UL)

1.3 EQUIPMENT LABEL:

A. All mechanical equipment and appliances shall be listed and labeled by a nationally recognized testing and inspection agency approved by the authority having jurisdiction. All equipment and appliances shall be installed in accordance with the conditions of the listing. Manufacturer's installation instructions shall be available at the job site at the time of inspection.

1.4 COMMISSIONING OF HVAC SYSTEMS:

A. The Contractor shall provide contact information to the Commissioning Agent indicated in Division 1 for all major items of Equipment.

B. Provide additional submittal copy of major equipment for Commissioning Agent specified in Division 1.

1.5 SUBMITTALS:

A. Submit shop drawings, product data and samples in accordance with Division 1 and Section 23 00 10.

B. Shop drawings, diagrams, catalog data and such other data necessary to fully describe and substantiate compliance with these specifications shall be submitted for all equipment and materials marked with notation set forth in Section 23 00 10.

C. Operation and maintenance data shall be submitted in accordance with Division1, for all items of equipment and materials marked with notation set forth in Section 23 01 00.

1.6 SPARE PARTS:

A. Each cooling or heating unit shall be provided with 3 sets of filters. At end of construction each unit shall be provided with a clean filter and one set shall be turned over to the Owner as spares.

B. Each belt driven piece of equipment shall be provided with one spare set of belts to be turned over to the Owner at the end of construction.

PART 2 - PRODUCTS

2.1 SPLIT SYSTEM AIR CONDITIONING UNITS [S] [O/M]:

A. General: Equipment and material specified under this heading shall be furnished and installed by a certified representative of Carrier or Trane. Each system shall consist of condensing unit, air unit, refrigerant piping and system controls. Each system shall conform with the applicable ARI Standard.

B. Condensing (outdoor) unit shall be complete with compressor-motor unit, condenser coil, welded-wire or stamped sheet metal condenser coil guards, condenser fans, motor starters, controls and piping enclosed in a sheet steel enclosure recommended for outside installation. Condenser fans shall be vertical or horizontal discharge as shown. Intake and discharge openings shall be provided with welded-wire or stamped sheet metal coil guards. Condensing unit controls shall provide automatic capacity modulation and condenser and evaporator pressure control for operation down to 0°F outside air temperature. Provide controls as required for enthalpy economizer. Crankcase heater shall be provided in compressor body. (Reduced voltage starter shall be provided on motors over 25 HP.)

C. Fan coil (indoor) unit shall be complete with cooling coils, heating coils, fans, fan motor and drive, filters, drain pan, controls and refrigerant piping enclosed in an insulated casing. Cooling coils shall be non-ferrous direct expansion type. Heating coils shall be (water) (steam) type as shown, non-ferrous, 125 psi service. Fan motor drive shall be adjustable, fully guarded. Filters shall be one inch thick pleated media. Provide thermal expansion valve and sight glass for each cooling coil circuit and liquid solenoid as required for compressor capacity control.

D. Refrigerant piping and specialties are specified in Section 23 20 00.

E. Controls for safe automatic controlled operation of each system (including hot gas bypass) shall be provided. Operation shall be as specified in Section 23 09 00. Provide thermostat to limit cooling coil discharge air to 45°F or above by cycling the compressor(s).

F. Refrigerant: Each system shall be cleaned, purged and completely charged with refrigerant and oil, and guaranteed to be free of leakage for one year.

G. Performance Test: Each system shall be tested and checked out for safe controlled operation. One week before final inspection, a letter in three copies from the certified representative shall be submitted to the Engineer certifying that each system is performing safely and satisfactorily.

H. Warranty: Motor-compressor shall be guaranteed for five (5) years.

I. See PART 1 for spare parts requirements.

2.2 DUCTLESS SPLIT SYSTEM AIR CONDITIONERS [S] [O/M]:

A. General: Equipment specified under this heading shall be manufactured by Mitsubishi, Daikin, Sanyo, or equal. Each system shall consist of condensing unit, air unit, refrigerant piping and system controls. Each system shall conform with the applicable ARI standards.

B. Condensing (outdoor) unit shall be complete with compressor-motor unit, condenser coil, welded-wire or stamped sheet metal condenser coil guards, condenser fans, motor starters, controls and piping enclosed in a sheet steel enclosure recommended for outside installation. Condenser fans shall be vertical or horizontal discharge. Intake and discharge opening shall be safely guarded. Condensing unit controls and accessories shall provide automatic capacity modulation and condenser and evaporator pressure control for operation down to 0°F outside air temperature. Crankcase heater shall be provided. Unit shall be supported in accordance with manufacturer's installation instruction.

C. Fan coil unit (indoor) shall be a wall mounted configuration complete with cooling coil. Fan motor and drive, filters, controls, refrigerant piping, insulated enclosure and guide vanes on air discharge. Cooling Coils shall be non-ferrous direct expansion type. Filters shall be manufacturer provided, permanent, washable filter which is user accessible. Provide capillary tube and sight glass for each cooling coil circuit.

D. Condensate pump shall be, in addition to manufacturer supplied unit, Sauermann Model # Si-3200. Pump shall be rated for minimum 3.3 GPH; 3.3 feet suction head; and 10 feet discharge head. Unit shall be provided with condensate drain pan safety switch to de-energize the unit upon accumulation of water in the drain pan.

E. Refrigerant piping and specialties shall be as specified in Section 23 20 00.

F. Controls for safe automatic controlled operation of the system (including low ambient controller, winter start control, evaporator freeze thermostat, crankcase heater, cycle protector, thermostatic expansion valve kit) shall be from wall mounted controller. All accessory controls shall be installed in accordance with manufacturer's recommendation.

G. Refrigerant: The piping system shall be completely charged with refrigerant and oil, and guaranteed to be free of leakages for one year.

H. Performance Test: The system shall be tested with a thoroughly cleaned filter and checked out for safe controlled operation. One week before final inspection, a letter in three copies from the certified representative shall be submitted to the Engineer certifying that the system is performing safely and satisfactorily.

I. Warranty: Motor-compressor shall be guaranteed for five (5) years.

J. See PART 1 for spare parts requirements.

K. Set rooftop condensing unit on roof mounted equipment supports. Supports shall be factory fabricated equipment mounting pedestals sized for the weight of the equipment indicated. Pedestals shall be minimum 12 inches high, complete with equipment rail, slide channel "U" shaped mounting brackets, 18 gauge threaded galvanized rods, lateral spacer bracket and galvanized slide assembly. Supports shall be located to adequately support duct with no more than 4 feet of duct unsupported.

L. Indoor unit shall be mounted maximum 6" below the ceiling.

2.3 HEATING AND COOLING COILS [S]:

A. General: This specification applies to all coils whether remote mounted, mounted in factory fabricated air handling units or mounted in site-built units and shall be used as a guideline to establish the minimum requirements unless definitely specified otherwise for the particular case involved.

B. Direct expansion (DX) refrigerant evaporator coils shall be full tube face, fin and tube type constructed of seamless copper tubes and aluminum fins mechanically bonded to tubes. Coil support frame shall be heavy gauge galvanized steel with heavy gauge flanges and support plates. Tubes shall be 1/2 inch or 5/8 inch diameter. Tube wall shall be minimum 0.020 inch thickness. Fins shall be minimum .0075 inch thickness. Tubes shall be staggered and circuited with equalizing distributing tubes to match the number of compressor refrigerant circuits provided. Coil circuiting shall be full face interlaced type where required for optimum capacity reduction. Units shall be provided with brass liquid distributors for each circuit. Coils shall be factory proof tested at 450 psig and leak tested at 300 psig, cleaned, dehydrated and sealed with dry nitrogen charge. Coils shall be coordinated with the manufacturer of the condensing unit for capacities indicated. Cooling coil ratings shall be certified in accordance with ARI Standard #410. Maximum cooling coil face velocity shall not exceed 550 feet per minute.

C. Electric coils shall be UL approved and shall be 80% nickel – 20% chromium bare wire heating elements, unless indicated otherwise, mounted in a frame and wired at the factory to an identified terminal strip enclosed in a metal box on one end of the coil. Heater frame shall be constructed for slip-in or flanged frame installation as applicable. Thermal cutout shall be provided to prevent the coil from overheating. (Magnetic contactor and fuse shall be provided for each step of control.) (Solid state silicone controlled rectifiers (SCR) shall be provided for fully modulating control.) Control voltage shall be suitable for control system indicated. Contactors and fuse block shall be UL approved and mounted and wired inside a steel cabinet for remote mounting with all wiring terminated at an identified terminal strip inside the cabinet. Provide air motion switch to prevent heater from operating unless there is proper air flow. Provide additional interlock connections as indicated in Section 23 09 00. An interlocking safety disconnect switch shall be provided in the terminal box door of each coil.

D. Heating and cooling coils in the same unit shall be provided as separate coils with independent fin sheets to allow preheat, dehumidification, and individual removal of each coil.

2.4 ELECTRIC WALL HEATERS [S] [O/M]:

A. Wall heaters shall be Markel Commercial down-flow model complete with enclosure, front panel, aluminum or corrosion resistant steel sheathed heating element, thermal limit switch, fan and fan motor and built-in disconnect switch and thermostat. All controls shall be concealed. Each unit shall be recessed type unless shown otherwise. Mount units nominal 12” above floor (except in toilets mount units nominal 6” below ceiling.)

2.5 MISCELLANEOUS APPURTENANCES [S] [O/M]:

A. Miscellaneous electric appurtenances such as transformers, solenoid valves, electric relays, selector switches, on-off switches, pilot lights and other similar items required by the electric sequence control diagrams and not shown to be provided by the Electrical Contractor shall be provided as part of the Mechanical Contract.

1. Solenoid valves shall be Asco or Alco of coil rating and size to accomplish the indicated requirement.
2. On-Off switches shall be toggle type, 20 amp. contract rating complete with engraved cover plate where required.
3. Selector switches shall be manual selector type with the indicated poles and contacts and engraved cover plate. Contact rating shall be a minimum of 20 amps.
4. Relays shall be G.E., Square D, or Cutler-Hammer 20 amp rating with sufficient contacts for the sequence indicated.

B. Thermostats [S] [O/M] shall be provided as indicated below. The use of thermostats containing mercury is not allowed.

1. Programmable Thermostats (s):

a. Programmable thermostats shall be Honeywell T7300A thermostat and a Q7300 subbase, or approved equal for (conventional heating/cooling) (heat pump) operation. The thermostat shall contain a keyboard for entering the times and temperatures along with a liquid crystal display for reading information. The thermostat shall contain a microprocessor that performs the calculations to control the system.
b. The T7300A thermostat shall contain a three hour override button, enabling programmed temperatures to be overridden from unoccupied mode to occupied mode.
c. The T7300A thermostat with Q7300 subbase shall provide a system that will control with system or fan switching and seven-day flexible programming with two occupied and two unoccupied periods per day for each of the seven days of the week. The system shall have individual setpoints for occupied heat and cool, and unoccupied heat and cool. System shall have auxiliary relay output for occupied/unoccupied control of auxiliary fans and dampers. System shall have capability to provide contact closures for two stages of output for heating and two stages of output for cooling.

C. Dampers and Damper Motors:

1. Automatic control dampers shall be opposed blade construction for modulating service and parallel blade construction for two-position service. Dampers shall be of the multi-louver construction with brass bearings, channel iron frame and maximum width of 10”. Damper blades shall be interlocking felt edged and air tight.
2. Damper motors shall be provided for all automatic dampers and shall be sufficient capacity to operate the connected damper. Damper motor shall be electric type.

PART 3 - EXECUTION

3.1 GENERAL:

A. All equipment and materials, specified herein or shown on the drawings shall be installed complete, coordinated with all other work, tested and made tight and put into safe controlled operation to perform its intended function as a part of this project.

B. All rooftop equipment shall be secured to the roof framing structure.

END OF SECTION 238000

SECTION 260500 – COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 WORK INCLUDED:

A. Every item of labor, material, devices and appurtenances for installing a complete Electrical System and other related systems included in Division 26 of the Specifications.

B. Section 26 05 00 – Common Work Results For Electrical

C. Section 26 05 19 – Low-Voltage Electrical Power Conductors and Cables

D. Section 26 05 23 – Control Voltage Electrical Power Cables

E. Section 26 05 26 – Grounding And Bonding For Electrical Systems

F. Section 26 05 33 – Raceway And Boxes For Electrical Systems

G. Section 26 05 36 – Cable Management For Electrical Systems

H. Section 26 05 43 – Underground Ducts And Raceways For Electrical Systems

I. Section 26 05 53 – Identification For Electrical Systems

J. Section 26 05 73 – Overcurrent Protective Device Coordination Study

K. Section 26 09 23 – Lighting Control Devices

L. Section 26 20 00 – Low-Voltage Electrical Distribution

M. Section 26 24 16 – Panelboards

N. Section 26 27 26 – Receptacles

O. Section 26 28 13 – Fuses

P. Section 26 28 16 – Enclosed Switches And Circuit Breakers

Q. Section 26 29 00 – Low-Voltage Controllers

R. Section 26 41 00 – Lightning Protection

S. Section 26 43 00 - Transient Voltage Suppression (TVSS)

T. Section 26 50 00 – Lighting

U. Section 26 60 13 - Electric Service

1.3 RELATED WORK:

A. General: See all other portions of these Contract Documents and apply to those portions of work, relating to Electrical Work, the same as if repeated herein in its entirety. The Division 26 Electrical Trade shall allow for wiring and controlling all equipment requiring electrical connections as described therein even though not shown on the electrical drawings. The Division 26 Electrical Trade shall provide and install all conduits, standard boxes and grounding for Divisions 27 and 28 Trades. Divisions 27 and 28 Trades shall provide all special boxes, cabinets and enclosures to Division 26 Electrical Contractor for installation. The Division 26 Electrical Contractor shall coordinate with Divisions 27 and 28 Trades for sizes and locations of conduits, boxes, cabinets and enclosures required by Divisions 27 and 28 Trades. The Division 26 Electrical Trade shall provide and install all conduits, standard boxes, cable trays, and grounding for Division 27 & 28 Trades.

B. Section 07 80 00 - Firestopping

C. Section 09 90 00 - Painting

D. Division 11 - Equipment

E. Division 23 – Mechanical

F. Division 22 – Plumbing

G. Division 27 – Communications

H. Division 28 – Electronic Safety and Security

I. Division 31 - Site Work

1.4 WORK NOT INCLUDED:

A. Certain electrical equipment will be provided in-place as specified under other Divisions of these Contract Documents and other pieces of equipment such as operating controls, etc., will be provided f.o.b. (freight on board) premises, which shall be mounted and connected to electrically under Division 26.

1.5 DRAWINGS:

A. Where conduit, equipment, devices and other electrical appurtenances are shown on the drawings, the general arrangement of such items on the electrical drawings shall be followed as closely as actual building construction and the work of other trades will permit. Because of the small scale of the electrical drawings, it is not feasible to indicate all offsets, fittings and accessories, which may be required. The Contractor shall investigate the construction conditions affecting the work and provide fittings and accessories as required to meet actual conditions.

1.6 QUALITY ASSURANCE:

A. Equipment and material used in the project shall be new and undamaged. The electrical installation shall fit into the space allotted and shall allow adequate, acceptable, clearances for entry, servicing, safety, and maintenance. The Contractor shall coordinate the work to ensure that the equipment may be moved into place without altering building components or other installations. All Electrical work shall be performed by a Commonwealth of Virginia Class-A licensed Electrical Contractor whose technicians, mechanics, or tradesmen shall be skilled in the trade involved. All electrical work shall be performed under the direct supervision of an electrician with a locally recognized and accepted master license.

B. Equipment and material in existing installations may be reused where specifically indicated on the drawings.

1.7 REFERENCES:

A. The complete installation and all materials and equipment under Division 26 shall conform to the Virginia Uniform Statewide Building Code, current issue, including all applicable portions of the National Electrical Code (NEC) and all other governing codes and regulations.

B. All equipment used shall bear the Underwriters Laboratory (U.L.) label for the intended application, or other organizations label if acceptable to the Authority having jurisdiction and concern with product evaluation.

C. In addition, the following codes, standards, and regulations shall apply to the complete installation and all materials and equipment. These are referred to by their accompanying abbreviations.

D.	National Electrical Code (NFPA 70) 2011	NEC
E.	National Electrical Manufacturers Association	NEMA
F.	Underwriters Laboratories, Inc.	UL
G.	Telecommunications Building Wiring Standards	TIA/EIA
H.	All Systems' Installation Certification Compliance Documents for Installing Trades	
I.	National Fire Protection Association	NFPA
J.	Uniform Federal Accessibility Standards	UFAS
K.	Americans with Disabilities Act Accessibility Guideline	ADAAG

L. The above standards are intended as a minimum and shall be exceeded if required by the Contract Documents. In the event information contained in the Contract Documents conflicts with one of the above mentioned codes, the codes shall take precedence.

1.8 PERMITS, LICENSES, TAXES AND INSPECTION CERTIFICATES:

A. All permits, bonds, licenses, electrical connection fees, inspection fees and taxes required for the execution of the work shall be obtained and paid for by the Contractor. Under each phase of the Electrical work the Contractor shall furnish three copies of certificates of final acceptance to the Engineer from any inspection authority having jurisdiction.

B. At the completion of the job, provide the Engineer with three (3) copies of an electrical inspection certificate from the local Electrical Inspector, if such inspection is provided and/or required by the locality.

1.9 REGULATIONS AND STANDARDS:

A. The completed installation and all materials and equipment shall conform to local ordinances and codes, other regulations and standards listed herein or in related sections. These are intended as a minimum and shall be exceeded if required by the specifications or Drawings. In the event of a conflict between the codes, standards, or regulations, and information contained in the Contract Documents, the applicable code, standard, or regulation shall take precedence.

1.10 SUBMITTALS:

A. Submit shop drawings, product data and samples in accordance with Division 1 for all items as specified in related sections of these specifications. One (1) electronic (PDF) copy of the submittal shall be submitted. One (1) electronic (PDF) copy of the submittal will be returned to the Contractor. If additional copies are required they will be the responsibility of the Contractor. Where drawings are submitted, the Contractor shall submit a minimum of two (2) sets of full scale prints. One (1) copy will be marked and returned to the Contractor, and the Contractor shall be responsible for all additional copies required for his use. All submittal data shall be correctly identified to show project name, and the exact model, style or size of item being submitted. Improperly identified submittals will not be reviewed by the Engineer. Each item submitted for review shall bear the Subcontractor's stamp which states that they have reviewed the submission, that it is complete, and that in their opinion it meets the contract requirements. Contractor's stamp shall identify the paragraph and page number for which the submittal is being made. Any submission which has not been reviewed and stamped by the Electrical Trade will not be reviewed by the Engineer. No reviews prior to award of Contract will be considered or accepted.

B. Shop drawings, samples, diagrams, catalog data and such other data necessary to fully describe and substantiate compliance with these contract documents shall be submitted as follows:

1. All the equipment and materials where submissions are specifically required by other Divisions of these Contract Documents.
2. All the equipment and materials that are indicated with an [S] behind the product title. This shall include submission of the specified products equipment and materials.
3. All the equipment and materials that are acceptable equal substitution.
4. If submission is NOT required for the SPECIFIED products "shop drawings and product data" under 1. and 2. above, the Contractor shall NOT submit a shop drawing for the SPECIFIED products.
5. Samples, in good working order, shall be submitted in accordance with Division 1, complete with all installation and service drawings and instructions. All samples will be returned at the submitter’s expense unless otherwise indicated. Samples may be subject to destructive testing by the Architect/Engineer.

C. Operation and Maintenance manual(s) shall be submitted in accordance with Division 1 and shall include a complete product index, a copy of all accepted shop drawings, installation and maintenance data, sequence of controls, parts lists, and the name, address and telephone number of supplier or nearest representative. All electrical devices, equipment and systems marked [O/M] in these specifications shall be included and all other such electrical items which will require servicing before the duration of its useful life has been reached. The manual(s) shall be presented to the Engineer for review and transmitted to the Owner before the final payment is recommended.

D. Equivalents: Manufacturers, trade names and model numbers indicated herein and on drawings shall be interpreted as establishing a standard of quality and shall not be construed as limiting competition. Unless definitely stated otherwise and upon complying with Division 1, the Contractor may use any article of equal appearance which, in his judgment is equal to that specified and is accepted by the Engineer. Where three or more manufacturers are named in the specifications for any item, the Contractor should use one of the manufacturers. No others shall be reviewed or accepted. Manufacturers listed first in these specifications and on drawings were used as a basis of design. It will be the responsibility of the Contractor to verify all connections, physical sizes and capacities of all other manufacturer's items, both items named herein, or items proposed. If the equipment necessitates changes in power distribution, conduit, wiring, lighting, ductwork, piping, or any other building systems from that indicated on the drawings, the Contractor shall be responsible for all additional costs included and notify other trades of the changes. Where such changes are required, detail drawings indicating all required changes shall be submitted for review at the same time the manufacturers drawings are submitted for approval. See Division 1 for substitutions.

E. The ten day prior approval requirements of The Instructions to Bidders, AIA 701, are waived for this Division of the Specifications, and unless stated otherwise the Contractor may use items that he deems as equivalent in quality and performance to the specified item subject to final acceptance of substituted items by the Engineer upon his review of shop drawings.

F. Guarantee: Electrical equipment, materials and labor required by these specifications and accompanying drawings shall be guaranteed to be free from defective materials or workmanship, including lamps, for a period of one year after final acceptance of the project except extended warranties as specified elsewhere in these documents on specific items of equipment will be furnished by the Trade providing the equipment. Defects in material or workmanship occurring during this period shall be corrected with new material and equipment or additional labor at no cost to the Owner. Manufacturer's certificates of warranty shall be transmitted to the Owner before final payment is recommended.

1.11 WARRANTIES:

A. The Contractor shall warrant for a period of one year all work provided under the Contract to include, but not necessarily limited to, all systems, equipment, materials, and workmanship. This shall not be construed to limit any extended warranty periods of longer than one year for specific items or systems specified elsewhere in the Contract Documents.

B. The warranty period shall commence on the date of acceptance by the Owner and shall cover all parts and labor as required to fulfill the warranty at no cost to the Owner.

C. Refer to Division 1 for additional warranty requirements.

D. Information on all warranties shall be included in the O&M Manuals specified herein to be provided to the Owner.

1.12 EXCAVATION AND BACKFILLING:

A. General: The Electrical Trade shall perform all excavations of every description and of whatever substances encountered, to the depths required for installation of his work. (No extras will be allowed for rock.) All excavated materials not required or suitable for backfill shall be removed and wasted as indicated on the drawings or as directed by the Engineer. OSHA approved shoring methods shall be provided as necessary to protect existing facilities, new work and the safety of personnel. Excavation shall be open cut except that

short sections of a trench may be tunneled if the conduit can be properly installed. Backfilling shall not commence until all tests have been performed and all utility systems conform to the contract documents. Refer to Section 26 05 43 for detailed specifications.

B. Protection of Existing Utilities: Existing utility lines to be retained, whether known or unknown and uncovered during excavation operations, shall be protected from damage during excavations and backfilling, and if damaged, shall be restored to original condition.

1.13 COORDINATION OF WORK:

A. General: The contract documents indicate the extent and general arrangement of the electrical systems. The Contractor shall be responsible for the coordination and proper relation of the electrical work to the building structure and to the work of other trades. No additional compensation or extension of completion time will be granted for extra work caused by the lack of coordination.

B. Cooperation: The Contractor shall provide dimensions and locations of all openings, shafts and similar items to the proper trades and install work as required so as not to interfere with, or delay, the building construction.

C. Locations of lines and equipment shall be determined from actual field measurements. The outlines of the building shown on the electrical drawings are intended only as a guide to indicate relative locations of the electrical work. Refer to architectural and structural drawings for building construction details. If conflicts prevent installation of electrical work at the locations indicated, minor deviations shall be made subject to acceptance by the Engineer, and without additional compensation.

D. Cutting and Patching: Unless stated otherwise, the Electrical Trade shall do all cutting necessary for the installation of his work. All work should be installed sufficiently in advance of new construction in order to permit installation of supports, sleeves, and similar items without cutting. Cutting which will in any way affect the building structure shall not be performed without permission of the Architect-Engineer. The Electrical Trade is responsible for patching where he does cutting. Patching shall be done to the satisfaction of the Architect-Engineer.

E. Roughing-In: Receptacles, switches, and other similar items shall align vertically or horizontally with each other, hose bibbs, thermostats, the building structure and features thereof when it appears obvious and logical that they should. All mounting heights shall be within the limits of Commonwealth of Virginia USBC and ADAAG.

F. Damage to Other Work: The Electrical Trade is responsible for damage to other work caused by his work or workmen. Repairing of damaged work shall be done by the Trade who installed the work, and as directed by the Architect-Engineer; the cost of which shall be paid for by the Electrical Trade.

1.14 ASBESTOS:

A. Asbestos Free Materials: The intention of these drawings and specifications is that there be no asbestos containing materials installed on this project. To the best of the Architects' and Engineers' knowledge, none of the material or equipment specified herein or shown on the drawings contains asbestos. The Contractor shall make every effort to prevent any asbestos materials from being installed in or used on the construction of the project. At the completion of the project, the Contractor shall certify by letter that to the best of his knowledge, no asbestos containing materials were used for or in the construction of this project.

B. Existing Materials:

1. Discovery: If during the construction of this project, work involving friable asbestos is suspected, or encountered, all work in this area shall be discontinued and the Owner or the Owner's representative, shall be notified immediately and the Owner with his own forces or by separate contract shall be responsible for complete investigation, removal, and disposition of the friable asbestos hazard in accordance with applicable laws and regulations. If the Contractor claims that delay or additional cost is involved because of such action by the Owner, he shall make such claim as provided elsewhere in the contract documents.
2. Removal: All work involving the removal of friable asbestos will be done under a separate contract.

1.15 GRAPHICS DATABASE:

A. This project's Computer Aided Design & Drafting (CADD) drawing files may be purchased directly from the Engineer for use in preparing computer graphics specific to this project. See Appendix A at the end of this Section for Letter of Indemnification and ordering instructions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS AND MATERIALS:

A. General: Manufacturers and materials shall be as specified in subsequent sections of these specifications and as noted on the drawings. Similar types of equipment shall be the products of the same manufacturer unless specified otherwise.

2.2 SLEEVES AND INSERTS:

A. General: Sleeves and inserts shall be provided and correctly located in the structure, as required for the work.

B. Inserts shall be steel and of proper size for loads encountered.

2.3 ACCESS DOORS:

A. Provide for all junction boxes or any item requiring access. Doors shall be of sufficient size and so located that the concealed items may be serviced or completely removed and replaced. Doors required for work shall be furnished as a part of this Division to the General Contractor for installation. Doors in acoustic tile ceilings shall be furnished in multiples of tile sizes. Doors are not required in exposed grid type ceilings where tiles are removable. Doors shall be metal access doors with cam lock, style to match ceiling or wall construction. Doors occurring in rated construction shall be fire rated U.L. labeled access doors correlated to preserve the integrity of the rated construction. Doors shall be prime finish steel except those in toilets, shower rooms, locker rooms, kitchens and other similar areas shall be aluminum with natural anodized finish. Doors shall match the access doors in Division 23 and meet the acceptance of the Architect.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. General: Materials and equipment shall be installed in accordance with manufacturer's instructions to conform to the details and application as specified in subsequent sections of these specifications and indicated on the drawings.

B. Supports: Provide necessary supports for all equipment and appurtenances as required; this includes, but is not limited to, frames or supports for items such as, lighting fixtures, disconnect switches, junction boxes, conduit, motor starters, outlet boxes, and other similar items requiring supports. Floor mounted equipment in Equipment Rooms shall be set on 4-inch high concrete foundation pads unless shown otherwise. All concrete pads shall have 1” chamfered corners and edges. Foundation drawings, bolt setting information and foundation bolts shall be furnished by the subcontractors furnishing the equipment that is required to have concrete foundations. Concrete for foundations shall be provided by the Electrical Trade and in accordance with Division 03 - Concrete Work, unless noted otherwise.

C. Sleeves: Provide sleeves for all conduits passing through concrete or masonry walls, partitions, concrete slabs or beams installed during construction of the wall, partition, slab or beam. Sleeves placed horizontally in walls or in any position in beams shall be standard weight ASTM A53 steel pipe of length equal to the thickness of the wall or beam. Those placed vertically in non-waterproof floors shall be 20 gauge galvanized sheet steel of length equal to the thickness of the slab, flared and nailed to the form, or fastened to reinforcing fabric and filled with sand during pouring to prevent deformation. Sleeves occurring in floors of rooms where hose bibbs or floor drains provided under Division 21 occur, and in pipe spaces, shall be standard weight steel pipe projecting 1/2" above finished floor except in Equipment Rooms they shall project four (4) inches above finished floor. Sleeves in floors with waterproof membrane shall be provided with flanges or flashing rings and shall be clamped or flashed into the membrane. All sleeves shall be of sufficient diameter to allow installation of conduit except sleeves on lines subject to movement, which shall clear the conduit at least one inch all around. Conduits through exterior walls, or floors, below grade shall have seals specified in Section 26 05 43 between the conduit and wall sleeve. Sleeve shall have anchor and water stop plate. The entire assembly shall be tightened and adjusted to make watertight. Sleeves for insulated wiring and conduit, penetrating fire (and smoke) rated partitions, walls and floors shall have seals as specified in Section 26 05 43 and shall be sealed in accordance with the terms of U.L. Listed Through-Penetration Firestop Systems (XHEZ) as published in the U.L. Fire Resistance Directory. Penetrations shall exactly conform to details of the Firestop System indicated for the type of partition, wall and floor construction encountered. All penetrations through nonfireresistance rated floor assemblies and through the ceiling membrane of nonfireresistance rated roof assemblies shall be fireblocked with tightly packed mineral-wool insulation secured in place. All penetrations through equipment room walls and other areas of noise or heat generation shall be tightly sealed with mineral fiber rope. All penetrations through draftstop partitions shall be sealed to maintain the integrity of the partition. All firestopping of sleeves for electrical work shall be provided under Division 26.

D. Temporary Requirements: Openings in equipment shall be kept capped at all times until connection is made to the system. The ends of all conduits and equipment openings shall be kept capped properly with approved devices. Approved devices are items such as specially molded plastic caps and sheet metal caps.

E. Access Doors: Provide access doors for all concealed electric equipment, pull boxes, junction boxes or any item requiring access. Doors shall be of sufficient size and so located that the concealed items may be serviced or completely removed and replaced. Doors required for Electrical work shall be furnished by the

Electrical Trade, to the Contractor for installation. Doors in acoustic tile ceilings shall be furnished in multiples of tile sizes. Doors are not required in exposed grid type ceilings where tiles are removable.

F. Painting: All work under this Division shall be painted in accordance with Section 26 05 53, Identification for Electrical Systems. Division 26 shall also paint and identify all conduits and boxes for Divisions 27 & 28 as described in Section 26 05 53.

3.2 EXISTING WORK AND DEMOLITION:

A. Electrical Demolition: Remove all existing electrical conduits, wiring, junction boxes, outlets, lighting fixtures, wiring devices, unused panelboards, etc., indicated for demolition. Additional amounts of demolition may be required to accommodate desired renovations and new construction. Not all demolition may be shown on the drawings. All existing electrical equipment not indicated for demolition shall remain in place.

B. Equipment and Fixtures Removed: The Owner will select and retain such existing electrical equipment and materials which are indicated to be removed and not reused, as he desires. All other existing equipment and materials indicated to be removed, and not reused shall become the property of the Contractor, who shall remove them from the premises within the time frame specified under other Divisions of this Contract Document.

C. Equipment and Fixtures Relocated: All existing lighting fixtures, panelboards and other electrical equipment and materials indicated to be relocated shall be disconnected, removed, and relocated. All electrical equipment and materials shall be protected from damage during demolition. Install new phase, neutral and grounding conductors, if grounding conductor is not already present, in each feeder and branch circuit to be reworked, from the panelboard to the outlet.

D. Power Interruption: Attention is called to the fact that the existing facility shall remain in operation throughout the construction period. All necessary temporary arrangements shall be made as required to keep all electrical circuits in continuous operation during this period except for scheduled outages for circuit change-overs. The outage shall be kept to the minimum and carefully scheduled to suit the Owner.

E. Mechanical Equipment: All existing mechanical equipment being removed or relocated under this contract shall be disconnected electrically, both power and control wise, so that the Mechanical Trade can remove or relocate same.

F. Miscellaneous: In all altered portions of the buildings, the Electrical Trade shall remove or alter as necessary all existing electrical work that does not fit with the new construction. All existing work or areas that are not altered shall be reconnected as required. Where indicated changes to non-electrical facilities require minor electrical changes, these changes shall be accomplished even if not specifically indicated. Only a small portion of the existing work is shown on the drawings. Contractors submitting proposals shall visit the site to determine the scope of work under this heading as no additional compensation will be granted because of existing conditions even though the existing conditions may not be indicated on the drawings. Contractor shall thoroughly inspect the electrical systems in reworked areas and bring to the attention of the Engineer all defective or unserviceable material not scheduled for removal or replacement. Demolition shall not begin until the work schedule is approved by the Owner. The work shall be scheduled to prevent any disruption to the normal operations of the building. Refer to other Divisions for work phasing.

3.3 FIELD QUALITY CONTROL:

A. System Readings: Certain system voltage and current readings shall be taken, the values recorded and submitted in triplicate to the Engineer. Two complete sets of readings are required, one under no load and one under maximum available load. The current and voltage shall be recorded on each phase (plus voltage between all phases) at main panelboard and at each branch circuit panelboard. Additional spot readings shall be made if required. Resistance of grounding system shall be tested and recorded. Forms for submitting this report may be obtained from the Engineer's office. A sample form is bound herewith.

B. Equipment Readings: Voltage and amperage readings on each phase of each motor circuit and each resistance heater circuit installed under this contract shall be measured, the values recorded, and submitted in triplicate to the Engineer. Also record motor nameplate data, actual motor heater protective device ratings and all other data necessary for selection of heater device.

C. Verification [V]: Upon completion of the project, the Contractor shall submit a separate letter of certification (or compliance) to the Owner/Architect/ Engineer that each of the following systems or equipment functions properly, conforms to all requirements of these specifications and all requirements of the manufacturer of the systems.

1. Section 26 50 00, Lighting.
2. Section 26 20 00, Low Voltage Electrical Distribution

3.4 MANUFACTURER'S ASSISTANCE:

A. Qualified technical representatives of manufacturers shall be available to visit the project and provide required assistance for any problems or trouble areas of any systems, material or equipment used in the project. Manufacturer's engineering assistance shall also be available for above problems or trouble areas. The Contractor shall purchase all materials, equipment or systems with these services included in the purchase price or otherwise be prepared to have the above service provided when needed or requested by the Engineer without additional compensation. Where one manufacturer's equipment constitutes the majority of the components or devices to make a system, the manufacturer's technically qualified representative shall inspect and accept the completed installation whether or not especially requested by the Engineer.

3.5 INSTRUCTION OF OWNER'S REPRESENTATIVE:

A. The Electrical Trade shall instruct the representative of the Owner in the proper operation and maintenance of all elements of the Electrical systems. Competent representatives of the Contractor shall spend such time as necessary to fully prepare the Owner to operate and maintain the Electrical systems.

3.6 CONSTRUCTION STATUS REPORT:

A. Each item of discrepancies noted on Construction Status Report prepared by the Engineer shall be answered in detail in writing by the Contractor before payment can be recommended.

3.7 RECORD OF UNDERGROUND LINES:

A. On completion of the project, the Contractor shall prepare and submit to the Architect-Engineer a drawing on tracing paper and one full-size print to show the location of any underground lines installed in locations different from those on the Architect-Engineer's drawings. The location and the distance from the building to outside lines and manholes shall be dimensioned.

3.8 SCHEDULE OF ABBREVIATIONS:

Electrical Abbreviations:

A	-	AMP
ABV	-	ABOVE
AC	-	AIR CONDITIONING OR ARMOR CLAD
ACB	-	AIR CIRCUIT BREAKER
ACI	-	AMERICAN CONCRETE INSTITUTE
ACS	-	ABOVE COUNTER SPLASHBACK
ADAAG	-	AMERICANS WITH DISABILITIES ACT
AEIC	-	ASSOC OF EDISON ILLUMINATING CO'S.
AFF	-	ABOVE FINISHED FLOOR
ANSI	-	AMERICAN NATIONAL STANDARDS INSTITUTE
ASME	-	AMERICAN SOCIETY OF MECHANICAL ENG.
ASTM	-	AMERICAN SOCIETY FOR TESTING AND MATERIALS
ATS	-	AUTOMATIC TRANSFER SWITCH
AUTO	-	AUTOMATIC
AUX	-	AUXILIARY
BALL	-	BUILDING ACOUSTICS AND LIGHTING LABS
BAT	-	BATTERY
BIL	-	BASIC INSULATION LEVEL
BOCA	-	BUILDING OFFICIALS AND CODE ADMIN.
BRK	-	BREAKER
CAP	-	CAPACITORS
CABO/MEC	-	COUNCIL OF AMER. BLDG. OFFICIALS MDL
CB	-	CIRCUIT BREAKER (CRT BRK)
CBM	-	CERTIFIED BALLAST MANUFACTURERS
CCCT	-	CROSS CURRENT COMPENSATION TRANSFORMER
CF	-	COIL FAN
CMU	-	CONCRETE MASONRY UNIT
CND	-	CONDUIT (COND)
CNDCT	-	CONDUCTOR
COMB	-	COMBINATION
CONC	-	CONCRETE
CONTR	-	CONTRACTOR
CPT	-	NEUTRAL GROUNDING TRANSFORMER
CRT	-	CIRCUIT
CS	-	CORNER SECTION
CT	-	CURRENT TRANSFORMER
CUH	-	CABINET UNIT HEATER
CW	-	COLD WATER
DB	-	DOORBELL
DF	-	DRINKING FOUNTAIN
DH	-	DOOR HOLDER
DISC SW	-	DISCONNECT SWITCH (D.S.)
DO	-	DRAW OUT
DP	-	DOUBLE POLE
DT	-	DOUBLE THROW
DW	-	DISHWASHER
E	-	EXISTING (EXST)
EA	-	EACH
EC	-	ELECTRIC CONVECTOR
EEI	-	EDISON ELECT. INST.
EGC	-	EQUIPMENT GROUNDING CONDUCTOR
EIA	-	ELECTRONIC INDUSTRIES ASSOC.
ELEC	-	ELECTRIC
EMER	-	EMERGENCY (EM)
EMT	-	ELECTRICAL METALLIC TUBING
EN	-	EXISTING OUTLET WITH A NEW DEVICE AND WIRING
ENG	-	ENGINE
EO	-	EXISTING OUTLET
EQUIP	-	EQUIPMENT
EP	-	EXPLOSION-PROOF
EP SW	-	ELECTRO- PNEUMATIC SWITCH
ER	-	EXISTING RELOCATED
ERL	-	ENVIRONMENTAL RESEARCH LABS
ESC	-	ELECTRIC SEQUENCE CONTROLS
ETL	-	ELECTRICAL TESTING LAB
EWC	-	ELECTRIC WATER COOLER
EXP	-	EXPANSION
FA	-	FIRE ALARM
FIN FL	-	FINISHED FLOOR
FIXT	-	FIXTURE
FL	-	FLOOR
FLA	-	FULL LOAD AMPS
FLUOR	-	FLUORESCENT
FS	-	FILLER SECTION
FU	-	FUSE
GBM	-	GROUND BUS MODULE
GEC	-	GROUNDING ELECTRODE CONDUCTOR
GEN	-	GENERATOR
GF	-	GROUND FAULT
GND	-	GROUND
GRS	-	GALVANIZED RIGID STEEL CONDUIT
HOA	-	HAND-OFF-AUTOMATIC
HP	-	HORSEPOWER
HPS	-	HIGH PRESSURE SODIUM
HV	-	HIGH VOLTAGE
HW	-	HOT WATER
HZ	-	HERTZ
IB	-	IN BASEBOARD
IBS	-	IN BASE OF SHELVES
ICEA	-	INSULATED CABLE ENGINEERS ASSOCIATION
ICL	-	IN COUNTER LIP
ICS	-	IN COUNTER SPLASHBACK
IEEE	-	INSTITUTE OF ELECTRICAL AND ELECTRONICS ENG'S
IGC	-	ISOLATED GROUNDING CONDUCTOR
IMC	-	INTERMEDIATE METAL CONDUIT
INCAND	-	INCANDESCENT
INTLK	-	INTERLOCK
ITL	-	INDEPENDENT TESTING LABORATORIES
JB	-	JUNCTION BOX
KV	-	KILOVOLTS
KVA	-	KILOVOLTS-AMPS
KVARS	-	KILOVAR
KW	-	KILOWATT
LA	-	LIGHTNING ARRESTOR
LV	-	LOW VOLTAGE
MAX	-	MAXIMUM
MC	-	METAL CLAD
MDH	-	MAGNETIC DOOR HOLDER
MECH	-	MECHANICAL
MFG	-	MANUFACTURER
MIN	-	MINIMUM
MH	-	MANHOLE
MO	-	MOTOR OPERATED
MOD	-	MOTOR OPERATED DAMPER
MP	-	MAIN PANEL
MP SW	-	MOTOR PROTECTIVE SWITCH
MS	-	MOTOR STARTER
MTD	-	MOUNTED
MTS	-	MANUAL TRANSFER SWITCH
MW	-	MEGAWATTS
NC	-	NORMALLY CLOSED
NCS	-	NURSES CALL SYSTEM
ND	-	NEW DEVICE IN EXISTING OUTLET
NEC	-	NATIONAL ELECTRIC CODE
NEMA	-	NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION
NESC	-	NATIONAL ELECTRICAL SAFETY CODE
NFPA	-	NATIONAL FIRE PROTECTION ASSOC
NIC	-	NOT IN CONTRACT
NEUT	-	NEUTRAL
NO	-	NORMALLY OPEN
OCB	-	OIL CIRCUIT BREAKER
OPR	-	OPERATED
OS	-	OIL SWITCH
OSHA	-	OCCUPATIONAL SAFETY & HEALTH ACT
P	-	POLE
PA	-	PUBLIC ADDRESS
PB	-	PULLBOX
PC	-	PHOTOCELL (PEC)
PD	-	PLUG DUCT
PE	-	PNEUMATIC ELECTRIC
PM	-	PLUG MOLD
PNL	-	PANEL
PS	-	PLUG STRIP
PT	-	POTENTIAL TRANSFORMER
PW	-	PART WINDING (MOTOR STARTER)
PWR	-	POWER
R	-	REMOVE
RR	-	REMOVE & REINSTALL
R&C	-	REMOVE DEVICE & CAP OUTLET
REC	-	RECEPTACLE
RHC	-	RE-HEAT COIL
RLY	-	RELAY
SEC	-	SECONDARY
SGA	-	SURGICAL GAS ALARM
S/N	-	SOLID NEUTRAL
S/O	-	SPACE ONLY
SP	-	SINGLE POLE
ST	-	SINGLE THROW
SURF	-	SURFACE
SUSP	-	SUSPENDED
SW	-	SWITCH
SYNCH	-	SYNCHRONIZE
TC	-	TIME CLOCK
TEL	-	TELEPHONE
TIA	-	TELE-COMMUNICATIONS INDUSTRY ASSOC
TRANS	-	TRANSFORMER (XFMR)
TYP	-	TYPICAL
UCL	-	UNDER COUNTER LIP
UFAS	-	UNIFORM FEDERAL ACCESSIBILITY STANDARDS
UH	-	UNIT HEATER
UL	-	UNDERWRITERS LAB
UV	-	UNIT VENTILATOR
V	-	VOLT
VDOT	-	VIRGINIA DEPARTMENT OF TRANSPORTATION
W	-	WATTS
WH	-	WALL HEATER
WM	-	WIRE MOLD
WP	-	WEATHERPROOF
Y	-	WYE
ι	-	PHASE

END OF SECTION 260500

ELECTRICAL TEST DATA REPORT

ASCENT ENGINEERING GROUP, INC.
4932 FRONTAGE ROAD NW
ROANOKE, VA 24019

PROJECT: _____
_____
_____
_____

Electrical Contractor: _____
Date tests were made: _____ Date Submitted: _____

Current Characteristics: _____Volts _____ Phase _____ Wires

Type voltmeter used: _____ When calibrated:_____
Type ammeter used: _____ When calibrated:_____

Service ground - Resistance in ohms _____
Resistance test must be made with hand crank, magneto type, megger.

PANEL	VOLTAGE - NO LOAD		VOLTAGE - MAX. LOAD		MAX. LOAD AMPERAGE			
	PH TO PHASE	PHASE TO GND	PHASE TO PHASE	PH - GND	PH A	PH B	PH C	NEUT

PROJECT:

CONTRACTORS:

GEN.:

MECH.:

ELEC.:

DATE:

MOTOR OVERLOAD PROTECTION

REQUIRED ON ALL PHASES
(SEE N.E.C. SECT. 430 FOR
MAX. PERCENT ALLOWABLE)

NOTES:

1. IDENTIFY EACH MOTOR THUS: CWP-1, H&V-1, F-1, ETC. SAME AS SHOWN ON DWGS.
2. SMALL MOTORS MAY BE RATED THUS: HP, WATTS OR FLA.
3. ALL DATA BY ELECTRICAL CONTRACTOR.
4. SERVICE FACTOR -- IF NOT AVAILABLE ENTER DEGREE C. RISE.
5. MOTOR CONTROLLER TYPE -- FVNR, RVPW, 2-SPD/1W, 2-SPD/2W, Y/Δ, MANUAL, ETC.
6. MOTOR PROTECTION -- INCLUDE COPIES OF HEATER TABLES WITH THIS REPORT.

EQUIP. MARK (1)	MOTOR DATA						MOTOR CONTROLLER		N.E.C.	MOTOR PROTECTION (6)		
	HP (2)	VOLTS	PHASE	N'PLATE AMPS	SERVICE FACTOR (4)	RUN AMPS*	TYPE (5)	NEMA SIZE	MAX. % ALLOWED	MIN. & MAX. AMPS	HEATER NO.	MFGR.

*AS MEASURED WITH AMMETER AT SITE.

APPENDIX A
LETTER OF INDEMNIFICATION

Project Name:

Project Location:

The contractor may purchase from Ascent Engineering Group, Inc. a CD-ROM or electronic mail version of the projects CADD database. The minimum fee on any request is $250.00, subject to receiving a signed Letter of Indemnification. There is an additional charge of $10.00 per sheet on projects greater than 20 sheets. Drawing files will consist of floor plan views only, of Electrical plan sheets. All seals, details, schematics, tables, controls, etc. will be deleted. All drawings will be provided in Autocad™ 2010 format. Payment shall be returned with a signed copy of the Letter of Indemnification. Payment shall be received before shipment or transfer of data.

Ascent Engineering Group, Inc. reserves all rights to the original drawing files.

The Purchaser agrees, to the fullest extent permitted by the law, to hold harmless and indemnify Ascent Engineering Group, Inc. and the Architect, as defined in the Bid Documents, from and against all claims, liabilities, losses, damages, and costs, including but not limited to attorney's fees, arising out of or in any way connected with the use, modification, misinterpretation, misuse, or reuse by the Purchaser or others of the machine readable information and data provided by Ascent Engineering Group, Inc. under this Agreement. The foregoing indemnification applies, without limitation, to any use of the project documentation on other projects, for additions to this project, or for completion of this project by others, excepting only such use as may be authorized, in writing, by Ascent Engineering Group, Inc.

The electronic drawing files are not part of the Contract Documents for the Project. The Purchaser assumes all risks associated with the use of the transmitted files. Ascent Engineering Group, Inc. will not be responsible for any differences in the information included in the transmitted files and the information shown on the Contract Documents. Modifications to the Contract Documents made before or during construction may or may not be included in the transmitted electronic drawing files.

The Purchaser further agrees that the drawing files will only be used in graphics preparation for the above-referenced project.

Company Name of Purchaser: _____

Purchaser's Designated Representative: _____

Title: _____

Signature: _____

Address: _____

Return to: Ascent Engineering Group, Inc.
4932 Frontage Road, NW
Roanoke, VA 24019
AEG # 16080

SECTION 260519 – LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL:

1.1 RELATED DOCUMENTS:

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

1.2 WORK INCLUDED:

A. Wires and Cables, Under 600 Volts.

B. Connectors and Lugs, Under 600 Volts

1.3 RELATED WORK:

A. Division 23 – Mechanical

B. Section 26 05 26 – Grounding And Bonding For Electrical Systems

C. Section 26 05 33 – Raceway And Boxes For Electrical Systems

D. Section 26 05 36 – Cable Management For Electrical Systems

E. Section 26 05 53 – Identification For Electrical Systems

F. Section 26 20 00 – Low-Voltage Electrical Distribution

G. Division 27 – Communications

H. Division 28 – Electronic Safety and Security

1.4 REFERENCES:

A. All wire, cables, connectors and lugs shall be U.L. listed for the application intended, and meet NEMA applicable standards.

B. All wiring methods shall meet with NFPA applicable codes.

1.5 CONDUCTOR CODING: (240/120-Volt)

A. Color Code Conductors of 240/120-volt system power and lighting conductors as follows:

Neutral	White
Ground	Green

Phase A	Black
Phase B	Red

B. No. 12 and No. 10 conductors shall have continuous insulation color. Color code conductors larger than No. 10 which do not have continuous insulation color by application of at least two laps of colored tape on each conductor at all points of access. Tape shall be “Scotch,” “Highland,” or “Timflex,” vinyl plastic electrical tape No. 35, or accepted equal. Wrap-around "Brady" markers or shrinkable PVC sleeving with hot-stamped lettering may be used and shall state the appropriate conductor identification.

C. Number code all control and instrumentation wiring at all points of access.

1.6 CONDUCTOR SIZES:

A. All conductor sizes (AWG) are based on copper. (See Section 2.02A.1 for provisions to utilize aluminum building wiring – Spec Writer to decide whether or not to permit aluminum feeder conductors)

1.7 SUBMITTALS:

A. Submit shop drawings and product data in accordance with Section 26 05 00.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. All wires and cables shall be as manufactured by General Cable, Capital Wire & Cable, Carol Cable, American Insulated Wire, Southwire, Senator, Rome, Cerro Wire and Cable, Circle Wire & Cable.

B. All connectors and lugs shall be as manufactured by T & B, Buchanan, 3M, Burndy, or accepted equal.

2.2 MATERIALS AND TYPE:

A. Wiring, Power and Control:

1. General:

   a. Conductors shall be **soft annealed copper** unless otherwise indicated.
   b. All conductors #8 AWG or larger shall be stranded (except in surface raceway SR, all conductors shall be stranded).
   c. All power wiring shall be #12 AWG minimum unless otherwise indicated.
   d. All control wiring shall be #14 AWG minimum for NEC Class I and #16 AWG minimum for NEC Class II, **extra fine stranding.**
   e. All insulation shall be rated for 600 volts unless otherwise indicated.

2. Building Wiring: Conductors shall be type "THWN" or "THHN" unless otherwise indicated. "THHN" shall not be used in damp or wet locations.
3. Underground Wiring (Refer to Part-3 for limitations):

a. #12 AWG through #6 AWG: Conductors shall be type UF copper cable with heat and moisture-resistant insulation, suitable for branch-circuit wiring. The cable shall have an insulated equipment grounding conductor. The overall covering shall be flame-retardant; moisture, fungus, and corrosion resistant; and shall be limited to use within the pole standard.
b. #12 AWG through 500 kcmil (MCM) AWG: Conductors shall be type RHH/USE/RHW stranded copper with Durasheath cross-linked polyethylene, thermosetting XLPE that is heat, fungus and moisture resistant.
c. #12 AWG through 500 kcmil (MCM) AWG: Conductors shall be type XHHW-2 stranded copper cable with cross-linked polyethylene, thermosetting XLPE that is chemical and oil resistant, and suitable for wet or dry locations.

4. Flexible Metal Conduit (Liquidtight) Connections and Motor Starter Enclosures: Power and line voltage control wiring Type MTW stranded copper unless otherwise indicated for all motor connections, HVAC equipment, transformers, all other equipment subject to movement and vibration, and motor starter enclosures.
5. Flexible Cable:

a. Shall be hard service cord, type "SO" with equipment ground conductor in addition to normal current carrying conductors, and "safety-yellow" jacket.
b. Connectors shall be Crouse-Hinds series CG, Appleton, Kellems, O.Z./Gedney, Raco, or T & B, complete with locknut, sealing gasket, gland nut and tapered neoprene bushing.
c. In hazardous areas, connectors shall be Crouse-Hinds CGBS.

B. Motor Connections:

1. Connection lugs shall be Thomas and Betts, Series 54200.
2. Insulation shall be motor stub splice insulators, Thomas and Betts, Series MSC, or Raychem MCK.

C. Connectors and Lugs, 600 Volts and Under:

1. Material: Copper, or suitable copper alloy, for all current carrying parts and all parts coming in contact with conductors.
2. Connectors and Lugs, No. 8 and Larger Conductors: Compression type T & B "Color-Keyed", or accepted equal by Burndy or Kearney. Mechanical compression lugs furnished with equipment are acceptable. Provide insulating covers or heat shrinkable insulators where required.
3. Connectors, No. 10 and Smaller Conductors: Permanently indented self-insulated pressure connectors T & B, Buchanan, or accepted equal. Snap-on insulating caps are acceptable insulation. "Scotch-loks" by the 3M Company, "Wing-Nut" by Ideal, "Legrands" by Pass & Seymour (P&S) are acceptable wing type wire connectors.
4. Lugs, No. 10 and Smaller Conductors: Permanently indented or compression type by Buchanan, Burndy, T & B, or accepted equal. Washer head screw terminals without lugs are acceptable on neutral bars, circuit breakers, wiring devices and other equipment, unless otherwise indicated. Mechanical compression lugs furnished with equipment are acceptable.
5. Exterior Splices: Compression type T & B "Color-Keyed", complete with T & B Shrink-Kon series HS heat shrinkable insulators, or accepted equal by Burndy or Kearney.
6. Connectors and Lugs, Aluminum: All connectors, lugs and fittings shall be UL listed for use with aluminum alloys, and aluminum to copper alloys where encountered.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Clean out raceway system before pulling wire.

B. Thoroughly inspect all existing raceway systems for burrs, deformation, rust, water, and other hazards. Inform Architect/Engineer in writing of any raceway conditions that would be detrimental to wiring, or not in compliance with Codes or practices. All existing raceways shall meet the requirements of Section 26 05 33.

C. Utilize an approved compound as required to facilitate pulling wires and cables, unless otherwise indicated.

D. 600 Volts and Under Wiring Methods:

1. Conductor Ties:

a. Inside each enclosure, other than outlet and junction boxes, conductors shall be bundled and trained utilizing T & B "Ty-Rap", 3M Brand Cable Ties, Tyton Cable Ties, or accepted equal, ties. All Switchboards, Panelboards, Motor Starters, Disconnects, etc. require at least one (1) conductor tie for each circuit entering and each circuit leaving the Switchboard, Panelboard, Motor Starter and Disconnect.

2. Conductor Sizes:

a. Line Voltage Power Wiring: No. 12 AWG minimum. Circuits and feeders larger than 20 amp. to have conductors sized for equal or greater ampacity than their protective device ratings unless otherwise indicated. All wires for 20 amp. circuits shall be #10 on runs 100 feet to 250 feet, #8 on runs 251 feet to 500 feet and #6 on runs 501 feet and above.

b. Control Wiring:

1) 120 Volt: If not carrying motor current, No. 14 AWG unless otherwise indicated, or required by load or distance encountered.

3. Terminal Strips: Where equipment does not have terminal strips, provide terminal strips to terminate and splice control, power limited and communication cables. Indicate wire numbers on strip with indelible pen.

4. Conductor Identification:

a. Wire Markers:

1) Identify lighting and receptacle branch circuit wiring by panelboard name and circuit number at all accesses.
2) Identify motor branch circuit wiring by circuit number and phase at all accesses.
3) Identify feeders by name of equipment from which they originate, circuit number, and phase.
4) Identify all control wiring with a unique number for each wire.

b. Color Code: Color code conductors to designate neutral conductor, ground conductor and phase conductors as described in Part 1 of this Section.

5. Splices:

    a. Feeders: Feeder conductors installed between electrical distribution equipment (i.e., switchboards, transformers, and panelboards) shall be free from splices, no exceptions. Any feeder conductor splices proposed by the Contractor shall be approved in advance by the Engineer; otherwise, they are not permitted.
    b. No splices shall be made in any conductor beyond the exterior walls of the Building, except in exterior pullboxes, and where approved by the Engineer.

6. Motor Connections: Shall use connection lugs with motor stub splice insulators.
7. Flexible Cable, Type SO: Flexible cable shall be used to connect portable equipment in kitchens, laboratories, shops, etc., as indicated and limited by the Codes.
8. Each applicable system shall have a separate conduit system unless the applicable system's manufacturer, Codes and Regulations permit other systems conductors to be installed in the same conduit.
9. Type RHH/USE/RHW conductors shall be used for exterior underground lighting branch circuits in schedule 40 PVC conduit. Refer to Section 26 05 43 for the exceptions to the specified complete concrete encasement. Direct burial of the RHH/USE/RHW wire is not permitted. The type UF conductors shall be used within the exterior lighting fixture pole or standard.
10. Type XHHW-2 conductors shall be used for the secondary underground service entrance cables unless otherwise indicated.

END OF SECTION 260519

SECTION 260523 – CONTROL VOLTAGE ELECTRICAL POWER CABLES

PART 1 - GENERAL:

1.1 RELATED DOCUMENTS:

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

1.2 WORK INCLUDED:

A. Power Limited Shielded Cable

1.3 RELATED WORK:

A. Division 23 - Mechanical

B. Section 26 05 26 – Grounding And Bonding For Electrical Systems

C. Section 26 05 33 – Raceway And Boxes For Electrical Systems

D. Section 26 05 36 – Cable Management For Electrical Systems

E. Section 26 05 53 – Identification For Electrical Systems

F. Section 26 20 00 – Low-Voltage Electrical Distribution

G. Division 27 – Communications

H. Division 28 – Electronic Safety and Security

1.4 REFERENCES:

A. All wire, cables, connectors and lugs shall be U.L. listed for the application intended, and meet NEMA applicable standards.

B. All wiring methods shall meet with NFPA applicable codes.

1.5 CONDUCTOR SIZES:

A. All conductor sizes (AWG) are based on **copper**.

B. Number code all control and instrumentation wiring at all points of access.

1.6 SUBMITTALS:

A. Submit shop drawings and product data in accordance with Section 26 05 00.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. All connectors and lugs shall be as manufactured by T & B, Buchanan, 3M, Burndy, or accepted equal.

B. All **power limited shielded twisted pair** shall be as manufactured by Manhattan, Belden, Alpha, West Penn, Anixter [S].

2.2 MATERIALS AND TYPE:

A. Wiring, Power and Control:

1. General:

a. All control wiring shall be #14 AWG minimum for NEC Class I and #16 AWG minimum for NEC Class II, **extra fine stranding.**
b. All insulation shall be rated for 600 volts unless otherwise indicated.

2. Plenum rated power limited twisted pair cable.

a. For Remote Control, Signaling and Power-Limited Circuits as per NEC-725 for Class 2 and 3 circuits.

1) General: Cable shall be UL classified, Subject 13, non-conduit application in ceiling air plenum in accordance with NEC 725 and as specified below.
2) Control and Instrumentation (24 volt) (Heating, Ventilating and Air Conditioning): Control and instrumentation (24 volt) shall be the minimum of two (2) #16 twisted pair configuration, type CL2P and CL3P insulated stranded tinned copper conductors with 1-1/2 minimum lay, flame retardant, low smoke insulation as required by Class, insulated jacket, color coded, 100% aluminum polyester tape shield, #18 AWG tinned copper drain wire or as indicated otherwise herein.
3) Control and Instrumentation (Heating, Ventilating and Air Conditioning): Thermocouple extension wire shall be compatible with the specific thermocouple material and shall have the same features as "(2)", except the wire shall meet ANSI standard MC96.1 (Temperature Measurement Thermocouples) and have proper amount of pairs for the application.
4) Direct Digital Control System: Wiring between pilot relays, sensors, DDC's and control processing unit shall have proper amount of pairs and be the type as required by Digital Control System installed by temperature control system trade, and shall have similar features of "(2)".
5) Other Systems: Wiring on the applicable systems load side shall be gauge, pairs and shield as required by the applicable system's manufacturer and shall have similar

features as to "(2)". Provide shield if required by applicable system's manufacturer or Codes.

b. For Telephone, Outside Wiring for Burglar Alarm, Telephone-like Systems Circuits per NEC 800:

1) Cable shall be UL Classified, Subject 13, non-conduit application in ceiling air plenum in accordance with NEC 800.
2) Cable features shall be twisted pair configuration, type CMP, color coded, solid tinned copper conductor, flame retardant, low smoke insulation, 100% aluminum polyester tape shield complete with tinned copper drain wire. The quantity of pairs, gauge and shielding requirements shall be determined by the applicable system's manufacturer. Provide shield if required by applicable system's manufacturer or Codes.

3. Power limited twisted pair cable (Not for air plenums):

a. For Remote Control, Signaling and Power-Limited Circuits as per NEC-725 for Class 2 and 3 circuits.

1) General: Cable shall be UL classified for non-conduit application in ceiling void (non-air plenum) in accordance with NEC 725 and for application in multi system common raceway in accordance with NEC 725 and as specified below.
2) Control and Instrumentation (24 volt) (Heating, Ventilating and Air Conditioning): Control and instrumentation (24 volt) shall be the minimum of two (2) #16 twisted pair configuration, insulated stranded tinned copper conductors with 1-1/2 minimum lay, types CL2 or CL3, or riser type cables CL2R or CL3R, as required by Class, insulated, jacket, color coded, 100% aluminum polyester tape shield, #18 AWG tinned copper drain wire or as indicated otherwise herein.
3) Control and Instrumentation (Heating, Ventilating and Air Conditioning): Thermocouple extension wire shall be compatible with the specific thermocouple material and shall have the same features as "(2)", except the wire shall meet ANSI standard MC96.1 (Temperature Measurement Thermocouples) and have proper amount of pairs for the application.
4) Direct Digital Control System: Wiring between pilot relays, sensors, DDC's and control processing unit shall have proper amount of pairs and be the type as required by Digital Control System installed by temperature control system trade, and shall have similar features of "(2)".
5) Other Systems: Wiring on the applicable systems load side shall be gauge, pairs and shield as required by the applicable system's manufacturer and shall have similar features as to "(2)". Provide shield if required by applicable system's manufacturer or Codes.

b. For Telephone, Outside Wiring for Burglar Alarm, Telephone-like Systems Circuits per NEC 800:

1) Cables shall be UL Classified for non-conduit application in ceiling void in accordance with NEC-800 and for application in multi-system common raceway application in accordance with NEC 800.
2) Cable features shall be twisted pair configuration, type CM or CMR, color coded, insulated solid tinned copper conductor, insulated jacket, 100% aluminum polyester tape shield complete with tinned copper drain wire. The quantity of pairs, gauge and

shielding requirements shall be determined by the applicable system's manufacturer. Provide shield if required by applicable system's manufacturer or Codes.

4. Terminal Strips shall be 600 volt barrier type with marking strip suitable for marking with indelible pens.
5. Pulling compound shall be U.L. listed.
6. Wire markers shall be wrap-around tags made of shrinkable PVC sleeving with hot-stamped blocks or slip-on beads.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Clean out raceway system before pulling wire.

B. Thoroughly inspect all existing raceway systems for burrs, deformation, rust, water, and other hazards. Inform Architect/Engineer in writing of any raceway conditions that would be detrimental to wiring, or not in compliance with Codes or practices. All existing raceways shall meet requirements of Section 26 05 33.

C. Utilize an approved compound as required to facilitate pulling wires and cables, unless otherwise indicated.

D. 600 Volts and Under Wiring Methods:

1. Conductor Ties:

a. All power limited cable shall be bundled and trained for each system in the ceiling voids. Each bundle shall be supported from the structure with proper metallic (Caddy) clamp or hanger at the required distances. Proper type of T & B Halar™ cable ties are permitted for use in air plenums.

2. Conductor Sizes:

a. Control Wiring:

1) 120 Volt: If not carrying motor current, No. 14 AWG unless otherwise indicated, or required by load or distance encountered.
2) 30 Volts or Under: No. 16 AWG unless otherwise indicated, or required by load or distance encountered.

3. Control and instrumentation wiring specified in Divisions 21 and 22 shall be furnished and installed by Division 26.
4. Control and instrumentation wiring specified in Division 23 shall be furnished and installed as follows:

a. All line voltage control wiring, 101 volts, 60 Hertz or higher voltage shall be provided under Division 26.
b. All low voltage control raceways and wiring, 100 volts and lower voltages and thermocouple extension wiring, shall be provided under Division 23, according to Section 26 05 33 and Section 26 05 23 product and material requirements, and installation methods.

5. Direct Digital Control System wiring specified in Division 23 shall be furnished and installed as follows:

    a. All line voltage control wiring, 101 volts, 60 Hertz or higher voltage, wired through the Digital Control System; and 120 volts, 60 Hertz power source wiring to the Direct Digital Control System shall be provided under Division 26.
    b. All low voltage control wiring (100 volts and lower voltages) for the Direct Digital Control System shall be provided under Division 23, in the manner as noted above for control and instrumentation wiring.

6. Plenum Rated (and Non-Plenum) Power Limited Shielded Twisted Pair Cable:

    a. All plenum rated (and non-plenum) shielded power limited cable shall be installed in accordance with NEC Article 725, 760 or 800 on the "load" side of the applicable system.
    b. Provide proper number, shielding and size of wires as required for operation of the applicable system in accordance with the manufacturer's instructions and applicable NFPA codes.
    c. Raceway Requirements:

        1) Where an accessible ceiling system or demountable partitions are installed; hollow spaces in casework are available; or similar accessible void is available; a conduit system will not be required. If a conduit system is not utilized cables shall be installed using the specified “Open Wire Management” system.
        2) Where cable is in inaccessible ceiling voids, in inaccessible wall void, penetrates a floor or wall, or exposed on wall or at ceiling, the cable shall be in conduit.
        3) Where partial, detached or “floating” ceilings are provided or no finished ceiling is provided, the cable shall be in conduit, terminating in an accessible corridor ceiling void.
        4) The above conduits shall terminate in an accessible void and shall be bushed to prevent damage to cable. All conduits shall also be grounded to the BGES.

    d. Wiring splices are to be avoided to the extent possible, and if needed, they must be made only in accessible junction boxes and shall be crimp connected.
    e. Transposing or changing color coding of wires shall not be permitted.
    f. Wire nut-type connections are not acceptable. All connections shall be made on terminal strips (in boxes or cabinets).
    g. All conductors shall be labeled on each end with "E-Z markers" or equivalent.
    h. Conductors in cabinets shall be carefully formed and harnessed so that each drops off directly opposite to its terminal.
    i. Cabinet terminals shall be numbered and coded. All controls, function switches, etc., shall be clearly labeled on all equipment panels.
    j. All connections to components and equipment shall be made with crimp type terminal connections, or method approved by applicable systems manufacturer.
    k. All wiring shall be checked and tested to insure that there are no grounds, opens or shorts.
    l. Ground all shields only at termination point (originating).
    m. If shield is not to be grounded, pull shield back over cable jacket and insulate with heat shrink tubing to prevent accidental grounding.
    n. Install cable connectors on all power limited cables entering enclosures except where cable is in protective conduit.
    o. All cables installed in ceiling voids shall be attached to or supported from a vertical surface, a structural member or electrical conduit with a Caddy flexible cable support, bridle ring or

cable clamp; or specified conductor tie (plenum rated where required). Absolutely **do not** support from ceiling system or fixture support wires **except** where accessing a ceiling mounted device. The cable(s) shall **not** block lay-in lighting fixtures, ceiling mounted HVAC equipment or ceiling tiles in order to allow **full** access to the ceiling void.

7. Terminal Strips: Where equipment does not have terminal strips, provide terminal strips to terminate and splice control, power limited and communication cables. Indicate wire numbers on strip with indelible pen.
8. Conductor Identification:

    a. Wire Markers:

        1) Identify all control wiring with a unique number for each wire.

    b. Splices:

        1) No splices shall be made in any conductor beyond the exterior walls of the Building except in exterior pullboxes, and where approved by the Engineer.
        2) Shielded power limited cable for Digital Control System wiring shall be splice free between sensors, DDC's and central processing unit.

9. Each applicable system shall have a separate conduit system unless the applicable system's manufacturer, Codes and Regulations permit other systems conductors to be installed in the same conduit.

END OF SECTION 260523

SECTION 260526 – GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 WORK INCLUDED:

A. Service Entrance Electrode Grounding System

B. Separately Derived System's Electrode Grounding System

C. Equipment Grounding Conductor (EGC)

1.3 RELATED WORK:

A. Section 26 05 19 – Low-Voltage Electrical Power Conductors and Cables

B. Section 26 05 23 – Control Voltage Electrical Power Cables

C. Section 26 05 33 – Raceway and Boxes for Electrical Systems

D. Section 26 05 36 – Cable Management for Electrical Systems

1.4 REFERENCES:

A. NFPA 70 (NEC), Article 250

1.5 DESCRIPTION:

A. The service entrance grounding electrode system shall be in accordance with NEC 250.64 and 250.66, and other applicable NEC Articles. The minimum grounding electrode system shall be a connection to the cold water main valve inside the building or structure plus the minimum of three (3) ground rods in a triangular pattern outside the building and the metal frame of the building or structure, where effectively grounded.

B. The separately derived system grounding electrode system shall be in accordance with NEC 250.30 and other applicable NEC Articles.

C. An insulated equipment grounding conductor, color coded per section 26 05 19, and the NEC, shall be provided for each alternating current circuit without exception.

1.6 TESTS:

A. The grounding electrode system shall have a resistance of 25 ohms or less as per N.E.C. 250.56. Resistance of the grounding electrode system shall be measured separately, with this system disconnected from the building, using the three-point "fall-of-potential" method. Measurements shall be made with appropriate ground resistance meters as manufactured by James G. Biddle; Associated Research, Inc.; or accepted equal.

B. The equipment grounding conductor shall be tested for continuity and proper bonding to metallic equipment enclosures, outlet boxes, wiring devices and similar items.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Ground Rods: 3/4" X 10' copper-clad steel ground rods as manufactured by Copperweld, "Permaground" stainless steel clad ground rods as manufactured by Teledyne Metal Forming, or accepted equal. The copper shall have a minimum thickness of .013 inch at any point on the rod. If necessary to install ground rods deeper than 10'-0", then sectional ground rods shall be installed.

B. Ground Clamps: Thomas & Betts “GUV,” O. Z. Gedney “CG” series or Blackburn “GUV” series, as required by water pipe size and/or grounding electrode conductor size.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. The service, which includes the service entrance conductors and raceways, and service equipment shall be grounded where required and in accordance with requirements of the National Electric Code.

B. Multiple-Rod Grounding Electrode System: The ground rods and ground grid system shall be of adequate design sufficient to allow for seasonal changes in soil characteristics and possible corrosion of the ground system by the soil, and shall be installed in virgin, undisturbed soil. Multiple-rod grids should be arranged in either a triangular arrangement or in a "hollow square" if of more than 3 rods, with spacing between adjacent rods not less than the average depth of the rods in the system. If the soil has been disturbed, either by the present construction or previous occupancies, then the ground rods shall be deep-driven, so that there shall be a minimum length of 10 feet in undisturbed soil.

C. Ground conductors shall be connected to the ground rod(s) by exothermic welding as manufactured by:

1. "Cadweld" process by Erico Products, Inc., or
2. The “ThermOweld” process by Continental Industries Inc.

D. Equipment Grounding Conductor (EGC):

1. Provide a separate insulated grounding conductor, color-coded as per Section 26 05 19, enclosed in the same raceway with the phase conductors for all alternating current circuits, even though not necessarily shown on the drawings.

2. The equipment grounding conductor shall be secured to the equipment enclosure at the source of power and at the apparatus being served by the alternating current supply.
3. The minimum size for the grounding conductor shall be as specified in Table 250.122 of N.E.C.
4. Existing alternating current circuits: If an equipment grounding conductor is not present in the existing feeder or branch circuit to be reworked, Division 26 shall provide new phase, neutral and grounding conductors from the related switchboard or panelboard to the indicated outlet.

END OF SECTION 260526

SECTION 260533 – RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL:

1.1 RELATED DOCUMENTS:

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

1.2 WORK INCLUDED:

A. Rigid Conduit (Heavy Wall, Intermediate Metal Conduit, Electrical Metallic Tubing and Rigid Non-Metallic Conduit)

B. Flexible Conduit (Liquidtight and "Greenfield")

C. Surface Raceway (SR) and Wireway

D. Fittings for Conduits, Flexible Metal Conduit, Surface Raceway (SR), Wireway.

E. Pull Boxes

F. Junction Boxes

G. Outlet Boxes

H. Exterior Pullboxes

I. Multi-Service Recessed Floor Boxes

1.3 RELATED WORK:

A. Section 26 05 36 - Cable Management for Electrical Systems

B. Section 26 05 53 – Identification For Electrical Systems

C. Section 26 09 23 – Lighting Control Devices

D. Section 26 20 00 – Low-Voltage Electrical Distribution

E. Section 26 27 26 – Receptacles

F. Section 26 50 00 – Lighting

G. Section 26 60 13 - Electric Service

H. Division 27 – Communications

I. Division 28 – Electronic Safety and Security

1.4 SUBMITTALS:

A. Submit shop drawings and product data in accordance with Section 26 05 00.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Rigid Heavy Wall Conduit (GRS): Essex, Allied Tubing, Republic, Steelduct, Triangle, L.T.V., Wheatland, or accepted equal.

B. Intermediate Metal Conduit (I.M.C.): L.T.V., Berger Industries, Inc., Allied Tubing, or accepted equal.

C. Electrical Metallic Tubing (E.M.T.): L.T.V., Wheatland, Republic, Steelduct, Berger Industries, Inc., or accepted equal.

D. Rigid Non-Metallic Conduit: Carlon "PLUS" Schedule 40, 90ºC, U.L. listed, Queen City Plastics, Sedco, Can-Tex Industries, or accepted equal.

E. Liquidtight Flexible Metal Conduit: Anaconda "Sealtite", O.Z./Gedney "Flex-Guard", Electri-Flex Co. "Liquid-Tight", or accepted equal.

F. Galvanized Single Strip Steel Flexible Conduit: American Flexible Conduit, Anaconda, Electri-Flex Co., or accepted equal.

G. Fittings (All fittings to be same materials as specified for conduit):

1. Rigid Heavy Wall and Intermediate Metal Conduit Fittings: O.Z., T & B, Efcor, Berger Industries, or accepted equal.
2. Electrical Metallic Tubing Fittings: T & B, Raco, Steel City, O.Z./Gedney, Berger Industries, Inc. or accepted equal.
3. Flexible Metal Conduit Fittings: T & B, O.Z./Gedney, Midwest, Steel City, or accepted equal.
4. Conduit "L's": Crouse Hinds, Killark, O.Z./Gedney, Shamrock Conduit Products, or accepted equal.
5. Cable Supports: O.Z. type M, or accepted equal.
6. **Underground Raceway Seals:** O.Z., Spring City Electrical MFG., or accepted equal [S].
7. Fire Wall and Smoke Partition Seals:

    a. O.Z. type CFS fire seals or T & B "Flame Safe" Fire Stop System or 3M Brand Fire Barrier Penetration Sealing System #7904, 3M Brand Fire Barrier Caulk CP-25 and Putty 303, Nelson "Flameseal" fire stop putty, or accepted equal for each conduit or cable as required [S].
    b. Wiremold FlameStopper™ FS series Thru-Wall Fitting, STI EZ-Path, or other accepted equal for installation of power limited cabling through fire wall [S].

8. Rigid Non-Metallic Conduit Fittings: Carlon, Queen City Plastics, Sedco, Can-Tex Industries, or accepted equal.

9. Insulated Throat Metallic Bushings: O.Z./Gedney Type B or BLG, T & B nylon insulated metallic, or acceptable equal by Efcor. Provide grounding lug type where required.
10. Service Heads: Appleton type F, or accepted equal by O.Z./Gedney, Steel City, or Crouse-Hinds.

H. Wireway: Square D or equal by Walker, or Hoffman.

I. **Surface Raceway:** Surface metal raceway and fittings shall be by the Wiremold Co. or acceptable equal by Walker and Mono-Systems [S].

J. Pull and Junction Boxes: General Metals, Electromate Mfg. Corp., Hoffman, or accepted equal.

K. Outlet Boxes: Appleton, Raco, Steel City, or accepted equal.

L. Outlet Box Brackets: E-Z Mount Bracket Co., Inc., Vinton, Virginia 24179 (703-345-3000), or accepted equal by Caddy, Raco.

M. **Multi-Service Floor Boxes:** Walker, Inc., or accepted equal [S].

N. **Exterior Pullboxes:** Quazite Corporation, Blackburn-Weaver, Bell, Perfect-Line, O.Z./Gedney, Carlon, or accepted equal [S].

2.2 MATERIALS AND USE:

A. Rigid Heavy Wall Conduits (GRS): Of mild steel tube, electro or hot-dipped galvanized and U.L. labeled.

B. Intermediate Metal Conduit (I.M.C.): Of mild steel tube in sizes 3/4" to 4", hot-dipped galvanized or electro-galvanized and U.L. labeled. Refer to limitations under Part 3 - EXECUTION.

C. Electrical Metallic Tubing (EMT): Of mild steel tube in sizes 3/4" to 4" hot-dipped galvanized or electro-galvanized and U.L. labeled. Refer to exceptions under Part-3.

D. Flexible Metal Conduit:

1. Liquidtight flexible metal conduit: Flexible galvanized steel tubing covered with extruded liquid-tight jacket of PVC and a continuous copper bonding conductor wound spirally between the convolutions. Refer to limitations in Part 3 - EXECUTION.
2. Galvanized single strip steel flexible conduit (Commercial Greenfield): UL 1 listed. Refer to limitations in Part 3 - EXECUTION.

E. Rigid Non-Metallic Conduit: Schedule 40 PVC (polyvinyl chloride) conduit that meets and exceeds UL 651, NEMA TC2-1978 for above ground, direct burial, concrete and exposed applications. Refer to limitations in Part 3 - EXECUTION.

F. Fittings:

1. For Rigid and Intermediate Conduit: Couplings to be galvanized or sheradized steel. Double galvanized steel locknuts shall be used where required by code. Single locknut and bushing may be used elsewhere. Insulated throat metallic bushings to be installed on all rigid conduit terminations

where such bushings are required by NEC to protect the wires from abrasion. Use ground lug type where required.

2. For E.M.T.: Steel set screw connectors, permanently indented or gland compression type. **Do not use cast metal type.**
3. For Flexible Metal Conduit: Standard liquidtight fittings for liquidtight conduit. Standard steel flexible metal conduit fittings for standard flexible metal conduit.
4. Conduit "L's": Galvanized steel, threaded, "LB" or "LBD".
5. Cable Supports: To be installed for the support of all conductors and cables as per NEC Article 300-19.
6. Underground Raceway Seals: Provided on each underground electrical raceway entering building. Provide type "FSK" "thruwall" seals on each conduit passing through the outside wall or floor. Provide type CSBG conduit sealing bushing on each underground conduit at the first pullbox, panel or other location as noted on drawings.
7. Fire Resistance Rated Wall and Smoke Partition Seals:

    a. Provide fire-seals for each conduit or cable passing through fire rated walls and floors where the floor, wall or smoke partition has a rating up to three (3) hours in accordance with Manufacturer's application data. All penetration systems shall have been tested per ASTM B14-88 fire test and UL listed for "Through-Penetration Fire Stop System".
    b. Provide UL approved thru-wall fittings for passage of power-limited cabling where cable tray, path of cable hooks, or other major cable pulling route intersects fire wall. The system shall expand rapidly where exposed to fire or high temperature to provide the required firestopping. The fittings shall be complete with built-in firestopping material and through-wall penetration. Each penetration shall be equivalent size of a 4" conduit sleeve or greater and shall remain fully accessible to add or remove cables without disturbing the firestopping material. The fittings shall have been UL-tested and meet the requirements of ASTM E814 UL1479 and shall be rated for 4 hours. Fittings shall be UL approved for use in air plenums.

8. For Rigid Non-Metallic Conduit: PVC fittings, elbows and cement shall be provided by the same manufacturer who provides the rigid non-metallic conduit.
9. Conduit Expansion Joints: O.Z. mechanical type, or accepted equal, on each conduit run crossing building expansion joint.

G. Surface Raceway:

1. The raceway shall consist of a base and cover section factory assembled and designed to accommodate pulling conductors through the raceway. Raceway shall be U.L. labeled.
2. The base section shall have a nominal material thickness of .040" and be manufactured of zinc plated or galvanized steel. 6000 base shall be .060" thickness.
3. The cover section shall have a nominal material thickness, as listed below, and be painted with a baked enamel finish which is capable of being over-painted in the field if required.

Mark	Series	Cover Thickness
SR3	Wiremold 3000	.040
SR4	Wiremold 4000 (w/divider)	.040"
SR6	Wiremold 6000 (w/divider)	.040"

4. Raceway dimensions shall be as follows:

Mark	Series	Dimensions
SR3	Wiremold 3000	2-3/4" W x 1-17/32" H

SR4	Wiremold 4000 (w/divider)	4-3/4" W x 1-3/4" H
SR6	Wiremold 6000 (w/divider)	4-3/4" W x 3-9/16" H

5. Fittings:

   a. General: A full complement of fittings must be available including, but not limited to, bushings to prevent wire abrasion, single and multiple gang boxes to accommodate device installation, adapters from conduit to raceway, transitions to both larger and smaller surface metal raceways, receptacle covers, wiring device brackets, take-off connectors, pre-wired receptacle harnesses, 90 degrees elbows, tees, fixture boxes and flexible sections to allow uninterrupted continuation of raceway along semi-circular or curved surfaces.
   b. SR4 (4000) Wiring Device Plates: Each receptacle location shall have a Wiremold #4048B device cover plate and specified duplex receptacle. Each Data/Comm. Location shall have a Wiremold #V4007C-1 Device cover plate and a blank faceplate per section 26 27 26 selection with color to match raceway.

6. Refer to limitations under PART 3 - EXECUTION.

H. Wireway:

1. Wireways shall be listed to meet UL 870.
2. Wireway covers and troughs shall be constructed from a minimum of 14 gauge steel before finishes are applied. The end flanges shall be constructed from ten gauge steel. All lengths and fittings shall have smooth, rounded edges to prevent damage to wire and cable insulation. Wireway shall be furnished without knockouts.
3. Wireway covers shall have oil-resistant closed cell gasketing for sealing purposes. A solid oil-resistant neoprene joint gasket shall be used between flanges for rigidity when sections and fittings are bolted together.
4. A gasketed captive hinged connector which interlocks with the covers shall be used at each joint. The connector shall be such that the covers cannot be closed and latched without closing the sealing connector.
5. Wireway shall be provided with quick-release cover latches which hold the cover securely in place when closed. Latches shall have provision for a sealing wire to be used when covers and latch are in the closed position.
6. Wireway covers shall be secured to the troughs with leaf type hinges which all allow full opening access to the wireway interior.
7. Provide NEMA-1, NEMA-3R, NEMA-4X, NEMA-12 or other NEMA enclosure where required by NEC or environmental conditions.

I. All boxes to be sheradized or galvanized (after fabrication) sheet steel (except floor boxes) code gauge boxes.

J. The minimum size of all boxes shall conform to the requirements of the National Electrical Code, unless noted to be larger on the drawings, and shall have adequate braces and supports.

K. Pull and Junction Boxes: All boxes shall have screw-on or hinged covers. All flush mounted boxes shall have 3/4" overlapping covers with flush-head cover retaining screws and covers in finished areas shall be prime coated with paint.

L. Outlet Boxes:

1. All boxes shall have ears turned in. Multiple gang boxes must be one piece type (not built-up). Provide 3/8" (or larger if required) fixture stud in all fixture boxes. Provide appropriate covers as required, including 3/4" deep plaster ring covers where plaster may be encountered. Provide vapor proof outlet boxes for vapor proof fixtures. Provide size and type of boxes as required by location and N.E.C., except where exposed masonry occurs, use one piece "tile boxes". All boxes shall be 4" square boxes with "tile rings" unless noted otherwise or where larger sizes are required. All outlet boxes requiring hangers shall be hung with metal hangers.
2. **All exposed boxes below ceiling level shall be cast type FS or FD.**

M. Stud Wall Outlet Box Brackets: Provide #E-Z 1-4, #E-Z 4-1116 or #E-Z 23-1 outlet box brackets with extension brackets or acceptable equal.

N. Outlet Box Bar Hangers: Provide adjustable or solid bar metal hangers by Appleton Electric Manufacturing or accepted equal.

O. Floor Boxes: Unless noted otherwise, provide Hubbell #B-2537-SA3725, or accepted equal, (or terrazzo type where needed) cast iron watertight floor box, aluminum cover and flange, with devices as specified under Wiring Devices. Each box shall have two Hubbell #S-3061 protective rings. For floors thicker than 3" provide Hubbell Series B-2536-SA-3725, or accepted equal. Telephone boxes, Hubbell #B-2537-SA-2525 with Hubbell #SA-3061 fitting. Other floor boxes are as specified elsewhere or called for on the drawings. Provide carpet flanges where carpet is encountered.

P. Recessed Floor Boxes: Unless otherwise indicated, provide "shallow" adjustable cast iron water-tight recessed floor boxes complete with aluminum cover and flange, carpet flange (if required), brass protective rings for cord connectors, low-profile bushed aluminum service heads (above floor) for telephone/data cable, and terrazzo type construction where required. All over height shall be 2-13/16" with a minimum of 30 cubic inch capacity.

Q. Through floor wiring for power and communications shall be Walker RC4 Series Multiple Service fire-rated poke-through fittings, UL classified, meeting NEC Article 300-21. Fire-rating of fitting shall match the fire-rating of the floor. Fitting shall be self-supporting without the attachment of an above-floor fitting, and consist of two (2) factory pre-wired NEMA 5-20R duplex receptacles to the integral junction box and two (2) blank plates for future installation of any of the following: Category 6, Category UTP, fiber optic, coax, audio and video connections. Each poke-thru fitting shall have two (2) runs of ½” conduit extending from its base to the location indicated on the drawings. Above floor fittings shall be flush, and provided with carpet flange in color to match Owner’s carpet where applicable. Box assembly shall meet UL 514 scrub water exclusion requirements in areas where hard floors are encountered, and in areas where scrub water is anticipated.

R. Exterior Pullboxes: Provide reinforced polymer concrete service box, extension, and cover with proper logo with a minimum of 7.4 cubic feet of interior space unless otherwise indicated and meets ASTM D-756, D-543, D-570, D-790 and D-365 test requirements.

S. Multi-Service Recessed Floor Boxes (FB): Walker Inc., #RFB4-CI-1, cast iron recessed four (4) compartment combination box complete with combination wire tunnel/mounting bracket, two (2) internal duplex receptacle brackets as required, internal blank brackets as required, telephone/data brackets as required (Contractor to match telephone and data jacks' specification), flush access hatch with floorport flanged activation kit consisting of die-cast aluminum trim ring in finish color selected by Architect and insert areas for carpet or tile cutouts to match surrounding finish, or doors with 1” conduit openings for

furniture feeds, as required. Box assembly shall meet UL 514 scrub water exclusion requirements in areas where hard floors are encountered, and in areas where scrub water is anticipated.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Provide raceway systems to achieve required distribution, switching and circuit control. All wires for all systems shall be installed in rigid metal raceways and terminated in boxes or cabinets, unless otherwise specified herein as partial conduit or non-conduit installation. Allow for making connections to all outlets, motors, etc., indicated and check plans to insure that all outlets, etc., have a designated circuit. Notify the Engineer of any discrepancies found.

B. Conduit runs are not shown on the drawings, unless specifically noted or indicated otherwise.

C. Conceal all (new) raceways (in existing and new construction) except where specifically noted on drawings or permitted as exposed. Runs in mechanical room areas may be exposed. Exposed conduit must be run parallel with the building walls and supported in a neat substantial manner. Refer to surface raceways under PART 3 - EXECUTION.

D. **Cap** raceway systems during course of construction and thoroughly clean inside before installation of conductors.

E. Provide a completely separate raceway system for all emergency lighting and exit sign circuits as required by N.E.C.

F. No rigid raceway for line voltage wiring shall be smaller than 3/4", except for flexible conduit, unless specifically indicated otherwise. The Electrical Trade shall size all other raceways based on the N.E.C. and verify the sizes shown on the drawings, increasing same if required by local authorities and/or codes.

G. All conduit feeding from one building area to another shall remain within the confines of the building, unless shown or noted otherwise on the drawings.

H. Field made conduit bends shall be made with an acceptable bending machine or conduit bender.

I. Flexible Metal Conduit:

1. Liquidtight flexible metal conduit cannot be used in an air plenum ceiling void. Standard galvanized single strip steel flexible conduit shall be used in air plenum ceiling void.
2. Liquidtight flexible metal conduit for **all** flexible connections, **plus** all short motor connections, transformers and all equipment subject to movement or vibration and where permitted by the Engineer. For flexible connections in an air plenum ceiling void, flexible metal conduit shall be substituted for liquidtight flexible metal conduit.
3. Galvanized single strip steel flexible conduit (6' maximum length) limited to use as the flexible connection to recessed lighting fixture assemblies *(only)* (and in existing wall voids).

J. Rigid Metal Heavywall Conduit (GRS):

1. All joints shall be properly threaded and made tight in standard conduit couplings.
2. All thread conduits or nipples are not acceptable.
3. All conduit cuts shall be square, made with a hacksaw or approved cutting machine, and reamed after threading and before installation to remove burrs.
4. All threads, both field-cut and factory-cut, not otherwise protected, shall be painted after installation with two coats of asphaltum paint if concealed and two coats of primer base paint if installed in an exposed location.
5. GRS shall be used in service entrance raceways where exposed.
6. Clamps to be malleable two (2) hole galvanized iron and hangers to be rod type steel.

K. Where conduits are exposed to occupants, up to 8'-0" feet above the floor, the conduits shall be snug to the wall and secured with two (2) hole clamps (utilizing specified detention type fasteners).

L. Intermediate Metal Conduit (IMC):

1. Applicable specifications for installation of rigid metal conduit applies to IMC.
2. IMC can be substituted for GRS per the NEC.

M. Electrical Metallic Tubing (EMT):

1. Applicable specifications for installation of rigid metal conduit applies to E.M.T.
2. E.M.T. shall **not** be used underground, cast in concrete, exposed on exterior of buildings, and exposed interior locations below 8'-0" (above finished floor).
3. E.M.T. may be routed down exposed interior walls to top of panelboards, motor starters, disconnect switches, light switches, etc.
4. E.M.T. is permitted in electrical and mechanical equipment rooms, per detail on drawings.

N. Rigid Non-Metallic Conduit (PVC):

1. All elbows and nipples to be same material as specified for conduit.
2. All joints to be solvent welded in accordance with conduit manufacturer's instructions.
3. Hanger clamps to be PVC coated malleable iron and hangers to be PVC coated rod type steel.
4. Conduit clamps to be PVC coated, two hole clamps complete with nylon hardware.
5. PVC conduit shall be limited to the following applications:

    a. Underground secondary service entrance concrete encased conduits outside the perimeter of the building and routed under the concrete floor slab on grade to the service entrance equipment.
    b. Underground branch circuit and feeders (under 600 volts), telephone, fire alarm, sound system, control conduits in specified concrete encasement outside the perimeter of the building and in or under the concrete floor slab on grade. The PVC conduit can be routed from the concrete floor slab on grade directly into the masonry unit wall cavities, metal wall stud cavities up to the first wall box only, maximum 4’ aff. PVC shall not be exposed within the building except if within a floor mounted enclosure or panelboard to floor conduit enclosure. The PVC conduits under a concrete floor slab on grade will not require concrete encasement if the slab is more than 2-1/2" thick. Exposed PVC conduit stubs above the concrete slab shall not be permitted. Only exposed rigid metal conduit stubs are permitted.
    c. Underground branch circuit and feeders (under 600 volts) for outdoor lighting only.
    d. Provide specified concrete encasement per Section 16115.

6. PVC shall not be acceptable in areas where subject to ambient temperatures exceeding those for which PVC conduit is approved, for the support of fixtures or other equipment and other areas not permitted by Codes.

O. Supports: Provide metallic supports as required for the proper installation of the raceway or conduit systems and all other equipment installed under this contract. **Wire shall not be used to support or tie down any conduit system.**

P. Empty Conduits: Pull #12 stranded gauge galvanized fishing wires or stranded nylon line through all empty conduits for all systems. These wires or lines to remain in the conduits.

Q. Exposed Masonry: Where wall finish is exposed masonry, raceways shall be so placed in wall that the masonry unit can be neatly set around it with minimum cutting and without injury to the exposed masonry face.

R. Wireways:

1. Furnish and install a complete lay-in wireway system where required. Wiring capacity shall be determined by NEC unless larger dimensions are indicated.
2. Wireway lengths and fittings shall be securely bolted together with same size slotted paint cutting hex-headed shoulder bolts and hex nuts with captive external tooth lock washers which maintain electrical ground continuity across the joint. Each joint shall be gasketed between end flanges. The sealing cover connector shall be installed so as to be held captive and maintain the lay-in ability of the wireway.
3. Wireway shall be installed in accordance with the National Electrical Code requirements.
4. Wireways shall be supported at intervals not exceeding five feet unless specially approved for supports at greater intervals. The ten-foot straight sections of wireway shall be Underwriters Laboratories, Inc. listed for support at ten-foot intervals.

S. Surface Raceway:

1. Install surface raceway in accordance with manufacturer’s recommendations and instructions. Raceway capacity shall be determined by NEC unless larger capacity is indicated.
2. Refer to drawings and elevations for routing of all surface raceways and multi-outlet systems.
3. Surface raceway systems shall be limited to the applications and locations indicated on drawings.

    a. Existing solid masonry or concrete walls without furred out drywall, plaster lathe, paneling or other wall covering or if the furred out space is less than the dimension of a conduit or metal clad cable, surface raceway shall be permitted.
    b. Existing hollow core masonry walls where indicated. All other hollow core masonry walls shall have recessed outlets unless cores are blocked with mortar or structural member.
    c. Unless otherwise indicated, route all surface one-piece raceways vertically to floor or ceiling with no horizontal runs except under whiteboards, tackboards, windows, or casework. Short horizontal runs shall be permitted with two (2) surface raceway outlets less than 48” apart.

4. Multi-system divided raceways, SR4 and SR6, are intended for power on one side and power limited cabling in the remaining side. Fire alarm system wiring shall be type MC cable if installed in the multi-systems raceways per NEC. Provide divided (or multiple) junction boxes at the termination of multi-system raceways to allow the "homerun" conduits to be routed to the various power sources and power limited cabled systems. Separation of the various wiring systems shall be governed by the

NFPA codes. Provide snap-in wire retainers to keep wiring in raceway during installation before cover is installed, and to facilitate future work.

T. All underground conduits including in grade and under floor slabs shall be watertight over the entire length, to prevent entry of water at connections. Provide compatible sealants for material encountered.

U. All conduits installed under the concrete slab shall be completely underneath the concrete slab. Care shall be taken to ensure that no part of the conduit is within the concrete slab.

V. Pull and Junction Boxes: Provide all necessary pull and junction boxes where indicated or required by National Electrical Code. Certain pull and junction boxes may be shown on the drawings for specific design reasons but is not to preclude the fact that additional boxes will be required to conform to codes and good practice.

W. Outlet Boxes:

1. General: All outlet boxes shall be set flush or set to meet the N.E.C. requirements; otherwise box extensions shall be installed. Mounting heights of all outlets shall be as indicated on the drawings, specified herein, or as permitted on the job. Support all boxes to maintain alignment and rigidity. Clean boxes of all foreign matter prior to installation of wiring and/or devices. Adjacent outlet boxes shall be aligned horizontally at the same height, or vertically in the same line, as required.
2. Wall Outlets:

    a. Where the outlet boxes are shown back-to-back in the walls of 6" or less in thickness, the boxes shall be offset horizontally. Through-the-wall outlet boxes shall not be permitted. Outlet boxes, indicated to be installed side-by-side in the same wall, shall be located 6" apart. All boxes shall be rigidly secured in the wall.
    b. Steel Outlet boxes in fire walls and fire separation assemblies shall be installed in accordance with Virginia USBC 704.1.1 and 714.1.6.1 respectively. Therefore outlet box openings cannot exceed 16 square inches per outlet with 100 square inches limit per 100 square feet of wall area. Where outlet boxes are shown in opposite sides of the wall or assembly, the boxes shall be separated by a horizontal distance of not less than 24 inches.

3. Exposed Masonry: The outlet boxes shall be placed in the wall to allow the masonry unit to be neatly set around the box, with the minimum of cutting and without injury to the exposed masonry face. The dimensioned heights of the outlets in the exposed masonry walls are intended to mean to the nearest masonry joint.
4. Stud Walls: The outlet boxes shall utilize the wall brackets and extensions as required. The Electrical Trade shall coordinate with the dry wall or plaster lathe installation trade for fastening the outboard part of bracket to prevent any movement of the outlet box within the wall cavity.
5. Floor Outlets: Outlets that are indicated to be installed side by side in the floor shall be located 3" apart.
6. Ceiling Outlets: All flush mounted ceiling outlet boxes shall be supported by adjustable or solid bar metal hangers or directly supported by threaded steel rods or stud type fasteners.
7. Local Switch Outlets: Prior to the installation of the local switch outlet boxes, the Contractor shall verify the door swings to insure the proper location of the box. This outlet shall be installed with a minimum of 4" of separation from door jamb trim. Refer to typical elevation for mounting outlet boxes at doors.

X. Conduit Termination: All rigid heavy wall metal conduits (G.R.S, I.M.C. and E.M.T.) and rigid non-metallic conduits (P.V.C.) shall terminate with locknut and bushing in all boxes, cabinets, panels, etc. Where a grounding means is not provided in the box, cabinet, panel, etc. provide a locknut and grounding bushing.

Y. Exterior Pullboxes: Install flush with finished grade on a minimum of tamped 6" gravel base.

Z. Multi-Service Recessed Floor Boxes: Install flush with finished covering or floor. Provide receptacles, telephone/data jacks and other outlet configurations as indicated. Install telephone, data and other systems jacks as specified hereinafter. Where the box penetrates to floor depth, coordinate with related trades for additional support.

END OF SECTION 260533

SECTION 260536 – CABLE MANAGEMENT FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL:

1.1 RELATED DOCUMENTS:

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

1.2 WORK INCLUDED:

A. Wall Brackets

1.3 SUBMITTALS:

A. Submit shop drawings and product data on all equipment specified in this section in accordance with Section 26 05 00. Provide installation shop drawings in accordance with 3.01.B.3 below.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Open Wire Management Hardware:

1. Brackets, Wall Metallic “C” shaped hanger by Mono-Systems, Inc. (The Hook).

2.2 MATERIALS AND USE:

A. Wall Brackets: Wall brackets shall be multi-use "C" shaped hanger with 9/32 (7mm) diameter holes on four (4) sides. The center space shall provide the required cross section area for the cable being supported. The bracket shall be 6063-T6 aluminum with extruded box beam design (19mm x 12mm x 2mm thick walls), one (1) inch radii turns, smooth and free from sharp edges, two (2) 7mm holes in long side, one (1) 7mm hole in both short sides, and mounted with 6mm (1/4") hardware or supported with rod and clamps from structure.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Wall Brackets: The metallic "C" shaped wall (or ceiling) brackets shall be wall mounted or suspended on a minimum of 24" centers for the support of Data, telephone, fire alarm, CATV, telephone communication and direct digital controls system (Division 23) wiring and cabling. Wall brackets shall be installed in

continuous and even rows, above each corridor ceiling, spaced as indicated above. Coordinate installation of wall brackets with piping, ductwork, conduits, etc. All wall brackets shall be readily accessible for installation of low voltage wiring systems. Wall brackets are required in all corridors where cable tray is not installed and in additional locations as indicated on the drawings.

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END OF SECTION 260536

SECTION 260543 - UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 WORK INCLUDED:

A. Underground Power, Telephone, CATV and Communication Raceways (Ducts)

B. Prefabricated Manhole(s)

1.3 RELATED WORK:

A. Section 26 05 00 - Common Work Results for Electrical

B. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables

C. Section 26 05 23 - Control Voltage Electrical Power Cables

D. Section 26 05 26 - Grounding and Bonding for Electrical Systems

E. Section 26 05 53 - Raceway and Boxes for Electrical Systems

F. Section 26 60 13 - Electric Service

G. Division 27 - Communications

H. Division 28 - Electronic Safety and Security

1.4 REQUIREMENTS:

A. Standards:

1. National Electric Safety Code (NESC)
2. Applicable AASHTO specification and testing for precast manholes.
3. National Electrical Manufacturers Association (NEMA)
4. American National Standards Institute (ANSI)
5. Local Electric Utility Company Regulations
6. NFPA-70

1.5 SUBMITTALS

A. Submit shop drawings and product data in accordance with Section 26 05 00.

1. Shop drawings for the pre-cast concrete manholes shall include:

a. Dimension layout and weight
b. Material and Structural Specifications
c. Manufacturing Procedures
d. Quality Control
e. Manhole lid and frame

2. Product Data: Submit application, technical and installation data.

PART 2 - PRODUCTS [S]

2.1 MANUFACTURERS:

A. Underground Marker Tapes: Seton Metallic Detection Tapes, Panduit Underground Hazard Tape, Thomas & Betts, Ideal.

2.2 MATERIALS:

A. Underground Marker Tapes (unless otherwise indicated):

1. Electric: Seton #37223 6" x 1000' metallic underground detection tape or similar by Panduit "HTU" series or Thomas & Betts #0700 series with proper logo and red background.
2. Telephone and CATV: Seton #45385 6" x 1000' metallic underground detection tape or similar by Panduit "HTU" series or Thomas & Betts #0700 series with proper logo and orange background.

PART 3 - EXECUTION

3.1 EXCAVATION, BACKFILLING, BEDDING AND RESEEDING:

A. See Division 31 for other excavation, backfilling, bedding and reseeding requirements.

3.2 EXCAVATION:

A. Perform all excavation of every description and of whatever substance encountered to the depths required for installation of the work as indicated on the drawings or specified herein. The amount of trench opened at one time shall not exceed 200 feet including the backfilled portion of any trench which is not in condition for traffic. All excavated materials not required, or which are not suitable for backfill, shall be removed by the Contractor. Shoring shall be provided as necessary to protect existing facilities, new work, and the safety

of personnel. Sheathing for duct banks trenches shall be left in place at the Contractor's expense. Provide cofferdams or other structures required for construction at no additional cost.

B. Trenches shall be necessary width for the proper laying of the duct bank with the banks as nearly vertical as practicable. Trench width at the top of the duct bank shall not exceed 8 inches on either side of duct bank. In rock excavation, the rocks shall be removed to a minimum of 6 inches from the sides of the duct bank. Trenches shall be excavated to a depth of 4" below the normal duct bank depth except where rock, shale or other hard material is encountered. Where rock, shale or other hard material is encountered, the trench shall be excavated to a depth of 4" below normal conduit depth. Care shall be taken not to excavate below the depths indicated. Unauthorized over depths shall be backfilled with No. 10 (Virginia size) aggregate stone to levels previously specified. Whenever wet or otherwise unsuitable soil that is incapable of properly supporting the duct bank is encountered in the bottom of the trench, such soil shall be removed to the depth required as determined by the Engineer and the trench backfilled to the proper grade with material as specified above for over depth.

C. Trenches shall be of a depth that will provide a minimum 24" cover from top of conduit to finished grade, as hereinbefore stated, unless otherwise indicated.

D. Excavation for Appurtenances: Excavation for handholes, and similar appurtenances shall be sufficient to leave at least 12 inches in the clear between their outer surfaces and the embankment or shoring. Final earth supporting elevations shall be of bearing capacity for loads encountered. Rock and over depth shall be treated same as described for trench excavation. Lid shall be flush with finished grade.

3.3 INSTALLATION:

A. Installation of Underground Non-Metallic Raceways: PVC type 40 conduit, laid to true alignment and uniform grades, encased in 4" minimum monolithic poured concrete and steel reinforcement unless otherwise indicated in the Contract Documents. All bends to have exactly the right curvature and have regular tapered joints. Where connecting to manhole or pull boxes, use a bell end. Loose dirt in the bottom of the trench shall be well tamped previous to placing of conduit. Use pre-cast concrete or composition separators spaced not more than 5 ft. apart and secured to the conduits by hemp twine. Joints shall be staggered at least 6 inches and the tapered ends shall be given an application of solvent cement for PVC conduit to insure a good joint between the conduit and sleeve coupling. Conduit shall be thoroughly cleaned before installation. During construction and after the duct line is completed, the ends of the conduits shall be plugged. Care shall be taken to keep conduits clean of concrete, dirt, and any other substance. The concrete envelope shall be 3000 pound concrete. While the concrete is being placed, it shall be tamped between and around the conduits to insure a solid mass of concrete without voids. After underground raceway installation is completed, a flexible mandrel not less than 12 inches long, having a diameter approximately 1/4 inch less than the inside diameter of the conduit, shall be pulled through each conduit, after which a brush with stiff bristles shall be pulled through each conduit. The trenches shall not be filled until 72 hours after the concrete is poured. Ready-mix 3000 pound concrete is permitted (air entrained).

3.4 BEDDING AND BACKFILLING:

A. Duct bank trenches shall be accurately graded to the duct bank level and thoroughly compacted as specified hereinafter. Trenches shall be backfilled, thoroughly haunched and tamped. Settling the backfill with water will not be permitted. The surface shall be graded to reasonable uniformity and mounded over trenches. The

precast manhole shall be accurately graded and bedded with No. 10 crushed stone to the base level and thoroughly compacted as specified hereinafter. The manhole shall rest firmly on the bedding. The excavation shall be backfilled, thoroughly haunched and tamped. Settling the backfill with water will not be permitted. The surface shall be graded to reasonable uniformity and mounded over excavation.

B. Compacted Backfill: All backfill material used in trenches under paved or future paved areas shall be classified as "compacted backfill". Backfill materials shall be approved excavated material, or other select material, as approved by the Engineer, free from large clods of earth, cinders, ashes, refuse, vegetable or organic matter, and rocks or stones over 1" dimension. Backfill from this duct bank to the top of the trench shall be placed in 6 inch layers and compacted to prevent future settlement. Methods and materials used in backfilling shall be provided to obtain 95 percent of maximum density at optimum moisture as determined by AASHO Standard T99, and as sufficient to prevent settlement of the pavement or surface.

C. Normal Backfill: For all backfill not under paved or future paved areas, backfill material shall be free from cinders, ashes, refuse, vegetable or organic matter, boulders, rocks or stones over 3" dimension. Backfill shall be placed and compacted in 6 inch layers to one foot above the top of the duct bank. The remainder of the backfill shall be placed in one foot layers and tamped.

D. The Contractor shall supply the backfill material as specified herein without additional cost to the Owner.

3.5 EXISTING UNDERGROUND UTILITIES:

A. The location of the existing underground utilities indicated on the drawings shall be considered approximate, and any locations may not be indicated or shown. The Contractor shall be responsible to have a thorough underground utility survey made in the path of the proposed underground utility work to locate and protect the known and unknown utilities, and to prevent disrupting the affected utility. The Contractor shall be responsible for repairing damage to any utility caused by their work.

B. Where any existing utilities are damaged, they shall be repaired as directed by the Engineer, with materials approved by the local utility company or the Owner, at no additional cost to the Owner.

3.6 SEPARATION OF UNDERGROUND RACEWAYS FROM OTHER UNDERGROUND UTILITIES

A. Where underground utilities are encountered, separation shall be provided as follows:

1. Parallel Installation:

    a. Normal conditions: Duct banks shall be laid at least ten feet horizontally from a utility line or related manhole whenever possible, the distance shall be measured edge-to-edge.
    b. Unusual conditions: When local conditions prevent horizontal separation of ten feet, the duct bank may be laid closer to a utility line or related manhole provided that: The bottom of the duct bank shall be at least twelve inches above the top or below the bottom of the other utilities.

2. Crossing:

    a. Normal conditions: Duct banks crossing other utilities shall be laid to provide a separation of at least 12 inches between the duct bank and the other utility whenever possible.

3.7 DISPOSITION OF DEBRIS:

A. The Contractor shall be responsible for removal from the property and disposal of all debris of whatever nature.

3.8 PROPERTY PROTECTION:

A. The Contractor shall be responsible for protecting all property and if damaged, repair to existing condition.

3.9 EROSION AND SEDIMENT CONTROL:

A. Precautions shall be taken throughout the duration of the project to prevent sediment throughout excavated area, as required by the Virginia Erosion and Sediment Control Law and shown on the drawings.

B. Erosion control measures shall be provided until the seeded areas are sufficiently prepared and accepted by the Owner.

3.10 CONNECTIONS TO EXISTING UTILITY SYSTEMS, ETC.:

A. All connections to existing utility systems, etc., shall be made as required or deemed necessary to insure the maintenance of continued operation of the above and provide the very minimum of interruption. This Contractor shall make such temporary connections as may be required to facilitate this work and to protect the existing systems from damage. Any work which will in any way affect the continued operation of any existing facility shall be coordinated with the proper authorities as well as the Engineer, and permission received, before any service is interrupted.

3.11 CUTTING AND PATCHING OF EXISTING WALKS, CURBS AND PAVEMENT:

A. All walks, curbs and pavement over trenches shall be restored to original condition and the Contractor will be responsible for any sinking in the walks, curbs, pavement or backfill which may occur within one year from acceptance by the Owner. All walks, curbs and pavement removed for trenching shall be saw cut before removal. Refer to other divisions for concrete paving specifications.

3.12 LAYING OUT THE WORK:

A. The Contractor shall lay out the work in accordance with the drawings, establish and maintain locations, lines, levels required for the work, and shall be responsible for its correctness. He shall report any discrepancies between the drawings and actual measurements to the Engineer for proper interpretation before proceeding with work affected by such discrepancies.

B. Prior to any excavation, the Contractor shall stake out the routes of the proposed underground electric and telephone/comm/data services for review by the Owner and Engineer. Minor deviations in the routing may be required.

3.13 VERIFYING MEASUREMENTS AND CONDITIONS:

A. The exactness of grades, elevations, dimensions, or locations given on the drawings, is not guaranteed by the Engineer. The Contractor shall, therefore, satisfy himself as to the accuracy of all grades, elevations, dimensions and locations. In all cases of interconnection of his work with existing or other work, he shall verify at the site all dimensions relating to such existing or other work. Any errors due to the Contractor's failure to so verify all such grades, elevations, locations, or dimensions shall be promptly rectified by him without cost to the Owner.

3.14 MISCELLANEOUS:

A. Grounding: Provide ground electrode(s) in each new manhole in accordance with N.E.C. and as covered by Section 26 05 26.

B. All manholes shall have pulling irons, cable racks, insulators and ladders. Refer to drawings for interior dimensions.

C. Exception: Underground CATV, telephone, and exterior branch circuit conduits do not require complete specified concrete encasement except where conduits intersect or parallel (within 10 feet) other underground utilities, cannot maintain the Code minimum burial depth below the finished grade or pavement, or are indicated to be encased. The specified concrete shall be required, where conduits change direction or at riser poles, for anchoring purposes during wire pulling procedures. Local utility's regulations or the Authority having jurisdiction's code for concrete encasement may nullify these exceptions.

D. Underground conduit dimensions (unless otherwise indicated): All primary and power conduit shall be a minimum 4" diameter. All communication conduit shall be a minimum 4" diameter.

E. Metallic detection tapes shall be installed at the 50% backfill depth (12" maximum).

F. Coordination is required with all existing and new underground utilities. Review all profiles indicated.

END OF SECTION 260543

SECTION 260553 – IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL:

1.1 RELATED DOCUMENTS:

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

1.2 WORK INCLUDED:

A. Prepare and paint Division 26 equipment supports and miscellaneous materials located in Equipment Rooms, Mechanical Rooms, and other utility areas housing mechanical and/or electrical equipment.

B. Identification of conduits, junction boxes, pull boxes, cabinets, panelboards, switchgear, motor starters, disconnect switches, motor protective switches, and Division 26 system enclosures.

1.3 WORK NOT INCLUDED:

A. Painting of factory finished Division 26 Equipment such as Switchboards, Panelboards, Emergency Generator Sets, etc.

1.4 RELATED WORK:

A. Division 23 – Mechanical

B. Section 26 05 00 – Common Work Results For Electrical

C. Section 26 05 33 – Raceway And Boxes For Electrical Systems

D. Section 26 05 36 – Cable Management For Electrical Systems

E. Section 26 22 00 – Low-Voltage Transformers

F. Section 26 24 16 – Panelboards

G. Section 26 28 16 – Enclosed Switches And Circuit Breakers

H. Section 26 29 00 – Low-Voltage Controllers

I. Division 27 – Communications

J. Division 28 – Electronic Safety and Security

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. Except as otherwise specified, materials shall be the products of the following manufacturers:

1. Sherwin-Williams
2. Pratt and Lambert
3. Devoe
4. Benjamin Moore

2.2 MATERIALS:

A. Deliver all paints and materials to the project site in their original containers with all labels intact and legible at the time of use.

B. Sherwin-Williams Industrial Maintenance Coatings System 4000 products are listed below to establish color and a standard of quality.

1. All Hangers and Supports: One coat Series 54 Gloss Black Alkyd Enamel.
2. Uninsulated diesel engine exhaust and other similar hot surfaces shall be painted with two coats of No. B59S8 Heat Resistant Aluminum.
3. Exterior of belt guards and other protective guards shall be finished with two coats of Series 54 Alkyd Gloss Enamel No. SW4084 safety yellow color. Interior of and all items covered by belt guards and other protective guards shall be finished with two coats of No. SW4083 safety orange color.
4. Factory Finished Equipment finishes shall be cleaned and properly touched up with equipment manufacturers touch-up paint unless finish is severely damaged or of unacceptable quality. In the latter case, the entire finish shall be restored in accordance with painted procedures herein specified.

PART 3 - EXECUTION

3.1 WORKMANSHIP:

A. The work shall be accomplished by qualified mechanics skilled in the painting trade. Painting of equipment and other materials shall not commence until all testing is complete and systems are ready for operation. Materials shall be evenly spread, and smoothly flowed on without runs or sags. Each coat shall be thoroughly dry before application of succeeding coats.

3.2 PROTECTION OF WORK:

A. The painters shall protect all adjacent surfaces with drop covers during the process of painting. Upon completion, paint spots, if any, shall be removed from all surfaces not intended to be painted.

3.3 PREPARATION OF SURFACE:

A. Surfaces to be painted shall be completely dry before applying paint. Metal surfaces shall be cleaned with mineral spirits before applying materials. Rust and scale shall be removed by wire brushing or sanding. Galvanized surfaces shall be chemically treated with crystalline zinc phosphate in strict accordance with the manufacturer=s recommendations. Surfaces shall not be painted when the temperature is, or is likely to be, near the freezing point, nor when they are exposed to hot sun.

3.4 IDENTIFICATION OF PIPES AND EQUIPMENT:

A. After **all** painting is completed, operating and control parts of the equipment and systems such as switchgear, panelboards, telephone cabinets, system cabinets, disconnect switches, motor starters and control cabinets shall be properly identified with laminated engraved plastic nameplates fastened with sheet metal screws, bolts or permanent adhesive. Pressure sensitive tape is **not** acceptable. Identification symbols or designations shall be the same as shown on the contract documents.

B. Boxes; Concealed and Surface Mounted: Each junction box, pullbox or similar enclosure shall be **neatly** identified by stencil marking which shall indicate service contained, and circuit numbers. Stencil letters shall be upper case (Capital) not less than one-half inch high and painted with Series 54 black gloss enamel.

C. Conduit:

1. Color bands shall be painted on each conduit where exposed or accessible. Bands shall be six inches wide and shall be placed along the conduit run immediately preceding the passage of the conduit through walls, ceiling or floor, and at each equipment connection or junction box. Where sub-bands are specified, they shall be two inches wide and centered in the color band. Adjacent to each color band, the abbreviation of the name of the service contained in the conduit shall be **neatly** stenciled. Stencil letters shall be one-half inch high upper case, applied with Series 54 black gloss enamel. Color bands shall be Series 54 Alkyd Gloss Enamel of colors listed below.
2. In lieu of painted color bands, the Contractor may use pressure sensitive tape a minimum of 2" wide. Each color band will require wraps as necessary to provide the full 6" wide band with or without the 2" sub-band.
3. In lieu of stenciled names of the pipe service, the Contractor may use vinyl "snap around" markers as manufactured by Seton, Bunting, Brady and Thomas & Betts (T&B).
4. Color Banding:

System	Abbrev./Color	Color Band	Color Sub-Bands
120/240 Volts (Normal)	240V/Black	Black	Yellow
Security Access	SA/Black	Black	Brown
Surveillance CCTV	CC/Black	Black	Brown
Telephone System	TE/Black	Black	Blue
Data Network	DN/Black	Black	Blue
Direct Digital Control	DDC/Black*	Black	Blue
CATV	TV/Black	Black	Green

D. The main panelboard, and other similar systems shall have an engraved informational laminated nameplate with the installing trade’s name, telephone number and address for the Owner to obtain preventive maintenance, service or parts. The nameplate shall include the job order number, shop number or other identification which will identify the related equipment.

If the above address and telephone number is a branch office, the main office or manufacturers address and telephone number shall be included.

END OF SECTION 260553

SECTION 260573 – OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 WORK INCLUDED

A. Short-Circuit analysis evaluation study

B. Protective Device Time-Current Coordination study

C. Field Adjustments To Equipment based on Study findings

1.3 RELATED WORK

A. Section 26 05 19 – Low Voltage Electrical Power Conductors and Cables

B. Section 26 20 00 – Low-Voltage Electrical Distribution

C. Section 26 24 16 – Panelboards

D. Section 26 28 13 – Fuses

E. Section 26 28 16 – Enclosed Switches and Circuit breakers

1.4 REFERENCES

A. Institute of Electrical and Electronics Engineers, Inc. (IEEE):

1. IEEE 141 – Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems
2. IEEE 242 – Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
3. IEEE 399 – Recommended Practice for Industrial and Commercial Power System Analysis
4. IEEE 241 – Recommended Practice for Electric Power Systems in Commercial Buildings
5. IEEE 1015 – Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.

B. American National Standards Institute (ANSI):

1. ANSI C57.12.00 – Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
2. ANSI C37.13 – Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures
3. ANSI C37.010 – Standard Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis
4. ANSI C 37.41 – Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories.

C. The National Fire Protection Association (NFPA)

1. NFPA 70 -National Electrical Code, latest edition

1.5 SUBMITTALS

A. Submit shop drawings in accordance with Section 26 05 00.

1. The studies shall be submitted to the design engineer prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment drawings for manufacturing. If formal completion of the study may cause delays in equipment shipments, approval from the Engineer may be obtained for a preliminary submittal of data to ensure that the selection of device ratings and characteristics will be satisfactory to properly select the distribution equipment. The formal study will be provided to verify preliminary findings.
2. The results of the short-circuit, protective device coordination study shall be summarized in a final report. A minimum of five (5) bound copies of the complete final report shall be submitted.

B. The report shall include the following sections:

1. Executive Summary including Introduction, Scope of Work and Results/Recommendations.
2. Short-Circuit Methodology Analysis Results and Recommendations
3. Short-Circuit Device Evaluation Table
4. Protective Device Coordination Methodology Analysis Results and Recommendations
5. Protective Device Settings Table
6. Time-Current Coordination Graphs and Recommendations
7. One-line system diagram that shall be computer generated and will clearly identify individual equipment buses, bus numbers used in the short-circuit analysis, cable and bus connections between the equipment, calculated maximum short-circuit current at each bus location, device numbers used in the time-current coordination analysis, and other information pertinent to the computer analysis.

C. Submit Operation and Maintenance Manuals in accordance with Section 26 05 00.

1.6 QUALIFICATIONS

A. The short-circuit, protective device coordination and arc flash hazard analysis studies shall be conducted under the responsible charge and approval of a Registered Professional Electrical Engineer skilled in performing and interpreting the power system studies.

B. The Registered Professional Electrical Engineer shall be an employee of the equipment manufacturer or an approved engineering firm.

C. The Registered Professional Electrical Engineer shall have a minimum of five (5) years of experience in performing power system studies.

D. The engineering firm shall have a minimum of twenty-five (25) years experience in performing power system studies.

1.7 COMPUTER ANALYSIS SOFTWARE

A. The studies shall be performed using one of the following software manufacturer programs:

1. CYME International, Inc.
2. EDSA Micro Corporation.
3. Electrical Systems Analysis, Inc.
4. SKM Systems Analysis, Inc.

PART 2 - PRODUCTS

2.1 STUDIES

A. The contractor shall furnish a short-circuit and a protective device coordination studies. All studies to be prepared by equipment manufacturer.

2.2 DATA

A. Contractor shall furnish all data as required for the power system studies. The Engineer performing the short-circuit, protective device coordination and arc flash hazard analysis studies shall furnish the Contractor with a listing of required data immediately after award of the contract. The Contractor shall expedite collection of the data to assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to the release of the equipment for manufacturing.

B. Source combination may include present and future motors and generators.

C. Load data utilized shall include existing and proposed loads obtained from Contract Documents.

D. If applicable, include fault contribution of existing motors in the study. The Contractor shall obtain required existing equipment data, if necessary, to satisfy the study requirements.

2.3 SHORT-CIRCUIT ANALYSIS

A. Transformer design impedances shall be used when test impedances are not available.

B. Provide the following:

1. Calculation methods and assumptions
2. Selected base per unit quantities
3. One-line diagram of the system being evaluated that clearly identifies individual equipment buses, bus numbers used in the short-circuit analysis, cable and bus connections between the equipment, calculated maximum short-circuit current at each bus location and other information pertinent to the computer analysis.
4. The study shall include input circuit data including electric utility system characteristics, source impedance data, conductor lengths, number of conductors per phase, conductor impedance values, insulation types, transformer impedances and X/R ratios, motor contributions, and other circuit information as related to the short-circuit calculations.
5. Tabulations of calculated quantities including short-circuit currents, X/R ratios, equipment short-circuit interrupting or withstand current ratings and notes regarding adequacy or inadequacy of the equipment rating.
6. Results, conclusions, and recommendations. A comprehensive discussion section evaluating the adequacy or inadequacy of the equipment must be provided and include recommendations as appropriate for improvements to the system.

C. For solidly-grounded systems, provide a bolted line-to-ground fault current study for applicable buses as determined by the engineer performing the study.

D. Protective Device Evaluation:

1. Evaluate equipment and protective devices and compare to short circuit ratings.
2. Adequacy of switchgear, motor control centers, and panelboard bus bars to withstand short-circuit stresses.
3. Manufacturer shall notify Engineer in writing, of any circuit protective devices improperly rated for the calculated available fault current.

2.4 PROTECTIVE DEVICE TIME-CURRENT COORDINATION ANALYSIS

A. Protective device coordination time-current curves (TCC) shall be displayed on log-log scale graphs.

B. Include on each TCC graph, a complete title with descriptive device names.

C. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.

D. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.

E. Plot the following characteristics on the TCC graphs, where applicable:

F. Electric utility’s overcurrent protective device

1. Medium voltage equipment overcurrent relays
2. Medium and low voltage fuses including manufacturer’s minimum melt, total clearing, tolerance, and damage bands
3. Low voltage equipment circuit breaker trip devices, including manufacturer’s tolerance bands

4. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves
5. Medium voltage conductor damage curves
6. Ground fault protective devices, as applicable
7. Pertinent motor starting characteristics and motor damage points, where applicable
8. Pertinent generator short-circuit decrement curve and generator damage point
9. The largest feeder circuit breaker in each motor control center and applicable panelboard.

G. Provide adequate time margins between device characteristics such that selective operation is provided, while providing proper protection.

H. Provide the following:

1. A One-line diagram shall be provided which clearly identifies individual equipment buses, bus numbers, device identification numbers and the maximum available short-circuit current at each bus when known.
2. A sufficient number of log-log plots shall be provided to indicate the degree of system protection and coordination by displaying the time-current characteristics of series connected overcurrent devices and other pertinent system parameters.
3. Computer printouts shall accompany the log-log plots and will contain descriptions for each of the devices shown, settings of the adjustable devices, and device identification numbers to aid in locating the devices on the log-log plots and the system one-line diagram.
4. The study shall include a separate, tabular printout containing the recommended settings of all adjustable overcurrent protective devices, the equipment designation where the device is located, and the device number corresponding to the device on the system one-line diagram.
5. A discussion section which evaluates the degree of system protection and service continuity with overcurrent devices, along with recommendations as required for addressing system protection or device coordination deficiencies.
6. Manufacturer shall notify Engineer in writing of any significant deficiencies in protection and/or coordination. Provide recommendations for improvements.

PART 3 - EXECUTION

3.1 FIELD ADJUSTMENT

A. Field adjustments to be completed by Manufacturer as part of this contract and prepare a report of all final settings.[V][O&M]

B. Contractor shall be responsible for making all modifications stated within these studies to the entire electrical system at no additional cost to the Owner. Contactor shall notify Engineer prior to making any modifications.

END OF SECTION 260573

SECTION 260923 – LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 WORK INCLUDED:

A. Switches

B. Dimmers

C. Low Voltage Lighting Controls

1. Wallpods
2. Daylighting Sensors
3. Occupancy Sensors

D. Low Voltage Lighting Control Equipment

E. Plates

F. Automatic Lighting Controls

G. Lighting Contactors

1.3 RELATED WORK:

A. Section 26 05 23 – Control Voltage Electrical Power Cables

B. Section 26 05 33 – Raceway And Boxes For Electrical Systems

C. Section 26 50 00 – Lighting

1.4 SUBMITTALS:

A. Submit shop drawings, product data and wiring device samples in accordance with Sections 26 05 00.

B. Submit Operation and Maintenance Manuals in accordance with Section 26 05 00.

C. Low Voltage Lighting Control Systems: Furnish the following for each system:

1. Building floor plans (1/8” = 1’- 0” scale) showing:

a. All lighting fixtures and low voltage control devices in their correct locations and configurations.
b. Separate plans showing control zones and orientations for all daylighting sensors.
c. Separate plans showing control zones and orientations for all occupancy and vacancy sensors.

2. System riser diagrams showing connections to all lighting fixtures and low voltage control devices.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Switches [S] shall be as manufactured by:

1. Bryant,
2. Hubbell,
3. Cooper-Crouse Hind
4. Pass and Seymour (P&S)

All switches shall be by the same manufacturer.

B. Dimmers shall be as manufactured by:

1. Hubbell,
2. Leviton,
3. Lutron

C. Low Voltage Lighting Controls and Equipment [S] shall be as manufactured by:

1. Sensorswitch,
2. Hubbell,
3. Lutron

D. Wiring Device Plates [S] and Blank Plates [S] shall be as manufactured by:

1. Bryant,
2. Hubbell,
3. Cooper Crouse-Hinds,
4. Pass & Seymour (P&S)

E. Lighting Contactors [S] shall be as manufactured by:

1. Square D
2. ABB
3. ASCO

F. Automatic Lighting Controls shall be as manufactured by:

1. Sensorswitch,
2. Hubbell,
3. Lutron

2.2 MATERIALS AND TYPE:

A. All switches, dimmers, and other wiring devices shall be as indicated on drawings and specified hereinafter.

B. Unless otherwise indicated on the drawings all switches shall be:

1. Bryant "Tech-Spec" series,
2. Hubbell HBL series (Industrial, Heavy-duty specification grade)
3. Cooper Industrial Specification grade AC Quiet series
4. Pass & Seymour (P&S) specification grade “PS” series

C. The switches shall be complete with green (brass) hexhead grounding screw, back and side wired high impact polycarbonate, LexanTM, high impact thermoplastic or nylon toggle. Switch shall be rated for the voltage, poles, amperage and circuit configuration required.

D. Plates: For all systems unless indicated otherwise.

1. High impact nylon, high impact thermoplastic or polycarbonate (Lexan) with smooth finish unless otherwise indicated. Color of plates shall be Ivory.
2. For Wet Locations:

a. While in Use (WL): Weatherproof NEMA-3R enclosure constructed of flame retardant U.V. stabilized polycarbonate, reinforced thermoplastic, die-cast metal or combinations of the above materials complete with sealing gaskets and stainless steel mounting screws; and meets OSHA and NEC requirements "WHILE IN USE". The cover shall be clear. Housing size shall depend on the wiring device being protected. Housing for receptacles shall allow both angled and straight cord connectors. As manufactured by Tay-Mac® Corp., P&S, Hubbell, Cooper Crouse-Hinds or acceptable equal.
b. While cover is Closed (WP): Weatherproof NEMA-3R enclosure constructed of die-cast metal complete with sealing gaskets and stainless steel mounting screws; and meets OSHA and NEC requirements while cover is "Closed". As manufactured by P&S, Bryant, Hubbell, Cooper Crouse-Hinds or acceptable equal.

3. For F.S. or F.D. Boxes (Interior Only): Die cast covers with gaskets, as manufactured by Crouse-Hinds, Appleton, Red Dot or acceptable equal.
4. Screws: Heads to match plate material and finish.
5. Provide blank plates for all unused outlets.

E. Wiring Device and Plate Colors: Architect will review and accept color of wiring devices and plates. Contractor shall allow for selection from "standard" colors (grey, white, ivory, brown) of wiring devices in his bid proposal.

F. All pilot lights shall be neon or L.E.D. type with Red color glass, unless otherwise noted. Lamp to be sized to adequately illuminate under daylight conditions. Incandescent pilot lights are not acceptable. LED conversion lamps are acceptable in incandescent lampholders.

G. Low Voltage Lighting Controls:

1. Low Voltage Lighting Controls shall all have the following features:

a. Fully addressable and compatible with Sensorswitch nLight control CAT-5e network.

b. Complete with power supply and 2 RJ-45 ports.
c. Shall be configured and engraved as specified here-in and as indicated on the drawings.
d. 5 year product warranty.

2. Wallpods, Low Voltage [O&M] [S]:

a. Graphic Wallpods:

1) 3.5" Full-color touch screen.
2) 16 On/Off/Dim controls and 16 scene controls with full user customization of all settings.
3) Password protection for controls and set-up screens.
4) Customizable screen saver image (.jpeg format) and onboard help screens.
5) Operating temperature 14°F to 160°F.
6) Sensorswitch nLight nPOD GFX or accepted equal by Hubbell or Lutron.

b. Low Voltage Dimming and On/Off control Wallpods:

1) 1, 2 or 4 channel raise/lower with 0-10V dimming control.
2) 1, 2 or 4 channel on/off.
3) Operating temperature 14°F to 160°F.
4) Sensorswitch nLight nPODM DX or accepted equal by Hubbell or Lutron.

c. Low Voltage Scene control Wallpods:

1) Runs locally stored scenes.
2) Runs remotely stored profiles from a gateway device. Remotely configurable and upgradeable.
3) 1, 2 or 4 scene control.
4) On/Off and Raise lower with 4 scene control.
5) Operating temperature 14°F to 160°F.
6) Sensorswitch nLight nPODM 1S/2S/4S or accepted equal by Hubbell or Lutron.

3. DayLighting Sensors, Low Voltage [O&M] [S]:

a. Remotely configurable and upgradeable.
b. Automatic Set-Point Calibration.
c. Blink-back Set-Point (in footcandles).
d. Set-Point (0-200 fc)
e. Sunlight Discount Factor (1-8)
f. Occupied Bright Level (0-100%)
g. Unoccupied Dim Level (0-100%)
h. Photocell On/Off Transition Time (45 sec. – 25 min.)
i. Adaptive cloud delay to prevent cycling on cloudy days.
j. Push-Button Programmable.
k. Full On/Off switching control.
l. Recessed Ceiling Applications: Sensorswitch nLight nRM ADCX series or accepted equal by Hubbell or Lutron.
m. Surface Ceiling Applications: Sensorswitch nLight nCM ADC series or accepted equal by Hubbell or Lutron.

4. Occupancy Sensors, Low Voltage [O&M] [S]:

   a. Recessed Ceiling Mounted:

      1) Dual technology; passive infrared and ultrasonic.
      2) Full 360° operation.
      3) Assorted lens choices for desired motion coverage.
      4) Minimum 24’ diameter small motion coverage at 9’ ceiling height.
      5) Minimum 48’ diameter large motion coverage at 9’ ceiling height.
      6) Sensorswitch nLight nRM PDT 9 (small motion) or nRM PDT 10 (large motion) or acceptable equals by Hubbell/Unenco, or Lutron.

   b. Surface Ceiling Mounted:

      1) Dual technology; passive infrared and ultrasonic.
      2) Full 360° operation.
      3) Assorted lens choices for desired motion coverage.
      4) Minimum 24’ diameter small motion coverage at 9’ ceiling height.
      5) Minimum 48’ diameter large motion coverage at 9’ ceiling height.
      6) Sensorswitch nLight nCM PDT 9 (small motion) or nCM PDT 10 (large motion) or acceptable equals by Hubbell/Unenco, or Lutron.

   c. Wall Mounted:

      1) Dual technology; passive infrared and ultrasonic.
      2) Full 120° operation.
      3) Small motion detection up to 40’.
      4) Large motion detection up to 70’.
      5) Beveled rear enclosure piece to facilitate corner mounting.
      6) Ceiling mounting bracket for mounting heights over 10’.
      7) Sensorswitch nLight nWV PDT 16 or acceptable equals by Hubbell/Unenco, or Lutron.

   d. Corridor Wall Mounted:

      1) Passive infrared technology.
      2) Long narrow motion.
      3) Linear coverage up to 130’ at 10’ mounting height.
      4) Ceiling mounting bracket for mounting heights over 10’.
      5) Sensorswitch nLight nHW 13 or acceptable equals by Hubbell/Unenco, or Lutron.

   e. High Bay Surface Mounted:

      1) Passive infrared technology.
      2) Full 360° operation.
      3) High bay and low bay lenses
      4) Minimum 30’ diameter detection at 15’ mounting height.
      5) Large motion detection at 35’ mounting height.
      6) Extra large motion detection at 45’ mounting height.
      7) Sensorswitch nLight nCM 6 or acceptable equals by Hubbell/Unenco, or Lutron.

   f. Wall Switch:

1) Dual technology; passive infrared and ultrasonic.
2) Full 180° operation.
3) Minimum 40’ diameter small motion detection.
4) Switching and dimming control.
5) Sensorswitch nLight nWSX PDT LV series or acceptable equals by Hubbell/Unenco, or Lutron. Include raise/lower dimming control option (DX) where required.

H. Low Voltage Lighting Control Equipment:

1. Low Voltage Lighting Equipment Components shall all have the following features:

a. Fully addressable and compatible with Sensorswitch nLight control CAT-5e network.
b. Complete with power supply and 2 RJ-45 ports.
c. Shall be configured and labeled as specified here-in and as indicated on the drawings.
d. 5 year product warranty.

2. Power/Relay Packs for Low Voltage Lighting Control [O&M] [S]:

a. Select the proper Power/Relay from the selection below.
b. Linear Power/Relay Packs with dimming:

1) For lighting fixtures capable of 0-10V dimming control that are not nLight capable from the factory.
2) Maximum load 16A.
3) Sensorswitch nLight nPP16 D Series Power Packs or acceptable equals by Hubbell/Unenco, or Lutron.

c. Secondary Relay Pack with phase control dimming:

1) For lighting fixtures requiring low voltage dimming control that are not 0-10V compatible.
2) For 2 wire ballast or 3 wire dimmable ballast.
3) Dimming ranges: High (0-100%), Low (0-100%).
4) Dimming offset: (-200% to 200%).
5) Requires CAT-5e power.
6) Sensorswitch nLight nSP5 PCD series lighting control relay or acceptable equals by Hubbell/Unenco, or Lutron.

d. For Switching of LED and T5 Fluorescent Lighting Loads:

1) Maximum Load 16A.
2) Combination unit includes power supply for up to 80ma. of bus load.
3) Sensorswitch nLight nPP16 series or acceptable equals by Hubbell/Unenco, or Lutron.

e. For switching of line voltage non nLight lighting loads:

1) Maximum Load 16A.
2) Sensorswitch nLight nSP16 series slave relay pack or acceptable equals by Hubbell/Unenco, or Lutron.

f. For switching of low voltage non nLight lighting loads:

1) Maximum Load 1A @ 40 VAC/VDC.
2) Sensorswitch nLight nAR 40 series auxiliary low voltage relay or acceptable equals by Hubbell/Unenco, or Lutron.

3. Power Supplies [O&M] [S]:

a. Power Supplies shall all have the following features:

1) Power supplies shall operate on 120V power.
2) Plenum Rated.
3) Complete with elongated chase nipples for direct connection through a ½" knock-out to a standard junction box.

b. For Bus and System Power over CAT-5e (80ma): Sensorswitch nLight nPS 80 series or acceptable equals by Hubbell/Unenco, or Lutron.
c. For Power to nLight Bridges: Sensorswitch nLight PS 150 series or acceptable equals by Hubbell/Unenco, or Lutron.
d. For Power to nLight Gateway Control Units and Gateway Touch Screens: Sensorswitch nLight PS 250 series or acceptable equals by Hubbell/Unenco, or Lutron.

4. Backbone Devices [O&M] [S]:

a. Gateway:

1) Automatically discovers nLight devices.
2) 400 and 1500 device models available. Select the appropriate model based on the total amount of system lighting fixtures and devices.
3) Provides system time clock.
4) Provides an Ethernet interface for the required Sensorswitch SensorView software.
5) Requires power supply as listed above.
6) Include one (1) Sensorswitch nLight nGWY2 GFX Gateway Touch Screen with each Gateway.
7) Sensorswitch nLight nGWY2 KIT or acceptable equals by Hubbell/Unenco, or Lutron.

b. Bridge:

1) Increases the number of lighting control zones in an nLight lighting control system.
2) Complete with 8 RJ-45 ports.
3) Connects zones of daisy-chained nLight enabled devices.
4) Acts as hubs to aggregate traffic from the connected downstream zones and as routers by forwarding information to the downstream zones.
5) Requires power supply as listed above.
6) Furnish required number of bridges necessary to completely connect all network devices to the gateway(s).
7) Sensorswitch nLight nBRG 8 series or acceptable equals by Hubbell/Unenco, or Lutron.

I. Lighting Contactors:

1. Lighting contactors shall be the mechanically held type, minimum 30A rated poles of number and amperage required, with factory wired controls:

a. Square D: Class 8903
b. ABB: A-Line
c. ASCO: 918 Series
d. Refer to detail on drawings.

J. Automatic Lighting Controls:

1. Photocells by Precision Multiple Controls:

a. Standard 120 Volts: #P2275 (1800VA - 120V)
b. Refer to detail on drawings.

2. Timeclocks by Intermatic or acceptable equal as indicated below [O/M]:

a. Intermatic ET2845C 365/7 day astronomic electronic control with independent 7 day and to the minute programming Astronomic programming, automatic daylight savings adjustment, 50 holiday blocks with schedules, manual operation. Non-volatile EEPROM memory. Includes four (4) independent output circuits. Controller shall operate from 120VAC-277VAC with auto voltage detection. 100 hour super capacitor eliminates battery dependency. Select proper enclosure for environmental condition encountered.

3. Occupancy Sensors, Line Voltage [O&M] [S]:

a. Ceiling or Wall-mounted: Provide dual technology (infrared and ultrasonic) occupancy sensors, complete with 120 volt power packs for lighting in indicated spaces. Sensors shall be ceiling or wall mounted as indicated as indicated on drawings. The local room switches shall be wired after the relay's contact. Provide a satellite relay for additional circuits under the sensor's control. Occupancy sensor shall be Watt-Stopper type DT-300 for 360 degree operation or DT-200 for 180 degree operation, or acceptable equals by Hubbell/Unenco, Sensorswitch, or Lutron.
b. Corridor: Provide ultrasonic sensors, complete with 120 volt power packs for in corridors and elsewhere as shown on the drawings. Sensors shall be listed for coverage up to a minimum 90 foot linear distance. Sensor shall be Watt-Stopper Type WT-2255 or acceptable equal by Hubbell/Unenco, Sensorswitch, or Lutron.
c. Wall Switch: Provide single pole (2 wire) dual technology infrared (motion) and ultrasonic occupancy sensing wall switch where shown on the drawings, 800 watts @ 120 volts, , 170 degree field of view. Switch shall be Watt-Stopper #DW-100 for single switches, #DW-200 for bi-level control, #DW-103 or #DW-203 for three-way switching or acceptable equals by Hubbell/Unenco, Sensorswitch, or Lutron.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. All wiring devices shall be mounted at elevations indicated.

B. Local switches shall be coordinated with the door swings to insure the proper location of the switch. Local switches shall be a minimum of 4" from door jamb trim. Refer to elevation for mounting outlet boxes at doors.

C. Install plates on all outlets and wiring devices, with all four edges in continuous contact with finished wall surfaces without the use of mats or similar devices. Plaster fillings will not be permitted. Plates shall be installed with an alignment tolerance of 1/16 inch. The use of sectional device plates will not be permitted.

D. Where the wall opening for a wall or casework outlet box is larger than a standard plate cover, repair the outlet opening to accept a standard size plate. "Jumbo" or "Junior Jumbo" device plates are not acceptable.

E. Low Voltage Dimming and ON/OFF Control System: Provide all components and wiring necessary for a complete and functioning Low Voltage Dimming and ON/OFF control system as indicated. Furnish and Install all wallpods, occupancy sensors, lighting sensors, power supplies and dimming controls, cat 5e cable and miscellaneous appurtenances necessary for each complete and operating system. Drawing symbols indicate which lighting zones and spaces are to have low voltage (0-10V) Dimming and ON/OFF controls.

F. Daylighting Sensors and Controls: Daylighting sensors are shown in spaces with LED and fluorescent lighting fixtures. Daylighting sensors and controls shall sense and dim these lighting fixtures via nLight CAT 5e network control of the fixtures. Dimming shall begin with fixtures located closest to exterior fenestration, and work inward in the space a minimum of 15' as appropriate for even total illumination of the space (A combination of daylighting and controlled lighting). In all cases daylighting control strategies must comply with the IECC, 2012 Paragraph C405.2.

G. Occupancy Sensing and Control: The low voltage lighting control system shall be programmed as follows:

1. When an occupant first enters a space with lighting enabled (fixtures off), the space shall illuminate to the 50% lighting power level. This requirement is based on ASHRAE 90.1, 2010 and applies to all spaces except those listed in Paragraph 9.4.1.a through d.
2. At all times, the occupant's manual control of the space (via wallpods or network control) will override automatic controls.

H. Vacancy Sensing and Control: In spaces containing occupancy sensors with a 'vs' designation, occupancy sensors shall be programmed as vacancy sensors (wallpod 'on,' occupancy sensor 'off').

I. All solid state line voltage dimmers shall have dedicated neutral wiring from the panelboard to the fixture. Light track systems that have a shared neutral shall be wired in accordance with the dimmer and light track systems manufacturers' drawings and instructions.

J. Photocells shall be installed with view window oriented to the North and away from direct or reflected artificial or natural light sources. Mount photocell(s) 1'-6" above roof on condulet fitting and connected to circuits indicated.

K. Lighting contactors shall be installed in a NEMA enclosure rated for the environment encountered.

END OF SECTION 260923

SECTION 262000 – LOW-VOLTAGE ELECTRICAL DISTRIBUTION

PART 1 - GENERAL:

1.1 RELATED DOCUMENTS:

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

1.2 WORK INCLUDED:

A. Connections For:
   1. Motorized Projection Screen

B. Contactors and Relays

C. Automatic Door Operators

D. Electric Door Strike

E. Surge and Transient (ILCP) Protection

1.3 RELATED WORK:

A.

B. Division 11 – Equipment - Projection Screens

C. Division 22 – Plumbing

D. Division 23 – Mechanical

E. Section 26 05 19 – Low-Voltage Electrical Power Conductors and Cables

F. Section 26 05 23 – Control Voltage Electrical Power Cables

G. Section 26 05 33 – Raceway And Boxes For Electrical Systems

H. Section 26 05 36 – Cable Management For Electrical Systems

I. Section 26 05 53 – Identification For Electrical Systems

J. Section 26 09 23 – Lighting Control Devices

K. Section 26 27 26 – Receptacles

L. Section 26 28 16 – Enclosed Switches And Circuit Breakers

M. Division 27 – Communications

N. Division 28 – Electronic Security and Safety

1.4 SUBMITTALS:

A. Submit shop drawings and product data in accordance with Section 26 05 00.

1. Shop Drawings for contactors, relays shall include:

a. Scale drawing of enclosure and internal components.
b. Internal wiring schematic.
c. Roughing-in requirements.

2. Product Data: Submit application, technical, and installation data.

B. Submit Operation and Maintenance Manuals in accordance with Section 26 05 00 for contactors, relays, buck/boost transformers.

PART 2 - PRODUCTS

2.1 PRODUCTS:

A. Contactors and Relays:

1. Shall be provided as required for proper circuit control. Each contactor shall have a hand-off-automatic switch and L.E.D. indicator [S] [O/M].
2. Square D Class 8903, Type L lighting contactor in NEMA-1 enclosures. Select correct coil voltage, normally open and normally closed contacts, quantity of paired contacts. The installation shall include an **undervoltage relay** if required, to drop out contactor at 85% of normal voltage [S] [O/M].

B. Isolated Loop Circuit Protector (ILCP) [S]:

1. The ILCP furnished is to have a line to line response time of less than one (1) nanosecond capable of accepting greater than 2000 amps (35 joules each line) to earth. Shield to earth current is to be 5000 amps maximum.
2. The ILCP is to be protected by a high dielectric insulating material and of small enough size to mount in a standard 4" square 2-1/8" deep electrical box.
3. Spark gap devices or devices incorporated in or installed within various systems' control panels in lieu of the specified ILCP are not acceptable.
4. All Isolated Loop Circuit Protectors must comply with UL #497B requirements.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. General: Division 26 shall provide the installation methods specified hereinafter for the following equipment:
   1. Motorized Projection Screens

   All electrical work for receptacles or connections to the above equipment shall be made by the Electrical Trade. Do no roughing-in or other electrical work in these areas until roughing-in drawings reviewed by the Architect-Engineer are received. The presumed location of all presently envisioned equipment having electrical connections is shown on the drawings and specified herein, but this is for estimating purposes only and the Contractor shall prepare his bid to allow for any possible rearrangement of the equipment listed, or as indicated. Provide permanent liquid-tight flexible metal conduit connections to the equipment from the outlet boxes or conduit stubbed up above the floor or conduit stubbed down from the ceiling for all equipment indicated, except where receptacles are indicated. These connections shall include but not be limited to; disconnect switches, service switches, combination motor starters, motor protective switches and other wiring devices as required per the manufacturer's drawings, the NEC and the Contract Documents.

B. Installation Methods:
   1. Motorized Projection Screens: Connect screen motor on circuit indicated. Provide proper control wiring to remote control switch at location indicated. Control switch will be furnished under other Divisions of this Contract and shall be installed in an outlet box by the Electrical Trade (Division 26).

C. Contactors and Relays: Install all contactors and relays in accordance with NEC as required.

D. Automatic Door Operators:

   1. Automatic door operators will be furnished in-place under Division 8. Under Division 26, power and control wiring shall be made to the door operator. The door operator push-button shall be installed and connected under Division 26, and furnished under Division 8. Provide proper control and power as recommended by door operator manufacturer.
   2. If required, Division 26 shall provide 120V AC circuitry, protected transformer and/or power supply above the ceiling to coordinate proper voltage with the door operator or provide the necessary power. Include any necessary control relays.
   3. Door release shall be connected to the fire alarms 24 VDC door release circuit if door is part of the path of egress and manual unlatching (such as a panic bar) is not provided. Provide proper wiring and conduit as recommended by fire alarm system and door operator manufacturers. Refer to Section 28 31 00.

E. Electric Door Strike:

   1. All electric door strike mechanisms shall be furnished in-place by Division 8 on indicated doors.
   2. Coordinate operation of the electric strike with all controls including Section 28 10 10 Electronic Access Control system. Division 26 shall provide all necessary controls, wiring, conduit, relays, connections not specifically specified as being provided under other Divisions.
   3. If required, Division 26 shall provide a 120 VAC circuitry, protected transformer and/or power supply above the ceiling to coordinate proper voltage with the electric strike or provide the necessary power. Include any necessary control relays.

4. The electric strike shall be connected to the fire alarms 24 VDC door release circuit if door is part of the path of egress and manual unlatching (such as a panic bar) is not provided. Provide proper wiring and conduit as recommended by fire alarm system and electric strike manufacturer. Refer to Section 28 31 00.

F. Surge and Transient (ILCP) Protection: All power and control equipment, between the building and site facility shall have surge and/or transient protection devices to comply with UL and NEC requirements. The protection shall be on both sides.

1. Provide ILCP devices for the Fire Alarm System and other systems as required.
2. Provide ILCP devices in accordance with NEC Article 800.

END OF SECTION 262000

SECTION 262416 - 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 this Section.

1.2 WORK INCLUDED:

A. Branch Circuit and Distribution Panelboards

B. Main Panelboard

1.3 RELATED WORK:

A. Section 26 05 53 – Identification for Electrical Systems

B. Section 26 28 16 – Enclosed Switches and Circuit Breakers

1.4 QUALITY ASSURANCE:

A. Integrated Circuit Breaker Panelboard Rating: Each panelboard, as a complete unit, shall have a rating equal to or greater than the integrated equipment rating shown on the panelboard schedule on the plans. Such rating shall be established by test with the circuit breakers mounted on the panelboard. The short-circuit tests on the circuit breaker and on the panelboard structure shall be made simultaneously by connecting the fault to each panelboard breaker with the panelboard connected to its rated voltage source. Method of testing shall be per proposed UL standards pertaining to listing of molded case circuit breakers for high-interrupting capacity ratings. The source shall be capable of supplying the specified panelboard short- circuit current or greater. Test data showing the completion of such tests upon the entire range of distribution and power panelboards to be furnished shall be submitted to the Engineer, if requested by him, with or before the submittal of approval drawings. Testing of panelboard circuit breakers for short-circuit rating only with the breaker individually mounted is not acceptable. Also, testing of the bus structure by applying a fixed fault to the bus structure alone is not acceptable.

1.5 REFERENCES:

A. All enclosed circuit breakers and panelboards shall meet and comply with applicable sections of UL, NEC and NEMA.

1.6 SUBMITTALS:

A. Submit shop drawings in accordance with Section 26 05 00.

1. Shop drawings for each panelboard shall include:

    a. Dimensioned layout.
    b. **EXACT** Arrangement of circuit breakers or fusible switches as indicated in the schedules. (Automatic "Rejection" of shop drawings if not followed.)
    c. Bus ampacity, interrupting capacity and composition.
    d. Main lug capacity and location.
    e. Future provision.

B. Submit Operation and Maintenance Manuals in accordance with Section 26 05 00.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. All panelboards shall be as manufactured by Square D or acceptable equal by Cutler-Hammer, G.E., or Siemens.

B. All replacement circuit breakers as indicated.

2.2 MATERIALS AND TYPE:

A. General:

1. Panels shall be dead front automatic circuit breaker as indicated and designed for type of service encountered.

B. **Panelboards** [S] [O/M]:

1. Breakers: Square D frame sizes are called for on the drawings to designate type of breaker to be installed. All breakers shall have a minimum interrupting capability of 10,000 amperes rms symmetrical or higher for 120 volt panels as noted on drawings, and shall be U.L. listed. The breaker's line terminal connection shall bolt directly to the panelboard's bus connecting strap or shall be a bus bar clamp type connection with bolt on device. Multi-pole breakers shall be in one molded case, common trip, with one operating handle. Where space only is indicated, provide mounting straps for future breaker.
2. Cabinets and Trim: Cabinets shall be of all code gauge galvanized steel, 6" minimum outside depth, with studs for mounting interiors. Minimum of 4" side gutters; top and bottom gutters as required; special gutter sizes as indicated on the drawings. Raceway openings to be 2" clear from front of cabinet. Steel front shall be grey lacquered Code gauge (#12 gauge) minimum for 225 amp bus panelboards and smaller amperage types, and (#10 gauge minimum) for 250 amp bus panelboards and higher amperage types, complete with metal framed index card holder, door with flush latch, concealed hinges, lock (two keys for each panel with all panels keyed alike) concealed adjustable trim clamps or screws and **hinged** trim.
3. Interior:

    a. All bus structure shall be copper with silver, cadmium or tin plating and insulated. Provide individual full solid plated copper neutral bus and solid plated copper ground bus. The bus

structure and main lugs, including any feed-through lugs, sub-feed (double) lugs and main circuit breaker where required, shall have the current ratings as indicated.

b. Panelboards that are indicated to be “Non-Linear” shall have 200% plated copper neutrals.

c. Provide mechanical screw type U.L. Listed lugs to accept solid and/or stranded copper and aluminum conductors for 90° C rated wire to accommodate the conductors indicated including derated conductors and oversized neutrals, as required.

4. Miscellaneous: Panelboards; that are indicated to be service equipment shall be rated and labeled for "Suitable for Service Entrance" by U. L.

C. **Main Panel** [S] [O&M]: Square D “I-Line”, or accepted equal, with circuit breakers arranged as shown on the drawings. All bus to be braced to withstand rms symmetrical amperes of short circuit stresses as noted on the drawings. Refer to paragraphs above for panelboard construction.

D. Molded Case Circuit Breakers (MCCB) shall be as specified in section 26 28 16.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Set all cabinets of all branch circuit and distribution panelboards, with top 6'-0" above finished floor, unless noted otherwise, or unless panel is taller than 4'-6".

B. Index cards to be properly labeled with typewritten letters indicating loads controlled by each circuit complete with room designation matching the Owner’s final labeling.

C. Engraved laminated plates on breakers of main panels shall be filled in with the load designation.

D. Interior trims of all panels shall be pulled up flush with front covers.

E. Coordinate voltage of shunt trips with connected systems.

F. Branch circuit breakers serving the following items shall have lock-on devices.

1. Exit signs
2. Walk-through and/or exit (egress) lighting
3. Security systems(s)
4. Timeclocks
5. Telephone power disconnect switches and receptacles
6. HVAC controls
7. Refrigerators

G. Panelboards shall not be activated ("hot") without **all** protective covers and enclosures installed.

H. Electric Heating Cable Circuits:

1. Provide 30 milliamp equipment protection circuit breakers for each electric heating (heat trace) cable circuit complete with dedicated neutral.

2. Do not connect any heat trace cable without written verification of testing and acceptance of the installed heat trace cable by the cable manufacturer's authorized technician.
3. Provide the minimum ampacity circuit breaker as indicated in Divisions 21, 22 & 23.

3.2 FIELD QUALITY CONTROL:

A. Technical Assistance: The panelboard manufacturer’s representative shall generally provide installation supervision of this equipment if requested by the contractor.

B. Calibration and Testing: The panelboard manufacturer’s representative shall provide a factory trained technician for initial calibration of circuit breaker trip and time delay settings to indicated values including ground fault protection system performance testing (NEC 230.95). All calibration and testing shall be in accordance with the manufacturer’s written instructions, NETA and all applicable codes and industry standards. Written records of the calibration and test procedures shall be submitted to the Owner, Architect/Engineer and Local Authority Having Jurisdiction (if required). These test procedures shall also include an insulation test, torquing of all connections, electrical interlocking verification, etc. The Architect/Engineer and/or Owner’s representative shall have the option of witnessing the testing procedures. The contractor shall coordinate the testing with all parties concerned.

END OF SECTION 262416

SECTION 262726 - RECEPTACLES

PART 1 - GENERAL:

1.1 RELATED DOCUMENTS:

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

1.2 WORK INCLUDED:

A. Receptacles

B. Weather Resistant Receptacles

C. Plates

1.3 RELATED WORK:

A. Section 26 05 33 – Raceway And Boxes For Electrical Systems

B. Section 26 50 00 – Lighting

1.4 REQUIREMENTS:

A. NEC 406 (Receptacles)

1.5 SUBMITTALS:

A. Submit shop drawings, product data and wiring device samples in accordance with Sections 26 05 00.

B. Submit Operation and Maintenance Manuals in accordance with Section 26 05 00.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. **All Receptacles [S]** shall be as manufactured by:

1. Cooper Industries
2. Hubbell
3. Leviton
4. Pass and Seymour (P&S)

All receptacles shall be by the same manufacturer.

B. Wiring Device Plates [S] and Blank Plates [S] shall be as manufactured by:

1. Hubbell,
2. Cooper Industries,
3. Leviton
4. Pass & Seymour (P&S)

All plates shall be by the same manufacturer. "Wet Location" (WL) plate and covers by:

1. Hubbell-Bell
2. Hubbell-TayMac
3. Legrand

2.2 MATERIALS AND TYPE:

A. All receptacles and other wiring devices shall be as indicated on drawings and specified hereinafter.

1. Unless otherwise indicated on the drawings all standard duplex receptacles shall be:

a. Leviton Industrial Series Extra Heavy Duty Specification Grade 5362 series.
b. Hubbell heavy duty specification grade “HBL 5362” series,
c. Cooper Industrial Specification grade “5362” series,
d. Pass & Seymour heavy duty specification grade “5362” series.

The receptacles shall be complete with one-piece plated grounding system, self-grounding, back side wired, and high impact polycarbonate, Lexan™, or nylon faces. Receptacle shall be rated for the voltage, poles, amperage and NEMA configuration required. Provide the proper nylon or polycarbonate bodied plug where indicated for equipment connection.

2. Selected NEMA 5-20 receptacles shall be corrosion resistant type as manufactured by:

a. Cooper Industries “CR” series or
b. Hubbell "CM and M" series unless otherwise indicated on the drawings.

3. Selected NEMA 5-20 receptacles shall be ground-fault circuit-interrupter type as indicated. Ground fault circuit interrupting receptacles, unless otherwise indicated on the drawings, shall be equal to the same receptacles series specified in paragraph A.2. Provide corrosion resistant type where indicated.
4. Selected NEMA 5-20 receptacles shall be “Hospital Grade” as indicated, and shall be the same receptacle series specified in paragraph A.2.
5. All other NEMA configurations (amperage and type) shall be equal to the same receptacle series specified in paragraph A.2. Provide matching nylon or polycarbonate bodies plug to match receptacle for all connected equipment where the equipment is not furnished with plug.

B. All Weather Resistant Receptacles shall be as indicated on the drawings and specified hereinafter.

1. Unless otherwise indicated on the drawings all weather resistant receptacles shall be:

a. Cooper Industrial Specification grade “5362” series,
b. Hubbell heavy duty specification grade “HBL 5362 WR” series,

c. Leviton Hospital Grade “WT599-HG” series,
d. Pass & Seymour heavy duty specification grade “WR5362” series.

C. The weather resistant receptacles shall be complete with a one-piece grounding system, self grounding, back side wired, and high impact polycarbonate, Lexan™, nylon or thermoplastic faces. Receptacle shall be rated for the voltage, poles, amperage and NEMA configuration required. Provide the proper nylon or polycarbonate bodied plug where indicated for equipment connection.

D. Plates: **For all systems** unless indicated otherwise.

High impact nylon, high impact thermoplastic or polycarbonate (Lexan) with smooth finish unless otherwise indicated. Color of plates shall be Ivory.

1. For Wet Locations, While in Use (WL): Weatherproof “Extra Duty” NEMA-3R enclosure constructed of die-cast aluminum complete with sealing gaskets and stainless steel mounting screws; and meets OSHA and NEC requirements **"WHILE IN USE"**. Housing size shall depend on the wiring device being protected. Housing for receptacles shall allow both angled and straight cord connectors, and shall incorporate a “cord catch” or “cord flap” gaskets.

a. Hubbell-Bell “RaynGuard” 5800 series
b. Hubbell-Taymac “CodeGuard” 5800 series.
c. Legrand WIUCAST1 series.

2. For F.S. or F.D. Boxes (Interior Only): Die cast covers with gaskets, as manufactured by Crouse-Hinds, Appleton, Red Dot or acceptable equal.
3. Screws: Heads to match plate material and finish.
4. Provide blank plates for all unused outlets.

E. Wiring Device and Plate Colors: Architect will review and accept color of wiring devices. Contractor shall allow for selection from "standard" colors (grey, white, ivory, brown) of wiring devices in his bid proposal.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. All wiring devices shall be mounted at elevations indicated.

B. All duplex receptacles shall be mounted vertical with ground slots towards floor, unless otherwise indicated by the Owner or Authority having jurisdiction.

C. Install plates on all outlets and wiring devices, with all four edges in continuous contact with finished wall surfaces without the use of mats or similar devices. Plaster fillings will not be permitted. Plates shall be installed with an alignment tolerance of 1/16 inch. The use of sectional device plates will not be permitted.

D. Where the wall opening for a wall or casework outlet box is larger than a standard plate cover, repair the outlet opening to accept a standard size plate. “Jumbo” or “Junior Jumbo” device plates are not acceptable.

E. Provide ground-fault interrupter type (GFCI or GFI) NEMA 5-20 receptacles where NEMA 5-20 receptacles are indicated in or at the following locations unless ground fault interrupter branch circuit breakers are indicated:

1. Bathrooms, and toilets.
2. Within 6'-0" radius of all lavatories and sinks, and at **all** elevations.
3. Receptacles that power refrigeration compressors, evaporators, etc., shall not be GFI protected due to inherent ground fault currents which will cause nuisance tripping, unless the receptacle device is located in a kitchen in which case it must be GFCI.
4. All other current Virginia USBC, NEC and OSHA GFCI required locations.

F. All exterior wiring device outlet boxes shall utilize weather resistant ground fault interrupter receptacles and wet location (WL) "**While in Use"** enclosures.

G. Receptacle contactors shall be installed in a NEMA enclosure rated for the environment encountered.

H. Each grade mounted exterior Division 23 (HVAC) equipment shall be provided with a NEMA 5-20 weather resistant ground fault interrupter work receptacle in a FS/FD box and gasketed **"While in Use" (WL)** weatherproof enclosure in compliance with the NEC. Connect on nearest available circuit unless a circuit is indicated.

I. Division 26 shall furnish the polycarbonate or nylon angular plugs for the indicated equipment as required. Division 26 shall install the plugs on the equipment including proper specified flexible cable (cord).

END OF SECTION 262726

SECTION 262813 - FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 WORK INCLUDED:

A. Fuses [S]

1.3 RELATED WORK:

A. Section 26 28 16 – Enclosed Switches And Circuit Breakers

B. Section 26 29 00 – Low-Voltage Controllers

1.4 SUBMITTALS:

A. Submit product data in accordance with Section 26 05 00.

1. Product Data: Submit application, technical, and installation data.

PART 2 - PRODUCTS [O/M]

2.1 MANUFACTURERS:

A. All Fuses shall be as manufactured by Cooper Industries, GEC Alsthon, Littlefuse, Gould-Shawmut (Nippon Mining). [S] [O/M]

B. **Fuse Cabinet** shall be as manufactured by the above fuse manufacturer, Hoffman, Austin or acceptable equal. [S]

2.2 MATERIALS AND TYPE:

A. Motor Fuses: Rejection type **C** class RK-1, dual element, time-delay, current limiting, cartridge type, by 300™ Low-Peak Yellow™ by Bussman, LoIp© by CEFCo, Power-Pro® by Littlefuse, "AMP-TRAP 2000" by Gould-Shawmut (Nippon Mining), with a minimum interrupting rating of 200,000 amperes rms symmetrical.

B. Cabinet: Wall mounted enclosure complete with shelves for storage of spare fuses and instruction manual. Door shall be lockable with same key as panelboards.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Fuses for motor circuits shall be sized in accordance with the fuse manufacturer's sizing chart for **"motor running overload protection"**, unless otherwise required for a specific motor. All other fuses for other than motor circuits shall be of size and type as required by the connected equipment manufacturer's written instructions unless otherwise indicated. Labels indicating size and type of replacement fuses shall be glued to inside of door on all fusible switches, fusible motor starters and panels.

3.2 SPARE FUSES:

A. 600 Amp Fuses and Smaller: Furnish spare fuses not to exceed 10% of each rating with a minimum of three (3) per rating.

B. Contractor shall deliver the spare fuses with invoice to the Owner's Maintenance Operations Center.

END OF SECTION 262813

SECTION 262816 – ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 WORK INCLUDED:

A. Disconnect Switches

B. Circuit Breakers

1.3 RELATED WORK:

A. Section 26 05 53 – Identification For Electrical Systems

B. Section 26 20 00 – Low-Voltage Electrical Distribution

C. Section 26 24 16 - Panelboards

D. Section 26 28 13 – Fuses

E. Section 26 29 00 – Low-Voltage Controllers

1.4 REFERENCES:

A. All disconnect switches and circuit breakers shall meet and comply with applicable sections of U.L., N.E.C. and NEMA.

1.5 SUBMITTALS:

A. Submit shop drawings and product data in accordance with Section 26 05 00.

1. Shop Drawings for Disconnect Switches shall include:

a. Scale drawing of enclosure and internal components.
b. Roughing-in requirements.

2. Circuit Breaker shop drawings shall include:

a. Frame type and ampere rating.
b. Trip amperage.
c. Interrupting rating in RMS symmetrical amps.

d. Accessories.

3. Product Data: Submit application, technical, and installation data.

B. Submit Operation and Maintenance Manuals in accordance with Section 26 05 00.

PART 2 - PRODUCTS [O/M]

2.1 MANUFACTURERS:

A. All disconnect switches shall be Square D (Group Schneider) Class 3110 Heavy Duty Visible-Blades® safety switches, General Electric Spec-Setter© Heavy Duty Type TH (to 600A), and Type TC (800A & 1200) safety switches [S][O/M], Cutler-Hammer/Eaton Heavy Duty Type DH series safety switches, and Siemens Vacu-Break VBII™ Heavy Duty safety switches.

B. All circuit breakers shall be as manufactured by Square D or acceptable equal by Cutler-Hammer/Eaton, General Electric (GE) or Siemens.

2.2 MATERIALS AND TYPE:

A. Disconnect Switches [S] [O/M]: Rated for voltage encountered, poles and amperage as required. Heavy Duty, NEMA enclosures, fusible for rejection type class R fuses only, solid neutral assembly, equipment grounding kit, unless otherwise indicated. Refer to NEMA type under PART 3 - EXECUTION.

B. Molded Case Circuit Breakers (MCCB) [S] [O/M]:

1. Ratings and special features shall be as scheduled.
2. Trips shall be thermal magnetic with inverse time delay and instantaneous time-current characteristics.
3. 225 ampere frame and larger MCCB shall have permanent non-interchangeable trips, factory-calibrated at 40 degrees C, and adjustable magnetic feature set by a single adjustment. Interchangeable trips will be considered as an alternative.
4. Industrial grade MCCB shall be provided except that commercial grade MCCB (quick-lag "Q-Line") may be used for MCCB 100 amperes and below where other indicated criteria are met.
5. Ambient compensating MCCB shall be provided for outdoor applications or where indicated on drawings.
6. MCCB shall not be used for switching lights unless they are specifically rated for switching duty.
7. U.L. listed HACR type circuit breakers shall be provided for use with air conditioning, heating and refrigeration equipment having motor group combinations and marked for use with HACR type circuit breakers.
8. Electronic Trip Circuit Breakers: Square D “Micrologic” trip system or accepted equal to include the following features (unless otherwise indicated in schedules):

a. 100% Rated
b. True RMS Sensing
c. Interchangeable Trip Units
d. LI, LIG, LS(I)G (Instantaneous OFF) Configurations (as scheduled)
e. Short-time Delay = I^2t IN & 1^2t OUT

f. Ground-fault Delay = I^2t IN & 1^2t OUT
g. Short-time Withstand Rating
h. Integral Ground-fault Testing
i. LED Long-time Pickup Indication
j. Zone Selective Interlocking (Short-time & Ground-fault) with main protective device and downstream protective devices
k. Thermal & Magnetic Backup Protection
l. Long-time & Ground-Fault Memory
m. Local Trip Indicators - Overload, Short-circuit, Ground-fault
n. Local Ammeter/Trip Indicator
o. Trip unit seal kit
p. Externally accessible test port
q. High level selective over-ride
r. Neutral Current Transformer
s. One (1) universal test set, for the entire project, to be used for required test procedures prior to project completion.

9. Circuit breakers shall have removable lugs. Lugs shall be UL listed for copper and aluminum conductors. Breakers shall be UL listed for installation of mechanical screw-type lugs and compression type lugs.
10. Current limiting circuit breakers shall meet UL 489 requirements, NEMA Standard AB3-2013 and Federal Specifications W-C-375B/GEN.
11. Combinations for series connected interrupting ratings shall be recognized by Underwriters Laboratories and shall appear in the Recognized Component Directory under the "Circuit Breakers - Series Connected" product category DKSY2. Current limiting circuit breakers shall allow the use of branch circuit breakers with lower interrupting capacities on systems capable of delivering fault currents up to 200,000 rms symmetrical amperes at 480V ac and 100,000 rms symmetrical amperes at 600V ac.
12. Add-on ground fault modules (GFM) shall be a U.L. Listed circuit breaker accessory complete with adjustable time and levels, ground fault sensing device and relay, push-to-test button, indicator, neutral transformer, zone-interlock restraint interface module, and 120 volt control power for integral test. Provide a factory installed ground-fault shunt trip in related circuit breaker.

C. Fuses: Provide specified fuses, sizes as required.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Provide disconnect switches for all motors and appliances for the project where required by the National Electrical Code; and rated for the voltage encountered complete with required poles, amperage rating and all accessories. Not all disconnect switches required by NFPA-70 are necessarily indicated on the drawings.

B. All roof mounted fans shall have a disconnect switch (device) mounted under the hood by the Mechanical Trade. This switch (device) shall be wired in series with the firestats on the fans.

C. Provide rain-tight NEMA-3R, NEMA-4, NEMA-4X, explosion-proof or other NEMA enclosures for switches where required by NEC and environmental conditions.

D. Certain fusible disconnect switches shall be fully U.L. Service Equipment rated and labeled as indicated by the electrical distribution system.

E. Coordinate voltage of shunt trips with connected systems.

3.2 FIELD QUALITY CONTROL:

A. Technical Assistance: The electrical gear manufacturer's representative shall generally provide installation supervision of this equipment if requested by the contractor.

B. Calibration and Testing: The electrical gear manufacturer's representative shall provide a factory trained technician for initial calibration of circuit breaker trip and time delay settings to indicated values. All calibration and testing shall be in accordance with the manufacturer's written instructions, and all applicable codes and industry standards. Written records of the calibration and test procedures shall be submitted to the Owner, Engineer and Authority Having Jurisdiction (if required). These test procedures shall also include an insulation test, torquing of all connections, electrical interlocking verification, etc. The Engineer and/or Owner's representative shall have the option of witnessing the testing procedures. The contractor shall coordinate the testing with all parties concerned.

END OF SECTION 262816

SECTION 262900 – LOW-VOLTAGE CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 WORK INCLUDED:

A. Motor Protective Switches

B. Control Accessories

1.3 RELATED WORK:

A. General: The Contractor shall consult all other sections of these Contract Documents specifications containing any type of equipment requiring electrical connections and allow for wiring and controlling all equipment as described therein even though not shown on the electrical drawings. See mechanical drawings for exact locations and names of Mechanical Equipment and Controls. (Division 23)

B. Division 23 - Mechanical

C. Section 26 28 13 - Fuses

1.4 SUBMITTALS:

A. Submit shop drawings and product data in accordance with Section 26 05 00.

1. Shop Drawings shall include:

a. Scale drawing enclosure and internal components.
b. Internal wiring schematic.
c. Roughing-in requirements.

2. Product Data: Submit application, technical, and installation data.

B. Submit Operation and Maintenance Manuals in accordance with Section 26 05 00.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. All motor protective devises shall be as manufactured by Square D, Furnas, Cutler-Hammer/Eaton, G.E., Siemens, or Allen Bradley. All controllers and accessories to be by the same manufacturer.

2.2 MATERIALS AND TYPE:

A. Motor Protective Switches [S] [O/M]: Marked 'MP' on drawings. Manual type with overload relay for each phase, with poles as required and separately wired neon or L.E.D. pilot light. M.P. switch and pilot shall be mounted on one (1) multi-gang plate.

B. **Heaters** [S] [O/M]: Install thermal overload heater elements in all switches and starters on the job whether or not the switches and starters are furnished by this subcontractor. Assume responsibility for proper application of motor running protection for all motors in accordance with the manufacturer's recommendations and the nameplate rating of the motors actually installed. All phases to have overload protection. (Not required on solid state overload relay.)

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Motors: All motors and motor-driven equipment will be provided in place by another Trade, ready for connection by the Electrical Trade with control equipment provided by the Trade who provides the equipment unless specifically indicated otherwise. Motor branch circuits, etc., are designed for motor sizes as shown on the drawings. The motors and motor-driven equipment actually installed may vary from these sizes. The Electrical Trade shall verify actual sizes and notify the Engineer of any required changes.

B. Provide all required motor starters and motor protective switches, rated for the voltage encountered, complete with required poles, amperage rating and all accessories, unless indicated otherwise. Required motor starters may not be indicated on the electrical drawings. Refer to mechanical (and other divisions) equipment drawings and specifications for additional starter requirements, and provide starters as required. Provide all H.O.A. switches, L.E.D. pilots, auxiliary contacts, etc. in starters and M.P. Switches as required by Electric Sequence Control Diagrams. Provide all other control devices as called for by drawings and specifications. Provide "power available" and "run" L.E.D. indicating lights for all motor starters. The "power available" L.E.D. indicating lights are not necessarily indicated in the Electric Sequence Control Diagrams.

C. Responsibility: The Mechanical Trade is responsible for the proper operation of the mechanical systems. The Electrical Trade is responsible for all electrical work in connection therewith.

D. Provide a motor protective switch in the cabinet of wall mounted unit heaters or fan coil units; and on one side of ceiling mounted units unless indicated otherwise. Position the switch to prevent the radiation from affecting the overload protection.

E. Motor Operated Dampers (MOD's): Division 26 shall interconnect all line voltage MOD's with Division 23 air-handling units and fans with proper voltage and ampacity wiring for sequence of operation as required by the Mechanical Drawings. Provide a 120 volt – 20 amp circuit from the next available spare breaker in the closest mechanical or receptacle circuit panel where a circuit is not specifically indicated on the drawings. MOD's may be connected as part of the motor control circuit, verify with the Division 23 Electric Sequence Control Diagrams.

F. Install all motor protective switches adjacent to the panelboard serving the switch unless indicated otherwise on the drawing or Division 23 Electric Sequence Controls. Each switch shall be installed in an individual outlet box, arranged in vertical or horizontal rows. Provide recessed outlet boxes if the adjacent panel is recessed. Provide **cast type** single gang boxes if the adjacent panel is surface mounted.

G. All wiring within the motor starter (control) enclosure and to the motor shall be Type MTW stranded copper per Section 26 05 19 and Section 26 05 23.

END OF SECTION 262900

SECTION 26 41 00 - LIGHTNING PROTECTION SYSTEM

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 WORK INCLUDED

A. Complete Lightning Protection System with Accessories

B. Ground System

1.3 RELATED WORK

A. Section 26 05 19 – Low-Voltage Electrical Power Conductors and Cables

B. Section 26 05 26 – Grounding And Bonding For Electrical Systems

C. Section 26 05 33 – Raceway And Boxes For Electrical Systems

D. Section 26 05 43 – Underground Ducts And Raceways For Electrical Systems

1.4 SYSTEM DESCRIPTION

A. The Lightning Protection System shall be a complete system of air terminals, conductors, ground terminals, interconnecting conductors, arresters, and other connectors or fittings required to complete the system, for the practical safeguarding of persons and property from hazards arising from exposure to lightning.

1.5 QUALITY ASSURANCE

A. The Lightning Protection System shall be installed by an accredited installer of a manufacturer of Underwriters' Laboratories listed materials, and in conformance with standards set forth by the specified references.

B. Lightning rods shall meet OSHA’s personnel implement protection requirement known as OSHA 1926.701 (b) and meet or exceed NFPA 780 (2014), UL96A and LPI requirements.

1.6 REFERENCES

A. NFPA-780-2014, "Standard for the Installation of Lighting Protection Systems@

B. UL96A, "Master Labeled Lightning Protection Systems".

1.7 SUBMITTALS

A. Submit shop drawings and product data in accordance with Section 26 05 00.

1. Shop drawings shall include:

a. Scale drawing of complete Lightning Protection System showing all air terminals, conductors, ground terminals, interconnecting conductors, arresters, and other connectors or fittings required to complete the system. Drawings shall include bonding and grounding of all metallic bodies of conductance and inductance, soil vent pipes, masts, and grounding system grids. Drawings shall include, but are not limited to, all rods and points shown or referenced on the architectural drawings, which do not necessarily include all required Lightning Protection System components.

b. As-Built Drawings of the complete Lightning Protection System.

2. Product Data: Submit application, technical, and installation data.

B. Submit configuration details and ground resistance test reports for all ground points. Ground tests shall be performed with all building components disconnecting from the ground points under test.

1.8 WARRANTY

A. The Master Label of Approval from Underwriters' Laboratories shall be furnished to the Architect/Engineer, upon completion of the installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Lightning Protection Systems by Loehr Lightning Protection Co., Richmond, VA (804-272-1627), Modern Lightning Protection Co., Inc., Raleigh, NC (800-368-8090), Robbins Lightning Protection, Inc., or acceptable equal.

2.2 MATERIALS AND ACCESSORIES [S] [O/M] [V]

A. The Lightning Protection Equipment shall be manufactured and labeled under the factory inspection program of Underwriters' Laboratories, Inc.

B. Materials shall be Class I for protection of ordinary buildings and structures not exceeding 75 feet in height.

C. Precautions shall be taken to provide against any tendency towards deterioration due to local conditions. Where any part of a copper protective system is exposed to the direct action of exhaust gases or other corrosive gases, it shall be protected by a continuous hot dip coating of lead. Such a coating shall extend at least 2 ft. (0.6m) below the top of the chimney.

D. Connectors and fittings shall be suitable for use with the conductor and the surfaces on which they are installed. Bimetallic connectors and fittings shall be used for splicing or bonding dissimilar metals.

PART 3 EXECUTION

3.1 INSTALLATION

A. Conductors shall be **copper**, sized in accordance with NFPA-780 (2008). Aluminum shall **not** be permitted

B. Splices, connectors, clamps, bases, bonding fixtures, and other miscellaneous material shall be as recommended by the manufacturer, shall be of substantial construction, and of material electrolytically compatible with the conductor and mounting surface.

C. Where any part of a protection system is exposed to mechanical injury, it shall be protected by covering it with molding or tubing. If ferrous metal pipe or tubing is used around the conductor, the conductor shall be electrically connected to the pipe or tubing at both ends.

D. Constrain conductors at least every three feet.

E. Bimetallic connectors shall be used for splicing or bonding dissimilar metals.

F. If required, aluminum joint compound shall be Thomas and Betts Catalog No. 21059.

G. Avoid penetration of roofing materials by fastening devices. When roof penetration is unavoidable, obtain Architect/Engineer's specific approval of the fastening method prior to installation.

H. Air terminals shall be uniformly and symmetrically positioned. The air terminals shall have a cast bronze mushroom type cap with a safety yellow or orange extension rod and a safety spring adapter for additional implement protection. This adaptation shall meet OSHA 1926.701 (b) requirements.

I. All portions of the systems shall be concealed except for the points of the air terminals. The Contractor shall schedule and coordinate his work so that the concealed components may be properly installed, or provided to other trades for building-in when required.

J. Down connectors shall be installed in non metallic conduits concealed in the air space or chase space between the interior and exterior walls.

K. System shall be bonded to the BGES.

3.2 FIELD QUALITY CONTROL

A. Technical Assistance: Manufacturer's representative shall generally supervise installation of this equipment with the Contractors concerned, providing up to five days of job supervision at various intervals during the job.

B. Resistances of ground points and grids shall be recorded and submitted to Architect/Engineer for approval.

C. Verification: Upon completion of the Lightning Protection System the Contractor shall submit the Master Label of Approval from Underwriters' Laboratories to Architect/Engineer.

END OF SECTION 264100

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SECTION 264300 - TRANSIENT VOLTAGE SURGE SUPPRESSION (TVSS)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 WORK INCLUDED:

A. Transient Voltage Surge Suppressors (TVSS)

1. Service Entrance Main Panelboard, TVSS-#1

1.3 RELATED WORK:

A. Section 26 05 53 – Identification For Electrical Systems

B. Section 26 24 16 – Panelboards

C. Section 26 60 13 - Electric Service

1.4 DESCRIPTION:

A. General. The TVSS shall be a hybrid high-energy power conditioning filter incorporating transient voltage surge suppression and high-frequency electrical line noise filtering. The specified unit shall provide effective high-energy transient voltage suppression, surge current diversion, high-frequency attenuation, and line control in ANSI/IEEE C62.41-1991 environments connected on the load side of the facility's electrical distribution system as indicated. The unit shall be connected in parallel with the facility's wiring system.

B. Parameters: The TVSS shall meet or exceed the following electrical parameters.

1. Unit Operating Voltage. The nominal unit operating voltage and configuration shall be as determined from the parameters of the circuit to which the TVSS is connected on the drawings.
2. Maximum Continuous Operating Voltage (MCOV). The maximum continuous operating voltage of all suppression components utilized in the unit shall not be less than 125% of the facility's nominal operating voltage for 120 volt nominal systems and not less than 115% of the facility's nominal operating voltage for 480 volt nominal systems.
3. Operating Frequency. The operating frequency range of the unit shall be 47 to 63 Hertz.
4. Protection Modes. The unit's primary mode of protection shall be line-to-line and line-to-neutral. The secondary modes of protection shall be line-to-ground and neutral-to-ground. This results in 10 modes of protection.
5. The Rated Single Pulse Surge Current Capacity. Based on ANSI/IEEE C62.41-1991's standard 8 x 20 microsecond current waveform, the rated single pulse surge current capacity, in amps, of the designated unit shall be no less than as follows:

TVSS-#1:

150,000A	=	L-N
150,000A	=	L-G
150,000A	=	N-G
150,000A	=	L-L
300,000A	=	Per Phase

In compliance with NEMA LS-1-1992, paragraphs 2.2.9 and 3.9, the system shall be single pulse surge current tested in all modes at rated surge currents by an industry-recognized independent test laboratory. Single pulse surge current capabilities of 200,000 amps or less are established by single-unit testing of all components within each mode. Due to present industry test equipment limitations, single pulse surge current capacities over 200,000 amps are established via testing of individual components or sub-assemblies within a mode. The test shall include a UL1449 Second Edition surge defined as a 1.2 x 50 Φsec, 6000V open circuit voltage waveform and an 8 x 20 Φsec, 500A short circuit current waveform to benchmark the unit's suppression voltage followed by a single pulse surge of maximum rated surge current (for units rated over 200,000A per mode, components or sub-assemblies are tested) magnitude with an approximated 8 x 20 Φsec waveform. To complete the test, another UL1449 surge shall be applied to verify the unit's survival. Survival is achieved if the suppression voltage measured from the two UL1449 surges does not vary by more than 10%.

6. Minimum Repetitive Surge Current Capacity. Per ANSI/IEEE C62.41-1991 and ANSI/IEEE C62.45-1992, the TVSS system shall be repetitive surge current capacity tested in every mode utilizing a 1.2 x 50 Φsec, 20 KV open circuit voltage, 8 x 20 Φsec, 10 KA short circuit current Category C3 bi-wave at one minute intervals without suffering either performance degradation or more than 10% deviation of clamping voltage at the specified surge current. The specified TVSS system shall be capable of withstanding the following category "C.3" impulses (per mode) without failure.

   Repetitive Surge Current Capacity-Number of Impulses

TVSS Mark	# of Impulses
TVSS-1	>5.500

7. NEMA LS-1-1992 Clamping Voltage Data. All TVSS system clamping voltages shall be in compliance with test and evaluation procedures outlined in NEMA LS-1-1992, paragraphs 2.2.10 and 3.10. The maximum clamping voltages for the specified system shall be no higher than 700 volts @ category C.3 volts, for 480Y/277V unit and 330 volts @ category C.3 for 208Y/120V type unit. The clamping voltage numbers include the integral disconnect.
8. Unit UL1449 Second Edition Suppression Voltage Ratings. The UL1449 Second Edition listed suppression voltage ratings shall be published, as assigned by Underwriters Laboratories utilizing the test procedure described in UL1449 Second Edition Suppression Voltage Performance Testing.
9. High Frequency Extended Range Power Filter. The TVSS system's EMI-RFI noise rejection or attenuation values shall be in compliance with test and evaluation procedures outlined in NEMA LS-1-1992, paragraphs 2.2.11 and 3.11.

Atten. Freq.	**50KHz**	**100KHz**	**500KH**	**1MHz**	**5MHz**	**10MHz**	**50MHz**	**100MH**
	53dB	41dB	32dB	31dB	32dB	35dB	47dB	53dB

NOTE: Standardized insertion loss data obtained utilizing MIL-STD-220A 50 ohm insertion loss methodology. Noise source path = 100' to model maximum average circuit distance, filter connection distance = 6".

The TVSS system shall function in conjunction with other suppression filter devices of the same manufacturer via coordinated filters within the facility-wide suppression filter system that provide minimum noise attenuation as follows:

Atten. Freq.	**50KHz**	**100KHz**	**500KH**	**1MHz**	**5MHz**	**10MHz**	**50MHz**	**100MH**
	85dB	83dB	68dB	68dB	68dB	67dB	78dB	84dB

NOTE: Standardized insertion loss data obtained utilizing MIL-STD-220A 50 ohm insertion loss methodology, based on a minimum of 100 ft. of #4 AWG conductor between the two devices. Noise source = 100' to model maximum average circuit distance, filter connection distance = 6".

C. Overcurrent Protection

1. Each suppression element shall be individually fused such that the failure of a single component or the operation of a single fuse element remains isolated and does not render the entire mode, or product, deficient by more than the 10%.
2. Every electrical current carrying conductor shall be fused such that every fault is isolated at the point of the fault or at the device level.
3. Fusing shall be present in all modes, including Neutral-to-Ground.
4. All overcurrent/fault current protection shall be UL248-1 recognized as a stand-alone fuse.
5. All fusing must be UL248-1 recognized and tested at 200kAIC. Testing shall be inclusive of all available product voltages.
6. In accordance with UL248-1, all fuses and overcurrent/fault current devices must be tested with a 0.2 power factor.
7. All fuses and overcurrent/fault current protection devices shall consist of self-arch-quenching, sand-encapsulated UL248-1 recognized fuse arrays. Each fuse shall be individually sealed in a manner that eliminates cross arching.
8. The device shall be capable of withstanding the full single pulse surge current capacity for every mode without the operation or failure of overcurrent/fault current protection or fuses.

D. Transient Conduction Path: All full magnitude transient currents shall be conducted on low-impedance solid copper bussing. If printed circuit boards are utilized in surge current paths, no single trace shall be allowed to conduct more than the proportional current share of the connected TVSS component.

E. Environmental Requirements:

1. Storage Temperature. Storage temperature range shall be -40º to +85ºC (-40º to +185ºF).
2. Operating Temperature. Operating temperature range shall be -40º to +60ºC (-40º to +140ºF).
3. Relative Humidity. Operation shall be reliable in an environment with 5% to 95% non-condensing relative humidity.
4. Operating Altitude: The unit shall be capable of operation in altitudes up to 13,000 feet above sea level.
5. Audible Noise: The unit shall not generate any audible noise.
6. Magnetic Fields: No appreciable magnetic fields shall be generated. Unit shall be capable of use directly in Computer Rooms in any location without danger to data storage systems or devices.

1.5 QUALITY ASSURANCE:

A. Source Quality Control: Materials and equipment shall be new, unused and UL listed for use as a TVSS.

B. The TVSS shall be supplied by a USA manufacturer of established reputation and experience who shall have produced similar apparatus for a period of at least five (5) years and who shall be able to refer to similar installations rendering satisfactory service.

C. The Electrical Trade shall furnish the services of the TVSS manufacturer's authorized technical representative who is qualified in the installation and operation of the TVSS being provided, and who shall be qualified and experienced in the inspection, testing, and maintenance of TVSS units. This authorized technical representative shall be factory trained and certified by manufacturer of the TVSS being installed.

D. The above TVSS manufacturer's authorized technical representative shall be hereinafter known as the "TVSS Technician". The TVSS Technician and his employer shall be capable of providing testing and maintenance in accordance with UL's requirements. The TVSS Technician shall supervise the hook-up, final testing and adjustment of the TVSS, and provide instruction to the Owner's representative. The TVSS installation shall include wiring, components, connections, adjustment, testing and certification. The Electrical Trade shall provide conduit, wire, circuit breaker, and boxes as indicated, and required by the manufacturer's drawings or instructions. The TVSS manufacturer shall furnish any special back boxes, cabinets, enclosures and similar items to the Electrical Trade for installation by the Electrical Trade in accordance with the manufacturer's drawings and instructions, and as indicated.

E. Certification shall be submitted verifying that the TVSS installation is by the manufacturer's authorized representative.

1.6 REFERENCES:

A. Standards:

1. The TVSS shall be designed, manufactured, tested and installed in compliance with the following:

   a. Underwriters Laboratories (UL 1449 Second Edition and 1283)
   b. National Fire Protection Association (NFPA-70, 75 and 78).
   c. American National Standards Institute (ANSI).
   d. Institute of Electrical and Electronics Engineers (ANSI/IEEE C62.41-1991, Categories A, Band C3 and C62.45-1987).
   e. National Electrical Manufacturers Association (NEMA).
   f. ANSI/IEEE Std. 1100-1999 Section 8.6.1 (Emerald Book).
   g. ANSI C84.1, American National Standard for Electric Power Systems and Equipment – Voltage Ratings (60Hz).

2. The unit shall be UL 1449 listed as a Transient Voltage Surge Suppressor.

B. Testing:

1. Single Pulse Surge Current Capacity Testing: In compliance with NEMA LS-1-1992, paragraphs 2.2.9 and 3.9, each design configuration shall have the maximum single pulse surge current capacity per mode verified through testing. The test shall include a UL1449 Second Edition surge defined as a 1.2 x 50 Φsec 6,000V open circuit voltage waveform and an 8 x 20 Φsec 500A short circuit current

waveform to benchmark the unit's suppression voltage, followed by a single pulse surge of maximum rated surge current magnitude with an approximated 8 x 20 Φsec waveform. To complete the test, another UL1449 surge shall be applied to verify the unit's survival. Survival is achieved if the suppression voltage found from the two UL1449 surges does not vary by more than 10%.

2. Minimum Repetitive Surge Current Capacity Testing. Each design configuration shall have a repetitive surge current capacity rating which shall be verified through testing. The test shall include a UL1449 Second Edition surge defined as a 1.2 x 50 Φsec 6,000V open circuit voltage waveform and an 8 x 20 Φsec 500A short circuit current waveform to benchmark the unit's suppression voltage, followed by a repetitive number of ANSI/IEEE C62.41-1991 Category C3 surges defined as a 1.2 x 50 Φsec 20,000V open circuit voltage waveform and an 8 x 20 Φsec 10,000A short circuit current waveform. To complete the test, another UL1449 surge shall be applied to verify survival. Survival is achieved if the suppression voltage resulting from the two UL1449 surges do not vary by more than 10%. Proof of such testing shall be the test log generated by the surge generator.
3. UL 1449 Second Edition Suppression Voltage Performance Testing. Each design configuration shall have a UL 1449 Second Edition Suppression Voltage Rating that has been tested and assigned by Underwriters Laboratories utilizing the following waveforms and procedures. The test shall be initiated with a surge of 6,000V / 500A, using waveshapes defined within ANSI/IEEE C62.41-1991 as a 1.2 x 50 Φsec open circuit voltage waveform and an 8 x 20 Φsec short circuit current waveform, to benchmark the unit's suppression voltage. The unit shall then be subjected to 10 positive polarity and 10 negative polarity 1.2 x 50 Φsec 6,000V open circuit voltage waveforms and an 8 x 20 Φsec 3,000A short circuit current waveform. For comparison with the initial benchmark voltage reading, another ANSI/IEEE surge defined as 1.2 x 50 Φsec 6,000V open circuit voltage waveform and an 8 x 20 Φsec 500A short circuit current waveform shall be applied. Deviation from initial to final clamping voltage may not exceed +/ - 10%. Upon successful completion, an appropriate UL1449 Second Edition Suppression Voltage Rating is assigned by Underwriters Laboratories.
4. Short Circuit Fuse Testing: Each design configuration shall be short circuit tested in accordance with the type of fusing utilized in the suppression path. Testing shall include application of a sustained overvoltage that causes the unit to enter a bolted fault condition. This bolted fault condition shall occur with the full rated A/C current of the fuse available. The fuse shall fail in a safe manner with no physical or structural damage to the unit and any failure shall be self-contained within the unit.
5. Surge Current Fuse Testing: Each design configuration shall be surge tested with fusing in series to verify that a transient of maximum surge current capacity magnitude is fully suppressed without fuse failure, operation, or degradation.
6. MCOV (Maximum Continuous Operating Voltage) Testing: Each unit shall be factory tested at the applicable MCOV to assure proper field operation.
7. Quality Assurance Testing. Each unit shall be thoroughly factory tested before shipment. Testing of each unit shall include, but shall not be limited to, UL manufacturing and production-line tests, quality assurance checks, MCOV and clamping voltage verification tests.
8. Start-Up Testing. Upon completion of installation, a factory-certified local service technician shall provide testing services. The following tests shall be performed: (a) voltage measurements from Line-to-Ground, Line-to-Neutral, Line-to-Line, and Neutral-to-Ground at the time of the testing procedure, (b) impulse injection to verify the system suppression voltage tolerances for all suppression paths. Impulse testing shall be completed while the unit is off-line to isolate the unit from the distribution system. Test results shall be recorded and compared to factory benchmark test parameters supplied with each individual unit. A copy of the start-up test results and the factory benchmark testing results shall be supplied to the engineer and the owner for confirmation of proper suppression filter system function. In addition, the integrity of the neutral-ground bond should be verified through testing and visual inspection. A Ten Year Limited Warranty shall initiate after the owner has accepted the testing results and taken possession of the equipment.

1.7 SUBMITTALS:

A. Refer to Section 26 05 00 for submittal procedures.

B. Shop drawings shall include:

1. Scale drawing of enclosure and internal components.
2. Internal wiring schematic.
3. Roughing-in requirements.

C. Product Data: Submit application, technical, and installation data.

D. Refer to Section 26 05 00 for submittal procedures for Operation and Maintenance Manuals.

E. Warranty, Service:

1. The manufacturer shall provide a Ten Year Limited Warranty from the date of shipment against failure when installed in compliance with applicable national/local electrical codes and the manufacturer's installation, operation, and maintenance instructions. The warranty shall cover overexposures. The warranty shall cover all parts, labor, and material to return the unit to serviceable condition. A factory trained local representative located within 250 miles of the jobsite shall provide on-site labor and system testing, if required, during the warranty period. The local representative shall own and operate test equipment capable of determining the clamping voltages of the systems provided on the project.
2. Refer to Section 26 05 00 for submission of warranty.
3. Major service and renewal parts service shall be readily available through authorized manufacturer's dealer located within 200 miles of this installation.

PART 2 - PRODUCTS [S] [O/M]

2.1 MANUFACTURERS:

A. Surelogic (Square D), or acceptable equal by APT, Liebert, EFI Electronics, Surge Suppression Inc. or General Electric (G.E.) only. No other TVSS manufacturers will be considered or approved.

2.2 MATERIAL:

A. Suppression System. The TVSS system shall include an engineered solid-state suppression system utilizing arrays of non-linear voltage dependent metal oxide varistors with similar operating characteristics. To maximize current density the device shall contain sufficient thermal mass allowing the device the ability to dissipate large amounts of average power that may be caused from sustained over-voltage events and voltage swells as well as repetitive transient impulses. The suppression system components shall optimally share surge currents in a seamless, low-stress manner assuring maximum performance and proven reliability. The suppression system shall not utilize silicon avalanche diodes (SADs) or other components which might short or crowbar the line, thus leading to interruption of normal power flow to or system upset of connected loads.

B. High Frequency Extended Range Power Filter. The TVSS system shall include a high frequency extended range power filter and shall be UL1283 listed as an Electromagnetic Interference Filter. The filter shall reduce fast rise-time, high frequency, error-producing transients, and electrical line noise to harmless levels, thus eliminating disturbances which may lead to electronic system upset. The filter shall provide minimum noise attenuation as specified in section 2.10 of this specification.

C. Internal Connections. All full magnitude transient currents shall be conducted utilizing low-impedance copper bus bars. No plug-in component modules or quick-disconnect terminals shall be used in surge current-carrying paths.

D. Internal and External Mounting: TVSS devices may be externally mounted or internally mounted inside switchboards or panelboards. TVSS shall meet all other requirements herein regardless of mounting. Internally mounted TVSS shall be factory installed and certified by the switchgear manufacturer and shall in no way affect the U.L. listing of the switchgear. The Contractor shall be responsible for insuring where switchgear size increases to support internally mounted TVSS, that the switchgear will fit in the allotted space shown on the drawings.

E. Field Connections. The TVSS system shall include mechanical or compression lugs for each phase, neutral and ground, if applicable. The system shall be capable of connection up to a #2 AWG copper wire size.

F. Field Installation. The unit shall be installed as close as practical to the facility's wiring system in accordance with applicable national/local electrical codes and the manufacturer's recommended installation instructions.

G. Enclosure. Standard unit shall be supplied in a NEMA 4 metallic enclosure. Enclosure sizes and weights shall not exceed 28@H x 16@ W x 9.5 AD. The weight shall not exceed 91 pounds.

H. The TVSS shall be provided with an integral monitoring option as specified below:

1. Dual Form "C" Dry Contacts: The TVSS system shall be provided with 2 sets of form "C" dry contacts (normally open and normally closed) to facilitate connection to a building management system or other remote monitoring system. The contacts shall be normally open or normally closed and shall change state upon failure of the suppression system or power loss in any of the phases. The contacts shall be optically isolated to insure transient energy does not "jump" over to the monitoring circuit.
2. Display Event Counter**:** The TVSS system shall be provided with a display event counter that makes available the cumulative number of transients the device has been subjected to. The detection circuitry must be current sensing to eliminate erroneous counts that may be produced from stray voltages and noise signals, both conducted and radiated. The event counter shall have a ten year lithium battery to provide back-up in the event of a power outage or when the unit is disconnected for service.
3. Battery Powered Audible Alarm and LED Indicators: The TVSS system shall be provided with a battery powered audible alarm that detects and provides notification of single or multiple phase failure of the suppression filter system. The alarm shall have a silence switch as well as a test switch for ensuring positive function and an alarm LED that illuminates when the alarm is disabled. The monitoring unit shall have an easily replaceable, commonly available battery for backup to ensure audible alarm function in the event of a total power failure. The unit shall have a battery backed-up monitor LED which shall illuminate when battery requires replacement.

I. INTEGRAL DISCONNECT SWITCH:

1. The device shall have a NEMA designed and certified safety interlocked integral disconnect switch located within the unit with an externally mounted metal manual operator. The disconnect shall be fused and rated for a minimum of 200 amps.
2. The switch shall disconnect all ungrounded circuit conductors from the distribution system to enable testing and maintenance without interruption to the facility's distribution system.
3. The switch shall be rated for 600VAC.
4. The TVSS device shall be UL1449 Second Edition listed with the integral disconnect switch and the UL1449 Second Edition Suppression Voltage Ratings shall be provided.
5. The integral disconnect switch shall be capable of withstanding the published maximum surge current magnitude without failure or damage to the switch.
6. The integral disconnect switch is required, unless a supply breaker is located in the adjacent panelboard or switchboard to provide an individual overcurrent protection and disconnecting means. For existing installations, the Engineer must approve the use of an existing supply breaker in advance of the product submittal before waiving the requirement of an integral disconnect switch.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. The TVSS system along with the remote status alarm contacts shall be installed including all connections, at the location and as indicated on the drawings and wiring diagrams as specified herein, and in accordance with the accepted shop drawings, the manufacturer's instructions, and the manufacturer's standard specification and dimension sheets.

B. The auxiliary monitor contacts shall be connected to the local DDC as an alarm point. Division 23 shall provide the wiring with Division 26 supervising the connection at the TVSS. Division 26 shall provide a non-metallic conduit within the TVSS enclosure for isolation.

3.2 FIELD QUALITY CONTROL:

A. Technical Assistance: The TVSS manufacturer's representative shall generally supervise installation of this equipment with the Contractors concerned providing up to four hours of job supervision during the job.

B. Initial Start-Up and Checkout: The TVSS manufacturer's representative shall provide a qualified technical representative to assist the Contractor in initial checkout of the system or the job after completion of installation. The manufacturer's representative shall be responsible for field testing making any adjustments that may be required for proper performance. The manufacturer's representative shall also instruct the Owner's representative in the proper operation and care of this equipment.

C. Field Testing: Upon completion of initial start-up and system checkout, the technical representative of the TVSS shall perform a field test, with the Engineer notified in advance.

END OF SECTION 264300

SECTION 265000 - LIGHTING

PART 1 - GENERAL

1.1 REQUIREMENTS

A. The general provisions of the Contract, including General and Supplementary Conditions and General Requirements, apply to the work specified in this Section.

1.2 SUMMARY

A. Section Includes:

1. Interior solid-state luminaires that use LED technology.
2. Emergency battery drivers.
3. Lighting fixture supports.

B. Related Requirements:

1. Division 26 Section "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, vacancy sensors, and multipole lighting relays and contactors.

1.3 DESCRIPTION

A. Furnish, assemble, and install LED luminaires complete with sockets, louvers, lenses, internal wiring, leads, trims, rings, frames, hangers, straps, reflectors, light engine, and power supply unit (driver) as applicable and required for a complete installation.

B. Luminaires that require remote mounting of any components needed for its operation, such as drivers, or light engine electronics are not permitted. All components needed to make the luminaire operational shall be integral to the luminaire housing.

1.4 DEFINITIONS

A. BIM: Building information model.

B. CCT: Correlated color temperature.

C. CRI: Color-rendering index.

D. CU: Coefficient of utilization.

E. LER: Luminaire efficacy rating.

F. Lumen: Measured output of lamp and luminaire, or both.

G. Luminaire: Complete lighting fixture.

H. RCR: Room cavity ratio.

1.5 SUBSTITUTIONS

A. The lighting fixture layouts of spaces indicated in the Contract Documents are based upon photometric data, quality, construction and appearance of fixtures listed in the lighting fixture schedule.

1.6 SCOPE

A. The work covered under this Section shall include furnishing and installing light- emitting diode (LED) luminaires (lighting fixtures) complete as shown on the Drawings, as described in the "Luminaire (Lighting Fixture) Schedule", and as herein specified.

1.7 SUBMITTALS

A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:

1. Arrange in order of luminaire designation.
2. Include data on features, accessories, and finishes.
3. Include physical description of lighting fixture including dimensions.
4. Emergency lighting units including battery and charger.
5. Installation instructions.
6. Energy-efficiency data.
7. Life, output (lumens, CCT, and CRI, and energy).
8. Photometric data and adjustment factors based on laboratory tests using Absolute Photometry, complying with IESNA Lighting Measurements Testing & Calculation Guides, of each light fixture type. The adjustment factors shall be for lamps, and accessories identical to those indicated for the lighting fixture as applied in this Project.

    a. LM-80-08: Approved Method for Measuring Lumen Maintenance of LED Light Sources.

        1) Relative photometry test method. L70 used for general lighting. L50 used for decorative lighting. Tests under 3 case temperatures: 55 degree C, 85 degree C, third one at the discretion of the manufacturer. Relative humidity <65%. Test duration 6000 hours with photometry taken every 1000 hours minimum. Operating at constant current.

    b. TM21-11: Projecting Long Term Lumen Maintenance of LED Light Sources. Calculates & Models.
    c. LM79-08: Approved method: Electrical and Photometric Measurements of Solid-state Lighting Products. Absolute photometry method of testing.
    d. LM82-12: Characterization of LED Light Engines and LED Lamps for Electrical and Photometric Properties as a Function of Temperature. Used primarily for decorative luminaires. Relative photometry method of testing (references LM-79).

e. Luminaires: ANSI/UL 1598:2008 (Secs 19.7, 19.10-16) Method established for in-situ temperature method (ISTM) testing for EnergyStar.
f. Track Lighting Systems: ANSI/UL 1574:2004 (Sec 54) Method established for in-situ temperature method (ISTM) testing for EnergyStar.
g. Manufacturer's Certified Data: Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program (NVLAP) for Energy Efficient Lighting Products.
h. Testing Agency Certified Data: For indicated luminaires, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
i. Manufacturer's LED binning procedures.

9. Lighting Illumination Calculations (Photometric Study): Provide lighting illumination calculations with the submittal package for the actual fixture, LEDs and driver combination submitted for the following rooms:

a. Toilet
b. Corridor
c. Office
d. Work Room
e. Work Areas

B. Field quality control test reports.

C. Shop Drawings: Show details of nonstandard or custom lighting fixtures.

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include detail luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Wiring Diagrams: For power, signal, and control wiring.

a. Wiring diagrams: Detail wiring for fixtures and differentiate between manufacturer installed and field-installed wiring.

D. Coordination Drawings: Reflected ceiling plan(s), sections, and other details, drawn to scale and coordinating fixture installation with ceiling grid, ceiling mounted items, and other components, on which the following items are shown and coordinated with each other, based on input from installers of the items involved. Include work of all trades that is to be installed near lighting equipment.

1. Luminaires.
2. Suspended ceiling components.
3. Partitions and millwork that penetrate the ceiling or extends to within 12 inches of the plane of the luminaires.
4. Structural members to which suspension systems for lighting fixtures will be attached.
5. Other items in finished ceiling including the following:

a. Other luminaires.
b. Air Diffusers.
c. Smoke and fire detectors.
d. Occupancy sensors.
e. Vacancy sensors.

6. Perimeter moldings.

E. Samples: For each lighting fixture indicated in the Lighting Fixture Schedule as requested by the Engineer during the review phase. Each Sample shall include the following:

1. Color and finish selection.
2. Cords and plugs.
3. Pendant support system.
4. LED drivers.

F. Operation and Maintenance Data

1. For lighting equipment and fixtures to include in Emergency, Operation, and Maintenance manuals.
2. Refer to Division 01 Section “Operation and Maintenance Data”.

G. Manufacturer’s recommended detailed installation instructions.

H. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, signed by product manufacturer.

I. Qualification Data: For agencies providing photometric data for lighting fixtures.

J. Field quality-control test reports. Provide test results for compliance with performance requirements.

K. Warranties: Special warranties specified in this Section.

1.8 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Lighting luminaires.
2. Suspended ceiling components.
3. Partitions and millwork that penetrate the ceiling or extend to within 12-inches of the plane of the luminaires.
4. Structural members to which luminaires will be attached.
5. Initial access modules for acoustical tile, including size and locations.
6. Items penetrating finished ceiling, including the following:

a. Other luminaires.
b. Air Diffusers.
c. Smoke and fire detectors.
d. Occupancy sensors.
e. Vacancy sensors.

B. Dimming down to 1%: Provide manufacturer’s type of dimming driver provided and what control systems it is compatible with.

C. Qualification Data: For testing laboratory providing photometric data for luminaires.

D. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

E. Product Certificates: For each type of luminaire.

1.9 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.

1.10 QUALITY ASSURANCE

A. Provide luminaires that are of a manufacturer engaged in the production of luminaires that are equal in material, design and workmanship. The manufacturer's luminaire shall have been in satisfactory commercial or industrial use for a minimum of three (3) years. The manufacturer's luminaire shall have been available on the commercial market during the three (3) year period.

B. LED luminaires shall conform to the requirements of the National Electrical Code (NEC), state and local codes, and these Specifications.

C. NFPA 101 Compliance: Comply with visibility and luminance requirements for exit signs.

D. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

E. Fixtures, emergency lighting units, accessories and electrical components, devices, and accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

F. Comply with NFPA 70.

G. FMG Compliance: Lighting fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FMG.

H. The luminaires shall be listed by Underwriters Laboratories, Inc. (UL).

I. Refer to Division 01 Section "Submittals".

J. Each luminaire type shall be binned within a four-step MacAdams Ellipse (4 SDCM) to ensure color consistency among luminaires.

K. Color Rendering Index (CRI): R9 > 80.

L. Lighting Calculations: Provide lighting calculations with submittal data for:

1. Toilet
2. Corridor
3. Office

4. Work Room
5. Work Areas

M. Nameplates: Except for required labels and operating data, do not attach or imprint manufacturer's or producer's nameplates or trademarks on exposed surfaces of products that will be exposed to view in occupied spaces or on the exterior.

1.11 COORDINATION

A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including other luminaires, and HVAC equipment.

1.12 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.13 WARRANTY

A. Deliver the work described herein in a first class operating condition in every respect. Warrant that the material and workmanship shall be entirely free from defects. Any materials, equipment, or workmanship in which defects may develop before or during the warranty period shall be repaired or replaced at the Contractors own expense. Refer to Division 01 Section “Warranties” for the start of the warranty period. The contractor shall further warrant that all material, equipment, and workmanship used in the installation, but not specifically mentioned in the Drawings and Specifications, is the best of their respective kinds and that the construction and installation was performed in accordance with the best accepted standard practices in all details.

1. LED board and driver: Minimum of five (5) years.

PART 2 - PRODUCTS

2.1 MATERIALS AND COMPONENTS

A. The LED luminaires supplied shall have the proper trim, frames, mounting devices, configuration, and accessories necessary to be properly installed in the building construction. Catalog numbers of luminaires in the “Luminaire Schedule” or "Lighting Fixture Schedule" on the Drawings are to establish a type of luminaire and <u>not</u> to determine a method of mounting.

1. Catalog numbers scheduled on the Drawings may indicate luminaire compatibility with certain types of ceiling construction. The Contractor shall determine exact type of ceilings actually to be furnished in each area and shall obtain luminaires to suit, deviating from specified catalog numbers or descriptions only where necessary, and only to the extent necessary to insure luminaire-ceiling compatibility. The Contractor shall notify the Architect/Engineer and Owner in writing where such changes are to be made.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Recessed Fixtures: Comply with NEMA LE 4.

D. CRI of minimum 80. Minimum CCT of 4000 K.

E. Rated lamp life of 50,000 hours.

F. Lamps dimmable from 100 percent to 0 percent of maximum light output where stipulated on drawings.

G. Internal driver.

H. Nominal Operating Voltage: 120 V AC/277 V AC.

I. Housings

1. Extruded-aluminum housing and heat sink.
2. Powder-coat painted finish to match luminaire.

J. Listed and labeled as complying with UL 8750.

K. Double lock nuts shall be used at the load bearing ends of threaded pipe used as part of a stem mounting assembly.

L. Metal Parts: Free of burrs and sharp corners and edges.

M. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.

N. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

O. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:

1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.
4. Laminated Silver Metallized Film: 90 percent.

P. Diffusers and Globes:

1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

    a. Lens Thickness: At least 0.125 inch minimum unless otherwise noted.
    b. UV stabilized.

Q. Glass: Annealed crystal glass, unless otherwise indicated.

R. Factory-Applied Labels: Comply with UL 1598. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles.

1. Label shall include the following:

a. "USE ONLY".
b. CCT and CRI for all luminaires.

S. Where vandal proof or tamper proof fixtures are specified, tamper proof screwdrivers shall also be provided.

1. Refer to Division 01 Section "Extra Materials."

T. Light Calculations for pendant high bay LED and Wire guard Fixtures: Provide fixtures with required drivers with absolute lumen output to match configuration and luminance shown on the drawings.

2.2 POWER SUPPLY UNIT (DRIVERS)

A. Luminaires shall be equipped with an LED driver(s) that accepts the voltage as indicated on the "Luminaire (Lighting Fixture) Schedule". Individual driver(s) shall be replaceable.

B. Driver(s) shall be UL8750 class 2 compliant for their intended purpose.

C. Total harmonic distortion (THD) for current: ≤ 20%:

1. Comply with NEMA SSL 1 and rated for a THD of less than 20 percent at all voltages.
2. Driver must be labeled to comply with RFI (Radio Frequency Interference) requirements of FCC Title 47 Part 15.

D. Driver(s) shall be rated to operate between -30ºC to 50ºC minimum.

E. Individual driver(s) shall be equipped with surge protection (6kV minimum) in accordance with IEEE/ANSI C62.4.1. Driver shall be protected against damage due to either an open circuit or short circuit fault condition on the driver output.

F. Driver(s) shall have a minimum efficiency of 85%.

G. Drivers shall deliver full-range dimming from 0-10V control signal.

2.3 LED LIGHT SOURCE (LIGHT ENGINE)

A. Individual light engine(s) shall be replaceable.

B. LED light engine(s) shall have a minimum lifetime of 50,000+ hours at 40º C and shall have a minimum efficiency of 80 lumens per watt.

C. LED dies shall be tested in accordance with I.E.S.N.A. LM-80-08 standards.

D. Thermal management shall be passive by design and shall consist of heat sinks with no fans, pumps, or liquids.

2.4 EXIT LIGHTS

A. Description: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Exit lights (signs) shall be universal mount and complete with factory installed light-emitting diodes (LED) mounted behind a red diffusing panel and with direction arrows as shown on the Drawings.

C. Operating at nominal voltage of 120 Vac or 277 Vac. Match voltage to surrounding luminaire type.

D. Internally Lighted Signs:

1. Lamps for AC Operation: LED: 70,000 hours minimum rated lamp life

E. Exit lights shall have wire guards where shown on the Drawings.

2.5 EMERGENCY DRIVERS

A. Provide emergency battery drivers where indicated on the plans. Emergency battery drivers shall interface with Section 26 09 23 Lighting Control Devices emergency lighting relay device(s). Emergency drivers shall be by Bodine.

2.6 EXTRA MATERIALS

A. Refer to Division 01 Section “Extra Materials”.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before fixture installation.

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

3.2 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. LED luminaires (lighting fixtures) shall be installed as shown on the Drawings and in accordance with the manufacturer's recommendations.

D. Recessed lay-in type linear LED luminaires shall be supported from the building structure independently of the ceiling grids with a minimum of four (4) steel tie wires per luminaire or as detailed on the Drawings.

E. Recessed lay-in type linear LED luminaires installed in lay-in type ceiling tile shall be securely fastened from the building structure and be installed in the lay- in type ceiling in such a manner that the louver/lens housing may be easily opened and so that the luminaires may be removed and relocated without forcing the luminaires or changing the grid system tie wires. Coordinate with the ceiling installer before the ceiling grid is installed to assure a mutually satisfactory installation of ceiling and luminaires.

F. Recessed LED luminaires installed in "hard" ceiling systems (i.e. drywall, metal pan, etc.) shall be securely fastened from the building structure and be installed in such a manner that the louver/lens housing may be easily opened and so that the luminaires may be removed and relocated without forcing the luminaires or changing the ceiling support system. Coordinate with the ceiling installer before the ceiling is installed to assure a mutually satisfactory installation of ceiling and luminaires.

G. Surface mounted linear LED luminaires shall be supported from the building structure with a minimum of two (2) 1/4-inch threaded rods per each one (1) foot wide by four (4) foot long and a minimum of four (4) 1/4 inch threaded rods per each two (2) foot wide by four (4) foot long luminaire as detailed on the Drawings.

H. Pendant/suspended luminaires shall be supported from the building structure with 1/4-inch threaded rods at each of the luminaires suspension points. Hardware connections to the threaded rods shall be listed components from the luminaire manufacturer and be specifically designed for the type of suspension called for on the Drawings. Installation shall be in accordance with the manufacturer's instructions.

I. Recessed non-linear LED luminaires (i.e. downlights) located in lay-in type ceiling tile shall be mounted in the center of the tile or as shown on the Drawings and shall be supported by means of bar hangers extended across the main ceiling support members and also supported from the building structure with no less than one (1) 1/4-inch threaded rod per luminaire. Where luminaires are installed in slopped ceilings the luminaires shall be complete with appropriate slopped ceiling adapters.

J. Surface mounted non-linear LED luminaires and exit lights shall be supported from the building structure with a minimum of two (2) 1/4 inch threaded rods per luminaire or exit light.

K. 1-1/2-inch x 1-1/2-inch steel framing channel shall be used where required to span bar joists and otherwise facilitate structural support for luminaires and exit lights.

L. Ceiling grid layouts when indicated on the electrical Drawings are for convenience only.

M. Pendant mounted luminaires and exit lights shall be located to avoid mechanical systems, ductwork, piping, structural members, and the like.

N. Supports shall <u>not</u> terminate or be fastened directly to the roof decking.

O. Coordinate the luminaires layout with the Architect/Engineer and all other trades before the ceiling grid, air outlets, and luminaires are installed. Coordinate layout and installation of luminaires and suspension system with other construction that penetrates ceilings or is supported by them.

3.3 GENERAL CONFORMANCE

A. Surface mounted luminaires shall not have gaps between the luminaire and attaching surface, except where required by code regulations or manufacturer's instructions.

B. Recessed luminaires shall not have gaps between the luminaire trim and the adjacent surface. Where light leaks occur, suitable gaskets shall be furnished and installed.

C. Install luminaires level, plumb and true. Align rows accurately in three (3) dimensions.

D. Where luminaires are to be installed in areas without ceilings, furnish supports consisting of threaded rods and steel channels as required to have a finished mounting height of 8'-0" to bottom of the luminaire (or other mounting height as shown on the Drawings), unless pendant or chain mounting is indicated on the Drawings or Luminaire Schedule.

E. Recessed luminaires shall be connected with flexible metal conduit (maximum 6'-0" length) from outlet boxes mounted above or alongside of luminaire. Luminaires shall be wired in such a way that removal of one shall not disrupt the continuity of power to the others.

F. Comply with requirements in Division 26 for wiring connections and wiring methods.

G. All luminaires designated for damp locations shall have sealed conduit entries. Any luminaire leaking water before or during the warranty period shall be repaired or replaced.

H. Prior to final inspection, check all LED luminaires for damages during construction and replace the damaged luminaires. All luminaires shall be cleaned at the time of final acceptance of the building.

3.4 IDENTIFICATION

A. Install labels with panel and circuit numbers on concealed junction and outlet boxes. Comply with requirements for identification specified in Division 26, Section "Identification for Electrical Systems".

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections.

B. Operational Test: After installing luminaires, switches, accessories, and after electrical circuitry has been energized, test units to confirm proper operation.

C. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.

D. Luminaire will be considered defective if it does not pass operation tests and inspections.

E. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.6 ADJUSTING

A. Occupancy Adjustments: When requested within twelve (12) months of date of Substantial Completion, provide on-site assistance in adjusting aimable luminaires to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose. Some of this work may be required after dark.

1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
3. Adjust aimable luminaires in the presence of Architect.
4. Conduct short-duration tests on all emergency lighting.

END OF SECTION 265000

SECTION 266013 - ELECTRIC SERVICE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 WORK INCLUDED:

A. Secondary Electric Service

B. Metering

C. Surge Protection

1.3 RELATED WORK:

A. Division 23 – Heating, Ventilating, and Air Conditioning

B. Section 26 05 00 – Common Work Results For Electrical

C. Section 26 05 19 – Low-Voltage Electrical Power Conductors and Cables

D. Section 26 05 23 – Control Voltage Electrical Power Cables

E. Section 26 05 26 – Grounding And Bonding For Electrical Systems

F. Section 26 05 33 – Raceway And Boxes For Electrical Systems

G. Section 26 05 36 – Cable Trays For Electrical Systems

H. Section 26 05 43 – Underground Ducts And Raceways For Electrical Systems

I. Section 26 24 16 – Panelboards

1.4 DESCRIPTION:

A. General: The electric service shall include the underground primary services, the pad mounted transformer, the underground secondary service, the metering, secondary surge protection and entrance service grounding.

B. Service Characteristics: Secondary: 240Y/120 volts, single phase, three wire.

1.5 REQUIREMENTS:

A. Standards:

1. National Electric Safety Code (NESC)
2. American National Standards Institute (ANSI)
3. Local Electrical Regulations
4. State Corporation Commission Regulations for Utilities.

1.6 SUBMITTALS:

A. Submit shop drawings and product data in accordance with Section 26 05 00.

PART 2 - PRODUCTS [S]

2.1 MATERIALS AND TYPE FOR SURGE PROTECTION:

A. Provide Square D Class 6671 #SDSA3650, 3 pole - 650V RMS, secondary surge arrestor or Delta Lightning Surge Arrestor LA-603 600 volt - 3 phase, 4 wire and General Electric #9L18BBB301, 3 pole - 650V RMS, secondary protective capacitor or Delta Surge #CA603 650 volt - 3 phase, 4 wire surge capacitor.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. The Power Company will provide:

1. Verification of the overhead primary electrical service conductors to the pole mounted transformers.
2. Verification of the pole mounted transformers.

The Power Company will furnish the following to the Contractor, for installation by the Contractor:

1. Current transformers (C.T.'s).
2. Meter base/cabinet.

The Contractor shall provide:

1. The underground secondary conductors and conduits from the pole mounted transformers to the C.T. section of the main panelboard (to the C.T. cabinet). The exact height of the conduit stubs and length of slack wire at the pad mounted transformer shall be determined by the Power Company.
2. All line and load side C.T. connections.
3. C.T. cabinet per Utility Company specifications.

B. Electric Utility Connection Services and Fees: The Contractor shall refer to other sections of the Project Manual for the Power Company charges and fees for installation of the underground electrical primary and

secondary services, and pad mounted transformer. The Contractor shall consult and coordinate this work for complete electrical entrance service with the Power Company.

C. Metering: C.T.'s, meter and meter control wiring by the Power Company. Provide a 1-1/4 inch empty conduit from the main switchboards C.T. Sections to the meters locations. The Contractor is to mount the meter cabinets provided by the Power Company. The Power Company will make provisions for future pulsing dry contacts from the meters with a maximum pulse not to exceed 5 pulses per second.

D. Installation of Underground Secondary Non-Metallic Service Raceways: Refer to Section 26 05 43.

E. Grounding: Ground service in accordance with N.E.C. and as covered by Section 26 05 26 Grounding and Bonding for Electrical Systems.

F. Surge Protection: Secondary surge protection arrestor(s) and capacitor(s) shall be installed on the secondary electric service at the service entrance in accordance to the manufacturer's instructions and N.E.C. (Article 280) and other locations as indicated.

G. The power company shall verify the continuity of the existing electrical services (primary) with the new electrical service (secondary).

H. Transformer Setting: The contractor shall coordinate and verify the selected tap setting of the local utility company’s pole mounted transformers to prevent excessive secondary under/over voltage at the main service disconnecting means.

END OF SECTION 266013

SECTION 270500 – COMMON WORK RESULTS FOR COMMUNICATIONS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 WORK INCLUDED:

A. Every item of labor, material, devices and appurtenances for installing a complete Electronic Communications Systems and other related systems included in Division 27 of the Specifications.

1. Section 27 05 26 – Grounding and Bonding for Communications Systems
2. Section 27 05 28 – Pathways for Communications Systems
3. Section 27 05 53 – Identification for Communications Systems
4. Section 27 20 00 – Data Communications
5. Section 27 30 00 – Voice Communications
6. Section 27 53 00.01 – Antenna Distributed System
7. Section 27 53 00 – CATV System

1.3 RELATED WORK:

A. General: See all other portions of these Contract Documents and apply to those portions of work, relating to the Division 27 systems, the same as if repeated herein in its entirety. The Division 27 Trades shall provide and install all wiring, all equipment, all electronics, all software and accessories as specified and shown on the drawings and as needed to provide complete and operational systems. Division 27 Trades shall provide to Division 26 special boxes, cabinets, racks, hangers, and etc.; for installation.

B. Division 23 - Mechanical

C. Division 26 - Electrical

D. Division 28 – Electronic Safety and Security

1.4 WORK NOT INCLUDED:

A. Provide roughing-in, including the empty boxes, conduit, pull strings, etc. under Division 26 for the following related Sections:

1. Section 27 20 00 – Data Communications
2. Section 27 30 00 – Voice Communications
3. Section 27 53 00.01 – Antenna Distributed System
4. Section 27 53 00 – CATV System

1.5 DRAWINGS:

A. Where conduit, equipment, devices and other electrical appurtenances are shown on the drawings, the general arrangement of such items on the electrical drawings shall be followed as closely as actual building construction and the work of other trades will permit. Because of the small scale of the electrical drawings, it is not feasible to indicate all offsets, fittings and accessories which may be required. The Contractor shall investigate the construction conditions affecting the work and provide fittings and accessories as required to meet actual conditions.

1.6 QUALITY ASSURANCE:

A. Equipment and material used in the project shall be new and undamaged. The installation shall fit into the space allotted and shall allow adequate, acceptable, clearances for entry, servicing, safety, and maintenance. The Contractors shall coordinate the work to ensure that the equipment may be moved into place without altering building components or other installations. All electronic communication systems (above) work shall be performed by a Commonwealth of Virginia Class-A licensed Electrical Contractor(s) whose technicians, mechanics, or tradesmen shall be skilled and certified in the trade involved. All Division 27 work shall be performed under the direct supervision of the equipment systems' authorized technician with a locally recognized and accepted master electrician's license. All work under Division 27 shall be provided by a single-source Division 27 vendor/subcontractor.

B. Equipment and material in existing installations may be reused where specifically indicated on the drawings.

1.7 REFERENCES:

A. The complete installation and all materials and equipment under Division 27 shall conform to the current Commonwealth of Virginia Statewide Building Code including all applicable portions of the National Electrical Code (NEC) and all other governing codes, regulations and certifications. All wiring methods shall adhere to Division 27 specified wiring methods.

B. All equipment used shall bear the Underwriters Laboratory (U.L.) label for the intended application, or other organizations label if acceptable to the Authority having jurisdiction and concern with product evaluation.

C. In addition, the following codes, standards, and regulations shall apply to the complete installation and all materials and equipment. These are referred to by their accompanying abbreviations.

1.	National Electrical Code (NFPA 70) 2011	NEC
2.	National Electrical Manufacturers Association	NEMA
3.	Underwriters Laboratories, Inc.	UL
4.	Telecommunications Building Wiring Standards	TIA/EIA
5.	All Systems' Installation Certification Compliance Documents for Installing Trades	
6.	National Fire Protection Association	NFPA
7.	Uniform Federal Accessibility Standards	UFAS
8.	Americans with Disabilities Act Accessibility Guideline	ADAAG

D. The above standards are intended as a minimum and shall be exceeded if required by the Contract Documents. In the event information contained in the Contract Documents conflicts with one of the above mentioned codes, the codes shall take precedence.

1.8 PERMITS, LICENSES, TAXES AND INSPECTION CERTIFICATES:

A. All permits, bonds, licenses, inspection fees and taxes required for the execution of the work shall be obtained and paid for by the Contractor. Under each phase of the Division 27 work, the Contractor shall furnish three copies of certificates of final acceptance to the Engineer from any inspection authority having jurisdiction.

1.9 REGULATIONS AND STANDARDS:

A. The completed installation and all materials and equipment shall conform to local ordinances and codes, other regulations and standards listed herein or in related sections. These are intended as a minimum and shall be exceeded if required by the specifications or the Drawings. In the event of conflict between the codes, standards, or regulations, and information contained in the Contract Documents, the applicable code, standards, or regulation shall take precedence.

1.10 SUBMITTALS:

A. Submit shop drawings, product data and samples in accordance with Division 1 for all items as specified in related sections of these specifications. Eight (8) copies of the submittal shall be submitted. Five (5) copies of the submittal will be returned to the Contractor. If additional copies are required, they will be the responsibility of the Contractor. Where drawings are submitted, the Contractor shall submit two (2) sets of full scale prints. One copy will be marked and returned to the Contractor and the Contractor shall be responsible for all additional copies required for his use. All submittal data shall be correctly identified to show project name, and the exact model, style or size of item being submitted. Improperly identified submittals will not be reviewed by the Engineer. Each item submitted for review shall bear the Subcontractor's stamp, which states that they have reviewed the submission, that it is complete, and that in their opinion it meets the contract requirements. Contractors stamp shall identify the paragraph and page number for which the submittal is being made. Any submission, which has not been reviewed and stamped by the Division 27 Trades, will not be reviewed by the Engineer. No reviews prior to award of Contract will be considered or accepted, unless otherwise specified.

B. Shop drawings, diagrams, catalog data and such other data necessary to fully describe and substantiate compliance with these Contract Documents shall be submitted as follows:

1. All the equipment and materials where submissions are specifically required by other Divisions of these Contract Documents.
2. All the equipment and materials that are indicated with a [S] behind the product title. This shall include submission of the specified products equipment and materials.
3. All the equipment and materials that are acceptable equal substitution.
4. If submission is NOT required for the SPECIFIED products "shop drawings and product data" under 1. and 2. above, the Contractor shall NOT submit the SPECIFIED products "shop drawings and product data".

5. Samples, in good working order, shall be submitted in accordance with Division 1, complete with all installation and service drawings and instructions. All samples will be returned at the submitter's expense unless otherwise indicated. Samples may be subject to destructive testing by Engineer.

C. Operation and Maintenance manuals shall be submitted in accordance with Division 1 and shall include a copy of all accepted shop drawings, installation and maintenance data, operation instructions, parts lists, and the name, address and telephone number of supplier or nearest representative. All electrical and electronic devices, equipment and systems marked [O/M] in these specifications shall be included and all other such electrical and electronic items which will require servicing before the duration of its useful life has been reached. Manuals shall be presented to the Engineer for review and transmitted to the Owner before the final payment is recommended.

D. Equivalents:

1. Not all of the Manufacturers, trade names and/or model numbers are indicated herein, or on the drawings.
2. Unless definitely stated otherwise and upon complying with Division 1, the Contractor may use any article of equal appearance, which in their judgment is equal to the article that is specified and is accepted by the Engineer.
3. Where three (3) or more manufacturers are named in the specifications for any item, the Contractor shall use one of the three (3) listed manufacturers. **No other manufacturers shall be reviewed or accepted.** Manufacturers that are listed first in these specifications and on drawings were used as a basis of design.
4. It will be the responsibility of the Contractor to verify all connections, physical sizes and capacities of all other manufacturer's items, both named or proposed. If the equipment necessitates changes in power distribution, conduit, wiring, lighting, wiring, or any other building systems from that indicated on the drawings, the Contractor shall be responsible for all additional costs included and notify other trades of the changes. Where such changes are required, detail drawings indicating all required changes shall be submitted for review at the same time the manufacturers drawings are submitted for approval.
5. Refer to Division 1 for substitutions.

E. The ten day prior approval requirements of The Instructions to Bidders, AIA 701, are waived for this Division of the Specifications, and unless stated otherwise, the Contractor may use items that he deems as equivalent in quality and performance to the specified item subject to final acceptance of substituted items by the Engineer upon his review of shop drawings.

F. Guarantee: Electronic Communication Systems equipment, materials and labor required by these specifications and accompanying drawings shall be guaranteed to be free from defective materials or workmanship for a period of one year after final acceptance of the project except extended warranties as specified elsewhere in these documents on specific items of equipment will be furnished by the Trade providing the equipment. Defects in material or workmanship occurring during this period shall be corrected with new material and equipment or additional labor at no cost to the Owner. Manufacturer's certificates of warranty shall be transmitted to the Owner before final payment is recommended.

1.11 WARRANTIES:

A. The Contractor shall warrant for a period of one year all work provided under the Contract to include, but not necessarily limited to, all systems, equipment, materials, and workmanship. This shall not be construed

to limit any extended warranty periods of longer than one year for specific items or systems specified elsewhere in the Contract Documents.

B. The warranty period shall commence on the date of acceptance by the Owner and shall cover all parts and labor as required to fulfill the warranty at no cost to the Owner.

C. Refer to Division 1 for additional warranty requirements.

D. Information on all warranties shall be included in the O&M manuals specified herein to be provided to the Owner.

1.12 COORDINATION OF WORK:

A. General: The contract documents indicate the extent and general arrangement of the communications systems. The Contractor shall be responsible for the coordination and proper relation of the communications systems work to the building structure and to the work of other trades. No additional compensation or extension of completion time will be granted for extra work caused by the lack of coordination.

B. Cooperation: The Contractor shall provide dimensions and locations of all openings, shafts and similar items to the proper trades and install work as required so as not to interfere with, or delay, installation of systems under construction in the buildings.

C. Locations of lines and equipment shall be determined from actual field measurements. The outlines of the building shown on the contract drawings are intended only as a guide to indicate relative locations of the electrical work. Refer to the existing buildings and structural components to determine actual measurements. If conflicts prevent installation of communications systems work at the locations indicated, minor deviations shall be made subject to acceptance by the Engineer, and without additional compensation.

D. Cutting and Patching: See Division 1 and Division 26.

E. Roughing-In: Equipment, racks, cabinets, devices, and other similar items shall align vertically or horizontally with each other, the building structure and features thereof when it appears obvious and logical that they should. All mounting heights shall be within the limits of Commonwealth of Virginia USBC and ADAAG.

F. Damage to Other Work: The Division 27 Trades are responsible for damage to other work caused by his work or workmen. Repairing of damaged work shall be done by the Trade who installed the work, and as directed by the Engineer; the cost of which shall be paid for by the Division 27 Trades.

1.13 ASBESTOS:

A. Asbestos Free Materials: The intention of these drawings and specifications is that there be no asbestos containing materials installed on this project. To the best of the Engineers' knowledge, none of the material or equipment specified herein or shown on the drawings contains asbestos. The Contractor shall make every effort to prevent any asbestos materials from being installed in or used on the construction of the project. At the completion of the project, the Contractor shall certify by letter that to the best of his knowledge, no asbestos containing materials were used for or in the construction of this project.

B. Existing Materials:

1. Discovery: If during the construction of this project, work involving friable asbestos is suspected, or encountered, all work in this area shall be discontinued and the Owner or the Owner's representative, shall be notified immediately and the Owner with his own forces or by separate contract shall be responsible for complete investigation, removal, and disposition of the friable asbestos hazard in accordance with applicable laws and regulations. If the Contractor claims that delay or additional cost is involved because of such action by the Owner, he shall make such claim as provided elsewhere in the contract documents.
2. Removal: All work involving the removal of friable asbestos will be done under a separate contract.

1.14 GRAPHICS DATABASE:

A. This project's Computer Aided Design & Drafting (CADD) drawing files may be purchased directly from the Engineer for use in preparing computer graphics specific to this project. See Appendix A at the end of this Section for Letter of Indemnification and ordering instructions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS AND MATERIALS:

A. General: Manufacturers and materials shall be as specified in subsequent sections of these specifications and as noted on the drawings. Similar types of equipment shall be the products of the same manufacturer unless specified otherwise.

2.2 SLEEVES AND INSERTS:

A. General: Sleeves and inserts shall be provided and correctly located in the structure, as required for the work.

B. Inserts shall be steel and of proper size for loads encountered.

2.3 ACCESS DOORS:

A. Provide for all junction boxes or any item requiring access. Doors shall be of sufficient size and so located that the concealed items may be serviced or completely removed and replaced. Doors required for work shall be furnished as a part of this Division to the General Contractor for installation. Doors in acoustic tile ceilings shall be furnished in multiples of tile sizes. Doors are not required in exposed grid type ceilings where tiles are removable. Doors shall be metal access doors with cam lock, style to match ceiling or wall construction. Doors occurring in rated construction shall be fire rated U.L. labeled access doors correlated to preserve the integrity of the rated construction. Doors shall be prime finish steel except those in toilets, shower rooms, locker rooms, kitchens and other similar areas shall be aluminum with natural anodized finish. Doors shall match the access doors in Division 23 and meet the acceptance of the Architect.

PART 3 – EXECUTION

3.1 INSTALLATION:

A. General: Materials and equipment shall be installed in accordance with manufacturer's instructions to conform with the details and application as specified in subsequent sections of these specifications and indicated on the drawings.

B. Supports: Provide necessary supports for all equipment and appurtenances as required; this includes, but is not limited to, frames or supports for items such as cabinets, junction boxes, conduit, outlet boxes, and other similar items requiring supports. Foundation drawings, bolt setting information and foundation bolts shall be furnished by the subcontractors furnishing the equipment for all equipment required to be bolted to the floor, wall or above ceiling structure.

C. Sleeves: Provided by Division 26.

D. Temporary Requirements: Openings in equipment shall be kept capped at all times until connection is made to the system. The ends of all conduits and equipment openings shall be kept capped properly with approved devices. Approved devices are items such as specially molded plastic caps and sheet metal caps.

E. Access Doors: Provide access doors for all concealed electric equipment, pull boxes, junction boxes or any item requiring access. Doors shall be of sufficient size and so located that the concealed items may be serviced or completely removed and replaced. Doors required for Division 27 work shall be furnished by Electrical Trade to the Contractor for installation. Doors in acoustic tile ceilings shall be furnished in multiples of tile sizes. Doors are not required in exposed grid type ceilings where tiles are removable.

F. Painting: All work under this Division shall be painted in accordance with Section 27 05 53, Identification for Communications Systems.

3.2 EXISTING WORK AND DEMOLITION:

A. Electrical Demolition: Remove all existing wiring, junction boxes, outlets, devices, cabinets, etc., indicated for demolition. Additional amounts of demolition may be required to accommodate desired renovations and new construction. Not all demolition may be shown on the drawings. All existing communications systems equipment not indicated for demolition shall remain in place.

B. Equipment and Fixtures Removed: The Owner will select and retain such existing communications systems equipment and materials which are indicated to be removed and not reused, as he desires. All other existing equipment and materials indicated to be removed, and not reused shall become the property of the Contractor, who shall remove them from the premises within the time frame specified under other Divisions of this Contract Document.

C. Equipment Relocated: All existing equipment and materials indicated to be relocated shall be disconnected, removed, and relocated. All equipment and materials shall be protected from damage during demolition.

D. Service Interruption: Attention is called to the fact that the existing facility shall remain in operation throughout the construction period. All necessary temporary arrangements shall be made as required to

keep all communication, alarm, control data, etc., circuits in continuous operation during this period except for scheduled outages for change-overs. The outage shall be kept to the minimum and carefully scheduled to suit the Owner.

E. Miscellaneous: In all altered portions of the buildings, the Communications Trade shall remove or alter as necessary all existing work that does not fit with the new construction. All existing work or areas that are not altered shall be reconnected as required. Where indicated changes to non-communications facilities require minor communications changes, these changes shall be accomplished even if not specifically indicated. Only a small portion of the existing work is shown on the drawings. Contractors submitting proposals shall visit the site to determine the scope of work under this heading as no additional compensation will be granted because of existing conditions even though the existing conditions may not be indicated on the drawings. Contractor shall thoroughly inspect the communications systems in reworked areas and bring to the attention of the Engineer all defective or unserviceable material not scheduled for removal or replacement. Demolition shall not begin until the work schedule is approved by the Owner. The work shall be scheduled to prevent any disruption to the normal operations of the building. Refer to other Divisions for work phasing.

3.3 FIELD QUALITY CONTROL:

A. Verification [V]: Upon completion of the project, the Contractor shall submit a separate letter of certification (or compliance) to the Owner/Engineer that each of the following systems or equipment functions properly, conforms to all requirements of these specifications and all requirements of the manufacturer of the systems.

1. Section 27 20 00 – Data Communications
2. Section 27 30 00 – Voice Communications
3. Section 27 53 00.01 – Antenna Distributed System
4. Section 27 53 00 – CATV System

3.4 MANUFACTURER'S ASSISTANCE:

A. Qualified technical representatives of manufacturers shall be available to visit the project and provide required assistance for any problems or trouble areas of any systems, material or equipment used in the project. Manufacturer's engineering assistance shall also be available for above problems or trouble areas. The Contractor shall purchase all materials, equipment or systems with these services included in the purchase price or otherwise be prepared to have the above service provided when needed or requested by the Engineer without additional compensation. Where one manufacturer's equipment constitutes the majority of the components or devices to make a system, the manufacturer's technically qualified representative shall inspect and accept the completed installation whether or not especially requested by the Engineer.

3.5 INSTRUCTION AND TRAINING OF OWNER'S REPRESENTATIVE:

A. The Division 27 Trades shall instruct and train the representatives of the Owner in the proper operation and maintenance of all elements of the Electronic Communication Systems. Competent representatives of the Contractor shall spend one (1) week for each of the respective Division 27 systems, unless noted otherwise hereinbelow. The times and locations for instruction and training to the Owner’s personal shall be set by the Owner at times and locations determined by the Owner over a period once the systems are functional for

instruction and training. The instruction and training shall be given to all personal as deemed necessary by the Owner. The instruction and training shall prepare the Owner to fully operate and maintain all of the above systems.

3.6 CONSTRUCTION STATUS REPORT:

A. Each item of discrepancies noted on Construction Status Report prepared by the Architect/Engineer shall be answered in detail in writing by the Contractor before payment can be recommended.

END OF SECTION 270500

APPENDIX A
LETTER OF INDEMNIFICATION

Project Name:

Project Location:

The contractor may purchase from Ascent Engineering Group, Inc. a CD-ROM or electronic mail version of the projects CADD database. The minimum fee on any request is $250.00, subject to receiving a signed Letter of Indemnification. There is an additional charge of $10.00 per sheet on projects greater than 20 sheets. Drawing files will consist of floor plan views only, of Electrical plan sheets. All seals, details, schematics, tables, controls, etc. will be deleted. All drawings will be provided in Autocad™ 2010 format. Payment shall be returned with a signed copy of the Letter of Indemnification. Payment shall be received before shipment or transfer of data.

Ascent Engineering Group, Inc. reserves all rights to the original drawing files.

The Purchaser agrees, to the fullest extent permitted by the law, to hold harmless and indemnify Ascent Engineering Group, Inc. and the Architect, as defined in the Bid Documents, from and against all claims, liabilities, losses, damages, and costs, including but not limited to attorney's fees, arising out of or in any way connected with the use, modification, misinterpretation, misuse, or reuse by the Purchaser or others of the machine readable information and data provided by Ascent Engineering Group, Inc. under this Agreement. The foregoing indemnification applies, without limitation, to any use of the project documentation on other projects, for additions to this project, or for completion of this project by others, excepting only such use as may be authorized, in writing, by Ascent Engineering Group, Inc.

The electronic drawing files are not part of the Contract Documents for the Project. The Purchaser assumes all risks associated with the use of the transmitted files. Ascent Engineering Group, Inc. will not be responsible for any differences in the information included in the transmitted files and the information shown on the Contract Documents. Modifications to the Contract Documents made before or during construction may or may not be included in the transmitted electronic drawing files.

The Purchaser further agrees that the drawing files will only be used in graphics preparation for the above-referenced project.

Company Name of Purchaser: _____

Purchaser's Designated Representative: _____

Title: _____

Signature: _____

Address: _____

Return to: Ascent Engineering Group, Inc.
4932 Frontage Road, NW
Roanoke, VA 24019
AEG # 16080

SECTION 270526 – GROUNDING AND BONDING FOR COMMUNICATION SYSTEMS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 WORK INCLUDED:

A. Equipment Grounding Conductor (EGC)

B. Grounding for Data and Telecommunications Systems (TMGB & TGB)

1.3 RELATED WORK:

A. Section 26 05 26 – Grounding and Bonding for Electrical Systems

1.4 REFERENCES:

A. NFPA 70 (NEC), Article 250

1.5 DESCRIPTION:

A. An insulated equipment grounding conductor, color coded per section 26 05 19, and the NEC, shall be provided for each alternating current circuit without exception.

1.6 TESTS:

A. The equipment grounding conductor shall be tested for continuity and proper bonding to metallic equipment enclosures, outlet boxes, wiring devices and similar items.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Data Room Ground Bus Bar Kits: Isolate grounding bus bars shall be provided in the Main Data Distribution Room and all Data Wiring Closets. Data grounding bus bars kits shall be by CPI or accepted equal. The main data distribution room shall have a (TMGB) 4” tall by 20” long by 0.25” thick pre-drilled copper bus bar with isolators and mounts (CPI #10622-020) & (CPI #10622-000). Each wiring closet shall

have a (TGB) 2” tall by 10” long by 0.25” thick pre-drilled copper bus bar with isolators and mounts (CPI #10622-010) & (CPI #10622-000).

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Equipment Grounding Conductor (EGC):

1. Provide a separate insulated grounding conductor, color-coded as per Section 26 05 19, enclosed in the same raceway with the phase conductors for all alternating current circuits, even though not necessarily shown on the drawings.
2. The equipment grounding conductor shall be secured to the equipment enclosure at the source of power and at the apparatus being served by the alternating current supply.
3. The minimum size for the grounding conductor shall be as specified in Table 250.122 of NEC.
4. Existing alternating current circuits: If an equipment grounding conductor is not present in the existing feeder or branch circuit to be reworked, Division 27 shall provide new phase, neutral, and grounding conductors from the related panelboard to the indicated outlet.

B. Data Room Ground Bus Bars:

1. Provide a separate insulated grounding conductor (#2 AWG) between each wiring closet’s grounding bus bar (TGB) homerun back the main data distribution room grounding bus bar.
2. Provide a separate insulated grounding conductor (# 2 AWG) between the main data distribution room grounding bus bar (TMGB) to the BGES.

END OF SECTION 270526

SECTION 270528 - PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 WORK INCLUDED:

A. Empty conduit system for Communications Systems including telephone and data as indicated.

1.3 RELATED WORK:

A. Section 26 05 00 – Common Work Results for Electrical

B. Section 26 05 26 – Grounding and Bonding for Electrical Systems

C. Section 26 05 33 – Raceway and Boxes for Electrical Systems

D. Section 26 05 36 – Cable Trays for Electrical Systems

E. Section 26 05 43 – Underground Ducts and Raceways for Electrical Systems

F. Section 26 05 53 – Identification for Electrical Systems

G. Section 27 05 00 – Common Work Results for Communications

H. Section 27 05 26 – Grounding and Bonding for Communications Systems

I. Section 27 05 53 – Identification for Communications Systems

1.4 GENERAL OPERATION AND DESCRIPTION:

A. General: The communications systems shall consist of a complete (partial) empty conduit system as indicated.

B. The raceway for this system shall be furnished and installed by the Division 26 electrical contractor in accordance with all related specification sections in Division 26 and 27. The Communications System Trade shall coordinate the work with Division 26.

1.5 REFERENCES:

A. The complete installation, including additions and modifications, shall be in accordance with:

1. National Electrical Code Article 800.
2. Minimum standards of Electronics Industries Association (EIA).

PART 2 – PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 INSTALLATION:

A. General: The Contractor shall provide all conduit, junction boxes, and materials required for the installation of an empty conduit Communications System in accordance with the specifications and drawings. Any material and/or equipment necessary for the proper operation of the system not specified or described herein shall be deemed part of this specification.

B. Wiring:

1. Partial Conduit Raceway System: All wiring methods (conduit only) shall be in accordance with NFPA-70, Article 800, and all other codes specified herein. All wiring to be installed under another contract.
2. Communications Raceway System: Provide empty raceway system for telephone, data, and other communication systems outlets with conduit, boxes, cabinets, etc., as shown. Outlets, raceways and plates as specified in Division 26. All conduit runs to have long sweep radius elbows; condulets not permitted. There shall be a maximum of two 90° bends between outlets. Any run over 100'-0" in length shall have a pull box where approved by the Communications System Trade. Provide fish wires as previously specified. Cabinets shall be flush or surface mounted as required.
3. Furnish and install a 1" conduit from each outlet to the nearest accessible ceiling void.
4. Communications systems service plywood panels shall be un-painted class "A" fire rated 4'-0" X 8'-0" X 3/4" thick plywood panels mounted at location shown on drawings with long dimension vertically. All conduits terminating at service panels shall be bushed 0'-6" above floor or 7'-6" above floor.
5. Provide a ground bar for each service panel as described in Section 27 05 26. Furnish and install #6 wire in 3/4" conduit from service plywood panel to cold water main for ground. Leave 6'-0" excess at panel and attach other end with ground clamp to cold water main. Bond this systems grounding electrode to the Section 26 05 26 building grounding electrode system (BGES) per NEC 800.
6. Provide two (2) four (4) inch underground service entrance conduits from the service entrance panels to the property line as shown on the drawings. The underground conduits shall be schedule 40 PVC with IMC or G.R.S. bushed stubs at the panel. Concrete encasement is not required unless the 24" minimum burial depth cannot be maintained. Refer to NEC and local utility company regulations for burial depths of less than 24".
7. All communications systems conduits, boxes, etc., shall be grounded to the building grounding electrode system (BGES) and properly bushed.

C. All boxes, conduits, etc., shall be of proper size, as determined by the Communications System Trade and shall be clearly marked for easy identification.

3.2 FIELD QUALITY CONTROL:

A. The Contractor shall submit the following information to the Architect/Engineer.

1. "As-built" conduit layout diagrams.

END OF SECTION 270528

SECTION 270553 – IDENTIFICATION FOR COMMUNICATION SYSTEMS

PART 1 – GENERAL:

1.1 RELATED DOCUMENTS:

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

1.2 WORK INCLUDED:

A. Prepare and paint Division 27 equipment supports and miscellaneous materials located in Equipment Rooms, IDF's, MDF and other utility areas housing mechanical, electrical, and communication equipment.

B. Identification of cabinets, racks, equipment and other system enclosures.

1.3 WORK NOT INCLUDED:

A. Painting of factory finished Division 27 Equipment such as Data Communications, Voice Communications, CATV Systems, etc.

1.4 RELATED WORK:

A. Section 26 05 53 – Identification for Electrical Systems

B. Section 27 05 00 – Common Work Results for Communications

C. Section 27 05 28 – Pathways for Communications Systems

D. Section 27 20 00 – Data Communications

E. Section 27 30 00 – Voice Communications

F. Section 27 53 00 – CATV System

G. Section 28 05 53 – Identification for Electronic Safety and Security Systems

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. Except as otherwise specified, materials shall be the products of the following manufacturers:

1. Sherwin-Williams

2. Pratt and Lambert
3. Devoe
4. Benjamin Moore

2.2 MATERIALS:

A. Deliver all paints and materials to the project site in their original containers with all labels intact and legible at the time of use.

B. Sherwin-Williams Industrial Maintenance Coatings System 4000 products are listed below to establish color and a standard of quality.

1. All Hangers and Supports: One coat Series 54 Gloss Black Alkyd Enamel.
2. Factory Finished Equipment finishes shall be cleaned and properly touched up with equipment manufacturers touch-up paint unless finish is severely damaged or of unacceptable quality. In the latter case, the entire finish shall be restored in accordance with painted procedures herein specified.

PART 3 - EXECUTION

3.1 WORKMANSHIP:

A. The work shall be accomplished by qualified mechanics skilled in the painting trade. Painting of equipment and other materials shall not commence until all testing is complete and systems are ready for operation. Materials shall be evenly spread, and smoothly flowed on without runs or sags. Each coat shall be thoroughly dry before application of succeeding coats.

3.2 PROTECTION OF WORK:

A. The painters shall protect all adjacent surfaces with drop covers during the process of painting. Upon completion, paint spots, if any, shall be removed from all surfaces not intended to be painted.

3.3 PREPARATION OF SURFACE:

A. Surfaces to be painted shall be completely dry before applying paint. Metal surfaces shall be cleaned with mineral spirits before applying materials. Rust and scale shall be removed by wire brushing or sanding. Galvanized surfaces shall be chemically treated with crystalline zinc phosphate in strict accordance with the manufacturer's recommendations. Surfaces shall not be painted when the temperature is, or is likely to be, near the freezing point, nor when they are exposed to hot sun.

3.4 IDENTIFICATION OF BOXES AND EQUIPMENT:

A. After **all** painting is completed, operating and control parts of the equipment and systems such as cabinets, racks, telephone cabinets, and system cabinets shall be properly identified with laminated engraved plastic nameplates fastened with sheet metal screws, bolts or permanent adhesive. Pressure sensitive tape is **not**

acceptable. Identification symbols or designations shall be the same as shown on the contract documents.

B. Boxes; Concealed and Surface Mounted: Each enclosure shall be **neatly** identified by stencil marking, which shall indicate service contained, circuit numbers (or zone numbers). Stencil letters shall be upper case (Capital) not less than one half inch high and painted with Series 54 black gloss enamel.

C. See Section 26 05 53 for Identification of Conduits associated with these systems.

D. The Division 27 Systems shall have an engraved informational laminated nameplate with the installing trade's name, telephone number and address for the Owner to obtain preventive maintenance, service or parts. The nameplate shall include the job order number, shop number or other identification, which will identify the related equipment.

If the above address and telephone number is a branch office, the main office or manufacturer's address and telephone number shall be included.

END OF SECTION 270553

SECTION 272000 - DATA COMMUNICATION/DATA

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 WORK INCLUDED:

A. Complete vertical and horizontal Communication/Data Network System as indicated.

1.3 RELATED WORK:

A. Division 26 – Electrical

B. Division 28 – Electronic Safety and Security

1.4 GENERAL OPERATION AND DESCRIPTION:

A. General: Furnish and install one (1) complete Communication/Data Network as described herein and as shown on the plans; to be wired, connected and left in first class operating condition. The network shall consist of three (3) systems (Data Network, Telephone, CCTV cabling). The three (3) systems making up the Communication/Data Network will be structured with individual backbones and horizontal distributions from the Main Communications room(MDF) and emanate to each data outlet, phone outlet and CCTV outlet. The Communication/Data network shall use SYSTIMAX© Structured Cabling Systems (SCS) for Fiber Cables, Category 6 cable and components for the Communication/Data Network System and all other necessary materials for complete Cable plant and infrastructure. The contractor shall furnish all new networking as required and as called for.

B. Description:

1. Backbone Distribution:

a. LAN: The backbone distribution cable for the LAN shall consist of One (1) 12 fiber multi-mode cable homerun to from the MDF to the new IDF. Terminate all fibers on both ends with LC connectors in fiber trays as needed. Cables shall be rated for indoor and outdoor/underground use as required.

2. Horizontal Distribution:

a. LAN (Computers and IP Telephone): The horizontal LAN cables shall be of Category 6, plenum rated and homeruns from station devices to the respective Rack patch panels.

b. Telephones; Section 27 51 23: The horizontal telephone cables shall be Category 6, plenum rated and homeruns from station devices to the respective Comm rooms horizontal backbone cross-connect field 110 blocks with legs. (For faxes and alarm systems)

3. Patch panel cables and fiber optic jumpers.

a. LAN Network Patch Panel Cables: Cables shall be Category 6, with Category 6 (RJ45) connectors on each end. Patch panel cables shall connect to rack mounted switches and rack mounted Category 6 patch panels.
b. LAN Network Fiber Optic Jumpers: Fiber optic jumpers shall each be a single fiber with LC connectors on each end, as required, and terminate between the fiber tray and a panel in racks containing switches. Also, jumpers shall connect between rack mounted panel and switches. Coordinate required connectors with electronic devices. All ends shall be factory terminated.
c. Station Outlet Jumper Cables: Cables shall be Category 6, with Category 6 (RJ45) connectors on each end. All ends shall be factory terminated.

4. LAN Racks and Station Termination Devices:

a. LAN Racks: LAN racks shall consist of enough Category 6 patch panels, cable organizers, hooks, optical patch panels and new switches. Racks shall be bolted to the floor, or thru-bolted to the wall, as indicated.
b. Station Termination Devices: Devices shall be multiple outlet devices, recessed mounted single gang with Category 6 (RJ45) jacks for voice and data with mounting kits required with double gang outlet boxes in walls as indicated.

5. Routing of Cable:

a. Backbone Distribution: Cables shall utilize conduits and specified Ahooks@. All cables shall be mounted and supported as necessary to ensure proper installation.
b. Horizontal Distribution: Cables shall utilize conduits and hooks in station termination areas and, “hooks” and conduits in corridors. All conduits shall be properly grounded.

6. Ethernet Electronic Equipment:

a. Cable support brackets
b. Patch panels with Category 6 RJ45 to 110 terminations.
c. Fiber Trays consisting of 24 couplers, with spools, ties, covers, etc.
d. 48-port RJ45 stackable switches with Fiber Optic Ethernet media adapters, advanced management module are provided by the Owner.
e. All necessary accessories, equipment, software, and programming, etc. necessary for a complete and working system.
f. Wall mounted 110 termination, 100 pair patch panels.

C. Operation:

1. Use: Cable plant for the Data Network shall be such that the Owner can activate any LAN termination as indicated on drawings by connecting a computer to any station outlet.
2. Testing: All cables and jumpers shall be tested before installation and after installation. The testing of all cables shall conform to TIA/EIA and Industry Test Standards for Category 6 cables, connector and fiber optic cables. The entire cable plant shall be Systimax certified with a twenty (20) year Systimax warranty. Test result for all cables shall be recorded and turned over to the Owner and Engineer.

3. Labeling: All cable shall be labeled and recorded. A copy of this wiring table shall be turned over to the Owner and Engineer. The Owner's approved room designation shall be part of the cable identification number. See architectural sheets for exact room numbers. A copy of this wiring table shall be retained by the installing trade.
4. Riser Diagram: A complete riser diagram labeled with origination point, destination prints, room numbers, jack ID, port ID and cable ID shall be turned over to the Owner and Engineer. A copy of this riser diagram shall be retained by the installing trade.

1.5 REFERENCES

A. Source Quality Control: Materials and equipment shall be new, unused, conform to present revisions TIA/EIA specifications and UL listed.

B. The Communication/Data Network and components shall be installed by one (1) single Communication/Data Network Trade of established reputation and experience in Communication and data network installation and shall have installed similar systems for a period of at least ten (10) years and shall be able to refer to similar installations rendering satisfactory service. The Communication/Data Network Trade shall be SYSTIMAX7 certified.

C. The Communication/Data Network Trade shall be qualified as stated hereinafter in the installation and testing of the System being provided and shall be completely versed in TIA/EIA standards and practices. The above Communication/Data Network Trade's authorized technical representative shall be hereinafter known as the "Comm/Data Trade". The Comm/Data Technician and his employer shall be capable of providing test reports containing the test data of all cables installed whether terminated or spared. The Comm/Data Technician shall install and test all components of the network not provided by the Owner, and provide wiring tables and certification to the Owner's representative and Engineer. The Comm/Data Network installation shall include cabling, connections, components, marking, testing, and certification. The Electrical Trade shall provide conduits, junction boxes and pull boxes as indicated or needed, and as required by the Comm/Data Trade's instructions. The Comm/Data Trade shall furnish all cabling, all racks, all patch panels, all connecting blocks, all couplers, all connectors, all terminating devices, all special boxes, and all accessories and parts associated with the above.

D. The Comm/Data Trade shall have a Registered Communication Distribution Designer (RCDD) certified by BICSI.

E. The Comm/Data Trade shall be certified SYSTIMAX reseller.

F. The Comm/Data Trade shall be a certified by Nortel Networks reseller.

G. The Comm/Data Trade shall also furnish a list of similar or equal installation (a minimum of 10) and shall have at least five (5) years of company experience in this type of work.

1.6 REFERENCES:

A. The complete installation, including additions and modifications, shall be in accordance with the following:

1. National Electrical Code Article 800.
2. TIA/EIA Standards to their latest revisions:

    a. The 2012 International Building Code.
    b. National Electrical Code Article 760.
    c. Twisted Pair Cables - (TSB-36).

b. Applicable Connectors - (TSB-40).
e. Measurement of Fiber or Cable Lengths Using an (OTDR) - (TIA/EIA-455-60).
f. Measurement of Fiber or Cable Attenuation Using an (OTDR) - (TIA/EIA-455-61).
g. ANSI/TIA/EIA-455, Standard test procedures for Fiber Optic Fibers, Cables and Transducers, sensors, connecting and terminating devices, and other fiber optic components.
h. ANSI/TIA/EIA-598-A, Color Coding of Optical Fiber Cable.
i. ANSI/TIA/EIA-604-3, FOCIS 3 Fiber Optic Connector Intermateability Standard
j. ANSI Z136.2, American Standard for the Safe Operation of Optical Fiber Communication Systems Utilizing Laser Diode and LED Sources.
k. ANSI/ICEA S-80-576-1988, Communications Wire and Cable for Wiring Premises
l. ANSI/ICEA S-83-596-1988, Fiber Optic Premises Distribution Cable.
m. ANSI/ICEA S-84-608-1988, Filled Telecommunications Cable
n. ANSI/TIA/EIA-568-A, Commercial Building Telecommunications Cabling Standard
o. ANSI/TIA/EIA-568-A-1, Standard, Propagation Delay and Delay Skew Specifications for 100 Ω 4-pair cable
p. ANSI/TIA/EIA-568-A-2, Corrections and Additions to TIA/EIA-568-A
q. ANSI/TIA/568-A-5, Additional Transmission Performance Specifications for 4-pair 100 Ω Enhanced Category 6 cabling.
r. ANSI/TIA/EIA-569-A, Standard, Commercial Building Standard for Telecommunications Pathways and Spaces
s. ANSI/TIA/EIA-569-A-1, Perimeter Pathways Addendum
t. ANSI/TIA/EIA-570-a, Standard Residential Telecommunication Cabling Standard (proposed revision to 570)
u. ANSI/TIA/EIA-606A, Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
v. ANSI/TIA/EIA-607, Commercial Buildings Grounding and Bonding Requirements for Telecommunications.
w. ANSI/TIA/EIA-758, Customer-Owned Outside Plant Telecommunications Cabling Standard (proposed new standard)
x. ANSI/TIA/EIA-758-1, Customer-Owned Outside Plant Telecommunications Cabling Standard (proposed revision to 758)
y. TSB67, Transmission Performance Specifications for Field Testing of Unshielded Twisted-Pair Cabling Systems
z. TSB72, Centralized Optical Fiber Cabling Guidelines
aa. TSB75, Additional Horizontal Cabling Practices for Open Offices.
bb. TBS95, Additional Transmission Performance Guidelines for 100 Ω 4-pair Category 6 cabling
cc. ISO/IEC 11801, Information Technology – Generic cabling for customer premises
dd. IEC 1000 5-2, Grounding and Bonding
ee. ASTM D 4565 – 90, Physical and Environmental Properties of Insulation and Jackets for Telecommunications Wire and Cable (see B1.7)
ff. ASTM D 4566-90, Electrical Performance Properties of Insulation's and Jackets for Telecommunications Wire and Cable.
gg. ASTM E 814, Fire Test of Through Fire Stops
hh. ANSI/TIA/EIA 568 B2.1 Transmission Performance Specifications for 4-Pair 100 Ohm Enhanced Category 6 Cabling (latest revision).

1.7 SUBMITTALS

A. Submit shop drawing and product data in accordance with Section 27 05 00.

1. Shop Drawings: The Comm/Data Trade shall provide engineering data sheets on each component and complete servicing data including part numbers of the various components.
2. Product Data: Submit application, technical and installation data.

B. Submit wiring table and test data in accordance with Section 27 05 00.

C. Submit Operation and Maintenance Manuals in accordance with Section 27 05 00.

D. Submit a complete one-line riser diagram showing all equipment, cable and outlets identified with room numbers, part numbers and cable ID. Room numbers shall be included in the cable I.D. The room numbers shall be as indicated on the Architectural drawings.

1.8 WARRANTY, SERVICES:

A. The Comm/Data Trade shall provide an Systimax warranty for this Network, minus electronic components, for a minimum of twenty (20) years from date of acceptance by Owner and shall provide parts and labor to fulfill this warranty at no cost to the Owner. The electronic components shall be warranted.

B. Refer to Division 1 for submission of warranty.

C. Qualified service and parts shall be available to call on within a 100 mile basis.

D. Service personnel shall respond within 72 hours (maximum) to all trouble calls.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. The backbone riser fiber optic distribution cable and end to end terminations (Plenum rated) shall be based on SYSTIMAX7 (SCS LAZR SPEED SPEED) products whose numbers are used herein and Amp, General Cable and CommScope shall be consider equal meeting all of the specified requirements.

B. The horizontal copper distribution cables (plenum rated) for the LAN shall be based on SYSTIMAX©(SCS) products whose numbers are used herein and Amp, General Cable and CommScope shall be consider equal meeting all of the specified requirements.

C. The wire management/equipment racks and cabinets with associated components shall be based on SYSTIMAX © (SCS) products whose numbers are used herein and Amp, Panduit and CommScope shall be consider equal meeting all of the specified requirements.

D. The multiple port station outlets, patch panels and wire management devices shall be based on SYSTIMAX© (SCS) products whose numbers are used herein and Amp, Panduit and CommScope shall be consider equal meeting all of the specified requirements.

E. All system copper wiring and components shall be furnished by a single manufacturer. All system fiber optic cabling and components shall be furnished by a single manufacturer.

F. All data system active electronic components shall be furnished by the Owner.

2.2 SYSTEM COMPONENTS [S] [O/M]:

A. Cables for Data Network: Plenum rated:

1. Backbone Distribuiton:

   a. LAN Distribution Cable: 12 fiber distribution cable, multi-mode, buffered fibers, 50.0 μm core, 125 μm cladding - SYSTIMAX7 Product Code #5201-012A-ZPAQ and

      12 fiber distribution cable, single mode, buffered fibers, 8.0 μm core, 125 μm cladding - SYSTIMAX7

      The above fiber cables is required to be pulled through 2" EMT conduit above ceilings or use under floor conduits between rooms for support and protection against damage.

   b. Telephone Distribution Cable:

      (1) 100 pair distribution cable, 24 AWG solid-copper conductors insulated color-coded PVC. SYSTIMAX Product Code #2010100 BWH (CMP/MPP).

2. Horizontal Distribution: LAN: (Data and Voice) Four (4) twisted-pair and meet all TIA/EIA Category 6 specifications. ITC approved cable. SYSTIMAX7 LAN Cable No. 2081, blue cable color.
3. Patch Panel Cables, Fiber Optic Jumper:

   a. Patch Panel Cables: Four (4) twisted-pair with RJ-45 connectors on both ends and meet all TIA/EIA Category 6 specifications. Patch cable shall be ITC approved cable, SYSTIMAX PN#GS8E series with lengths as required.
   b. Fiber Optic Jumpers: Two (2) fiber optic conductors, factory terminated to desired lengths as needed. Dual fiber cable multi-mode, buffered, 50.0 μm Core, 125 μm cladding with LC multi-mode connections - SYSTIMAX Product Code #FPCXLCLC series. The is required for dual single mode 8 μm Core, 125 μm cladding jumpers with LC multi-mode connections - SYSTIMAX
   c. Outlet Jumper Cables: Four (4) twisted-pair with RJ-45 connectors on both ends and meet all TIA/EIA Category 6 specifications. Patch cable shall be ITC approved cable, SYSTIMAX PN#GS8E series at 10'-0" lengths.

B. Rack LAN Termination Devices:

1. SYSTIMAX LST1F-07217 series 72 port fiber tray: Rack mounted complete with the following:

   a. Fiber Organizer Spools.
   b. Tray Cover, cable restraints and miscellaneous hardware.
   c. Couplers: For LC type multi-mode fiber optic connectors Snap in type. Forty Eight Four (48) couplers minimum per enclosure. SYSTIMAX Product Code #P1001. Use SYSTIMAX product code #C1001 Series multi-mode fiber connect for buffered fiber only inside the tray.

2. Fiber Optic Connectors: LC multi-mode connector plugs - for terminating both ends of fiber optic distribution cables. SYSTIMAX Product Code #P1001 Series. Provide LC single mode fiber connectors. Provide enough to terminate all fiber ends.
3. Consumable Kits: Enough supplies per kit to terminate 100 LC multi-mode connectors. SYSTIMAX Product Code #D-182738 and 100 LC single mode connectors.
4. Couplers: For LC type multi-mode fiber optic connectors. Coupler - Snap in. SYSTIMAX Product

Code #C1001 Series.

5. Racks:

    a. Rack: 7' tall, open rack, boltable to floor and 79" of mounting space. SYSTIMAX XLBET 720 series.
    b. 24 and 48 Port Patch Panels: RJ45/110, Cat 6. SYSTIMAX PMGS3-(24,48) series with copper modules and required accessories (distribution modules, front and rear retainer, fasteners, labels, icons, etc.)
    c. Spacer/Cable Organizers: SYSTIMAX 1100D1 Patch Cord Organizer series as required.
    d. Vertical Cable Brackets: Use as needed. Ortronics Part #'s OR-808004868, OR-808004859.
    e. Cabinet power strips shall be horizontal (Tripp-Lite RS-1215) and vertical cabinet (Tripp-Lite vertical single phase switched PDUs, 20 amp, 24 NEMA 5-15/20 receptacles, visual current meters, Ethernet interface for reporting power and load characteristic PDUMNV20). Provide temperature monitoring from vertical power strips to shutdown equipment in the event of a high temperature condition. The vertical power strips shall support alarm via the network before equipment is shutdown. Power Strips are as indicated on the Drawings.

C. Data Communications (Room or Closet) Telephone Termination Devices: SYSTIMAX 110 Block Equipment.

1. 110 Wiring Blocks: 100 Pair Capacity. SYSTIMAX Product Code #110 AW2-100.
2. 110-C Connecting Blocks: 4 pair capacity. SYSTIMAX Product Code #110C-4.
3. Cable trough between 110 blocks for cable support.
4. Cross connect cables.

D. Station Termination Devices:

1. Single gang 6 port 100 style Keystone Jack Faceplate - SYSTIMAX 6 Port Series #M16A- 246 (Ivory).
2. Single gang 2 port M106FR2 Modular mounting frame-SYSTIMAX 2 port series #M106FR2 C (for floor boxes only).
3. Category 6 (RJ45) Jack (voice and data) - SYSTIMAX #MGS400-246 (Ivory).
4. Blank Inserts - SYSTIMAX #M20AP-246 (Ivory).
5. Computer Icon - SYSTIMAX #M61-112 (Orange).
6. Telephone Icon SYSTIMAX #M61-226 (Green) (Intercom and IP Telephone).

E. Ethernet Electronic Equipment: See drawings for Rack Layouts. All electronic equipment shall be Owner provided.

F. Rack Mounted Power Strips as indicated on the Drawings.

G. Rack-Mounted Battery Back-Up Units: APC-UPS-SU1400-RM-XL-3U complete with eleven (22) minutes battery back-up at half power output and line conditioning for power losses and surges. Regulation input voltage range shall be 92 to 147 volts with full noise and spike suppression. Provide units as indicated on the Electrical Plan's Rack Layouts.

PART 3 – EXECUTION

3.1 INSPECTION:

A. The Comm/Data Trade shall be responsible for all arrangements for testing, recording and certification of the Comm/Data Network cabling to meet all applicable and current TIA/EIA standards before the Comm/Data Network is accepted by the Owner and the Engineer.

B. The Owner retains the right to conduct inspections of the Comm/Data Trade's work at the Owner's discretion. For record purposes the Owner is requested to submit their observations in writing to the Engineer. Upon completion of all testing and acceptance is given by the Owner and the Engineer, all inspection reports shall be given to the Owner.

3.2 INSTALLATION:

A. General: The Comm/Data Trade shall provide all new equipment, accessories and material required for the installation of the Comm/Data Network in accordance with the specifications and drawings. Any material and/or equipment necessary for the proper operation of the system that is not specified or described herein shall be deemed part of this specification.

B. Wiring:

1. Complete Conduit, Raceway and “Hooks” System: Provide proper number and size of conductors as required for connection of the data network components in accordance with the manufacturer's instructions. All wiring methods shall be in accordance with NEC 800, and applicable TIA/EIA specifications.
2. No wiring other than that directly associated with the Comm/Data network shall be permitted in data conduits, raceways, cable tray and “hooks”.
3. Conductor splices are not permitted.
4. Transposing or changing color coding of wires shall not be permitted.
5. All conductors shall be labeled on each end with "E-Z markers" or equivalent.
6. The labels on both ends of the conductors shall be marked in accordance with TIA/EIA standards. Cable identifiers shall also be located in each wall jack and the respective patch panel jack.
7. Conductors in racks and cabinets shall be carefully formed and harnessed so that each drops off directly opposite to its termination. All cable bends shall conform to TIA/EIA standards.
8. All equipment shall be numbered.
9. Each riser cables shall be secured as it is broken out and/or passes through rack, for support.
10. All wiring shall be checked and tested to insure their integrity and performance in accordance with all applicable TIA/EIA specifications to their latest revisions before installation and after installation.
11. The labels on both ends of the conductors and jack plates shall be marked in a fashion such as “R1-01”. “R1" is the data network rack number in which the conductor terminates. “01" is the port number in the associated rack.

C. All boxes, conduits, etc., shall be of proper size, as determined by the Comm/Data Trade, shall be clearly marked for easy identification, continuously grounded together and bonded to the building grounding electrode system (BGES) via the TMGB. The Comm/Data Trade shall furnish special boxes to the Electrical Trade for installation by the Electrical Trade.

D. All power cables must maintain their minimum clearances from the Comm/Data network cables per TIA/EIA Standards.

E. The complete wiring for the Comm/Data network is not shown on the drawings. The actual conductor routing of the Comm/Data network shall be by the Comm/Data Trade based on the location of the devices, conductor limitations and cable limitations.

F. Each recessed new Comm/Data and Telephone outlet located in walls shall consist of a 4" x 4" x 2- 1/8" deep outlet box with a double gang adapter plate. The depth of the adapter's offset shall depend on the wall construction encountered. Provide a one (1) inch conduit with **long** sweep ells to terminate at the cable tray in the corridors. Provide grounding type bushings and ground to the cable tray. Cable tray "conduit bushing dropouts" can be used in lieu of grounding type bushings. Provide additional junction boxes as needed after every two (2) 90 degree bends.

G. Color coding at administration panels to identify the distribution fields should be as follows as a minimum:

1. Blue: Work Location and Horizontal cables
2. White: Backbone and campus cables
3. Purple: Common equipment
4. Green: Incoming Telco trunks
5. Orange: Multiplexed output
6. Yellow: Auxiliary Equipment
7. Gray: Tie Cable

H. Backbone Distribution inside and outside (copper and fiber):

1. Testing: All cables shall be tested before and after installation to TIA/EIA Standards and those mentioned herein to ensure the integrity and performance of each conductor.
2. See riser diagram for routing.

I. Horizontal Distribution:

1. LAN: The horizontal LAN cables for computers and Owner IP telephones shall be Category 6, plenum rated and homeruns from station devices to respective rack's or cabinet's patch panels. Cables shall attach to patch panels via 110 style punch downs. Cables shall terminate to (RJ45) Category 6 jacks on station ends via 110 style punch downs. Cable shall utilize conduits, raceways, or hangers as required.
2. Testing: All cables shall be tested before and after installation to TIA/EIA Standards and those mentioned herein to ensure the integrity and performance of each conductor to Category 6 levels.

J. Patch Panel Cables, Classroom Jumper Cables and Fiber Optic Jumpers:

1. Patch Panel Cables: The patch panel cables are factory assembled. The cable shall be Category 6 with Category 6 (RJ45) connectors on both ends. There shall be as many patch cables as there are connections to the patch panels from station devices. Patch panel cables shall connect from the patch panel to the hubs as directed by the Owner (port assignments). Lengths shall be as required. Train all cables neatly and cleanly. Classroom jumpers shall be 10'-0" in length and provided for every classroom data outlet.
2. Fiber Optic Jumpers: The LAN network fiber optic jumpers shall each be a dual fibers with LC connectors on ends and terminate between respective rack mounted fiber trays and switches as directed by the Owner (port assignments). The jumpers are factory assembled.
3. Testing: Patch panel cables shall meet or exceed requirements in TIA/EIA Standard and those mentioned herein.

K. LAN Racks: Refer to drawings for rack layouts and schedule of equipment.

L. Station Termination Devices: Devices shall be multiple outlet devices, single gang with Category 6 (RJ45) jacks for voice and data as indicated by the symbols on the drawings.

M. Grounding: All racks, surface raceways, cable tray, conduit and conduit devices shall be grounded as a continuous system and connected to the building grounding electrode system per NFPA-70.

N. All racks shall be bolted in place.

3.3 TECHNICAL ASSISTANCE:

A. Instruction: The Comm/Data Network Technician shall instruct the Owner's proper designated authority on the overall cable plant, devices, wiring tables and test data after the installation is completed.

3.4 FIELD QUALITY CONTROL:

A. General: Upon completion of the installation, the Comm/Data Trade shall have performed all necessary TIA/EIA specified tests to the latest published revisions of the TIA/EIA standards and corrected any problems found during testing. The above representative shall then submit all documents and a letter of certification certifying test data required herein to the Owner and Engineer that the system functions and conforms to all requirements of the manufacturer of the equipment, the Contract Documents and all requirements of the latest revisions of the TIA/EIA standards.

B. The Comm/Data Trade shall perform all electrical tests required by present revisions of TIA/EIA specifications to ensure that all components of the Comm/Data network shall meet and exceed the following:

1. All Category 6 cables shall conform to or exceed the TIA/EIA 568 Rev. B, Commercial Building Wiring Standard, Horizontal Cable Section and the TIA/EIA Technical Systems Bulletin 36 for Unshielded Twisted Pair Cables. Other standards supported include IEEE 802.3, 1BASE5, 10BASE-T; IEEE 802.5, 4Mbps, 16Mbps (328 ft [100m], 104 Workstations) and proposed ANSI X3T9.5 TP-PMD requirements for UTP at 100 Mbps. In addition, cables shall be capable of supporting evolving high-end applications such as 155 Mbps ATM, 622 Mbps at 100 MHz, and 1Gbps.
2. Category 6: All plenum Category 6 Unshielded Twisted Pair (UTP) cables shall be composed of 24 AWG bare solid-copper conductors, insulated with TEFLON. The insulated conductors are twisted into pairs and sheathed with a low smoke PVC jacket and shall meet or exceed the Manufacture's Electrical Specifications.
3. All Category 6 outlets shall utilize crossover lead technology to address data circuit applications up to 100 MHZ and meet or exceed the Manufacturer's electrical, mechanical and NEXT specifications.
4. Outlets shall be wired in an TIA/EIA 568B configuration.
5. Category 6: All Category 6 cordage shall be round, 23 gauge tinned copper, stranded conductors insulated with solid polyolyfin, tightly twisted into individual pairs and jacketed with flame retardant PVC and shall meet or exceed the Manufacturer's Electrical Specifications and the Worst Pair to Pair Near-End Crosstalk (NEXT) values.
6. The fiber patch cord shall meet the following specifications:

a. Minimum bend radius: 1.00 inch (2.54 cm)

b. Operating temperature: -4 to 158EF (-20 to 70EC)

c. Loss: 0.4 Db/mated connector

d. Minimum bandwidth: 160 MHZ-km at 850 nm
500 MHZ-km at 1300 nm

7. All Category 6 patch panels shall support 100 Mbps TP-PMD and 155 Mbps ATM and shall meet or exceed the Manufacturer's NEXT Values.
8. The fiber cable shall meet the NEC requirements for OFNR or OFNP and comply with Bellcore, FDDI, TIA / EIA-568 and ICEA standards.
9. The fiber cable shall meet the following specifications:

a. Fiber Dimensions:

(1) 50.0µm - core
(1) 125µm - cladding
(2) 250µm - coating
(3) 900µm - buffering

b. Cable Minimum Bending Radius:

(1) During Installation: 20 times cable diameter
(2) After Installation: 10 times cable diameter

c. Buffered Fiber Minimum Bend Radius: .75 in. (1.91 cm)
d. Operating Temperature Range: 32ºF to 122ºF (0ºC to 50ºC)
e. Storage Temperature Range: -40ºF to 149ºF (-40ºC to 65ºC)

10. Optical Specifications:

a. Maximum Fiber Loss: 3.5 dB/km at 850 nm (typical range 3.0 to 3.5 dB/km)
b. Maximum Fiber Loss: 1.5 dB/km at 1300 nm (typical range 0.5 to 0.8 dB/km)

11. Minimum Bandwidth: 500 MHZ at 850 nm
500 MHZ at 1300 nm

a. Numerical Aperture: 0.275
b. UL Listed.

12. LC connectors shall meet or exceed the following specifications:

a. Operating Temperature: -40 to 185ºF (-40 to 85ºC)
b. Average Loss: 0.3 dB

C. After completion of installation and testing, the Comm/Data Trade shall submit the following information to the Owner's authorized representative, and the Engineer.

1. Cross Connection Documentation: Provide cross connect records for all data devices, and all racks and cabinets.

2. Wiring table of all conductors whether active or spare.
3. Labeling of all components.
4. Riser Diagram completely labeled.

D. Documentation shall be submitted in the following format:

1. Two (2) copies of all cross connect documentation in computerized form.
2. Two (2) copies of all wiring tables in computerized form.
3. Two (2) copies of all component labeling forms in computerized form.
4. Two (2) copies of the riser diagrams.
5. Two (2) copies of the test data in electronic form and paper form. Provide viewing software for the test data in electronic form or store the electric form in a format viewable by a word processor of standard browser.

E. Upon completion of the project, Comm/Data Trade shall prepare "As Built" documentation showing actual installation as constructed.

F. In addition to the Data Trades diagrams, the following items shall be provided by the Comm/Data Trade:

1. Test data conducted on all conductors and certification that the data is true and accurate.

END OF SECTION 272000

SECTION 273000 – VOICE COMMUNICATIONS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 WORK INCLUDED:

A. Partial raceway system for Telephone System as indicated (For wiring, cabling, jacks and terminating refer to Section 27 20 00 Data Communications)

1.3 RELATED WORK:

A. Division 26 - Electrical

B. Section 27 05 53 – Identification for Communications Systems

C. Section 27 20 00 – Data Communications

1.4 GENERAL OPERATION AND DESCRIPTION:

A. General: The telephone system shall consist of a partial empty conduit system.

1.5 REFERENCES:

A. The complete installation, including additions and modifications, shall be in accordance with:

1. National Electrical Code Article 760 & 800.
2. Minimum standards of Electronics Industries Association (EIA).

1.6 SUBMITTALS:

A. Submittals not required.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 INSTALLATION:

A. General:

1. The Division 26 Contractor shall provide all conduits, junction boxes, and materials required for the installation of a partial conduit Telephone System in accordance with the specifications and drawings. Any material and/or equipment necessary for the proper operation of the system not specified or described herein shall be deemed part of this specification.
2. The station lines, the horizontal backbone telecommunications cable, the cross-connect fields (“110" blocks) outlet jacks and plates, testing shall be provided in Section 27 20 00.
3. The Owner’s telephone system vendor will provide the telephone switch, attendant station and station telephones in-place and make the connections.

B. Wiring:

1. Telephone Raceway System: Division 26 shall provide a partial empty raceway system for telephones with conduit, boxes, etc., as shown. Outlets, raceways and plates as specified elsewhere herein. All conduit runs to have long sweep radius elbows; condulets not permitted. There shall be a maximum of two 90ºbends between outlets. Any run over 100'-0" in length shall have a pull box where approved by the Telephone Company. Provide fish wires as previously specified.
2. Division 26 shall furnish and install 1" conduit from each telephone outlet to the nearest cable tray as located on drawings. Where two (2) telephone outlets are in the same room or back to back in the same wall, furnish and install 1" conduits between the outlets and 1-1/4" conduit to the nearest cable tray and terminating in a cable tray conduit bushing dropout.
3. Telephone service entrance panels shall consist of two (2) class "A" fire rated 3/4" thick by 48" wide by 96" high non-painted plywood panels mounted at location shown on the drawings with the long dimension vertically unless otherwise indicated. All conduits terminating at the service entrance panels shall be bushed 0'-6" above the floor.
4. Furnish and install #2 wire in 1" conduit from service plywood panel for ground. Leave 6'-0" excess at panel and attach other end to the Section 16450 Building Grounding Electrode System (BGES) per NEC 800-40.
5. Refer to the Special Systems’ Partial Riser Diagram for routing of backbone telecommunications cables.
6. All telephone conduits, boxes, etc., shall be grounded to the building grounding electrode system (BGES).

C. All boxes, conduits, etc., shall be of proper size, as determined by the Telephone System Trade and shall be clearly marked for easy identification.

3.2 FIELD QUALITY CONTROL:

A. The Electrical Trade shall submit the following information to the Architect/Engineer.

1. "As-built" conduit layout diagrams.

END OF SECTION 273000

SECTION 27 53 00.01 - ANTENNA DISTRIBUTED 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 this Section.

1.2 WORK INCLUDED

A. Complete Antenna Distribution System (DAS) for Owner's future selection of radio broadcasts for police, fire, rescue, safety and EMS staff and support communication throughout the building addition as indicated.

1.3 RELATED WORK

A. Division 26 – Electrical

B. Section 27 05 53 – Identification for Communication Systems

1.4 GENERAL OPERATION AND DESCRIPTION

A. General: This specification describes technical and performance criteria for deploying a Antenna Distribution System capable of supporting (future) Public Safety Networks (PSN) radio broadcast systems, (future) Wireless Service Providers (WSP) and, (future) operations and security, (future) video and broadcast camera applications. This includes but is not limited to applications such as (future) two-way first responder/police/fire radios, two-way building operations radios, (future) two-way security radios, future cellular telephones, future handheld POS, future wireless ticket scanners, future wireless TV broadcast cameras, future VoIP telephones (as part of the antenna distribution system, and other future emergency broadcast systems. The Owner is responsible for providing components of the system for all signaling by coordinating with proper authorities to insure the correct signaling interface components are provided, installed and tested. The Contractor shall provide the headend card cabinet controller, distribution cable and antenna nodes. This system shall not be installed until the Fire Marshal has completed the radio survey to determine if the DAS system is required. The survey shall be completed once the building is closed end. If the radio signal evaluation concludes the DAS system is not required, the Contractor shall provide a credit to the Owner for the complete system. Materials for this system shall not be ordered until the radio survey has been completed.

B. Operation:
   1. Antenna Distribution System shall allow the extend broadcast of future two-way first responder/police/fire radios, future two-way building operations radios, future two-way security radios, future broadcast systems for cellular telephones, future handheld POS, future wireless ticket scanners, future wireless TV broadcast cameras, future VoIP telephones via hubs remote access units, coaxial antennas, donor antennas, bi-directional amplifiers, connectors, splitters, combiners, couplers, and future fiber optic cable, connectors and jumpers.

2. All future system generated active signals shall be distributed from the head-end equipment cabinet located in the MDF room or main data room next to the Library on the second floor. The passive signals from handheld radio devices shall have access to the coaxial cable system via internal passive antennas to allow the respective radio signal to propagate throughout the building and not be blocked by the building components or structure. Some basic components are main hubs (chassis enclosures for future equipment), expansion hubs (chassis enclosures for future equipment), remote access units (chassis enclosures for future equipment), coaxial antennas, donor antennas, bi-directional amplifiers (BDA), coax cable and connectors, splitters, combiners, couplers, and fiber optic cable (future cabling), connectors and jumpers.

C. System Requirements:
1. The antenna distribution system shall allow all broadcast of two-way first responder/police/fire radios, two-way building operations radios, two-way security radios to propagate throughout building without being obstructed by the building structure or building components.

1.5 QUALITY ASSURANCE

A. Source Quality Control: Materials and equipment shall be new, unused and U.L. listed for use in the antenna distribution system.

B. The system and components shall be supplied by manufacturers of established reputation and experience who shall have produced similar apparatus for a period of at least five (5) years and who shall be able to refer to similar installations rendering satisfactory service.

C. The antenna distribution system shall be installed by the manufacturer's authorized installation contractor, hereinafter known as the "Antenna Distribution System Trade." The installation shall include wiring, components, connections, adjustment, testing and certification. The Division 26 Electrical Trade shall provide conduit, junction boxes and pull boxes as indicated and required by the Antenna Distribution System manufacturer's drawings or Trade instructions. The Antenna Distribution System Trade shall furnish any special boxes, cabinets, enclosures and similar items to the Division 26 Electrical Trade for installation by the Division 26 Electrical Trade in accordance with the Antenna Distribution System manufacturer's drawings, Trade instructions, and as indicated.

1.6 REFERENCES

A. The complete installation, including additions and modifications, shall be in accordance with:
1. National Electrical Code Article 820.
2. Minimum standards of Electronics Industries Association (EIA).
3. Conform with FCC regulations for Antenna Distribution Systems.
4. Meet current practices of industry.

B. All work, including but not limited to: cabling, pathways, support structures, wiring, equipment, installation, workmanship, maintenance and testing shall comply with the latest editions of the National Electrical Code, National Electrical Safety Code, all applicable local rules and regulations, equipment manufacturer's instructions, and the National Electrical Contractors Association (NECA) Standard of Installation and all applicable sections of currently adopted editions of the codes and standards listed below or the codes, standards and specifications published by the organizations listed below:
- International Building Code (IBC)
- State and local codes
- ANSI: American National Standards Institute (ANSI)

- ANSI/EIA/TIA-526: Standard Test Procedures for Fiber Optic Systems.
- ANSI/EIA/TIA-568-C: Commercial Building Telecommunications Cabling Standard
- ANSI/EIA/TIA-569-A: Commercial Building Standard for Telecommunications Pathways and Spaces
- ANSI/EIA/TIA-606A: Administrative Standard for Commercial Telecommunications
- ANSI/EIA/TIA-607: Commercial Building Grounding and Bonding Requirements for Telecommunications
- ASTM: American Society for Testing and Materials
- BICSI TDM Telecommunications Distribution Methods Manual (current edition).
- BICSI Wireless Design Reference Manual (current)
- EIA/TIA TSB67: Transmission Performance Specifications for Field Testing of Unshielded Twisted-Pair Cabling.
- FCC Part 15, 22, 24, 27, and 90
- Federal Specification Compliance: Comply with applicable requirements of FS W-C 586, “Electrical Cast Metal Conduit Outlet Boxes, Bodies, and Entrance Caps.”
- ICEA: Insulated Cable Engineers Association
- IEEE: Applicable requirements and recommended installation practices of IEEE Standards 80, 81, 141 and 142 pertaining to grounding and bonding of systems, circuits and equipment
- IEEE-802.11 a, b, g, n: Wireless Local Area Networks
- IEEE-802.3: 10Mb/s, 100Mb/s, 1Gb/s, and 10Gb/s Ethernet Standards as applicable based on media types (twisted pair copper, fiber optics, etc.)
- IEEE-802.3ak: 10Gb/s Ethernet (evolving copper standard)
- IEEE-802.3af: Power-over-Ethernet (PoE)
- IEEE-1100-1999: Recommended Practice for Powering and Grounding Sensitive Electronic Equipment
- IEEE-141: Comply with applicable requirements for installation of cable tray systems
- IEEE-241: Recommended Practice for Electric Power Systems in Commercial Buildings
- ISO/IEC 11801: International Standard on Information Technology – Generic Cabling of Customer Premises
- NEC: Applicable local electrical code requirements of the authority having jurisdiction, and the NEC as applicable to electrical boxes and fittings, cable tray systems, and grounding and bonding, pertaining to systems, circuits and equipment.
- NESC: National Electrical Safety Code
- NEMA: Applicable requirements of NEMA Stds/Pub No.’s OS1, OS2 and PUB 250 pertaining to raceways, outlet and device boxes, covers, and box supports.
- NEMA: NEMA Stds/Pub No. VE 1 “Cable Tray Systems”
- NFPA-70/NEC: National Electrical Code.
- NFPA-70B: “Recommended Practice for Electrical Equipment Maintenance” pertaining to installation of cable tray systems.
- UL Compliance.
- UL Compliance: Applicable requirements of UL 50, UL 514-series, and UL 886 pertaining to electrical boxes and fittings.
- UL Compliance: Applicable requirements of UL Standards No.’s 467, Electrical Grounding and Bonding Equipment”, and 869 “Electrical Service Equipment”, pertaining to grounding and bonding of systems, circuits and equipment. In addition, comply with UL Std 486A, “Wire

Connectors and soldering Lugs for Use with Copper Conductors." Provide grounding and bonding products which are UL-listed and labeled for their intended usage.

C. Where there is a conflict between the code and the contract documents, the code shall have precedence only when it is more stringent than the contract documents. Items that are allowed by the code but are less stringent than those specified on the contract shall not be substituted.

D. Requirements set forth by first-responder code, ordinance, or the PSN AHJ shall supersede the requirements described herein and shall be met in their entirety. It is the Contractor's responsibility to ensure that the Antenna Distribution System complies with local code, ordinances or requirements established by the PSN AHJ.

1.7 SUBMITTALS

A. Submit shop drawings, existing signal analysis and product data in accordance with Section 27 05 00.
   1. Shop Drawings: The Antenna Distribution System manufacturer and trade shall provide a one-line riser diagram of the system extension and head-end equipment indicating route and conduit size, and external wiring and connections of system proposed. Also furnish complete operating instructions, including schematic and wiring diagrams of the system, engineering data sheets on each component and complete servicing data including part numbers of the various components. A schematic diagram of the system is shown on the contract documents.
   2. Product Data: Submit application, technical, and installation data.
   3. Signal analysis: The Antenna Distribution System Trade shall provide an analysis indicating passive radio signal strength throughout the building indicate point requiring amplification and provide the proper amplification components to ensure proper signal propagation throughout the building.

B. Submit Operation and Maintenance Manuals in accordance with Section 27 05 00.

1.8 WARRANTY, SERVICES

A. The Antenna Distribution System manufacturer and Trade shall warrant the Antenna Distribution System for a minimum of one (1) year from date of acceptance by Owner against defective parts and/or workmanship and shall provide parts and labor to fulfill this warranty at no cost to Owner.

B. The Contractor shall warrant and supply evidence that the installation of materials and hardware will be made in strict compliance with all applicable provisions of the National Electric Code, the rules and regulations of the Federal Communications Commission, and state and/or local codes or ordinances that may apply.

C. The Contractor shall warrant that the Antenna Distribution System will function as specified in the approved manufacturer's Technical Description Guide.

D. Warranty Documents:
   1. Submit for all manufactured Components specified in this Section.
   2. Submit Contractor's System Warranty.
   3. Submit Manufacturer's Extended Warranty.

F. Refer to Division 1 for submission of warranty.

G. Qualified service and parts shall be available to call on within a 100 mile 6-hour basis.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT [S] [O/M]

A. General: All materials, equipment, accessories, devices and other facilities and appurtenances shall be new, best suited for its intended use and shall conform to applicable and recognized standards for their use. TE Connectivity and the items mention herein are the basis of design.

B. Equipment:

1. Antenna Distribution System shall meet the following requirements:

ADMIN/LAN:	1 RJ-45, female
Interface Connector:	1 9-pin D-sub, male for optional modem
Fiber Connectors:	4 Pair, SC/APC

Select desired bands and frequencies:
(Mark with X the desired bands in the "Selected Bands" columns)

		Frequency (MHz)	
Selected Bands	**Supported Bands**	**TX**	**RX**
	700 Lower ABC (LTE)	728-746	698-716
	700 Upper C (LTE)	746-757	776-787
	850 CELL	869-894	824-849
	800 iDEN	851-869	806-824
	900 IDEN	935-941	896-902
	900 GSM	925-960	880-915
	1800 DCS	1805-1880	1710-1785
	1900 PCS (A-F)	1930-1990	1850-1910
	1900 PCS (A-G)	1930-1995	1850-1915
	AWS	2110-2155	1710-1755
	2100 UMTS	2110-2170	1920-1980
	WiMAX	2496-2690	2496-2690

Composite Output Power at Antenna Port (dBm):

	P1dB (dBm)
700 Lower ABC (LTE)	26
700 Upper C (LTE)	26
850 CELL	26
800 iDEN	25
900 IDEN	25
900 GSM	26
1800 DCS	26

1900 PCS (A-F)	26
1900 PCS (A-G)	26
AWS	26
2100 UMTS	26
WiMAX	42.5

2. Additional Antenna Distribution System requirements:
    a. Points of interface and remote distribution units shall provide multiple connections among the primary RF services frequency bands (e.g. 450 to 512 MHz, 746 to 960 MHz, 1700 to 2170 MHz, 2.4 GHz WiMAX) to accommodate proposed wireless carriers, public safety services, in-house building operations, and any other service identified in this specification.
    b. Primary Antenna Distribution System head-end equipment shall include a data network interface for connecting to Management and Monitoring System. Interface shall be 10/100/1000 Mbps Ethernet (RJ45).
    c. The remote units shall include a data network interface for connecting to Management and Monitoring System. Interface shall be 10/100/1000 Mbps Ethernet (RJ45).
3. The Contractor shall provide the following information:
    a. RF power per RF carrier, band and protocol.
    b. Method to measure RF output power is measured and where in the system the measurement is taken (i.e. at antenna point, at remote, etc.)
    c. System performance metrics measured at the output of the remote unit or description of measurement method include if cable loss is factored in.
    d. System noise figure and how it is defined.
    e. Definition of point to point cable distances and effect of cable loss on the system. Attach a chart with cable specifications and maximum distances.
    f. Waveform accuracy specification for all supported protocols and performance test documentation and test results for support of 64QAM data
    g. System support of 3G/4G services (HSPA/HSPA+, WiMAX, LTE) and description of how this is achieved
    h. Description of solution support of MIMO.
    i. Supported power options: AC or DC
    j. Use of UPS systems and how are they alarmed. Describe the various options (duration of support, amount of equipment).
    k. System support of SNMP. Describe how it is supported (external box or integrated) and what are the connectivity options (LAN, wireless modem, POTS line).
    l. NOC/NMS capability for centralized monitoring/maintenance and the number of systems that can be simultaneously monitored and managed
    m. For systems that support multiple frequency bands, description of how each band is managed independently. Description of method to shut down a frequency band on a system wide basis and at a specific antenna point
    n. Application of attenuation via software to a single antenna point.
    o. Description of support and management of capacity and coverage changes post installation.
    p. Description of solutions for outdoor areas or “hybrid” type environments such as plazas and parking garages
    q. Scalability of proposed solutions to support multiple facilities
    r. Use of existing cable infrastructure in or between buildings
    s. Flexibility of the system architecture of the proposed solution(s)

t. Mean Time between Failures (MTBF) of all proposed Antenna Distribution System products
u. Percentage of total cost of the cable and installation in your proposal
v. Physical space requirements for main equipment locations based on the system configuration proposed in this RFP.
w. List the potential RF interfaces your system can support (base station, BDA/repeater, CPRI/OBSAI base station interface, etc.).
x. Provide Remote Access Units or Expansion HUBS at Intermediate Communication Rooms as necessary to transition from single-mode fiber optic backbone to horizontal copper distribution. This project does not have remote access units or expansion hubs.
y. Provide the neutral demark point-of-interface for RF services to be distributed over the Antenna Distribution System.

4. Main Hubs
   a. Approved Manufacturer Part Number: FSN-1-MH-1 or TE Connectivity appropriate equivalent
   b. Characteristics

- Operating Temperature Range: 0° to +45° C (32° to +113° F)
- Power Consumption: 30W
- IF/RF Connectors: 6 N, female (50 ohms); 1 Downlink/Uplink Per MIMO channel
- AC Power: 100-240V, 50-60Hz, 6A
- Enclosure Dimensions (H x W x D): 3.5” X 17.25” X 15”
- Weight: <12 lbs

5. Expansion Hubs
   a. Approved Manufacturer Part Number: FSN–EH-2 or appropriate TE Connectivity equivalent
   b. Characteristics

- Operating Temperature Range: 0° to +45° C (32° to +113° F)
- Power Consumption 4 RAU: 240W typical – 310W max
- IF/RF Connectors: 8 F, female (CATV-75 ohms)
- AC Power: 100-240V, 50-60Hz, 6A
- Enclosure Dimensions (H x W x D): 3.5” X 17.25” X 15”
- Weight: <14.5 lbs

6. Remote Access Units (RAU)
   a. Approved Manufacturer Part Number: FSN-8519-1 or TE Connectivity appropriate equivalent
   b. Characteristics

- Operating Temperature Range: -25° to +45° C (-13° to +113° F)
- IF/RF Connectors: 1 F, female (CATV-75 ohms); 1 or 2 N, (antenna-50 ohms)
- Power: 54V DC (from the Expansion Hub)
- Enclosure Dimensions (H x W x D): 2.13” X 11.25” X 11.13”
- Weight: <4.6 lbs

PART 3 EXECUTION

3.1 INSTALLATION

A. General: The Antenna Distribution System Trade shall furnish and install all equipment, accessories, and material required for the installation of a complete Antenna Distribution System in accordance with the specifications and drawings. Any material and/or equipment necessary for the proper operation of the system not specified or described herein shall be deemed part of this specification.

B. The Contractor shall design, install, commission and test the Antenna Distribution System in accordance with the manufacturer's instructions and recommendations.

C. The Contractor shall be knowledgeable of work to be performed by other trades and take necessary steps to integrate and coordinate their work with other trades.

D. The Contractor shall be responsible for furnishing all materials as specified herein for a complete Antenna Distribution System.

E. All Antenna Distribution System and communications infrastructure antennas shall be discreet and installed to minimize any aesthetic disruption. Antennas shall be concealed wherever possible using stealth technology to ensure installation maintains high architectural form critical to the high-end finish of this project. Install antennas per manufacturer's requirements.

F. All raceways shall be concealed in the building.

G. All communications infrastructure shall be installed for optimal performance.

H. When possible, all Antenna Distribution System and communications infrastructure shall be installed to allow for easy additions, moves, and other changes in the future.

I. All Antenna Distribution System cables shall be bundled and combed to provide a neat and organized appearance. Cables shall be bundled using only manufacturer and industry approved wire ties with tensions that do not deform and damage cable resulting in loss of transmission or performance. Any bundles and combing methods used shall not exceed manufacturer or industry standard recommendations for that cable type.

J. Install cables according to manufacturer's recommended installation practices using approved hangers (C-Hook) at a maximum spacing of every 48-inches. Antenna cabling is not allowed in cable tray systems.

K. All equipment locations shall be coordinated with Architect, Owner, Engineer or appropriate personnel prior to initiating any work.

L. Install surge suppressors where ac-power-operated devices are not protected against voltage transients by integral surge suppressors specified in UL1449. Install surge suppressors at the devices' power-line terminals. Comply with Division 26 Section "Transient Voltage Suppression."

M. Wiring Methods:

1. All wiring methods shall be in accordance with NFPA-70, Article 820, applicable FCC regulations and all other applicable codes. Provide the proper number and type of cables as required for proper operation of the system in accordance with the manufacturer's instructions.
2. All cabling methods on the systems' RF side and others shall be plenum rated as specified in NEC Article 725 and installed in an open cable support away from other communication system cabling.
3. No other wiring or cabling other than that directly associated with the transmission of the Antenna Distribution System signals, remote control, or auxiliary functions shall be permitted in this systems cable pathways.
4. Each Antenna Distribution System antenna node shall be spaced on 60 feet minimum centers above the entire first floor, second floor and third floor corridor ceilings. Antenna cabling shall only be located above ceilings indicated above.
5. All conduits and boxes shall be grounded to building grounding electrode system (BGES) or cable tray via the conduit bushing dropout.
6. All boxes, conduits, etc., shall be of proper size, as determined by the Antenna Distribution System installation organization, shall be clearly marked for easy identification. The Antenna Distribution
   System installation organization shall furnish any special boxes to the Division 26 Electrical Trade for installation by the Electrical Trade.
7. Provide main antenna cables from the Antenna Distribution System headend cabinet through the corridor ceiling plenums via the separate cable handing system (C-Hook) for support. Plenum rated tie wraps shall be used where required.
8. Provide proper lightning protection for all Antenna Distribution System entrance cables and power sources, to prevent voltage surge and spike damage to the system.
9. The actual cable routing of the Antenna Distribution System shall be through the corridors and determined in the field by the installing trade based on the location of the devices, circuit limitations and wire limitations.

N. Provide signal analysis to determine the number of antenna loops in the building. A minimum of one antenna loop in each area of the building an on all floor is required. Utilized the main data closets and remote data closet for main panels and extender panels. Utilize under floor conduits for access to data closet for trunk cabling to extender panels. Ensure all cabling in underground conduits are indoor/outdoor and plenum rated. All cabling above ceiling shall be plenum rated.

3.2 TECHNICAL ASSISTANCE

A. Instruction: The installation supervising technician for the Antenna Distribution System Trade shall instruct the proper designated authority on the correct operation of the system after the installation is completed. This instruction shall consist of:
   1. Eight (8) hours of technical service training to the Owner's technical staff using the factory operation manuals previously specified.
   2. All training specified herein shall be performed by a factory certified technician.

3.3 FIELD QUALITY CONTROL

A. General: Upon completion of the installation, the Antenna Distribution System Trade's factory-trained technician shall perform all necessary electrical tests and adjustments and who shall then submit a Letter of Certification to the Owner/Architect/Engineer that the system functions and conforms to all requirements of the manufacturer of the equipment, these specifications; all requirements of International Building Code for type of building in which the system is installed.

B. The factory trained technician shall perform all electrical and mechanical tests, measurements and adjustments required below. All tests and report costs shall be in the Contract price. A checkout report shall be prepared by the installation technicians and submitted in triplicate. The report shall include, but not be limited to:

1. A complete list of equipment and parts installed and wired.
2. Indication that all equipment is properly installed and functions and conforms to these specifications.
3. Frequency sweep for abnormal losses.
4. Sample Measure signals and levels throughout the building and determine if the system is function properly and provide a report indicating tested levels and testing locations.
5. Technician's name and date.
6. Spare Parts Lists.
7. As-Built Documents.
8. Operations and Maintenance Manuals and Trouble Shooting Guide.
9. Maintenance Schedule.
10. Maintenance Company Contact Information.
11. Product Data and Manufacturer Cut-Sheets.
12. Warranty Information and Contact.
13. Manufacturer’s Product and Installation Certificate.
14. Log (troubleshooting, replacement, expansion, and replacements).
15. Labeling Scheme.

C. After completion of all tests and adjustments listed above, the Antenna Distribution System Trade shall submit the following information to the Architect/Engineer.

1. "As-built" cabling layout diagrams including wire color code and/or tag number.
2. Complete "as-built" wiring diagrams.

D. Final tests and inspection shall be held in the presence of the Architect/Engineer's representatives and to their satisfaction. The Antenna Distribution System Trade shall supply personnel and required auxiliary equipment for this test without additional cost.

E. The completed Antenna Distribution System shall be tested to insure that it is operating properly. This shall be adequately demonstrated if the system operates for a ninety (90) day test period without any problems. Should a problem occur, the Antenna Distribution System Trade shall readjust or replace the defective component and begin another ninety (90) day test period. This test shall not start until the Owner has obtained beneficial use of the building under tests.

F. If the requirements provided in the paragraph above are not completed within one (1) year after beginning the tests described therein, the Antenna Distribution System Trade shall replace the system with another acceptable manufacturer and the process repeated until acceptance of the equipment by the Architect/Engineer.

END OF SECTION 275300.01

SECTION 275300 – DISTRIBUTED SYSTEMS (CATV)

PART 1 – GENERAL (This Section is Not Used)

END OF SECTION 275300

SECTION 280500 – COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 WORK INCLUDED:

A. Every item of labor, material, devices and appurtenances for installing a complete Electronic Safety and Security System and other related systems included in Division 28 of the Specifications.

1. Section 28 05 26 – Grounding And Bonding For Electronic Safety And Security Systems
2. Section 28 05 28 – Pathways for Electronic Safety and Security
3. Section 28 05 53 – Identification for Electronic Safety And Security
4. Section 28 13 00 – Electronic Access Control and Intrusion Detection
5. Section 28 20 00 – Electronic Surveillance
6. Section 28 31 00 – Fire Alarm System

1.3 RELATED WORK:

A. General: See all other portions of these Contract Documents and apply to those portions of work, relating to the following Electronic Safety and Security Systems: Electronic Access Control and Intrusion Detection, Fire Detection and Alarm, Electronic Surveillance, the same as if repeated herein in its entirety. The Division 28 Trades shall provide and install all wiring, all equipment, all electronics, all software and accessories as specified and shown on the drawings and as needed to provide complete and operational systems. Division 28 Trades shall provide to Division 26 special boxes, cabinets, racks, hangers, and etc. for installation.

B. Division 23 - Mechanical

C. Division 26 – Electrical

D. Division 27 - Communications

1.4 WORK NOT INCLUDED:

A. Provide roughing-in, including the empty boxes, conduit, pull strings, etc. under Division 26 for the following related Sections:

1. Section 28 05 26 – Grounding And Bonding For Electronic Safety And Security Systems
2. Section 28 10 00 – Electronic Access Control and Intrusion Detection
3. Section 28 20 00 – Electronic Surveillance
4. Section 28 31 00 – Fire Alarm System

1.5 DRAWINGS:

A. Where conduit, equipment, devices and other electrical appurtenances are shown on the drawings, the general arrangement of such items on the electrical drawings shall be followed as closely as actual building construction and the work of other trades will permit. Because of the small scale of the electrical drawings, it is not feasible to indicate all offsets, fittings and accessories which may be required. The Contractor shall investigate the construction conditions affecting the work and provide fittings and accessories as required to meet actual conditions.

1.6 QUALITY ASSURANCE:

A. Equipment and material used in the project shall be new and undamaged. The installation shall fit into the space allotted and shall allow adequate, acceptable, clearances for entry, servicing, safety, and maintenance. The Contractors shall coordinate the work to ensure that the equipment may be moved into place without altering building components or other installations. All electronic safety and security systems (above) work shall be performed by a Commonwealth of Virginia Class-A licensed Electrical Contractor(s) whose technicians, mechanics, or tradesmen shall be skilled and certified in the trade involved. All Division 28 work shall be performed under the direct supervision of the equipment systems' authorized technician with a locally recognized and accepted master electrician's license. All work under Division 28 shall be provided by a single-source Division 28 vendor/subcontractor approved by the Owner to be utilized for this work.

B. Equipment and material in existing installations may be reused where specifically indicated on the drawings.

1.7 REFERENCES:

A. The complete installation and all materials and equipment under Division 28 shall conform to the current Commonwealth of Virginia Statewide Building Code including all applicable portions of the National Electrical Code (NEC) and all other governing codes, regulations and certifications. All wiring methods shall adhere to Division 28 specified wiring methods.

B. All equipment used shall bear the Underwriters Laboratory (U.L.) label for the intended application, or other organizations label if acceptable to the Authority having jurisdiction and concern with product evaluation.

C. In addition, the following codes, standards, and regulations shall apply to the complete installation and all materials and equipment. These are referred to by their accompanying abbreviations.

1.	National Electrical Code (NFPA 70) 2011	NEC
2.	National Electrical Manufacturers Association	NEMA
3.	Underwriters Laboratories, Inc.	UL
4.	Telecommunications Building Wiring Standards	TIA/EIA
5.	All Systems' Installation Certification Compliance Documents for Installing Trades	
6.	National Fire Protection Association	NFPA
7.	Uniform Federal Accessibility Standards	UFAS
8.	Americans with Disabilities Act Accessibility Guideline	ADAAG

D. The above standards are intended as a minimum and shall be exceeded if required by the Contract Documents. In the event information contained in the Contract Documents conflicts with one of the above mentioned codes, the codes shall take precedence.

1.8 PERMITS, LICENSES, TAXES AND INSPECTION CERTIFICATES:

A. All permits, bonds, licenses, inspection fees and taxes required for the execution of the work shall be obtained and paid for by the Contractor. Under each phase of the Division 28 work, the Contractor shall furnish three copies of certificates of final acceptance to the Engineer from any inspection authority having jurisdiction.

B. At the completion of the job, provide the Engineer with three (3) copies of the fire alarm inspection certificate from the Authority having jurisdiction, if such inspection is provided and/or required by the locality.

1.9 REGULATIONS AND STANDARDS:

A. The completed installation and all materials and equipment shall conform to local ordinances and codes, other regulations and standards listed herein or in related sections. These are intended as a minimum and shall be exceeded if required by the specifications or the Drawings. In the event of conflict between the codes, standards, or regulations, and information contained in the Contract Documents, the applicable code, standards, or regulation shall take precedence.

1.10 SUBMITTALS:

A. Submit shop drawings, product data and samples in accordance with Division 1 for all items as specified in related sections of these specifications. Eight (8) copies of the submittal shall be submitted. Five (5) copies of the submittal will be returned to the Contractor. If additional copies are required, they will be the responsibility of the Contractor. Where drawings are submitted, the Contractor shall submit two (2) sets of full scale prints. One copy will be marked and returned to the Contractor and the Contractor shall be responsible for all additional copies required for his use. All submittal data shall be correctly identified to show project name, and the exact model, style or size of item being submitted. Improperly identified submittals will not be reviewed by the Engineer. Each item submitted for review shall bear the Subcontractor's stamp, which states that they have reviewed the submission, that it is complete, and that in their opinion it meets the contract requirements. Contractors stamp shall identify the paragraph and page number for which the submittal is being made. Any submission, which has not been reviewed and stamped by the Division 28 Trades, will not be reviewed by the Engineer. No reviews prior to award of Contract will be considered or accepted, unless otherwise specified.

B. Shop drawings, diagrams, catalog data and such other data necessary to fully describe and substantiate compliance with these Contract Documents shall be submitted as follows:

1. All the equipment and materials where submissions are specifically required by other Divisions of these Contract Documents.
2. All the equipment and materials that are indicated with a [S] behind the product title. This shall include submission of the specified products equipment and materials.
3. All the equipment and materials that are acceptable equal substitution.
4. If submission is NOT required for the SPECIFIED products "shop drawings and product data" under 1. and 2. above, the Contractor shall NOT submit the SPECIFIED products "shop drawings and product data".

5. Samples, in good working order, shall be submitted in accordance with Division 1, complete with all installation and service drawings and instructions. All samples will be returned at the submitter's expense unless otherwise indicated. Samples may be subject to destructive testing by Engineer.

C. Operation and Maintenance manuals shall be submitted in accordance with Division 1 and shall include a copy of all accepted shop drawings, installation and maintenance data, operation instructions, parts lists, and the name, address and telephone number of supplier or nearest representative. All electrical and electronic devices, equipment and systems marked [O/M] in these specifications shall be included and all other such electrical and electronic items which will require servicing before the duration of its useful life has been reached. Manuals shall be presented to the Engineer for review and transmitted to the Owner before the final payment is recommended.

D. Equivalents:

1. Not all of the Manufacturers, trade names and/or model numbers are indicated herein, or on the drawings.
2. Unless definitely stated otherwise and upon complying with Division 1, the Contractor may use any article of equal appearance, which in their judgment is equal to the article that is specified and is accepted by the Engineer.
3. Where three (3) or more manufacturers are named in the specifications for any item, the Contractor shall use one of the three (3) listed manufacturers. **No other manufacturers shall be reviewed or accepted.** Manufacturers that are listed first in these specifications and on drawings were used as a basis of design.
4. It will be the responsibility of the Contractor to verify all connections, physical sizes and capacities of all other manufacturer's items, both named or proposed. If the equipment necessitates changes in power distribution, conduit, wiring, lighting, wiring, or any other building systems from that indicated on the drawings, the Contractor shall be responsible for all additional costs included and notify other trades of the changes. Where such changes are required, detail drawings indicating all required changes shall be submitted for review at the same time the manufacturers drawings are submitted for approval.
5. Refer to Division 1 for substitutions.

E. The ten day prior approval requirements of The Instructions to Bidders, AIA 701, are waived for this Division of the Specifications, and unless stated otherwise, the Contractor may use items that he deems as equivalent in quality and performance to the specified item subject to final acceptance of substituted items by the Engineer upon his review of shop drawings.

F. Guarantee: Electronic safety and security systems equipment, materials and labor required by these specifications and accompanying drawings shall be guaranteed to be free from defective materials or workmanship for a period of one year after final acceptance of the project except extended warranties as specified elsewhere in these documents on specific items of equipment will be furnished by the Trade providing the equipment. Defects in material or workmanship occurring during this period shall be corrected with new material and equipment or additional labor at no cost to the Owner. Manufacturer's certificates of warranty shall be transmitted to the Owner before final payment is recommended.

1.11 WARRANTIES:

A. The Contractor shall warrant for a period of one year all work provided under the Contract to include, but not necessarily limited to, all systems, equipment, materials, and workmanship. This shall not be construed

to limit any extended warranty periods of longer than one year for specific items or systems specified elsewhere in the Contract Documents.

B. The warranty period shall commence on the date of acceptance by the Owner and shall cover all parts and labor as required to fulfill the warranty at no cost to the Owner.

C. Refer to Division 1 for additional warranty requirements.

D. Information on all warranties shall be included in the O&M manuals specified herein to be provided to the Owner.

1.12 COORDINATION OF WORK:

A. General: The contract documents indicate the extent and general arrangement of the electronic safety and security systems. The Contractor shall be responsible for the coordination and proper relation of the electronic safety and security system work to the building structure and to the work of other trades. No additional compensation or extension of completion time will be granted for extra work caused by the lack of coordination.

B. Cooperation: The Contractor shall provide dimensions and locations of all openings, shafts and similar items to the proper trades and install work as required so as not to interfere with, or delay, installation of systems under construction in the buildings.

C. Locations of lines and equipment shall be determined from actual field measurements. The outlines of the building shown on the electrical drawings are intended only as a guide to indicate relative locations of the electronic safety and security work. Refer to the existing buildings and structural components to determine actual measurements. If conflicts prevent installation of electronic safety and security work at the locations indicated, minor deviations shall be made subject to acceptance by the Engineer, and without additional compensation.

D. Cutting and Patching: See Division 1 and Division 26.

E. Roughing-In: Equipment, racks, cabinets, manual pull stations, smoke detectors, devices, and other similar items shall align vertically or horizontally with each other, the building structure and features thereof when it appears obvious and logical that they should. All mounting heights shall be within the limits of Commonwealth of Virginia USBC and ADAAG.

F. Damage to Other Work: The Division 28 Trades are responsible for damage to other work caused by his work or workmen. Repairing of damaged work shall be done by the Trade who installed the work, and as directed by the Engineer; the cost of which shall be paid for by the Division 28 Trades.

1.13 ASBESTOS:

A. Asbestos Free Materials: The intention of these drawings and specifications is that there be no asbestos containing materials installed on this project. To the best of the Engineers' knowledge, none of the material or equipment specified herein or shown on the drawings contain asbestos. The Contractor shall make every effort to prevent any asbestos materials from being installed in or used on the construction of the project. At

the completion of the project, the Contractor shall certify by letter that to the best of his knowledge, no asbestos containing materials were used for or in the construction of this project.

B. Existing Materials:

1. Discovery: If during the construction of this project, work involving friable asbestos is suspected or encountered, all work in this area shall be discontinued and the Owner or the Owner's representative, shall be notified immediately and the Owner with his own forces or by separate contract shall be responsible for complete investigation, removal, and disposition of the friable asbestos hazard in accordance with applicable laws and regulations. If the Contractor claims that delay or additional cost is involved because of such action by the Owner, he shall make such claim as provided elsewhere in the contract documents.
2. Removal: All work involving the removal of friable asbestos will be done under a separate contract.

1.14 GRAPHICS DATABASE:

A. This project's Computer Aided Design & Drafting (CADD) drawing files may be purchased directly from the Engineer for use in preparing computer graphics specific to the project. See Appendix A at the end of this Section for Letter of Indemnification and ordering instructions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS AND MATERIALS:

A. General: Manufacturers and materials shall be as specified in subsequent sections of these specifications and as noted on the drawings. Similar types of equipment shall be the products of the same manufacturer unless specified otherwise.

2.2 SLEEVES AND INSERTS:

A. General: Sleeves and inserts shall be provided and correctly located in the structure, as required for the work.

B. Inserts shall be steel and of proper size for loads encountered.

2.3 ACCESS DOORS:

A. Provide for all junction boxes or any item requiring access. Doors shall be of sufficient size and so located that the concealed items may be serviced or completely removed and replaced. Doors required for work shall be furnished as a part of this Division to the General Contractor for installation. Doors in acoustic tile ceilings shall be furnished in multiples of tile sizes. Doors are not required in exposed grid type ceilings where tiles are removable. Doors shall be metal access doors with cam lock, style to match ceiling or wall construction. Doors occurring in rated construction shall be fire rated U.L. labeled access doors correlated to preserve the integrity of the rated construction. Doors shall be prime finish steel except those in toilets,

shower rooms, locker rooms, kitchens and other similar areas shall be aluminum with natural anodized finish. Doors shall match the access doors in Division 23 and meet the acceptance of the Architect.

PART 3 – EXECUTION

3.1 INSTALLATION:

A. General: Materials and equipment shall be installed in accordance with manufacturer's instructions to conform with the details and application as specified in subsequent sections of these specifications and indicated on the drawings.

B. Supports: Provide necessary supports for all equipment and appurtenances as required; this includes, but is not limited to, frames or supports for items such as cabinets, junction boxes, conduit, outlet boxes, and other similar items requiring supports. Foundation drawings, bolt setting information and foundation bolts shall be furnished by the subcontractors furnishing the equipment for all equipment required to be bolted to the floor, wall or above ceiling structure.

C. Sleeves: Provided by Division 26.

D. Temporary Requirements: Openings in equipment shall be kept capped at all times until connection is made to the system. The ends of all conduits and equipment openings shall be kept capped properly with approved devices. Approved devices are items such as specially molded plastic caps and sheet metal caps.

E. Access Doors: Provide access doors for all concealed electric equipment, pull boxes, junction boxes or any item requiring access. Doors shall be of sufficient size and so located that the concealed items may be serviced or completely removed and replaced. Doors required for Division 28 work shall be furnished by Electrical Trade to the Contractor for installation. Doors in acoustic tile ceilings shall be furnished in multiples of tile sizes. Doors are not required in exposed grid type ceilings where tiles are removable.

F. Painting: All work under this Division shall be painted in accordance with Section 28 05 53, Identification for Electronic Safety and Security Systems.

3.2 EXISTING WORK AND DEMOLITION:

A. Demolition: Remove all existing wiring, junction boxes, outlets, devices, cabinets, etc., indicated for demolition. Additional amounts of demolition may be required to accommodate desired renovations and new construction. Not all demolition may be shown on the drawings. All existing electronic safety and security systems equipment not indicated for demolition shall remain in place.

B. Equipment Removed: The Owner will select and retain such existing electronic safety and security systems equipment and materials which are indicated to be removed and not reused, as he desires. All other existing equipment and materials indicated to be removed, and not reused shall become the property of the Contractor, who shall remove them from the premises within the time frame specified under other Divisions of this Contract Document.

C. Equipment Relocated: All existing equipment and materials indicated to be relocated shall be disconnected, removed, and relocated. All equipment and materials shall be protected from damage during demolition.

D. Service Interruption: Attention is called to the fact that the existing facility shall remain in operation throughout the construction period. All necessary temporary arrangements shall be made as required to keep all security, alarm, control, etc., circuits in continuous operation during this period except for scheduled outages for change-overs. The outage shall be kept to the minimum and carefully scheduled to suit the Owner.

E. Miscellaneous: In all altered portions of the buildings, the Electronic Safety and Security Systems Trade shall remove or alter as necessary all existing work that does not fit with the new construction. All existing work or areas that are not altered shall be reconnected as required. Where indicated changes to non-safety and security facilities require minor safety and security systems changes, these changes shall be accomplished even if not specifically indicated. Only a small portion of the existing work is shown on the drawings. Contractors submitting proposals shall visit the site to determine the scope of work under this heading as no additional compensation will be granted because of existing conditions even though the existing conditions may not be indicated on the drawings. Contractor shall thoroughly inspect the electronic safety and security systems in reworked areas and bring to the attention of the Engineer all defective or unserviceable material not scheduled for removal or replacement. Demolition shall not begin until the work schedule is approved by the Owner. The work shall be scheduled to prevent any disruption to the normal operations of the building. Refer to other Divisions for work phasing.

3.3 FIELD QUALITY CONTROL:

A. Verification [V]: Upon completion of the project, the Contractor shall submit a separate letter of certification (or compliance) to the Owner/Engineer that each of the following systems or equipment functions properly, conforms to all requirements of these specifications and all requirements of the manufacturer of the systems.

1. Section 28 10 00 – Electronic Access Control and Intrusion Detection
2. Section 28 20 00 – Electronic Surveillance
3. Section 28 31 00 – Fire Alarm System

3.4 MANUFACTURER'S ASSISTANCE:

A. Qualified technical representatives of manufacturers shall be available to visit the project and provide required assistance for any problems or trouble areas of any systems, material or equipment used in the project. Manufacturer's engineering assistance shall also be available for above problems or trouble areas. The Contractor shall purchase all materials, equipment or systems with these services included in the purchase price or otherwise be prepared to have the above service provided when needed or requested by the Engineer without additional compensation. Where one manufacturer's equipment constitutes the majority of the components or devices to make a system, the manufacturer's technically qualified representative shall inspect and accept the completed installation whether or not especially requested by the Engineer.

3.5 INSTRUCTION AND TRAINING OF OWNER'S REPRESENTATIVE:

A. The Division 28 Trades shall instruct and train the representatives of the Owner in the proper operation and maintenance of all elements of the Electronic safety and security systems. Competent representatives of the Contractor shall spend one (1) week for each Division 28 system. The times and locations for instruction and training to the Owner’s personal shall be set by the Owner at times and locations determined by the Owner over a period once the systems are functional for instruction and training. The instruction and

training shall be given to all personal as deemed necessary by the Owner. The instruction and training shall prepare the Owner to fully operate and maintain all of the above systems.

3.6 CONSTRUCTION STATUS REPORT:

A. Each item of discrepancies noted on Construction Status Report prepared by the Architect/Engineer shall be answered in detail in writing by the Contractor before payment can be recommended.

END OF SECTION 280500

APPENDIX A
LETTER OF INDEMNIFICATION

Project Name:

Project Location:

The contractor may purchase from Ascent Engineering Group, Inc. a CD-ROM or electronic mail version of the projects CADD database. The minimum fee on any request is $250.00, subject to receiving a signed Letter of Indemnification. There is an additional charge of $10.00 per sheet on projects greater than 20 sheets. Drawing files will consist of floor plan views only, of Electrical plan sheets. All seals, details, schematics, tables, controls, etc. will be deleted. All drawings will be provided in Autocad™ 2010 format. Payment shall be returned with a signed copy of the Letter of Indemnification. Payment shall be received before shipment or transfer of data.

Ascent Engineering Group, Inc. reserves all rights to the original drawing files.

The Purchaser agrees, to the fullest extent permitted by the law, to hold harmless and indemnify Ascent Engineering Group, Inc. and the Architect, as defined in the Bid Documents, from and against all claims, liabilities, losses, damages, and costs, including but not limited to attorney's fees, arising out of or in any way connected with the use, modification, misinterpretation, misuse, or reuse by the Purchaser or others of the machine readable information and data provided by Ascent Engineering Group, Inc. under this Agreement. The foregoing indemnification applies, without limitation, to any use of the project documentation on other projects, for additions to this project, or for completion of this project by others, excepting only such use as may be authorized, in writing, by Ascent Engineering Group, Inc.

The electronic drawing files are not part of the Contract Documents for the Project. The Purchaser assumes all risks associated with the use of the transmitted files. Ascent Engineering Group, Inc. will not be responsible for any differences in the information included in the transmitted files and the information shown on the Contract Documents. Modifications to the Contract Documents made before or during construction may or may not be included in the transmitted electronic drawing files.

The Purchaser further agrees that the drawing files will only be used in graphics preparation for the above-referenced project.

Company Name of Purchaser: _____

Purchaser's Designated Representative: _____

Title: _____

Signature: _____

Address: _____

Return to: Ascent Engineering Group, Inc.
4932 Frontage Road, NW
Roanoke, VA 24019
AEG # 16080

SECTION 280526 – GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY SYSTEMS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 WORK INCLUDED:

A. Equipment Grounding Conductor (EGC)

1.3 RELATED WORK:

A. Section 26 05 26 – Grounding and Bonding for Electrical Systems

B. Section 27 05 26 – Grounding and Bonding for Communication Systems

1.4 REFERENCES:

A. NFPA 70 (NEC), Article 250

1.5 DESCRIPTION:

A. An insulated equipment grounding conductor, color coded per section 26 05 19, and the NEC, shall be provided for each alternating current circuit without exception.

1.6 TESTS:

A. The equipment grounding conductor shall be tested for continuity and proper bonding to metallic equipment enclosures, outlet boxes, wiring devices and similar items.

PART 2 – PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Equipment Grounding Conductor (EGC):

1. Provide a separate insulated grounding conductor, color-coded as per Section 26 05 19, enclosed in the same raceway with the phase conductors for all alternating current circuits, even though not necessarily shown on the drawings.
2. The equipment grounding conductor shall be secured to the equipment enclosure at the source of power and at the apparatus being served by the alternating current supply.
3. The minimum size for the grounding conductor shall be as specified in Table 250.122 of NEC.
4. Existing alternating current circuits: If an equipment grounding conductor is not present in the existing feeder or branch circuit to be reworked, Division 28 shall provide new phase, neutral, and grounding conductors from the related panelboard to the indicated outlet.

END OF SECTION 280526

SECTION 280528 - PATHWAYS FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 WORK INCLUDED:

A. Empty conduit system for Electronic Safety and Security Systems including Electronic Access Control and Intrusion Detection, and Electronic Surveillance.

1.3 RELATED WORK:

A. Section 26 05 00 – Common Work Results for Electrical

B. Section 26 05 26 – Grounding and Bonding for Electrical Systems

C. Section 26 05 33 – Raceway and Boxes for Electrical Systems

D. Section 26 05 36 – Cable Trays for Electrical Systems

E. Section 26 05 53 – Identification for Electrical Systems

F. Section 28 05 00 – Common Work Results for Electronic Safety and Security

G. Section 28 05 26 – Grounding and Bonding for Electronic Safety and Security Systems

H. Section 28 05 28 – Identification for Electronic Safety and Security

1.4 GENERAL OPERATION AND DESCRIPTION:

A. General: The Electronic Access Control and Intrusion Detection and Electronic Surveillance systems shall consist of a complete (partial) empty conduit system as indicated.

B. The raceway for this system shall be furnished and installed by the Division 26 electrical contractor in accordance with all related specification sections in Division 26 and 28. The Electronic Safety and Security System Trade shall coordinate this work with Division 26.

1.5 REFERENCES:

A. The complete installation, including additions and modifications, shall be in accordance with:

1. National Electrical Code Article 800.
2. Minimum standards of Electronics Industries Association (EIA).

PART 2 – PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 INSTALLATION:

A. General: The Contractor shall provide all conduit, junction boxes, and materials required for the installation of an empty conduit Electronic Safety and Security System in accordance with the specifications and drawings. Any material and/or equipment necessary for the proper operation of the system not specified or described herein shall be deemed part of this specification.

B. Wiring:

1. Partial Conduit Raceway System: All wiring methods (conduit only) shall be in accordance with NFPA-70, Article 800, and all other codes specified herein. All wiring to be installed under another contract.
2. Electronic Safety and Security Raceway System: Provide empty raceway system for motion detection, card readers, key pads, camera, and other electronic safety and security systems outlets and/or devices with conduit, boxes, cabinets, etc., as shown. Outlets, raceways and plates as specified in Division 26. All conduit runs to have long sweep radius elbows; condulets not permitted. There shall be a maximum of two 90° bends between outlets. Any run over 100'-0" in length shall have a pull box where approved by the Electronic Safety and Security System Trade. Provide fish wires as previously specified. Cabinets shall be flush or surface mounted as required.
3. Furnish and install a 1" conduit from each outlet/device to the nearest accessible ceiling void.
4. All Electronic Safety and Security systems conduits, boxes, etc., shall be grounded to the building grounding electrode system (BGES) and properly bushed.

C. All boxes, conduits, etc., shall be of proper size, as determined by the Electronic Safety and Security Trade and shall be clearly marked for easy identification.

3.2 FIELD QUALITY CONTROL:

A. The Contractor shall submit the following information to the Architect/Engineer.

1. "As-built" conduit layout diagrams.

END OF SECTION 280528

SECTION 280553 – IDENTIFICATION FOR ELECTRONIC SAFETY AND SECURITY

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 WORK INCLUDED:

A. Prepare and paint Division 28 equipment supports and miscellaneous materials located in Equipment Rooms, IDF's, MDF and other utility areas housing mechanical, electrical, safety and security equipment.

B. Identification of cabinets, racks, equipment and other system enclosures.

1.3 WORK NOT INCLUDED:

A. Painting of factory finished Division 28 Equipment such as Access Control, Electronic Surveillance, Fire Detection and Alarm, etc.

1.4 RELATED WORK:

A. Section 26 05 53 – Identification for Electrical Systems

B. Section 27 05 53 – Identification for Communications

C. Section 28 05 00 – Common Work Results For Electronic Safety And Security

D. Section 28 05 28 – Pathways for Electronic Safety and Security

E. Section 28 10 00 – Electronic Access Control and Intrusion Detection

F. Section 28 20 00 – Electronic Surveillance

G. Section 28 31 00 - Fire Detection And Alarm

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. Except as otherwise specified, materials shall be the products of the following manufacturers:

1. Sherwin-Williams

2. Pratt and Lambert
3. Devoe
4. Benjamin Moore

2.2 MATERIALS:

A. Deliver all paints and materials to the project site in their original containers with all labels intact and legible at the time of use.

B. Sherwin-Williams Industrial Maintenance Coatings System 4000 products are listed below to establish color and a standard of quality.

1. All Hangers and Supports: One coat Series 54 Gloss Black Alkyd Enamel.
2. Factory Finished Equipment finishes shall be cleaned and properly touched up with equipment manufacturers touch-up paint unless finish is severely damaged or of unacceptable quality. In the latter case, the entire finish shall be restored in accordance with painted procedures herein specified.

PART 3 - EXECUTION

3.1 WORKMANSHIP:

A. The work shall be accomplished by qualified mechanics skilled in the painting trade. Painting of equipment and other materials shall not commence until all testing is complete and systems are ready for operation. Materials shall be evenly spread, and smoothly flowed on without runs or sags. Each coat shall be thoroughly dry before application of succeeding coats.

3.2 PROTECTION OF WORK:

A. The painters shall protect all adjacent surfaces with drop covers during the process of painting. Upon completion, paint spots, if any, shall be removed from all surfaces not intended to be painted.

3.3 PREPARATION OF SURFACE:

A. Surfaces to be painted shall be completely dry before applying paint. Metal surfaces shall be cleaned with mineral spirits before applying materials. Rust and scale shall be removed by wire brushing or sanding. Galvanized surfaces shall be chemically treated with crystalline zinc phosphate in strict accordance with the manufacturer's recommendations. Surfaces shall not be painted when the temperature is, or is likely to be, near the freezing point, nor when they are exposed to hot sun.

3.4 IDENTIFICATION OF BOXES AND EQUIPMENT:

A. After **all** painting is completed, operating and control parts of the equipment and systems shall be properly identified with laminated engraved plastic nameplates fastened with sheet metal screws, bolts or permanent adhesive. Pressure sensitive tape is **not** acceptable. Identification symbols or designations shall be the same

as shown on the contract documents.

B. Boxes; Concealed and Surface Mounted: Each enclosure shall be **neatly** identified by stencil marking, which shall indicate service contained, circuit numbers (or zone numbers). Stencil letters shall be upper case (Capital) not less than one half inch high and painted with Series 54 black gloss enamel. All fire alarm system boxes shall be painted red.

C. See Section 26 05 53 for identification of conduit associated with these systems.

D. The Division 28 Systems shall have an engraved informational laminated nameplate with the installing trade's name, telephone number and address for the Owner to obtain preventive maintenance, service or parts. The nameplate shall include the job order number, shop number or other identification, which will identify the related equipment.

If the above address and telephone number is a branch office, the main office or manufacturer's address and telephone number shall be included.

END OF SECTION 280553

SECTION 281300 - ACCESS CONTROL (EMPTY CONDUIT)

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Empty conduit system for Security Access and Intrusion Alarm System.

1.2 RELATED WORK

A. Division 8 – Openings

B. Division 26 – Electrical

C. Section 28 05 00 – Common Work Results For Electronic Safety And Security

D. Section 28 05 26 – Grounding And Bonding For Electronic Safety And Security Systems

E. Section 28 05 53 – Identification For Electronic Safety And Security

1.3 GENERAL OPERATION AND DESCRIPTION

A. General: The access control system shall consist of a complete (partial) empty conduit system as indicated.

1.4 REFERENCES

A. The complete installation, including additions and modifications, shall be in accordance with:

1. National Electrical Code Article 725 & 800.
2. Minimum standards of Electronic Industries Association (EIA).

1.5 SUBMITTALS

A. Submit shop drawings product data and Virginia Licenses (copy) in accordance with Section 28 05 00.

1. Shop Drawings: The Access Control System manufacturer and Trade shall provide a one-line riser diagram indicating route and conduit size, external wiring and connections of system proposed, also furnish complete operating instructions, including schematic and wiring diagrams of the system, engineering data sheets on each component and complete servicing data including part numbers of the various components. A schematic diagram of the complete system is not shown on the contract documents.
2. Product Data: Submit application, technical, and installation data.
3. Virginia “Private Security Services License”: Submit copies, for the employer and certification of employees with the shop drawings.

B. Submit Operation and Maintenance Manuals in accordance with Section 28 05 00.

1.6 WARRANTY, SERVICES

A. The Access Control System Trade shall warrant this System expansion for a minimum of one (1) year from date of acceptance by Owner against defective parts and/or workmanship and shall provide parts and labor to fulfill this warranty at no cost to Owner. This warranty shall not apply if damage is caused by abuse, accident, improper operation or negligence.

B. Refer to Division 1 and Section 28 05 00 for submission of warranty.

C. Qualified service and parts shall be available to call on within a 150 mile basis.

PART 2 – PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: The Access Control System Trade shall provide all conduits, junction boxes, and materials required for the installation of an empty conduit system in accordance with the specifications and drawings. Any material and/or equipment necessary for the proper operation of the system not specified or described herein shall be deemed part of this specification.

B. Wiring:

1. Empty Conduit, Raceway, Cable Tray and “Hooks” System: Provide proper number and size of conduits, boxes and hangers as required for cable pathway. All wiring methods (empty conduits) shall be in accordance with NEC 800, and applicable EIA /TIA specifications.
2. Access Control System Raceways: Provide empty raceway system for access control system with conduit, boxes, etc., as shown. Outlets, raceways and plates as specified elsewhere herein. All conduit runs to have long sweep radius elbows; condulets not permitted. There shall be a maximum of two 90° bends between outlets. Any run over 100'-0" in length shall have a pull box. Provide fish wires as previously specified.
3. Furnish and install a 1" conduit from each outlet to the accessible corridor ceiling or corridor ceiling void.
4. Conduit sleeve shall be installed in interior and exterior walls as needed and indicated on the drawings.
5. All outlet boxes for access control system shall be recessed and be 4"X4"X2.125" with single gang reducing ring or as needed by the installing trade.
6. All access control system conduits, boxes, etc., shall be grounded to the building grounding electrode system (BGES) via the TMGB and properly bushed.
7. Label the start and end of all security conduits with yellow bands.
8. All conduits shall be concealed.
9. Conduits shall be installed under floor where device are located in or near clearstory areas with exposed ceilings.
10. Coordinate all box locations with access control hardware installed.

C. All boxes, conduits, etc., shall be of proper size, shall be clearly marked for easy identification, continuously grounded together and bonded to the building grounding electrode system (BGES) via the TMGB. The Division 28 Trade shall furnish special boxes to the Electrical Trade for installation by the Electrical Trade.

3. 2 FIELD QUALITY CONTROL

A. The Access Control System Trade shall submit the following information to the Architect/Engineer.

1. "As-built" conduit layout diagrams.

END OF SECTION 281300

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SECTION 281600 – INTRUSION ALARM SYSTEM

PART 1 – GENERAL

1.1 WORK INCLUDED

A. Security Multiplex Intrusion Alarm System.

1.2 RELATED WORK

A. Division 23 – Heating. Ventilation, and Air Conditioning

B. Division 26 – Electrical

C. Division 27 - Communications

D. Section 28 05 00 – Common Work Results For Electronic Safety And Security

E. Section 28 05 26 – Grounding And Bonding For Electronic Safety And Security Systems

F. Section 28 05 53 – Identification For Electronic Safety And Security

1.3 GENERAL OPERATION AND DESCRIPTION

A. General: The intrusion alarm system shall consist of an U.L. commercial burglar control platform that supports hardwired, polling (multiplex) loop zones; supervision of alarms, keypads, power supplies; motion detectors, remote point modules; remote cabinets; relay modules; interface devices; conduit and wiring; cabling; remote annunciators; DACT; as required and specified herein in accordance with applicable codes listed hereinafter.

1. The system shall be capable of being expanded at any time up to the pre-determined maximum capacity of the system that shall include eight (8) partitions.
2. The system shall be capable of operating motion detection devices, reed switches, manual panic switch, key pads, series or shunt circuit wiring via hardwiring, or multiplex polling methods.
3. The control panel shall provide power, annunciation, polling, supervision and control for the detection and alarm system. The control panel shall contain equipment meeting the requirements of this specification necessary for proper operation.
4. The system shall be designed such that alarm indications override trouble conditions.
5. On/off capability of individual zones and/or partitions by use of coded numbers at the indicated multiple locations (32 maximum).
6. Time delay for entry or exit with an adjustable timing mechanism.
7. Supports up to nine (9) style - B hardwired zones and 120 additional multiplex zones with built-in multiplex interface for monitoring points of motion.
8. Generate a test tone through the Section 27 51 23 Intercommunications and Program Systems to allow periodical checking by Owner.
9. Emergency power supply for 60 hours of standby surveillance.
10. External circuit supervision shall not require additional wires other than the pair used for detection or

alarm. Two wires shall be used from the control panel to each loop of initiating devices and two wires for the audible devices. These two wires shall provide both supervision and alarm signals.

11. Alpha-numeric annunciator display panels are indicated on the electrical drawings and shall provide for alarm and trouble indications in the security intrusion alarm system.
12. Stand-alone UL listed digital communicator for transmission of security intrusion system to monitoring station shall be included. Coordinated with Owner for exact DACT requirements and parameters.

B. Operation:

1. Trouble Mode: The system shall be electrically supervised against both short and open wiring faults in the alarm initiating circuits, the annunciation circuits, an open in the system alarm and trouble relay coils and a.c. power loss. An open wiring fault occurring in these circuits shall cause an audible and visual trouble indicator at the control panel.
2. Alarm Mode: The general alarm portion of the system shall function as follows when any motion detector is actuated.

    a. Automatically transmit individual zone digital signals via telephone lines to an existing contracted 24 hour central station's digital receiver.
    b. Display zone number-message on alpha-numeric displays.

3. Supervision Mode (Local Alarm): The supervision mode of the system shall function as follows when a supervisory alarm input is activated:

    a. Sound a distinct local visual and audible alarm at the control panel and remote annunciator.
    b. Display a zone number -error message on alpha-numeric display.

4. System shall turn off walk-through lighting 5 minutes after the system is armed and turn walk-through lighting on when the system is disarmed. Control of lighting shall be through contactors as indicated on the floor plans.

1.4 QUALITY ASSURANCE

A. Source Quality Control: Materials and equipment shall be new, unused and U.L. listed for use as a security intrusion system.

B. The system and components shall be supplied by manufacturers of established reputation and experience who shall have produced similar apparatus for a period of at least ten (10) years and who shall be able to refer to similar installations rendering satisfactory service.

C. The Security Intrusion Alarm System hereinafter shall be known as the "Security Intrusion System". The Security Intrusion Alarm System shall be installed by the manufacturer's authorized installation contractor, hereinafter known as the "Security Intrusion System Trade." The Security Intrusion System installation shall include wiring, components, connections, adjustment, testing and certification. The Electrical Trade shall provide conduit, junction boxes and pull boxes as indicated and required by the Security intrusion System manufacturer's drawings or Trade instructions. The Security Intrusion System Trade shall furnish any special back boxes, cabinets, enclosures and similar items to the Electrical Trade for installation by the Electrical Trade in accordance with the manufacturer's drawings, instructions, and as indicated.

D. The Security Intrusion System Trade shall furnish a list of similar or equal installation (a minimum of ten)

and shall show at least five (5) years of company experience in this type of work.

E. In accordance with the Commonwealth of Virginia, the Security Intrusion System Trade shall be licensed as a “Private Security Services Business” and all employees shall be state certified as an “E.S. Employee”

1.5 REFERENCES

A. The complete installation, including additions and modifications, shall be in accordance with:

1. National Electrical Code Article 725 & 800.
2. Minimum standards of Electronic Industries Association (EIA).

1.6 SUBMITTALS

A. Submit shop drawings product data and Virginia Licenses (copy) in accordance with Section 28 05 00.

1. Shop Drawings: The Security Intrusion System manufacturer and Trade shall provide a one-line riser diagram indicating route and conduit size, external wiring and connections of system proposed, also furnish complete operating instructions, including schematic and wiring diagrams of the system, engineering data sheets on each component and complete servicing data including part numbers of the various components. A schematic diagram of the complete system is not shown on the contract documents.
2. Product Data: Submit application, technical, and installation data.
3. Virginia “Private Security Services License”: Submit copies, for the employer and certification of employees with the shop drawings.

B. Submit Operation and Maintenance Manuals in accordance with Section 28 05 00.

1.7 WARRANTY, SERVICES

A. The Security Intrusion System Manufacturers and Trade shall warrant this System for a minimum of one (1) year from date of acceptance by Owner against defective parts and/or workmanship and shall provide parts and labor to fulfill this warranty at no cost to Owner. This warranty shall not apply if damage is caused by abuse, accident, improper operation or negligence.

B. Refer to Division 1 and Section 28 05 00 for submission of warranty.

C. Qualified service and parts shall be available to call on within a 50 mile basis.

D. The Security Intrusion System Trade shall include in his quotation the cost of three (3) inspections of the system during the two (2) years subsequent to the installation. The Trade installing this equipment shall be prepared to offer the Owner a service contract after the guarantee period has ended. On-the-premises service furnished at other than normal working hours shall also be available and shall be charged at current labor rates.

PART 2 - PRODUCTS [S] [O/M]

2.1 MANUFACTURERS

A. System shall be based on BOSCH.

2.2 MATERIALS AND EQUIPMENT

A. General: All materials, equipment, accessories, devices and other facilities and appurtenances shall be new, best suited for its intended use and shall conform to applicable and recognized standards for their use. All equipment shall be the standard cataloged products of BOSCH.

B. Equipment:

1. Control Panel: Bosch D9412GV4-C Burglar Package with control board, enclosure lock, key power transformer, Bosch D8125 derial data port module, Bosch D9217t address module (80 port), Bosch D166 telephone jack, Bosch D162 telephone cord, Bosch B420 Ethernet communication module, Bosch D126 7 Amp hour batteries (2), Bosch D122L battery harness with long leads, Bosch D110 enclosure tamper switch, batteries, circuit loop cards, additional cabinet as required. Provide all components in quantities as required for all for a fully functioning system. Provide suitable DACT to work with the Owner's monitoring facility.
2. LCD Key Pads, Bosch D1260. Provide quantities as indicated on the electrical drawings.
3. Wall Mounted Motion Detector, Bosch ISC-PDL1-WA18X, Tri Tech + Detectors with Anti-mask. Provide quantities as indicated on the electrical drawings.
4. Ceiling Mounted Motion Detector, Bosch DS9370, Tri Tech + Detector. Provide quantities as indicated on the electrical drawings.
5. Remote control panel with cards as required.
6. Provide Bosch D829 relay module with eight separate relays to interface with Division 26 lighting contactors to turn walk-through lighting off and on when the system is armed or disarmed. System shall turn off walk-through lighting 5 minutes after the system is armed and turn walk-through lighting on when the system is disarmed. Control of lighting shall be through contactors as indicated on the floor plans.
7. 18 gauge twisted pairs, non-shielded, mid capacitance and plenum rated by General Wire or Belden or West Penn. Provide the proper number of conductors for each cable run and coordinate with devices and panels.

PART 3 - EXECUTION

3.1 INSPECTION

A. The Security Intrusion System Trade shall be responsible for all arrangements for testing and approval of the System by the Authority Having Jurisdiction before the system is accepted by the Owner and Architect/Engineer.

3.2 INSTALLATION

A. General: The location of the main control panel with integral DACT, key pads, annunciator, motion detectors are indicated on the drawings for bidding purposes. The exact location of the above devices shall be determined on the job and the Security Intrusion System Trade shall prepare his bid to allow for any

possible re-arrangement of the equipment. The routing of the conduit and wiring required for this system is not shown on the drawings for security reasons.

B. Wiring:

1. All wiring methods shall be in accordance with NFPA-70, Article 725, and all other applicable codes specified herein. Provide proper number and size of wires as required for operation of the system in accordance with the manufacturer's instructions.
2. All wiring methods on the system's load side shall be shielded power limited type as specified in NEC Article 725 and in a limited conduit system as specified in Section 26 05 19, terminating in the nearest applicable cable tray.
3. No wiring other than that directly associated with detection, alarm or auxiliary protection functions shall be permitted in security intrusion systems conduits, except in the cable tray in accordance with the NEC and if permitted by the EIA/TIA standards for compatibility with other specified EIA/TIA systems.
4. Wiring splices are to be avoided to the extent possible, and if needed they must be made only in junction boxes and shall be crimp connected.
5. Transposing or changing color coding of wires shall not be permitted.
6. Wire nut-type connections are not acceptable. All connections shall be made on screw type terminal strips in boxes or auxiliary cabinets.
7. All conductors shall be labeled on each end with "E-Z markers" or equivalent.
8. Conductors in cabinets shall be carefully formed and harnessed so that each drops off directly opposite to its termination.
9. Cabinet terminals shall be numbered. All controls, function switches, etc., shall be clearly labeled on all equipment panels.
10. All connections to panels, devices and detectors shall be made with crimp type terminal connections, or method approved by security intrusion system manufacturer.
11. All wiring shall be checked and tested to insure that there are no grounds, opens or shorts.

C. All boxes, conduits, etc., shall be of proper size, as determined by the Security Intrusion System Trade, shall be clearly marked for easy identification, and continuously grounded together.

D. The actual circuit routing of the Security Intrusion System shall be by the Security Intrusion System Trade based on the location of the devices, circuit limitations and wire limitations.

E. Key Pads/Annunciator:

1. Install the switches with a recessed flush wall outlet box.

F. Motion Detectors:

1. Install at locations as shown on drawings with the detectors mounted at 7'-6" for 8'-0" ceilings or as recommended by manufacturer on higher ceilings.
2. Each detector requires separate DC power, tamper and alarm circuit wiring and remote point module(s).
3. The exact location shall be determined on the job to assure the protected area is not blocked or obscured.

G. Provide all equipment, accessories and material complete in strict accordance with specifications and applicable drawings as required for a Security Intrusion System. All material and/or equipment necessary for proper operation of the system not specified or described herein shall be deemed part of the

specifications.

H. Upon alarm (or trouble), the control panel shall activate the Owner's presently contracted control station operator's communicator to call the pre-programmed numbers and give the appropriate zoned digital signal to the digital receiver at the contracted central station.

I. Provide Bosch D829 relay module with ten separate relays to interface with Division 26 lighting contactors to turn egress lights off and on when the system is armed and disarmed. System shall turn off walk-through lighting 5 minutes after the system is armed and turn walk-through lighting on when the system is disarmed. Control of lighting shall be through contactors as indicated on the floor plans.

3.3 TECHNICAL ASSISTANCE

A. Instruction: The installation supervising technician for the Security Intrusion System Trade shall instruct the proper designated authority on the correct operation of the system after the installation is completed. The Owner shall be instructed to walk-test the motion detectors periodically (daily preferred) to assure the protect area is not accidentally blocked or obscured.

3.4 FIELD QUALITY CONTROL

A. General: Upon completion of the installation, the Security Intrusion System Trade's factory-trained technician shall perform all necessary electrical tests and adjustments and who shall then submit a Letter of Verification to the Owner/Architect/Engineer that the system functions and conforms to all requirements of the manufacturer of the equipment, these specifications, and all requirements of Uniform Statewide Building Code and UL for type of building in which the system is installed.

B. The factory trained technician shall perform all electrical and mechanical tests. All test and report costs shall be in the Contract price. A checkout report shall be prepared by the installation technicians and submitted in triplicate. The report shall include, but not be limited to:

1. A complete list of equipment installed and wired.
2. Indication that all equipment is properly installed and functions and conforms to these specifications.
3. Tests of individual zones as applicable.
4. Technician's name and date.

C. After completion of all tests and adjustments listed above, the Security Intrusion System Trade shall submit the following information to the Architect/Engineer.

1. "As-built" conduit layout diagrams including wire color code and/or tag number.
2. Complete "as-built" wiring diagrams.

D. Final tests and inspection shall be held in the present of Architect/ Engineer's representatives and to their satisfaction. The Security Intrusion System Trade shall supply personnel for this test without additional cost.

E. The completed Security Intrusion System shall be tested to insure that it is operating properly. Failure of the devices to properly operate shall be considered a failure of the system and all such devices in that system shall be readjusted or replaced. Acceptance of the system shall also require a demonstration of the stability of the system. This shall be adequately demonstrated if the system operates for a ninety (90) day test period

without any unwarranted alarms. Should an unwarranted alarm(s) occur, the Security Intrusion System Trade shall readjust or replace the Defective component and begin another ninety (90) day test period. This test shall not start until the Owner has obtained beneficial use of the building under tests.

F. If the requirements provided in the paragraph above are not completed within one (1) year after beginning the tests described therein, the Security Intrusion System Trade shall replace the defective portion of the system with another acceptable manufacturer and the process repeated until acceptance of the equipment by the Architect/Engineer.

G. After completion of all tests and adjustments listed above, the Security Intrusion System Trade shall turn over all data disks and other information used in configuring the Security System. All such information shall be the property of the Owner upon the acceptance of the system by the Project Manager.

END OF SECTION 281600

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SECTION 282000 – ELECTRONIC SURVEILLANCE

PART 1 – GENERAL (This Section is not Used)

END OF SECTION 282000

SECTION 283100 - FIRE DETECTION AND ALARM

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 WORK INCLUDED:

A. A complete Automatic/Manual Microprocessor Based Fire Alarm system.

B. Provide full conduit system.

C. Conceal all conduits in walls and above ceiling.

D. Identify, band and all mark all fire alarm boxes and conduits.

1.3 RELATED WORK:

A. Division 26 – Electrical

C. Division 27 - Communications

D. Section 28 05 00 – Common Work Results For Electronic Safety And Security

E. Section 28 05 26 – Grounding And Bonding For Electronic Safety And Security Systems

F. Section 28 05 53 – Identification For Electronic Safety And Security

1.4 GENERAL DESCRIPTION:

A. General: Provide a complete stand-alone microprocessor based fire alarm system that displays all individual device address, custom messages, time and date, and event on a single LCD display. The fire alarm system shall be intelligent device addressable, analog detecting, low voltage and modular construction with multiplexed communication operation in full compliance with applicable codes and standards, as specified herein and indicated on the drawings. The system shall be wired, connected and left in first class operating condition. The system including remote (in the garage bay), shall include, but not limited to the following for a complete operating system.

1. Master system CPU including all modules for fire detection; horn (sounders), horn and strobe alarms, network for each system indicated.
2. RS-485-LAN, NFPA Style 7 configuration.
3. Circuit interface panels including all modules.
4. Power supplies, batteries and battery chargers.
5. Equipment enclosures.

6. Intelligent addressable manual pull stations, heat detectors, analog smoke detectors, duct detectors, flame detectors, alarm monitoring modules and supervised control modules.
7. Connection of conventional non-addressable devices and fire suppression systems as required for performance to this specification.
8. Annunciator panels and provisions for printer(s) and video display terminal(s).
9. Audible (horn) and visual evacuation signals.
10. Load control relays and enclosures.
11. Capable of color graphic displays and historical archiving.
12. Software and firmware as required to provide a complete functioning system.
13. Wiring and raceway, outlet boxes, and junction boxes.
14. Installation, testing and Certification and education labor.
15. MULTIPLEX, system driven remote LCD alpha numeric displays/commands center(s) (RCC) with the fire alarm system and remote locations, where indicated.
16. Interface modules and wiring from this system to an U.L. listed central station via digital alarm communicator provided by the Contractor.

B. Fire Suppression System Connections and Interfaces:

1. Connect the sprinkler fire suppression system to the Fire Alarm. Display the system's individual device address, custom messages, time and date, and event on LCD display of the fire alarm.

C. Provide the duct mounted smoke detectors indicated on Division 23 drawing.

D. Provide flame detectors in the enclose garage area for coverage at vehicle repair areas as indicated on the drawings

1.5 SYSTEM OPERATION:

A. Activation of any fire alarm initiating device shall cause the following actions and indications:

1. Display a custom message describing the device originating the local alarm condition, at the local fire alarm control panel and including its related RCC LCD alpha numeric displays. The LCD annunciators shall display the alarm condition via unique messages as required by Owner.
2. Under general alarm operation, the FACP shall sound the audible (horn) signals, and flash the synchronized strobes in the building.

a. Audible (horn) signals shall be silenceable from the FACP or its related RCC(s) by an alarm acknowledge switch, if permitted by the Authority having jurisdiction. The alarm acknowledge indication shall be transferred to a visual indicator on the FACP and related RCC (s) and the alarm signals shall resound for a subsequent alarm condition, reported by a different device.
b. The FACP shall transmit a descriptive alarm to the DACT. The alarm transmission shall be capable of transmitting the minimum of the building address, the room, type of device to inform the fire department of a manual, water-flow or detection alarm; and location.

c. The FACP shall transmit the fully addressed alarm to all related remote command centers (RCC's) and (**future**) terminal and (**future**) printer.
d. The Authority having jurisdiction shall be requested to allow the audible (horn) silencing of the tone portion of the evacuation alarm during the flow of any fire suppression system in the form of written authorization.

3. Record within the non-volatile system historical memory the occurrence of the event, the time and date of occurrence and the device initiating the event.

B. Activation of any supervisory circuit or fire suppression system abnormal, shall cause the following actions and indications:

1. Display the origin of the supervisory condition report at each local alarm control panel and RCC alphanumeric LCD display, and the **future** terminal and printer.
2. Activate supervisory audible and visual signals as indicated audible (horn) signals shall be silenceable from the local fire alarm control and RCC panel by an alarm acknowledge switch. The supervisory indication shall be transferred to a visual indicator on the control panel and the supervisory signals shall resound for a subsequent supervisory condition, reported by a different device.
3. Provide an addressed signal for all **supervisory** alarms.
4. Record within the non-volatile system historical memory and the **future** terminal and (**future**) printer the occurrence of the event, the time of occurrence and the device initiating the event.

C. Receipt of a trouble report such as primary power loss, open or grounded initiating or signaling circuit wiring, open, grounded or shorted indication system wiring, device communication failure, battery disconnect at each new local fire alarm control panel shall cause the following actions and indications:

1. Display at the local alarm control panel and its related RCC and the **future** terminal and **future** printer, an alphanumeric LCD display, with the origin of the trouble condition report.
2. Activate trouble audible (horns) and visual signals at the control panel and RCC panel as indicated on the drawings. Audible (horns) signals shall be silenceable from the related fire alarm control and its related RCC; by a trouble acknowledge switch. The trouble indication shall be transferred to a visual indicator on the control panel and the trouble signals shall resound for a subsequent trouble condition reported by a different device.
3. Provide an alarm system single auxiliary closure for the system **trouble** alarm. Offsite trouble reports for primary system power failure shall be automatically delayed for a period of time equal to 25% of the system standby battery capacity to eliminate spurious reports as a result of power fluctuations if permitted by the Authority having jurisdiction. Extend the fire alarm systems auxiliary contact via wiring to the DACT. This extension is in addition to the **future** terminal and **future** printer.
4. Record within the non-volatile system historical memory the occurrence of the event, the time of occurrence and the device initiating the event.

1.6 QUALITY ASSURANCE

A. Source Quality Control: Materials and equipment shall be new, unused and U.L listed for use as a Fire Protective Signalizing System. The Fire Alarm System shall be listed and on file with the U.L. "Certificate of Compliance" upon completion of the system.

B. The system and components shall be supplied by one single manufacturer of established reputation and experience who shall have produced similar apparatus and who shall be able to refer to similar installations rendering satisfactory service.

C. The installing trade shall furnish the services of the Fire Alarm System manufacturer's authorized technical representative who is qualified in the installation and operation of the system being provided, and who shall be qualified and experienced in the inspection, testing, and maintenance of fires alarm systems. This local authorized technical representative shall be:

1. Factory trained and certified by manufacturer of the system being installed. Fire Alarm Trade shall submit "letter of certification" and proof of continuing education.
2. An on-site National Institute for Certification in Engineering Technologies (NICET) Fire Alarm certified **Level 3** Senior Engineering Technician to supervise on site NICET certified **Level 1** personnel.
3. Trained and qualified personnel employed by and organization listed by a national and Virginia recognized testing laboratory (U.L.) for the servicing of maintaining and testing of fire alarm systems.
4. All wiring pulling, device installation, component wiring, system wiring and testing shall be performed by NICET certified personnel. Non-NICET certified personnel shall not install, wire or test any system component of the fire alarm system.

D. Certification shall be submitted verifying the 'Fire Alarm Trade" is the manufacturer's authorized dealer and installer has NICET certified personnel (indicate levels) and whose local project office is listed in the U.L. "Fire Protection Equipment Directory".

E. The installing Trade shall furnish the services of the Fire Alarm System manufacturer's authorized technical representative who is qualified in the installation and operation of the system being provided, and who is listed and on file with the Underwriters Laboratories (U.L.) Inc. The above Fire Alarm System manufacturers authorized technical representative shall be hereinafter known as the "Fire Alarm Technician" and his employer as the "Fire Alarm Trade". The Fire Alarm Technician and his employer shall be capable of providing Underwriters Laboratories "Follow-Up Service" to identify that the fire alarm system is installed, tested and maintained in accordance with U.L.'s requirements and issue a U.L. "Certificate of Compliances" and NFPA-72 "Record of Completion". The Fire Alarm Technician (NICET certified) shall supervise the hook-up, final testing and adjustment of the system, and provide instruction to the Owner's representative. The Fire Alarm System installation shall include wiring, components, connections, adjustment, testing and certification by NICET certified personnel. The Installing Trade shall provide conduit, junction boxes and pull boxed as indicated; and required by Fire Alarm System manufacturer drawings or Fire Alarm Trade instructions. The Fire Alarm Trade shall furnish special back boxes, cabinets, enclosures and similar items to the Electrical Trade for installation by the electrical trade in accordance with the fire alarm system manufacturer's drawings, Fire Alarm Trade instructions, and as indicated. The Fire Alarm Trade (NICET certified) shall provide and install all low voltage wiring for the fire alarm system. Non-NICET certified personnel shall not install, wire or test any system component of the fire alarm system.

F. The Fire Alarm Trade shall also furnish a list of similar or equal installations and shall show company experience in this type of work.

1.7 REFERENCES:

A. The complete installation, including additions and modifications, shall be in accordance with:

1. Uniform Statewide Building Code for the Commonwealth of Virginia (2012 IBC).
2. National Electrical Code Article 760 & 800.
3. National Fire Protection Association Standard 72, (2010).
4. Listed by Underwriters Laboratories, Inc.
6. ASME/ANSI 117.1 (2009)
7. All of the above references shall be current issue in effect at time of bid.
8. Authority having jurisdiction's regulations, mandates and certification processes that are either part of applicable local government ordinance or applicable state law.

1.8 SUBMITTALS

A. Submit shop drawings and product data in accordance with Section 28 31 00.

1. Shop Drawings: The Fire Alarm System manufacturer and Fire Alarm Trade shall provide a one-line riser diagram indicating route and conduit size, external wiring and connections of system proposed; furnish complete operating instructions, including schematic and wiring diagrams of the systems, engineering data sheets on each component and complete servicing data including part numbers of the various components. A schematic diagram of the complete systems is not shown on the contract documents.
2. Product Data: Submit application, technical, and installation data.

B. Submit Operation and Maintenance Manuals in accordance with Section 28 31 00. The Operation and Maintenance Manuals' shall include the documentation as described in the 2010 NFPA 72.

C. **Substitution**: If the system being submitted by Contractor does not meet the specified points of the system operation, the Contractor shall state what specific points their system's operation differs from the specified points of the specified system operation. A differential report shall be submitted to the Design Engineers as part of the review process referencing every paragraph of this specification.

1.9 WARRANTY, SERVICES:

A. The Fire Alarm System manufacturer and Fire Alarm Trade shall warrant this system for a minimum of two (2) years from date of acceptance by the Design Engineer and Owner against defective parts and/or workmanship and shall provide parts and labor to fulfill this warranty at no cost to Owner.

B. Refer to Division 1 for submission of warranty.

C. Qualified service and parts shall be available to call on within a 70 mile basis.

D. The installing Trade shall include the cost of the above Fire Alarm System manufacturer's authorized technical representative providing maintenance of the installed system for a period of one (2) years, after final acceptance, in compliance with the Underwriters Laboratories (U.L.) Guidelines. On-the-premises service furnished at other than normal working hours shall also be available and shall be charged at normal hour labor rates. The above representative shall be prepared to offer Owner a service contract after the warranty period has ended through the Owner's procedural method and in accordance with NFPA 72.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. The system specified herein is based on the arrangement of a Notifier "Fire Warden 100-2" series intelligent analog fire alarm system and how the system components are grouped into the basic panels, additional modules, auxiliaries and accessories. It is the intent of this specification to allow the total assembly of components to accomplish the specified operation and installation herein and not the exact arrangement of the various subcomponents. An alternative to the Notifier fire alarm system is the Edwards "EST3" fire alarm system and Siemens "Fire Finder XLS" fire alarm system. The alternates shall fully comply with the specifications without any qualifications or exceptions. Where proprietary items are involved, consideration will be given for acceptable alternatives.

2.2 MAIN FIRE ALARM CONTROL PANEL OR NETWORK NODE:

A. Main FACP or network node shall be a NOTIFIER Fire Warden 100-2 and shall contain a microprocessor based Central Processing Unit (CPU) and power supply in a single board design. The CPU shall communicate with and control the following types of equipment used to make up the system: intelligent addressable smoke and thermal (heat) detectors, duct detectors, flame detectors, addressable modules, printer, annunciators, and other system controlled devices.

B. Operator Control

1. Acknowledge Switch:

a. Activation of the control panel acknowledge switch in response to new alarms and/or troubles shall silence the local panel piezo electric signal and change the alarm and trouble LEDs from flashing mode to steady-ON mode. If multiple alarm or trouble conditions exist, depression of this switch shall advance the LCD display to the next alarm or trouble condition.

b. Depression of the Acknowledge switch shall also silence all remote annunciator piezo sounders.

2. Alarm Silence Switch:

a. Activation of the alarm silence switch shall cause all programmed alarm notification appliances and relays to return to the normal condition after an alarm condition. The selection of notification circuits and relays that are silenceable by this switch shall be fully field programmable within the confines of all applicable standards. The FACP software shall include silence inhibit and auto-silence timers.

3. Alarm Activate (Drill) Switch:

    a. The Alarm Activate switch shall activate all notification appliance circuits. The drill function shall latch until the panel is silenced or reset.

4. System Reset Switch:

    a. Activation of the System Reset switch shall cause all electronically-latched initiating devices, appliances or software zones, as well as all associated output devices and circuits, to return to their normal condition.

5. Lamp Test:

    a. The Lamp Test switch shall activate all local system LEDs, light each segment of the liquid crystal display and display the panel software revision for service personal.

C. System Capacity and General Operation

1. The control panel or each network node shall provide, or be capable of 198 intelligent/addressable devices.
2. The control panel or each network node shall include Form-C alarm, trouble, supervisory, and security relays rated at a minimum of 2.0 amps @ 30 VDC. It shall also include four Class B (NFPA Style Y) or Class A (NFPA Style Z) programmable Notification Appliance Circuits.
3. The control panel or each network node shall support up to 8 additional output modules (signal, speaker, telephone, or relay), each with 8 circuits for an additional 64 circuits. These circuits shall be either Class A (NFPA Style Z) or Class B (NFPA Style Y) per the project drawings.
4. The system shall include a full featured operator interface control and annunciation panel that shall include a backlit Liquid Crystal Display (LCD), individual color coded system status LEDs, and an alphanumeric keypad with easy touch rubber keys for the field programming and control of the fire alarm system.
5. The system shall be programmable, configurable, and expandable in the field without the need for special tools, PROM programmers or PC based programmers. It shall not require replacement of memory ICs to facilitate programming changes.
6. The system shall allow the programming of any input to activate any output or group of outputs. Systems that have limited programming (such as general alarm), have complicated programming (such as a diode matrix), or require a laptop personal computer are not considered suitable substitutes. The FACP shall support up to 20 logic equations, including "and," "or," and "not," or time delay equations to be used for advanced programming. Logic equations shall require the use of a PC with a software utility designed for programming.
7. The FACP or each network node shall provide the following features:

    a. Drift compensation to extend detector accuracy over life. Drift compensation shall also include a smoothing feature, allowing transient noise signals to be filtered out.
    b. Detector sensitivity test, meeting requirements of NFPA 72, Chapter 7.
    c. Maintenance alert, with two levels (maintenance alert/maintenance urgent), to warn of excessive smoke detector dirt or dust accumulation.
    d. Nine sensitivity levels for alarm, selected by detector. The alarm level range shall be .5 to 2.35 percent per foot for photoelectric detectors and 0.5 to 2.5 percent per foot

for ionization detectors. The system shall also support sensitive advanced detection laser detectors with an alarm level range of .03 percent per foot to 1.0 percent per foot. The system shall also include up to nine levels of Prealarm, selected by detector, to indicate impending alarms to maintenance personnel.

e. The ability to display or print system reports.
f. Alarm verification, with counters and a trouble indication to alert maintenance personnel when a detector enters verification 20 times.
g. PAS pre-signal, meeting NFPA 72 3-8.3 requirements.
h. Rapid manual station reporting (under 3 seconds) and shall meet NFPA 72 Chapter 1 requirements for activation of notification circuits within 10 seconds of initiating device activation.
i. Periodic detector test, conducted automatically by the software.
j. Self optimizing pre-alarm for advanced fire warning, which allows each detector to learn its particular environment and set its prealarm level to just above normal peaks.
k. Cross zoning with the capability of counting: two detectors in alarm, two software zones in alarm, or one smoke detector and one thermal detector.
l. Walk test, with a check for two detectors set to same address.
m. Control-by-time for non-fire operations, with holiday schedules.
n. Day/night automatic adjustment of detector sensitivity.
o. Device blink control for sleeping areas.

8. The FACP shall be capable of coding main panel node notification circuits in March Time (120 PPM). Panel notification circuits (NAC 1, 2, 3 and 4) shall also support Two-Stage operation, Canadian Dual Stage (3 minutes) and Canadian Dual Stage (5 minutes). Two stage operation shall allow 20 Pulses Per Minute (PPM) on alarm and 120 PPM after 5 minutes or when a second device activates. Canadian Dual stage is the same as Two-Stage except will only switch to second stage by activation of Drill Switch 3 or 5 minute timer. The panel shall also provide a coding option that will synchronize specific strobe lights designed to accept a specific "sync pulse."
9. All strobe devices shall be synchronized and shall flash at the rate determined by the Local Authority Having Jurisdiction.

D. Central Microprocessor

1. The microprocessor shall be a high speed, 16-bit RISC device and it shall communicate with, monitor and control all external interfaces. It shall include an EPROM for system program storage, Flash memory for building-specific program storage, and a "watch dog" timer circuit to detect and report microprocessor failure.
2. The microprocessor shall contain and execute all control-by-event programs for specific action to be taken if an alarm condition is detected by the system. Control-by-event equations shall be held in non-volatile programmable memory, and shall not be lost even if system primary and secondary power failure occurs.
3. The microprocessor shall also provide a real-time clock for time annotation of system displays, printer, and history file. The time-of-day and date shall not be lost if system primary and secondary power supplies fail. The real time clock may also be used to control non-fire functions at programmed time-of-day, day-of-week, and day-of-year.
4. A special program check function shall be provided to detect common operator errors.
5. An auto-program (self-learn) function shall be provided to quickly install initial functions and make the system operational.
6. For flexibility and to ensure program validity, an optional Windows(TM) based program

utility shall be available. This program shall be used to off-line program the system with batch upload/download, and have the ability to upgrade the manufacturers (FLASH) system code changes. This program shall also have a verification utility, which scans the program files, identifying possible errors. It shall also have the ability to compare old program files to new ones, identifying differences in the two files to allow complete testing of any system operating changes. This shall be in incompliance with the NFPA 72 requirements for testing after system modification.

E. System Display

1. The system shall support the following display mode options:

    a. 80 character display option. The display shall include an 80-character backlit alphanumeric Liquid Crystal Display (LCD) and a full PC style QWERTY keypad.

2. The display shall provide all the controls and indicators used by the system operator:

    a. The 80-character display shall include the following operator control switches: ACKNOWLEDGE, ALARM SILENCE, ALARM ACTIVATE (drill), SYSTEM RESET, and LAMP TEST.

3. The display shall annunciate status information and custom alphanumeric labels for all intelligent detectors, addressable modules, internal panel circuits, and software zones.
4. The display shall also provide Light-Emitting Diodes.

    a. The 80-character display shall provide 8 Light-Emitting-Diodes (LEDs) that indicate the status of the following system parameters: AC POWER, FIRE ALARM, PREALARM WARNING, SECURITY ALARM, SUPERVISORY SIGNAL, SYSTEM TROUBLE, DISABLED POINTS, and ALARM SILENCED.
    b. The 80-character display keypad shall be an easy to use QWERTY type keypad, similar to a PC keyboard. This shall be part of the standard system and have the capability to command all system functions, entry of any alphabetic or numeric information, and field programming. Two different password levels shall be provided to prevent unauthorized system control or programming.

5. The system shall support the display of battery charging current and voltage on the 80-character LCD display.

F. Signaling Line Circuits (SLC)

1. Each FACP or FACP network node shall support up to two SLCs. Each SLC interface shall provide power to and communicate with up to 159 intelligent detectors (ionization, photoelectric or thermal) and 159 intelligent modules (monitor or control) for a loop capacity of 318 devices. The addition of the optional second loop shall double the device capacity, supporting a total of 636 devices. Each SLC shall be capable of NFPA 72 Style 4, Style 6, or Style 7 (Class A or B) wiring.
2. CPU shall receive analog information from all intelligent detectors to be processed to determine whether normal, alarm, prealarm, or trouble conditions exist for each detector. The software shall automatically maintain the detector's desired sensitivity level by adjusting for the effects of environmental factors, including the accumulation of dust in each detector. The

analog information shall also be used for automatic detector testing and for the automatic determination of detector maintenance requirements.

G. Serial Interfaces

1. The system shall include two serial EIA-232 interfaces. Each interface shall be a means of connecting UL Listed Information Technology Equipment (ITE) peripherals.

    a. The system shall include an EIA-485 port for the serial connection of optional annunciators and remote LCD displays.
    b. The EIA-485 interface may be used for network connection to a proprietary-receiving unit.

H. Notification Appliance Circuit (NAC) Module

1. The Notification Appliance Circuit module shall provide four fully supervised Class A or B (NFPA Style Z or Y) notification circuits. An expansion circuit board shall allow expansion to eight circuits per module.
2. The notification circuit capacity shall be 3.0 amperes maximum per circuit and 6.0 amperes maximum per module.
3. The module shall not affect other module circuits in any way during a short circuit condition.
4. The module shall provide eight green ON/OFF LEDs and eight yellow trouble LEDs.
5. The module shall also provide a momentary switch per circuit that may be used to manually turn the particular circuit on or off or to disable the circuit.
6. Each notification circuit shall include a custom label inserted to identify each circuit's location. Labels shall be created using a standard typewriter or word processor.
7. The notification circuit module shall be provided with removable wiring terminal blocks for ease of installation and service. The terminal strips shall be UL listed for use with up to 12 AWG wire.
8. Each circuit shall be capable of, through system programming, deactivating upon depression of the signal silence switch.

I. Control Relay Module

1. The control relay module shall provide four Form-C auxiliary relay circuits rated at 5 amperes, 28 VDC. An expansion circuit board shall allow expansion to eight Form-C relays per module.
2. Each relay circuit shall be capable of being activated (change in state) by any initiating device or from any combination of initiating devices.
3. The relay module shall provide 8 green ON/OFF LEDs and 8 yellow LEDs (indicates disabled status of the relay).
4. The module shall provide a momentary switch per relay circuit that may be used to manually turn the relay ON/OFF or to disable the relay.
5. Each relay circuit shall include a custom label inserted to identify its location. Labels shall be created using a standard typewriter or word processor.
6. The control relay module shall be provided with removable wiring terminal blocks for ease of installation and service. The terminal blocks shall be UL listed for use with up to 12 AWG wire.

J. Enclosures:

1. The control panel shall be housed in a UL-listed cabinet suitable for surface or semi-flush mounting. The cabinet and front shall be corrosion protected, given a rust-resistant prime coat, and manufacturer's standard finish.
2. The back box and door shall be constructed of 0.060 steel with provisions for electrical conduit connections into the sides and top.
3. The door shall provide a key lock and shall include a glass or other transparent opening for viewing of all indicators. For convenience, the door may be site configured for either right or left hand hinging.

K. Power Supply:

1. An off-line switching power supply shall be available for the fire alarm control panel or network node and provide 6.0 amps of available power for the control panel and peripheral devices.
2. Provisions will be made to allow the audio-visual power to be increased as required by adding modular expansion audio-visual power supplies.
3. Positive-Temperature-Coefficient (PTC) thermistors, circuit breakers, or other over-current protection shall be provided on all power outputs. The power supply shall provide an integral battery charger for use with batteries up to 60 AH or may be used with an external battery and charger system. Battery arrangement may be configured in the field.
4. The power supply shall continuously monitor all field wires for earth ground conditions, and shall have the following LED indicators:

   Ground Fault LED
   AC Power Fail LED
   NAC on LED (4)

5. The main power supply shall operate on 120 VAC, 60 Hz, and shall provide all necessary power for the FACP.
6. The main power supply shall provide a battery charger using dual-rate charging techniques for fast battery recharge and be capable of charging batteries up to 60 AH.
7. All circuits shall be power-limited, per UL864 requirements.

L. Field Charging Power Supply (FCPS): The FCPS is a device designed for use as either a remote 24 volt power supply or used to power Notification Appliances.

1. The FCPS shall offer up to 6.0 amps (4.0 amps continuous) of regulated 24 volt power. It shall include an integral charger designed to charge 7.0 amp hour batteries and to support 60 hour standby.
2. The Field Charging Power Supply shall have two input triggers. The input trigger shall be a Notification Appliance Circuit (from the fire alarm control panel) or a relay. Four outputs (two Style Y or Z and two Style Y) shall be available for connection to the Notification devices.
3. The FCPS shall include an attractive surface mount backbox.
4. The Field Charging Power Supply shall include the ability to delay the AC fail delay per NFPA requirements.
5. The FCPS include power limited circuitry, per 1995 UL standards.

M. Specific System Operations

1. Smoke Detector Sensitivity Adjust: A means shall be provided for adjusting the sensitivity of any or all addressable intelligent detectors in the system from the system keypad. Sensitivity range shall be within the allowed UL window and have a minimum of 9 levels.
2. Alarm Verification: Each of the intelligent addressable smoke detectors in the system may be independently selected and enabled to be an alarm verified detector. The alarm verification delay shall be programmable from 5 to 30 seconds and each detector shall be able to be selected for verification. The FACP shall keep a count of the number of times that each detector has entered the verification cycle. These counters may be displayed and reset by the proper operator commands.
3. Point Disable: Any addressable device or conventional circuit in the system may be enabled or disabled through the system keypad.
4. Point Read: The system shall be able to display or print the following point status diagnostic functions:

    a. Device status
    b. Device type
    c. Custom device label
    d. View analog detector values
    e. Device zone assignments
    f. All program parameters

5. System Status Reports: Upon command from an operator of the system, a status report will be generated and printed, listing all system status.
6. System History Recording and Reporting: The fire alarm control panel shall contain a history buffer that will be capable of storing up to 800 events. Up to 200 events shall be dedicated to alarm and the remaining events are general purpose. Systems that do not have dedicated alarm storage, where events are overridden by non-alarm type events, are not suitable substitutes. Each of these activations will be stored and time and date stamped with the actual time of the activation. The contents of the history buffer may be manually reviewed, one event at a time, or printed in its entirety. The history buffer shall use non-volatile memory. Systems that use volatile memory for history storage are not acceptable substitutes.
7. Automatic Detector Maintenance Alert: The fire alarm control panel shall automatically interrogate each intelligent detector and shall analyze the detector responses over a period of time. If any intelligent detector in the system responds with a reading that is above or below normal limits, then the system will enter the trouble mode, and the particular detector will be annunciated on the system display, and printed on the optional printer. This feature shall in no way inhibit the receipt of alarm conditions in the system, nor shall it require any special hardware, special tools or computer expertise to perform.
8. Pre-Alarm Function: The system shall provide two levels of pre-alarm warning to give advance notice of a possible fire situation. Both pre-alarm levels shall be fully field adjustable. The first level shall give an audible indication at the panel. The second level shall give an audible indication and may also activate control relays. The system shall also have the ability to activate local detector sounder bases at the pre-alarm level, to assist in avoiding nuisance alarms.
9. Software Zones: The FACP shall provide 100 software zones, 10 additional special function zones, 10 releasing zones, and 20 logic zones.
10. The fire alarm control panel shall include a walk test feature. It shall include the ability to test initiating device circuits and notification appliance circuits from the field without returning to the panel to reset the system. Operation shall be as follows:

a. Alarming an initiating device shall activate programmed outputs, which are selected to participate in walk test, for 3 seconds.
b. Introducing a trouble into the initiating device shall activate the programmed outputs for 8 seconds.
c. All devices tested in walk test shall be recorded in the history buffer.

11. Supervisory Operation

a. An alarm from a supervisory device shall cause the appropriate indication on the system display, light a common supervisory LED, but will not cause the system to enter the trouble mode.

12. Signal Silence Operation

a. The FACP shall have the ability to program each output circuit (notification, relay, speaker etc) to deactivate upon depression of the signal silence switch.

13. Non-Alarm Input Operation

a. Any addressable initiating device in the system may be used as a non-alarm input to monitor normally open contact type devices. Non-alarm functions are a lower priority than fire alarm initiating devices.

14. Combo Zone

a. A special type code shall be available to allow waterflow and supervisory devices to share a common addressable module. Waterflow devices shall be wired in parallel, supervisory devices in series.

2.3 SYSTEM COMPONENTS:

A. Programmable Electronic Sounders:

1. Electronic sounders shall operate on 24 VDC nominal.
2. Electronic sounders shall be field programmable without the use of special tools, at a sound level of at least 90 dBA measured at 10 feet from the device.
3. Shall be flush mounted as shown on plans.

B. Strobe lights shall meet the requirements of the ADA, UL Standard 1971, be fully synchronized, and shall meet the following criteria:

1. The maximum pulse duration shall be 2/10 of one second.
2. Strobe intensity shall meet the requirements of UL 1971.
3. The flash rate shall meet the requirements of UL 1971.
4. Visual devices shall be SpectrAlert series.

C. Horn/Visual Combination Devices:

1. Shall meet the applicable requirements of Section A listed above for audibility.
2. Shall meet the requirements of Section B listed above for visibility.
3. Horn/Visual devices shall be SpectrAlert series.

D. Alphanumeric LCD Type Annunciator:

1. The alphanumeric display annunciator shall be a supervised, remotely located back-lit LCD display containing a minimum of eighty (80) characters for alarm annunciation in clear English text.
2. The LCD annunciator shall display all alarm and trouble conditions in the system.
3. An audible indication of alarm shall be integral to the alphanumeric display.
4. The display shall be UL listed for fire alarm application.
5. It shall be possible to connect up to 32 LCD displays and be capable of wiring distances up to 6,000 feet from the control panel.
6. The annunciator shall connect to a separate, dedicated "terminal mode" EIA-485 interface. This is a two-wire loop connection and shall be capable of distances to 6,000 feet. Each terminal mode LCD display shall mimic the main control panel.
7. The system shall allow a minimum of 32 terminal mode LCD annunciators. Up to 10 LCD annunciators shall be capable of the following system functions: Acknowledge, Signal Silence and Reset, which shall be protected from unauthorized use by a keyswitch or password.
8. The LED annunciator shall offer an interface to a graphic style annunciator and provide each of the features listed above.

E. All interfaces and associated equipment are to be protected so that they will not be affected by voltage surges or line transients consistent with UL standard 864.

F. Universal Digital Alarm Communicator Transmitter (UDACT). The UDACT is an interface for communicating digital information between a fire alarm control panel and an UL-Listed central station.

1. The UDACT shall be compact in size, mounting in a standard module position of the fire alarm control cabinet. Optionally, the UDACT shall have the ability for remote mounting, up to 6,000 feet from the fire alarm control panel. The wire connections between the UDACT and the control panel shall be supervised with one pair for power and one pair for multiplexed communication of overall system status. Systems that utilize relay contact closures are not acceptable.
2. The UDACT shall include connections for dual telephone lines (with voltage detect), per UL/NFPA/FCC requirements. It shall include the ability for split reporting of panel events up to three different telephone numbers.
3. The UDACT shall be completely field programmable from a built-in keypad and 4 character red, seven segment display.
4. The UDACT shall be capable of transmitting events in at least 15 different formats. This ensures compatibility with existing and future transmission formats.
5. Communication shall include vital system status such as:

    - Independent Zone (Alarm, trouble, non-alarm, supervisory)
    - Independent Addressable Device Status
    - AC (Mains) Power Loss
    - Low Battery and Earth Fault

- System Off Normal
- 12 and 24 Hour Test Signal
- Abnormal Test Signal (per UL requirements)
- EIA-485 Communications Failure
- Phone Line Failure

6. The UDACT shall support independent zone/point reporting when used in the Contact ID format. In this format the UDACT shall support transmission of up to 2,040 points. This enables the central station to have exact details concerning the origin of the fire or response emergency.

G. Field Wiring Terminal Blocks

For ease of service all panel I/O wiring terminal blocks shall be removable, plug-in types and have sufficient capacity for #18 to #12 AWG wire. Terminal blocks that are permanently fixed are not acceptable.

2.4. SYSTEM COMPONENTS - ADDRESSABLE DEVICES

A. Addressable Devices – General:

1. Addressable devices shall use simple to install and maintain decade, decimal address switches. Devices shall be capable of being set to an address in a range of 001 to 159.
2. Addressable devices, which use a binary-coded address setting method, such as a DIP-switch, are not an allowable substitute.
3. Detectors shall be intelligent (analog) and addressable, and shall connect with two wires to the fire alarm control panel Signaling Line Circuits.
4. Addressable smoke and thermal detectors shall provide dual alarm and power/polling LEDs. Both LEDs shall flash green under normal conditions, indicating that the detector is operational and in regular communication with the control panel, and both LEDs shall be placed into steady red illumination by the control panel, indicating that an alarm condition has been detected. If required, the LED flash shall have the ability to be removed from the system program. An output connection shall also be provided in the base to connect an external remote alarm LED.
5. The fire alarm control panel shall permit detector sensitivity adjustment through field programming of the system. The panel on a time-of-day basis shall automatically adjust sensitivity.
6. Using software in the FACP, detectors shall automatically compensate for dust accumulation and other slow environmental changes that may affect their performance. The detectors shall be listed by UL as meeting the calibrated sensitivity test requirements of NFPA Standard 72, Chapter 7.
7. The detectors shall be ceiling-mount and shall include a separate twist-lock base with tamper proof feature. Bases shall include a sounder base with a built-in (local) sounder rated at 85 DBA minimum, a relay base and an isolator base designed for Style 7 applications.
8. The detectors shall provide a test means whereby they will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself (by activating a magnetic switch) or initiated remotely on command from the control panel.
9. Detectors shall also store an internal identifying type code that the control panel shall use to identify the type of device (ION, PHOTO, THERMAL).

10. Detectors will operate in an analog fashion, where the detector simply measures its designed environment variable and transmits an analog value to the FACP based on real-time measured values. The FACP software, not the detector, shall make the alarm/normal decision, thereby allowing the sensitivity of each detector to be set in the FACP program and allowing the system operator to view the current analog value of each detector.
11. Addressable devices shall store an internal identifying code that the control panel shall use to identify the type of device.
12. Addressable modules shall mount in a 4-inch square (101.6 mm square), 2-1/8 inch (54 mm) deep electrical box.

B. Addressable Double-Action Manual Fire Alarm Box (manual station)

1. Addressable manual fire alarm boxes shall, on command from the control panel, send data to the panel representing the state of the manual switch and the addressable communication module status. They shall use a key operated test-reset lock, and shall be designed so that after actual emergency operation, they cannot be restored to normal use except by the use of a key.
2. All operated stations shall have a positive, visual indication of operation and utilize a key type reset.
3. Manual fire alarm boxes shall be constructed of Lexan with clearly visible operating instructions provided on the cover. The word FIRE shall appear on the front of the stations in raised letters, 1.75 inches (44 mm) or larger.

C. Intelligent Photoelectric Smoke Detector:

1. The detectors shall use the photoelectric (light-scattering) principal to measure smoke density and shall, on command from the control panel, send data to the panel representing the analog level of smoke density.

D. Addressable Dry Contact Monitor Module:

1. Addressable monitor modules shall be provided to connect one supervised IDC zone of conventional alarm initiating devices (any N.O. dry contact device) to one of the fire alarm control panel SLCs.
2. The IDC zone shall be suitable for Style D or Style B operation. An LED shall be provided that shall flash under normal conditions, indicating that the monitor module is operational and in regular communication with the control panel.
3. For difficult to reach areas, the monitor module shall be available in a miniature package and shall be no larger than 2-3/4 inch (70 mm) x 1-1/4 inch (31.7 mm) x 1/2 inch (12.7 mm). This version need not include Style D or an LED.

E. Two Wire Detector Monitor Module:

1. Addressable monitor modules shall be provided to connect one supervised IDC zone of conventional 2-wire smoke detectors or alarm initiating devices (any N.O. dry contact device).
2. The IDC zone may be wired for Class A or B (Style D or Style B) operation. An LED shall be provided that shall flash under normal conditions, indicating that the monitor module is operational and in regular communication with the control panel.

F. Addressable Control Module:

1. Addressable control modules shall be provided to supervise and control the operation of one conventional NACs of compatible, 24 VDC powered, polarized audio/visual notification appliances.
2. The control module NAC may be wired for Style Z or Style Y (Class A/B) with up to 1 amp of inductive A/V signal, or 2 amps of resistive A/V signal operation.
3. Audio/visual power shall be provided by a separate supervised power circuit from the main fire alarm control panel or from a supervised UL listed remote power supply.
4. The control module shall be suitable for pilot duty applications and rated for a minimum of 0.6 amps at 30 VDC.

G. Addressable Relay Module:

1. Addressable Relay Modules shall be available for HVAC control and other building functions. The relay shall be form C and rated for a minimum of 2.0 Amps resistive or 1.0 Amps inductive. The relay coil shall be magnetically latched to reduce wiring connection requirements, and to insure that 100% of all auxiliary relay or NACs may be energized at the same time on the same pair of wires.

H. Isolator Module:

1. Isolator modules shall be provided to automatically isolate wire-to-wire short circuits on an SLC Class A or Class B branch. The isolator module shall limit the number of modules or detectors that may be rendered inoperative by a short circuit fault on the SLC loop segment or branch. At least one isolator module shall be provided for each floor or protected zone of the building.
2. If a wire-to-wire short occurs, the isolator module shall automatically open-circuit (disconnect) the SLC. When the short circuit condition is corrected, the isolator module shall automatically reconnect the isolated section.
3. The isolator module shall not require address-setting, and its operations shall be totally automatic. It shall not be necessary to replace or reset an isolator module after its normal operation.
4. The isolator module shall provide a single LED that shall flash to indicate that the isolator is operational and shall illuminate steadily to indicate that a short circuit condition has been detected and isolated.

2.5 BATTERIES:

A. The battery shall have sufficient capacity to power the fire alarm system for not less than twenty-four hours plus 5 minutes of alarm upon a normal AC power failure.

B. The batteries are to be completely maintenance free. No liquids are required. Fluid level checks for refilling, spills, and leakage shall not be required.

C. If necessary to meet standby requirements, external battery and charger systems may be used.

2.6 FACP (CONTROL) RELAYS & CONTACTORS:

A. Provide for the control of air handler motor starters, control relays and contractors as follows:

1. All relays and contractors shall be supervised as required by NFPA 101 and mounted within three feet of the device controlled.
2. Refer to Section 26 20 00 for relays and Contactors.

PART 3- EXECUTION

3.1 INSPECTION:

A. The Fire Alarm Trade shall be responsible for all arrangements for testing and approval of the Fire Alarm System by the Authority having jurisdiction before the Fire Alarm System is accepted by the Project Manager.

3.2 INSTALLATION:

A. General: The Fire Alarm Trade shall provide all new equipment, accessories and material required for the installation of the fire alarm system in accordance with the specifications and drawings. Any material and/or equipment necessary for the proper operation of the system that is not specified or described herein shall be deemed part of this specification.

B. Wiring Methods:

1. All wiring methods shall be in accordance with NFDA-70, Article 760, and all other codes specified herein.
2. Provide proper number and size of wires as required for proper operation of the system in accordance with the system's manufacturer's instructions and the above codes.
3. All non-power limited wiring shall be installed in a separate conduit system, as specified in Section 26 05 19.
4. All shielded power limited cable shall be installed in a full conduit system per NEC Article 760 and as specified in Section 26 05 23 for plenum and non-plenum applications.
5. No wiring other than that directly associated with fire alarm detection, alarm or auxiliary fire protection functions shall be permitted in fire alarm conduits, (except in the cable tray, in accordance with the NEC and if permitted by the TIA/EIA standards for compatibility with other listed TIA/EIA systems).
6. Wiring splices are to be avoided to the extent possible, and if needed they must be made only in junction boxes and shall be crimp connected.
7. Transposing or changing color coding of wires shall not be permitted.
8. Crimped type connections are not acceptable for final connections at terminating locations.
9. All conductors shall be labeled on each end with "E-Z markers" or equivalent.
10. Conductors in cabinets shall be carefully formed and harnessed so that each drops off directly opposite to its termination.
11. Cabinet terminals shall be numbered. All controls, function switches, etc., shall be clearly labeled on all equipment panels.
12. All connections to panels, devices and detectors shall be made with screw terminal connections, or method approved by fire alarm manufacturer.
13. All wiring shall be checked and tested to insure that there are no grounds, opens or shorts.
14. All fire alarm addressable signal line circuits (SLC) shall be Class B.

15. The wiring for the fire alarm system is not shown on the drawings. The actual circuit routing of the fire alarm system shall be by the Fire Alarm Trade based on the location of the devices, circuit limitations and wire limitations.
16. All fire alarm hard wired indicating appliance circuits (IAC) shall be Class B.
17. All fire alarm signal line circuits, and other wiring leaving the building location shall have surge arresters or transient protectors as required by U.L., NEC and equipment manufacturer.
18. All fire alarm systems' wiring 100 volts and less is part of Section 26 31 00. All fire alarm systems' wiring 101 volt and above is part of Division 26.
19. All boxes, conduits, etc., shall be of proper size, as determined by the Fire Alarm System Trade, shall be clearly marked for easy identification, continuously grounded together and bonded to the existing building grounding electrode system (BGES). The Fire Alarm Trade shall furnish special boxes to the Electrical Trade for installation by the Electrical Trade.

C. The activation of smoke sensor(s) shall operate through an Intelligent System (Addressable) interface module or base relay to the remote alarm indicator on the ceiling above the entrance door to the area. Individual sensor's base can drive one (1) remote alarm indicator without a relay.

E. All smoke sensors shall be installed only after the final clean up by all of the Trades, but before inspection by the Local Authority Having Jurisdiction. No compensation shall be given for smoke sensors that are required to be replaced if installed before this date.

F. All ceiling smoke and heat sensors shall be properly located from HVAC supply and return discharges per NFPA 72E distances.

G. Remote Command Centers (RCC): Provide remote LCD alpha-numeric display/command center(s) as indicated on the drawings.

H. All fire alarm systems' Intelligent System (Addressable) interface modules shall be mounted adjacent to the controlled equipment. Auxiliary relays located in ceiling mounted sensor bases shall be in the same room as the controlled equipment and within the NFPA limits.

I. Each application for visual indicating appliances (strobe) intensity requirements shall meet or exceed ADAAG guidelines, ADAAG General Section 2.2 Equivalent Facilitation, NFPA 72 (Chapter 6) and ANSI 117.1. All visual indicating appliances shall be synchronized to minimize adverse neurological stimulation. The visual and audible indicating appliances shall be separately circuited for audible silencing. Visual signals shall be mounted at the “ADA not to exceed” height of 88 inches above the highest level of the finish floor or six inches below the ceiling, whichever is lower unless the Authority having jurisdiction indicates otherwise. The subscript number adjacent to the indicating appliance indicates the minimum required candela for the space.

J. The fire alarm remote alarm contact shall be connected to the UDACT. Upon alarm (or trouble) the digital communicator shall transmit the proper signal to the Owner-contracted central station.

3.3 TECHNICAL ASSISTANCE:

A. Instruction: The Fire Alarm Technician shall instruct the Authority having jurisdiction and the Owner and Fire Department personnel on the correct operation of the system after the installation is completed.

3.4 FIELD QUALITY CONTROL:

A. General: Upon completion of the installation, the Fire Alarm Systems Technician shall perform all necessary NFPA tests and adjustments. The above representative shall then submit a Record of Completion and an Underwriters Laboratories (U.L.) Certificate of Compliance to the Owner and Design Engineers that each system and the network functions and conforms to all the requirements of the manufacturer of the equipment, the Contract Documents, and all requirements of the Uniform Statewide Building Code including IBC 2012 acceptance test for the type of building in which the system is installed. The U.L. "Certificate of Compliance" shall be filed at U.L. for inspection by the insurance underwriters and all other authorities. The NFPA 72 "Record of Completion" shall be filed with the Local Authority having jurisdiction.

B. The Fire Alarm Technician shall perform all electrical and mechanical tests required by the fire alarm systems manufacturer's form. All test and report costs shall be in the Contract price. A checkout report shall be prepared by the installation technicians and submitted in triplicate, one copy of which will be registered with the equipment manufacturer. The report shall include, but not be limited to:

1. A complete list of equipment installed and wired.
2. Indication that all equipment is properly installed and functions and conforms with these specifications.
3. Tests of individual zones and addressable devices as applicable.
4. Serial numbers, locations by zone and model number for each installed detector.
5. Voltage (sensitivity) settings for each photoelectric detector as measured in place with the HVAC system operating.
6. IBC Acceptance Test
7. Technician's name, certificate number and date.

C. After completion of all tests and adjustments listed above, the Fire Alarm Trade shall submit the following information to the Design Engineers.

1. "As-built" conduit layout diagrams including wire color code and/or tag number.
2. Complete "as-built" wiring diagrams.
3. Detailed catalog data on all installed system components.
4. Copy of the test report described in Par. B.

D. Final tests and inspection shall be held in the presence of the Project Manager and to his or her satisfaction. The Fire Alarm Trade shall supply personnel and required auxiliary equipment for this test without additional cost.

E. The completed smoke detection system shall be tested to insure that it is operating properly. This test will consist of exposing the installed units to a standard fire test. Failure of the devices to sense the smoke shall be considered a failure of the system and all detectors in that system shall be readjusted or replaced. Acceptance of the system shall also require a demonstration of the stability of the system. This shall be adequately demonstrated if the system operates for a ninety (90) day test period without any unwarranted alarms. Should an unwarranted alarm(s) occur, the Fire Alarm Trade shall readjust or replace the detector(s) and begin another ninety (90) day test period. As required by the Design Engineers, the Fire Alarm Trade shall recheck the detectors using the fire test after each readjustment or replacement of detectors. This test shall not start until Owner has obtained beneficial use of the building under tests.

F. If the requirements provided in the paragraph above are not completed within one (1) year after beginning the tests described therein, the Fire Alarm Trade shall replace the system with another acceptable manufacturer and the process repeated until acceptance of the equipment by the Design Engineers, Owner and Project Manager.

G. After completion of all tests and adjustments listed above, the Fire Alarm Trade shall turn over the Fire Alarm System data disk to the Owner. The data disk will be considered to be the property of the Owner upon acceptance of the Fire Alarm System by the Project Manager.

END OF SECTION 283100

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APPENDIX

VDH VIRGINIA DEPARTMENT OF HEALTH
Protecting You and Your Environment

Rockbridge-Lexington Health Department
PO BOX 900
Lexington, Virginia 24450
(540) 463-3185
(540) 463-6677 Fax

PE Sewage Disposal System Construction Permit Letter (COV 32.1-163.6)

May 15, 2017

JEFFERSON NATIONAL FOREST SERVICE-NATURAL BRIDGE STATION
27 Ranger Ln
Natural Bridge Station, VA 24579

RE: **Tax Map/GPIN:** 113-8--6A (was 118-8-7) (6C) **HDID:** 181-17-0050 **Reserve:** 50% reserve area provided **System Capacity:** Residential, **Conditiona**l to 400 gallons per day

Dear JEFFERSON NATIONAL FOREST SERVICE-NATURAL BRIDGE STATION:

This letter and the attached drawings, specifications and calculations dated May 02, 2017 constitute your **permit** to install a sewage disposal system [and private well if applicable] on the property referenced above. Your application for a permit was submitted pursuant to §32.1-163.6 of the *Code of Virginia,* which requires the Virginia Department of Health (VDH) to accept designs for onsite sewage systems from individuals licensed as Professional Engineers (PEs). This law allows PEs to design onsite sewage systems that do not fully comply with the *Sewage Handling and Disposal Regulations* (12 VAC 5-610-10 *et seq.)* and requires VDH to accept such designs provided they comply with standard engineering practices, performance requirements set by the Board of Health, and certain horizontal setback requirements necessary to protect public health and the environment. VDH hereby recognizes that the design submitted by **Burleson, John , P.E.** complies with the requirements of the *Code of Virginia* and the *Regulations for Alternative Onsite Sewage Systems* and grants permission to install the system as designed in the area shown on the attached plans and specifications.

If modifications or revisions are necessary between now and when the system is constructed, please contact the PE who designed the system upon which this permit is based. Should revisions be necessary during construction, your contractor should consult with the PE. The PE is authorized to make minor adjustments in the location or design of the system provided that adequate documentation is provided to the Rockbridge-Lexington Health Department.

The PE that submitted the design for this permit is required by the *Sewage Handling and Disposal Regulations* to conduct a final inspection of this sewage system when it is installed and to submit an inspection report and completion statement to the Rockbridge-Lexington Health Department. The health department is not required to inspect the installation, but may do so at its sole discretion. The sewage system may not be placed into operation until you have obtained an Operation Permit from the Rockbridge-Lexington Health Department. If your PE did not submit an Operation and Maintenance Manual for review and approval with the plan package, then (s)he will be required to do so prior to issuance of an Operation Permit.

This Construction Permit is null and void if site and soil conditions are changed from those shown on your application or if conditions are changed from those shown on the attached plans and specifications. VDH may revoke or modify any permit if, at a later date, it finds that the system would threaten public health or the environment.

This permit approval has been issued in accordance with applicable regulations based on the information and materials provided at the time of application. There may be other local, state, or federal laws or regulations that apply to the proposed construction of this onsite sewage system. The owner is responsible at all times for complying with all applicable local, state, and federal laws and regulations. If you have any questions, please contact me.

This permit expires **November 14, 2018**. This permit is not transferable to another owner or location.

Sincerely,

Eric Royer
Environmental Health Specialist, Sr.

C: Burleson, John , P.E.

Glenwood-Pedlar Ranger Office

Rockbridge County, Virginia
TM: 113-8-6A

400 GPD Drainfield
w/Advantex AX-RT

PDF Notice: This document is meant to be read as an 11" x 17" sheet of paper. Zooming may reveal superfluous lines and features used during the CAD process.

COMMONWEALTH OF VIRGINIA
PROFESSIONAL ENGINEER
5/2/17

A Pre-Construction conference with Engineer, John Burleson, is required prior to excavation/installation.

This sewage system must be installed by a DPOR licensed "Alternative Onsite Sewage System Installer".

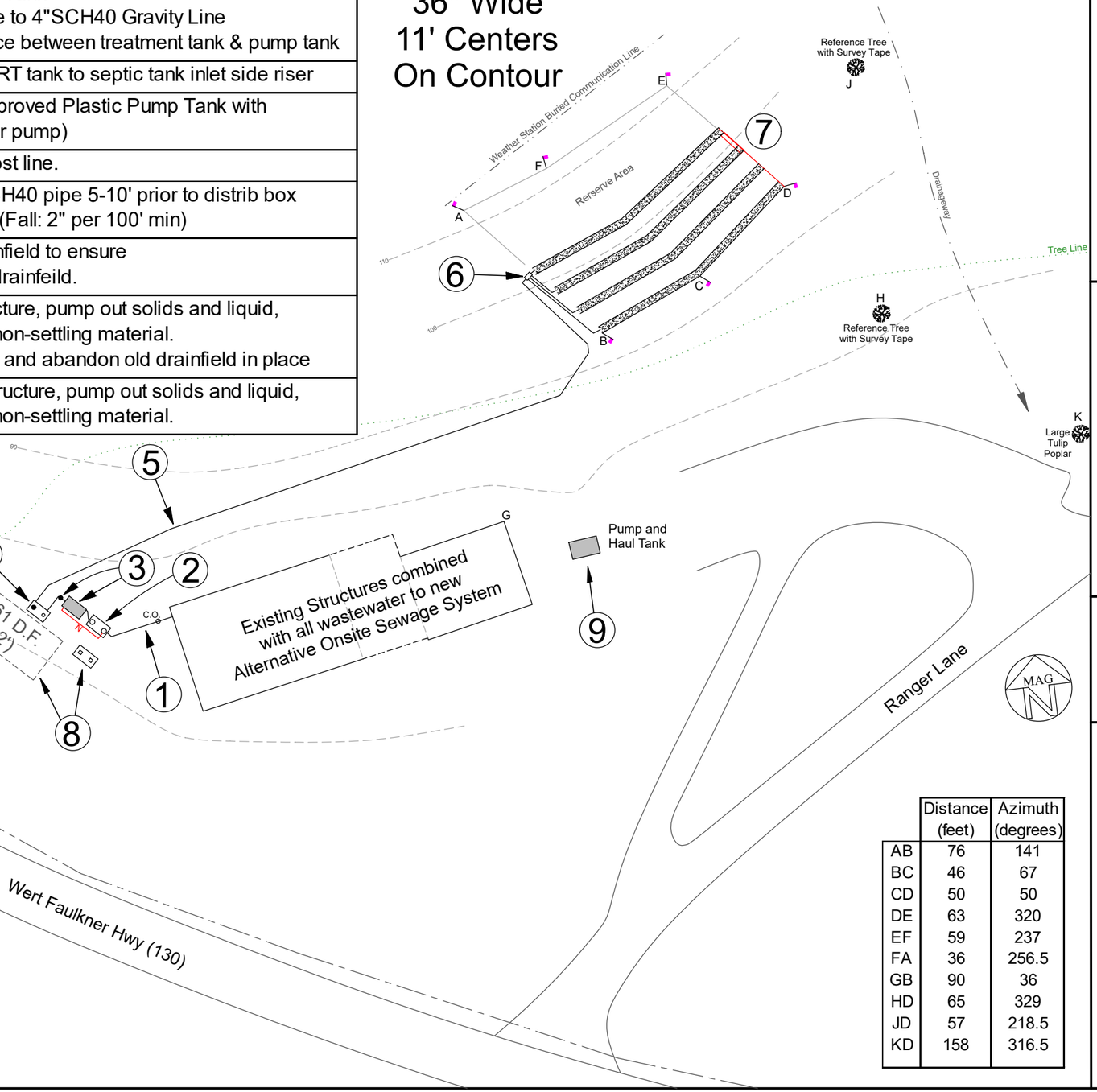
May 2, 2017	Project No. CKR17

Burleson Engineering, PLLC
1374 Big Spring Drive
Lexington, Virginia 24450
540-464-9242

COMMONWEALTH OF VIRGINIA
JOHN T. BURLESON
Lic. No. 028503
5/2/17
PROFESSIONAL ENGINEER

1	4" SCH40 Sewer Main with at least one cleanout on exterior of structure and cleanouts every 50' to 60' (Min Fall: 1.24" per 10')
2	1000 Gallon Concrete (Top Seam) or Approved Plastic Septic Tank with Access Risers on Inlet and Outlet Sides and Orenco Biotube Effluent Filter on Outlet Side.
3	Advantex AX-RT Treatment/Recirculation Tank a. Expand Treatment Unit Discharge Pipe to 4"SCH40 Gravity Line b. Install 4" SCH40 Sample Port to Surface between treatment tank & pump tank
N	1" SCH40 N-Recirculation Line from AX-RT tank to septic tank inlet side riser
4	1000 Gallon Concrete (Top Seam) or Approved Plastic Pump Tank with Access Riser on Outlet Side of Tank (over pump)
5	Force Main: 2" SCH40 installed below frost line.
6	a. Expand 2" SCH40 force main to 4" SCH40 pipe 5-10' prior to distrib box b. Header Lines: 4" SCH40 or 4"SDR35 (Fall: 2" per 100' min)
7	Measure 11' Centers on Far Side of drainfield to ensure 11'+ Centers are maintained throughout drainfeild.
8	a. Old Septic Tank: Disconnect from structure, pump out solids and liquid, collapse and/or remove and fill hole with non-settling material. b. Old Drainfield: Collapse old distrib box and abandon old drainfield in place
9	Pump and Haul Tank: Disconnect from structure, pump out solids and liquid, collapse and/or remove and fill hole with non-settling material.

4 x 95's
20" Deep
36" Wide
11' Centers
On Contour



	Distance (feet)	Azimuth (degrees)
AB	76	141
BC	46	67
CD	50	50
DE	63	320
EF	59	237
FA	36	256.5
GB	90	36
HD	65	329
JD	57	218.5
KD	158	316.5

Water Softerner should not discharge to the sewage treatment & disposal system.

This system must be installed by a DPOR Licensed Alternative Onsite Sewage System Installer.

Notes:
1. DO NOT install during wet, icy or snowy weather.
2. Identify all buried utilities prior to any excavation.
3. Read all plans and specifications carefully.
4. Follow installation procedures detailed in treatment unit installation manuals.
5. This drainfield should not be installed unless the plans and specifications have a signed authorization letter or signed permit from the Health Department.
6. Treatment Tank, Septic Tank and Drainfield should be located 10'+ from house or any structure without basement, 10'+ from downhill side of walkout basement, 20'+ from full basement or sides or uphill of walkout basement.
7. No system component substitutions without approval from the project engineer.
8. A pre-construction conference is required with project engineer prior to installation.
9. Drainfield corners marked with pink flags.
10. If drainfield corner flags are missing, project engineer must re-flag prior to any installation.
11. Drainfield area should be seeded, strawed and fertilized immediately after backfilling, covering and grading.

Burleson Engineering, PLLC
1374 Big Spring Drive
Lexington, Virginia 24450
540-464-9242

Rockbridge County TM: 113-8-6A

100'
50'
0

1/5

CKR17

Glenwood-Pedlar Ranger Office
400 GPD Drainfield
w/Advantex AX-RT
Site Plan

General Notes:
1. All components of this system should be 5'+ from any property line.
2. Contact Miss Utility 48 hours before any excavation.
3. Do Not install during wet, icy or snowy weather.
4. Any questions regarding location and/or layout of drainfield or components, or drainfield flags are missing, contact engineer, John Burleson, at 540-817-0350 prior to installation.
5. Trees should be removed from the installed drainfield area.
6. Trees with water loving roots (maples) should be removed to at least 10'+ from the installed drainfield area.
7. All sewage system components should be located 10'+ from house or any structure without basement, 10'+ from downhill side of walkout basement, 20'+ from full basement or sides or uphill of walkout basement.
8. Protect the drainfield area during any land disturbance and/or building construction.
9. The sewage disposal system is to be constructed as specified by the permit or attached plans and specifications. Failure to install sewage disposal system as specified may require reinstallation.
10. All construction materials and methods must conform to applicable local regulations and with Virginia Sewage Handling and Disposal Regs.
11. Concrete tanks should be installed on uniformly firm and stable compacted soil or undisturbed soil. Number 57 stone recommended to provide uniform support to tank bottom. If rock is encountered in bottom of tank hole, at least 6" of number 57 stone is required and should be graded and leveled before tanks are set.
12. Backfill tanks and piping with suitable loose material that is free of large or damaging objects.
13. Compact soil in lifts around tanks to reduce settling.
14. Drainfield should be seeded, strawed and fertilized immediately after backfilling and final grading.
15. Ensure that the final grade sheds water away from the drainfield area. Stormwater from gutters, etc. should be diverted away from the drainfield area and the septic/treatment/pump tanks.
16. If the drainfield is not marked, flags are missing or can't be located using the construction drawing, Do Not Begin installation on any part of the system. Contact engineer, John Burleson, at 540-817-0350 or 540-464-9242. Failure to contact the engineer and installing the drainfield in the incorrect location, incorrect depth, etc. may result in inspection rejection and may require reinstallation.
17. Sewage disposal system requires inspection. Contact, engineer, John Burleson at 540-817-0350 or 540-464-9242 a minimum of 48 hours in advance to arranged for inspection.
18. Unless specifically authorized by engineer, the system should not be covered until the engineer has inspected and approved the installation.
19. NO EQUIPMENT SUBSTITUTIONS ALLOWED, unless authorized by project engineer.
20. Before installing, contractor should have a copy of the signed Health Department Approval Letter with Health Dept ID#, and PE Plans and Specs.
21. Sewer main: 4" SCH40, fall: 1.25" per 10' minimum.
22. Gravity Lines: 4" SCH40 or SDR35, fall: 6" per 100' minimum.
23. Unless noted differently, all piping and fittings should be SCH40 PVC and designed for pressure applications.

COMMONWEALTH OF VIRGINIA
JOHN T. BURLESON
Lic. No. 028503
5/2/17
PROFESSIONAL ENGINEER

TOP SEAM TANKS REQUIRED

Treatment Unit/Septic Tank Notes:
1. Treatment Unit: Advantex AX-RT.
2. Tank: 800 Gallon, Recirculation/Processing Tank from Approved Manufacturer (see Advantex AX20RT Plan Sheet).
3. Advantex Rep: Reed Johnson, 757-645-8662.
4. Contractor must be a officially trained Advantex installer.
5. Follow Advantex installation manual and specification sheets provided with equipment for installation details.
6. Control Panel: Vericom AXB PT (if phone service does not exist at property, appropriate Orenco non-Vericom panel may be substituted.)
7. Septic Tank: 1000 Gallon, Top Seam, Orenco Approved Tank.
8. Effluent Filter: Orenco Biotube.

Drainfield Notes:
1. Drainfield: 4 x 95's x 3', 11' Centers, 20" deep.
2. Distribution Box: 12+ Port, Concrete or Approved Plastic
3. Gravel: 0.5 to 1.5 inches, clean.
4. Gravelless: Do Not use Chamber Type gravelless system.
5. Authorized Peanut Style or pipe bundle type gravelless systems may be used for this drainfield.
6. NO GRAVELLESS REDUCTION MAY BE TAKEN.

Pump Tank Notes:
1. 1000 Gallon Concrete (TOP SEAM) or Approved Plastic Tank.
2. Pump: Goulds, WE10H.
3. Follow pump manufacturers installation procedures.
4. NO PUMP SUBSTITUTIONS without approval of engineer.
5. Pump control panel should have the following min characteristics.
   a. Pump must have an audiovisual alarm in an area where it will be easily seen or heard.
   b. Highwater alarm must have electrical circuitry separate from the pump circuitry.
   c. All electrical connections must be hard wired.
   d. Pump station should have controls for automatically starting and stopping the pump based on water level and include a manual overide switch.

Orenco Tank Testing Requirement
(Processing, Pump and Septic Tanks)

Tank Testing Specification:
Concrete tanks may be allowed 24 hours to absorb water prior to hydrostatic testing. All tanks shall be tested in the field by filling the tank with water to 2 (two) inches into the riser for a minimum of 2 hours. Any drop in water level indicates leakage. The tank may be drained and the installer and tank manufacturer may make one attempt to repair the tank to make the tank watertight. The tank shall be retested according to the procedure specified above. If the tank leaks during the retest, it shall be removed from the site and replaced with a struturally sound watertight tank at no cost to the homeowner.

Burleson Engineering, PLLC
1374 Big Spring Drive
Lexington, Virginia 24450
540-464-9242

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CKR17

Glenwood-Pedlar Ranger Office
400 GPD Drainfield
w/Advantex AX-RT
Project Notes

TOP SEAM TANKS REQUIRED

Risers on Inlet and Outlet Sides

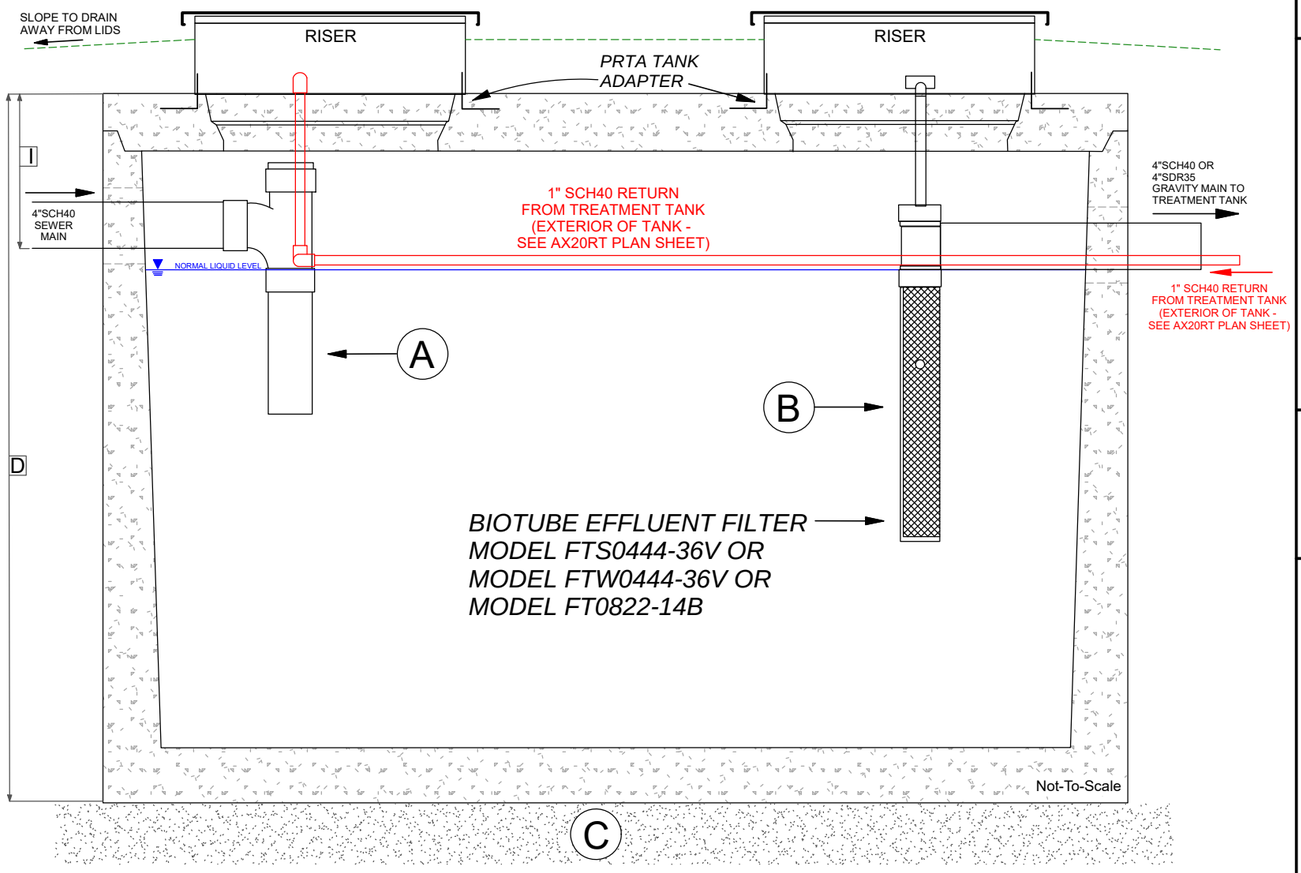
Orenco Septic Tank requirement. *Note: Only discharge tanks from the manufacturers listed below shall be used.*			
Discharge Tank Manufacturer	Tank Size	I	D
Orenco Fiberglass Tank	1000 Gal.	11"	65"
Wrights Ready Mix	1000 Gal.	15"	65"
Beasley Concrete	1000 Gal.	16"	66"
C.T. Jamison	1000 Gal.	14"	65"
Hanover Precast	1000 Gal.	16"	66.5"
Rockingham Precast	1000 Gal.	14"	65"

NOTE: ALL TANKS SHALL BE TESTED FOR WATERTIGHTNESS. ALL CONCRETE TANKS SHALL HAVE PRTA24 CAST INTO TANK FOR ACCEPTANCE OF MODEL RR24CC RISER.

ORENCO RISER
ORENCO MODEL RR24XX
24" PVC RISER WITH
MODEL FL24G-4BU-ATX
24" GASKETED FIBERGLASS
LID WITH S.S.BOLTS.

ALL CONCRETE TANKS SHALL HAVE PRTA24 TANK ADAPTER CAST INTO TANK FOR ACCEPTANCE OF RR24XX RISER.

A. SCH40 sanitary tee on the inlet pipe. Inlet Tee should extend 6" to 8" below and 8" to 10" above the normal liquid level.
B. Biotube Effluent Filter.
C. Concrete tanks should be installed on uniformly firm and stable compacted soil or undisturbed soil. 6" (minimum) of Number 57 stone required to provide uniform support to tank bottom. Stone base should be graded and leveled before tank is set.



1 1000 Gallon Septic Tank (TOP SEAM)

COMMONWEALTH OF VIRGINIA
JOHN T. BURLESON
Lic. No. 028503
5/2/17
PROFESSIONAL ENGINEER

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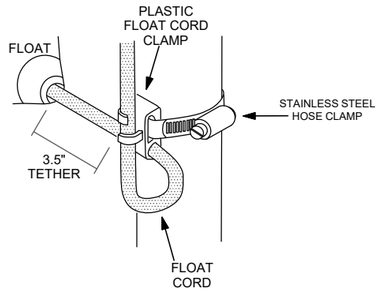
CKR17

Glenwood-Pedlar Ranger Office
400 GPD Drainfield
Septic Tank



1. Place the cord into the plastic clamp as shown.
2. Locate clamp at activation level shown on pump tank schematic.
3. Do not install cord under steel hose clamp.
4. Tighten hose clamp using screwdriver. Over tightening may result in damage to plastic clamp.
5. All hose clamp components should be made of 18-8 stainless steel material.
6. Follow all installation and safety procedures provided with manufacturers instructions.

2 Float Tree Assembly (Typical)

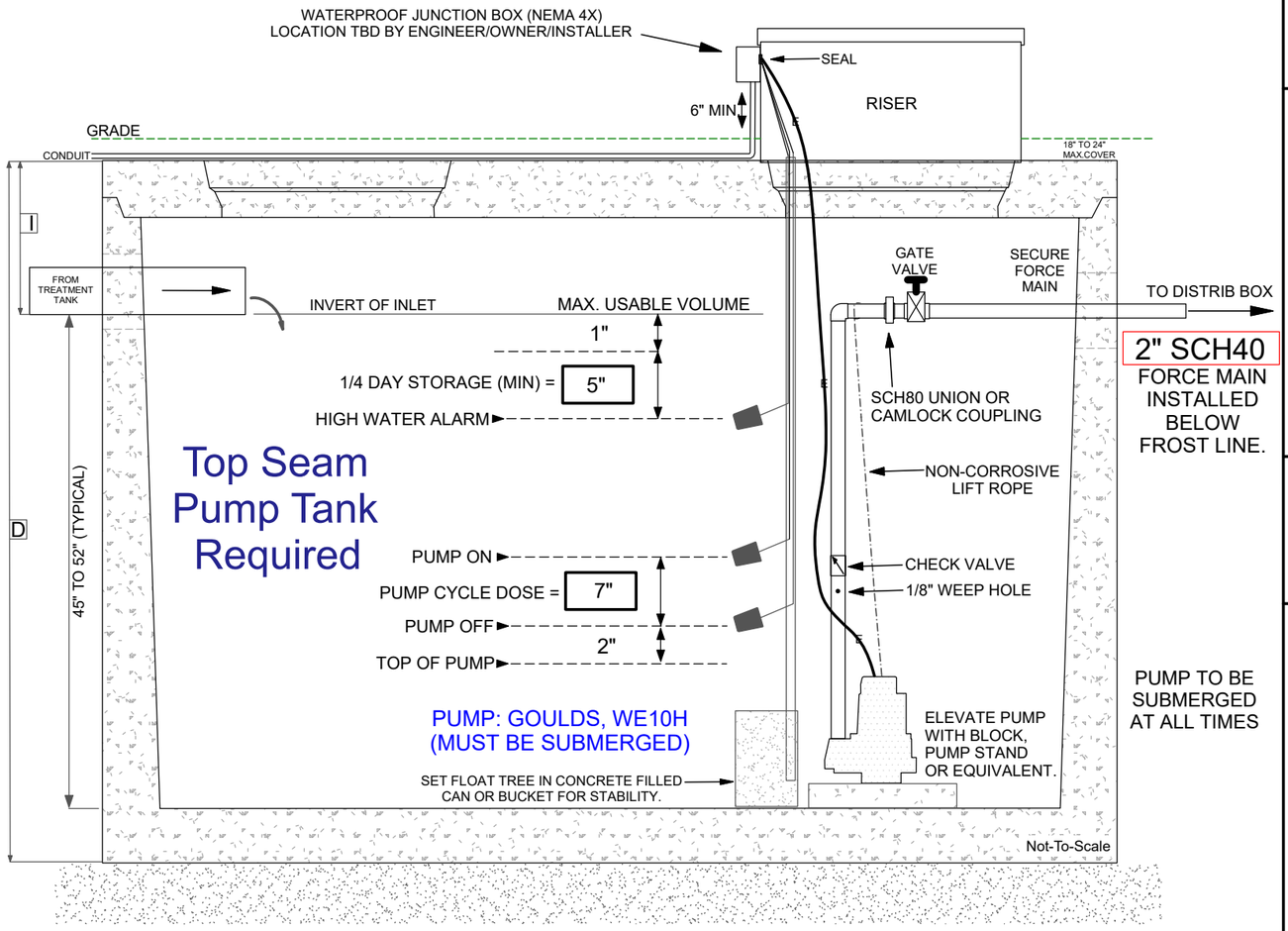
Min Flow TDH	49 feet at	20.9 GPM
Operating Point TDH	57 feet at	36 GPM
Pump	Goulds WE10H	
Pump Chamber Size	1000 Gallons	
Gallons per Cycle	140 Gallons	
Drawdown per Cycle	7 Inches	
Pump Cycle Time	3:54 m:s at	36 GPM

ORENCO RISER
ORENCO MODEL RR24XX
24" PVC RISER WITH
MODEL FL24G-4BU-ATX
24" GASKETED FIBERGLASS
LID WITH S.S.BOLTS.

ALL CONCRETE TANKS SHALL HAVE PRTA24 TANK ADAPTER CAST INTO TANK FOR ACCEPTANCE OF RR24XX RISER.

Orenco Discharge (Pump) Tank requirement.
Note: Only discharge tanks from the manufacturers listed below shall be used.

Discharge Tank Manufacturer	Tank Size	I	D
Orenco Fiberglass Tank	1000 Gal.	11"	65"
Wrights Ready Mix	1000 Gal.	15"	65"
Beasley Concrete	1000 Gal.	16"	66"
C.T. Jamison	1000 Gal.	14"	65"
Hanover Precast	1000 Gal.	16"	66.5"
Rockingham Precast	1000 Gal.	14"	65"



1 1000 Gallon Pump Tank (TOP SEAM)

Notes:
1. The pump station must be provided with controls for automatically starting and stopping the pump based on water level.
2. The electrical motor control center and master disconnect switch shall be placed in a secure location and above grade.
3. Each motor control center shall be provided with a manual override switch.
4. A high water alarm with remote sensing and electrical circuitry separate from the motor control center circuitry shall be provided.
5. The alarm shall be audiovisual and shall alarm in an area where it may be easily monitored.
6. All electrical connections shall be hardwired in the electrical junction box.
7. All piping shall be of the pressure type with pressure fittings that are chemically fused.
8. Do not use any compression fittings. Use glue or screw fittings only.
9. Contact Engineer prior to substituting pump.
10. Pump chamber must be level and watertight.
11. Use an approved pump chamber only.
12. Concrete tanks should be installed on uniformly firm and stable compacted soil or undisturbed soil. 6" of Number 57 stone (minimum) required to provide uniform support to tank bottom. Stone base should be graded and leveled before tank is set.

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CKR17

Glenwood-Pedlar Ranger Office
400 GPD Drainfield
Pump Tank

Seeding/Mulching

a. All areas disturbed by construction shall be stabilized with permanent seeding immediately following final/finish grading. Seeding should be pursuant to Virginia Erosion and Sediment Control Manual, Table 3.32-C for specific areas/requirements or the following general mixture.

Seed	Application Rate (#/acre)
Kentucky 31 Fescue	128
Red Top Grass	2
Seasonal Nurse Crop March-May:Annual Rye May-August: Foxtail Millet August-October: Annual Rye November-February: Winter Rye	20

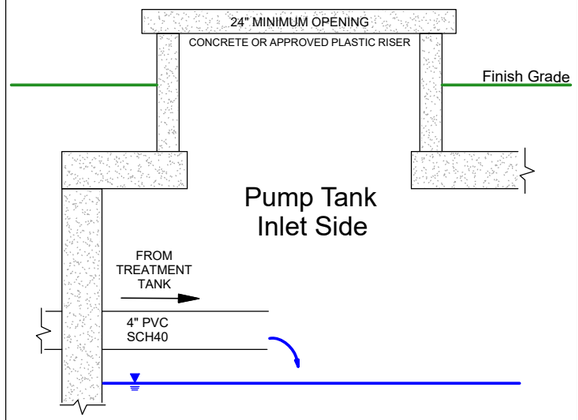
b. Lime and Fertilizer should be applied pursuant to guidance in the VESC manual, specification 3.32 for Piedmont and Appalachian Region;

1.) Lime: 2 tons/acre pulverized agricultural grade limestone (90#/1000SF)
2.) Fertilizer: 1000#/acre 10-20-10 or equivalent nutrients (23#/1000SF)

c. Straw mulch should be used on relatively flat surfaces and applied after seeding has occurred. Straw should be applied to provide at a rate of 1.5 to 2 tons per acre (70-90#/1000SF or 1.5 to 2 square bales per 1000SF). In all seeding operations, seed, fertilizer and lime will be applied prior to mulching. Seeding and/or strawing, may have to be repeated to establish appropriate temporary and permanent vegetation.

5 Seeding/Mulching

Notes:
1. The purpose of the sample port is to collect free flowing treated effluent.
2. Extend 4"SCH40 gravity line from treatment tank to under the access hole on the inlet side of the pump tank.
3. Install Access Riser (Concrete or Approved Plastic) to surface on the inlet side of the pump tank.
4. With this option there will be two access risers on the pump tank: one on the inlet side and one on the outlet side.

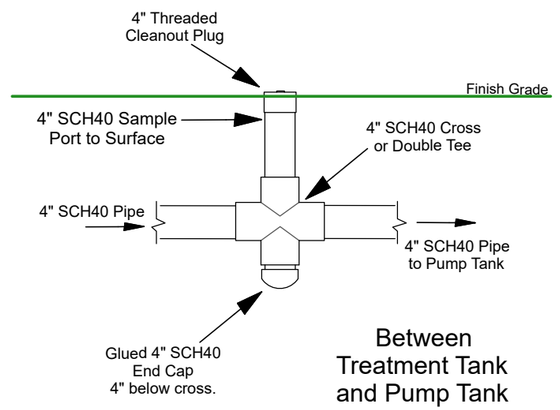


4 Sample Port - Option 2

Not-To-Scale

or

Notes:
1. The purpose of the sample port is to collect free flowing treated effluent.
2. Gravity lines should be 4" SCH40 or 4" SDR35 pipe (min. fall: 6" per 100').
3. Install 4" SCH40 sample port to surface between treatment tank and pump tank.



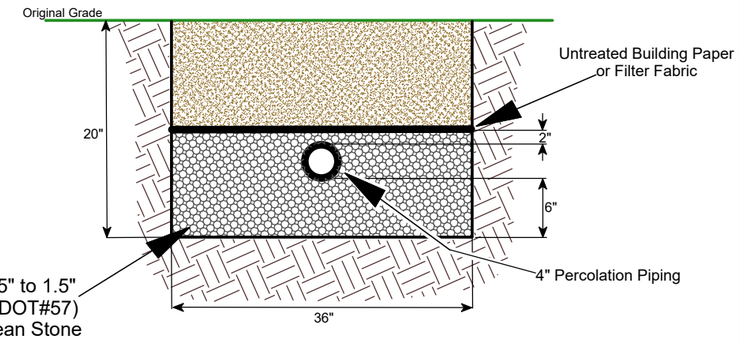
3 Sample Port - Option 1

Not-To-Scale

NO GRAVELLESS SYSTEM LINE OR AREA REDUCTIONS ALLOWED.

Authorized "peanut style" or "pipe bundle" Gravelless Systems may be substituted for gravel.

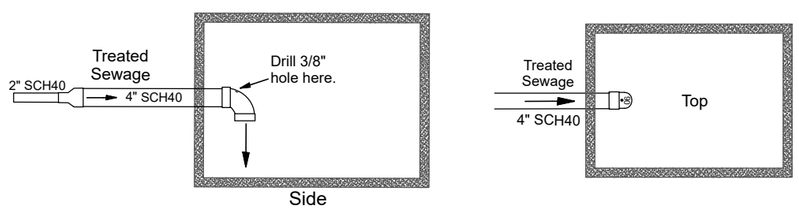
DO NOT USE "CHAMBER TYPE" GRAVELLESS DRAINFIELD SYSTEMS.



1 Trench Cross Section with Gravel

Not-To-Scale

1. Pipe entering box should have 90 ell forcing flow to bottom of box(es).
2. Use Speed Levelers to balance flow in box.
3. Header Lines should be 4" SCH40 or 4" SDR35 pipe.
4. Header Line Fall: 2" per 100' Min.
5. Expand 2" SCH40 force main to 4" SCH40 five to ten feet prior to the distribution box to ensure tight fit into box port.



Header Lines Not Shown.

2 12+ Port Distribution Box

Not-To-Scale

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Glenwood-Pedlar Ranger Office
400 GPD Drainfield
Trench, Distrib. Box
and Sample Port

GOULDS PUMPS

Submersible Effluent Pump

MODEL 3885

WE Series

PROSURANCE AVAILABLE FOR RESIDENTIAL APPLICATIONS.

APPLICATIONS

Specifically designed for the following uses:

- Homes
- Farms
- Trailer courts
- Motels
- Schools
- Hospitals
- Industry
- Effluent systems

SPECIFICATIONS

Pump

- Solids handling capabilities: ¾" maximum.
- Discharge size: 2" NPT.
- Capacities: up to 140 GPM.
- Total heads: up to 128 feet TDH.
- Temperature: 104°F (40°C) continuous 140°F (60°C) intermittent.
- See order numbers on reverse side for specific HP, voltage, phase and RPM's available.

FEATURES

■ **Impeller:** Cast iron, semi-open, non-clog with pump-out vanes for mechanical seal protection. Balanced for smooth operation. Silicon bronze impeller available as an option.

■ **Casing:** Cast iron volute type for maximum efficiency. 2" NPT discharge.

■ **Mechanical Seal: SILICON CARBIDE VS. SILICON CARBIDE** sealing faces. Stainless steel metal parts, BUNA-N elastomers.

■ **Shaft:** Corrosion-resistant, stainless steel. Threaded design. Locknut on all models to guard against component damage on accidental reverse rotation.

■ **Fasteners:** 300 series stainless steel.

■ Capable of running dry without damage to components.

■ Designed for continuous operation when fully submerged.

MOTORS

■ Fully submerged in high-grade turbine oil for lubrication and efficient heat transfer.

■ Class B insulation on ⅓-1½ HP models.

■ Class F insulation on 2 HP models.

Single phase (60 Hz):

- Capacitor start motors for maximum starting torque.
- Built-in overload with automatic reset.
- SJTOW or STOW severe duty oil and water resistant power cords.
- ⅓ and ½ HP models have NEMA three prong grounding plugs.
- ¾ HP and larger units have bare lead cord ends.

Three phase (60 Hz):

- Class 10 overload protection must be provided in separately ordered starter unit.
- STOW power cords all have bare lead cord ends.

■ **Designed for Continuous Operation:** Pump ratings are within the motor manufacturer's recommended working limits, can be operated continuously without damage when fully submerged.

■ **Bearings:** Upper and lower heavy duty ball bearing construction.

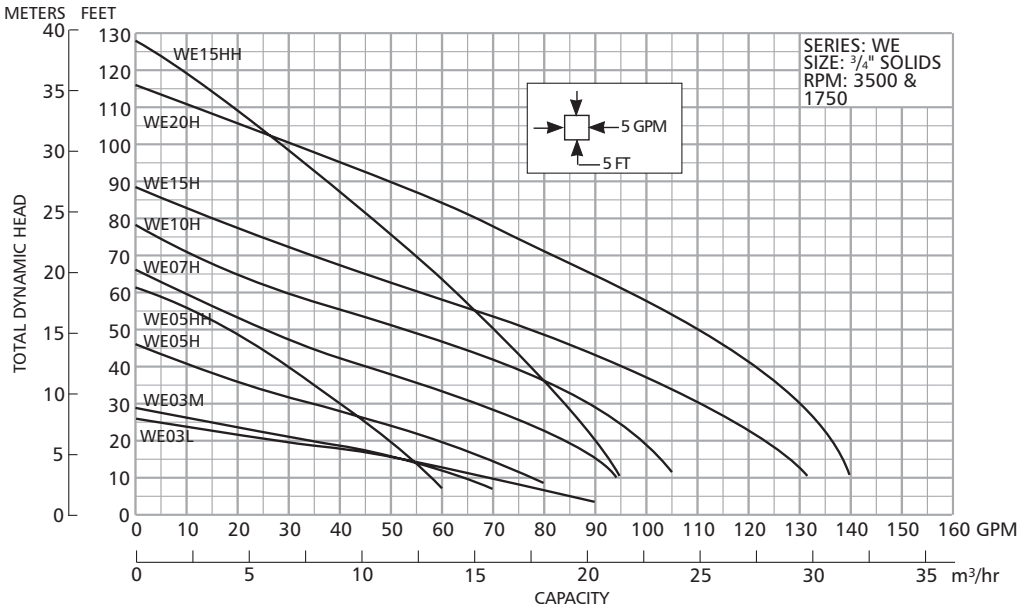
■ **Power Cable:** Severe duty rated, oil and water resistant. Epoxy seal on motor end provides secondary moisture barrier in case of outer jacket damage and to prevent oil wicking. Standard cord is 20'. Optional lengths are available.

■ **O-ring:** Assures positive sealing against contaminants and oil leakage.

AGENCY LISTINGS

Tested to UL 778 and CSA 22.2 108 Standards By Canadian Standards Association File #LR38549

Goulds Pumps is ISO 9001 Registered.



Goulds Pumps

ITT Industries

Effective July, 2003
B3885

GOULDS PUMPS

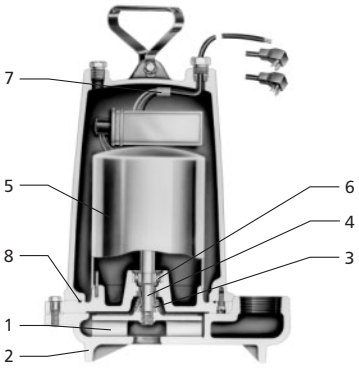
Submersible Effluent Pump

MODEL 3885

WE Series

COMPONENTS

Item No.	Description
1	Impeller
2	Casing
3	Mechanical Seal
4	Motor Shaft
5	Motor
6	Ball Bearings
7	Power Cable
8	Casing O-Ring



MODELS

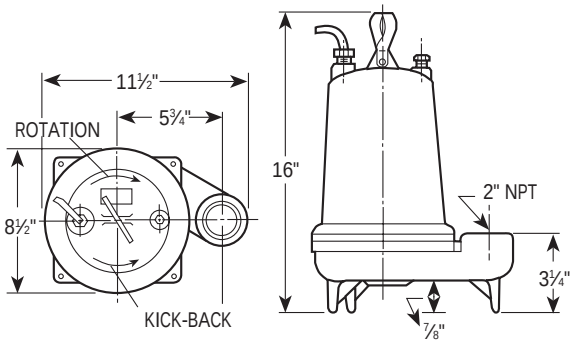
Order No.	HP	Volts	Phase	Max. Amp.	RPM	Solids	Wt. (lbs.)
WE0311L	⅓	115	1	10.7	1750	¾"	56
WE0318L		208		6.8			
WE0312L		230		4.9			
WE0311M		115		10.7			
WE0318M		208		6.8			
WE0312M		230		4.9			
WE0511H	½	115	1	14.5	3500		60
WE0518H		208		8.1			
WE0512H		230		7.3			
WE0538H		200	3	4.9			
WE0532H		230		3.3			
WE0534H		460		1.7			
WE0537H		575		1.4			
WE0511HH		115	1	14.5			
WE0518HH		208		8.1			
WE0512HH		230		7.3			
WE0538HH		200	3	4.9			
WE0532HH		230		3.6			
WE0534HH		460		1.8			
WE0537HH		575		1.5			
WE0718H	¾	208	1	11.0			70
WE0712H		230		10.0			
WE0738H		200	3	6.2			
WE0732H		230		5.4			
WE0734H		460		2.7			
WE0737H		575		2.2			
WE1018H	1	208	1	14.0			
WE1012H		230		12.5			
WE1038H		200	3	8.1			
WE1032H		230		7.0			
WE1034H		460		3.5			
WE1037H		575		2.8			
WE1518H	1½	208	1	17.5			80
WE1512H		230		15.7			
WE1538H		200	3	10.6			
WE1532H		230		9.2			
WE1534H		460		4.6			
WE1537H		575		3.7			
WE1518HH		208	1	17.5			
WE1512HH		230		15.7			
WE1538HH		200	3	10.6			
WE1532HH		230		9.2			
WE1534HH		460		4.6			
WE1537HH		575		3.7			
WE2012H	2	230	1	18.0			83
WE2038H		200	3	12.0			
WE2032H		230		11.6			
WE2034H		460		5.8			
WE2037H		575		4.7			

PERFORMANCE RATINGS (gallons per minute)

Order No.		WE03L	WE03M	WE05H	WE07H	WE10H	WE15H	WE05HH	WE15HH	WE20H
Total Head Feet of Water	HP	⅓	⅓	½	¾	1	1½	½	1½	2
	RPM	1750	1750	3500	3500	3500	3500	3500	3500	3500
	5	86	–	–	–	–	–	–	–	–
	10	70	63	78	–	–	–	58	–	–
	15	52	50	70	90	–	–	53	–	–
	20	27	35	60	83	98	123	49	90	136
	25	–	–	48	76	94	117	45	87	133
	30	–	–	35	67	88	110	40	83	130
	35	–	–	20	57	82	103	35	80	126
	40	–	–	–	45	74	95	30	77	121
	45	–	–	–	35	64	86	25	74	116
	50	–	–	–	25	53	77	–	70	110
	55	–	–	–	–	40	67	–	66	103
	60	–	–	–	–	30	56	–	63	96
	65	–	–	–	–	20	45	–	58	89
	70	–	–	–	–	–	35	–	55	81
	75	–	–	–	–	–	25	–	51	74
	80	–	–	–	–	–	–	–	47	66
	90	–	–	–	–	–	–	–	37	49
	100	–	–	–	–	–	–	–	28	30

DIMENSIONS

(All dimensions are in inches. Do not use for construction purposes.)



AX20RT Treatment System - Gravity Discharge

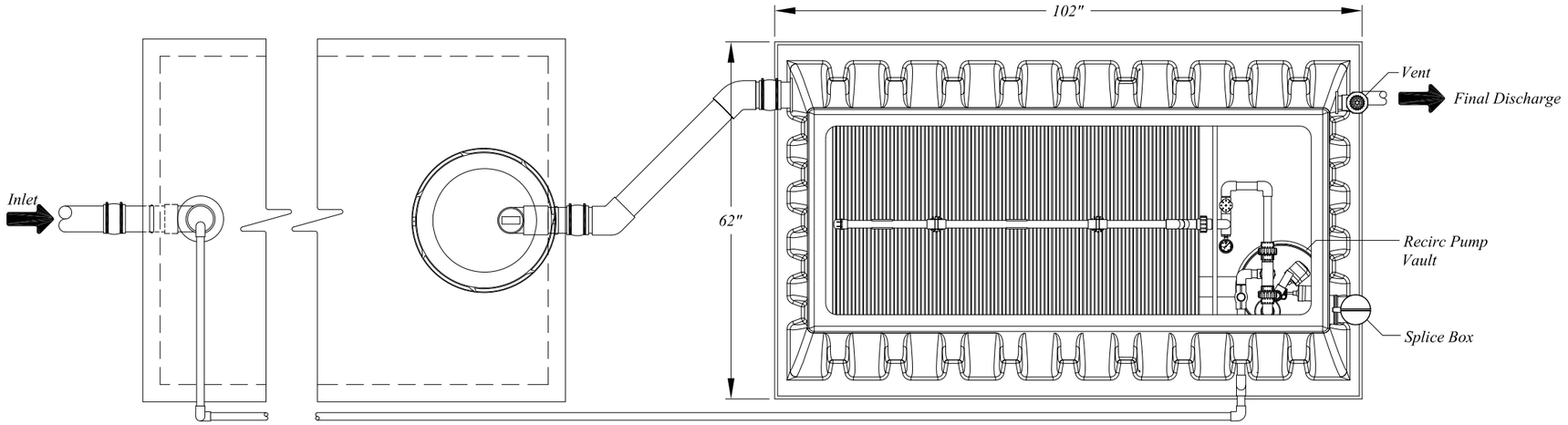
Filter Tank Dry Weight: 860 lbs

Design Notes

For residential strength waste up to 4 bedrooms.

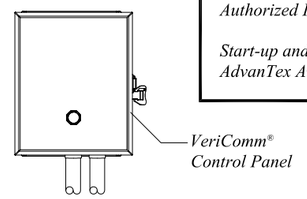
Installation to be performed by an AdvanTex Authorized Installer only.

Start-up and service to be performed by an AdvanTex Authorized Service Provider only.

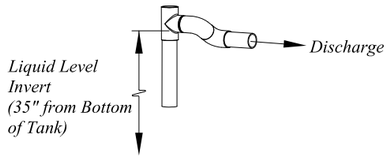


1000 gal. Primary Tank - Top View

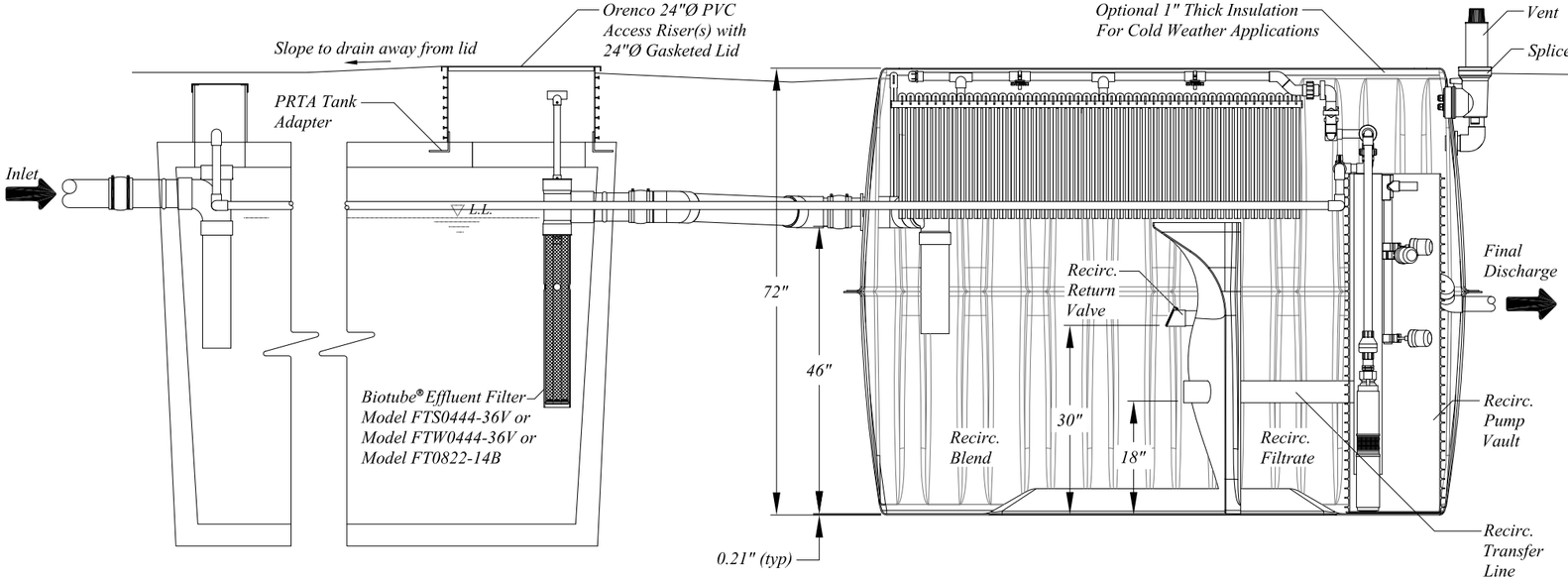
AX20 800 gal. Recirc. Tank - Top View



Control Panel Detail
Not To Scale

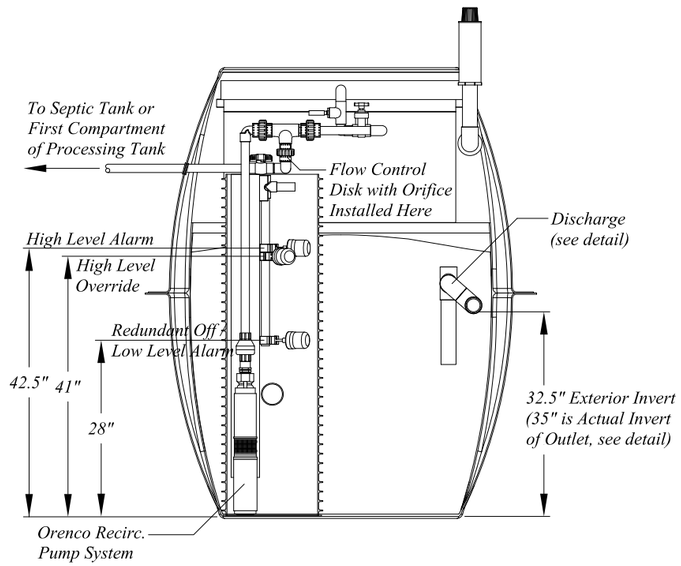


Discharge Detail
Not To Scale



1000 gal. Primary Tank - Side View

AX20 800 gal. Recirc. Tank - Side View



Discharge Chamber - End View

PRODUCT CONFIGURATION DRAWINGS

Orenco Systems® Incorporated
Changing the Way the World Does Wastewater®

Drawn By: BEN SMITH	Project: AX20RT Mode 3A	Scale: 1" = 2'-0"	
Drawn For:		Sheet: 1 OF 1	
	Title: NDW-ATX-RT-STD-08	Rev: A-05	Date: 4/22/2013