PROJECT MANUAL
for
LULLWATER AT LANGLEY APARTMENTS
West Columbia, South Carolina

February 18, 2022

OWNER
Fickling & Company, Inc.
577 Mulberry Street
Suite 1100
Macon, Georgia 31201
478-746-9421

ARCHITECT
SGN+A, Inc.
315 West Ponce de Leon Avenue
Suite 755
Decatur, Georgia 30030
404-373-7370
South Carolina License No.: 7943

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LULLWATER AT LANGLEY APARTMENTS
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DIVISION NO. **TITLE**

DIVISION 33 **UTILITIES**
(See Note 3)

Note 1: Interior Design is provided through a separate agreement between the Interior Designer and the Owner and is not part of the Architect prepared work. Interior Design Drawings and Specifications are prepared and issued by the Interior Designer.

Note 2: Swimming Pool Design is provided through a separate agreement between the Swimming Pool Designer and the Owner and is not part of the Architect prepared work. Swimming Pool Drawings and Specifications are prepared and issued by the Swimming Pool Designer.

Note 3: Civil Engineering Design is provided through a separate agreement between the Civil Engineer and the Owner and is not part of the Architect prepared work. Civil Engineering Drawings and Specifications are prepared and issued by the Civil Engineer.

Note 4: See Landscape Architectural Drawings for additional landscape specifications and requirements.

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DOCUMENT 00 01 00
PROJECT DIRECTORY

Owner/Developer:
Joint Venture between
Fickling & Company, Inc.
and Novare Group
577 Mulberry Street
Suite 1100
Macon, Georgia 31201
Phone: 478-746-9421
Fax: 478-742-2015

Contact: Todd Andersen
E-mail: TAndersen@novaregroup.com

Contact: Bobby Cleveland
E-mail: bcleveland@fickling.com

General Contractor:
Great Southern, LLC.
2009 Springhill Drive
Valdosta, Georgia 31602
Phone: 229-506-6876
Fax: 229-506-6879

Contact: Frank Perullo

Architect:
SGN+A, Inc.
315 West Ponce de Leon Avenue
Suite 755
Decatur, Georgia 30030
Phone: 404-373-7370
Fax: 404-373-7372

Contact: Jim Moran
E-mail: jmoran@sgnplusa.com

Landscape Architect:
SGN+A, Inc.
315 West Ponce de Leon Avenue
Suite 755
Decatur, Georgia 30030
Phone: 404-373-7370
Fax: 404-373-7372

Contact: Brian Nonemaker
E-mail: bnonemaker@sgnplusa.com

Structural Engineer:
Davis & Church, LLC
1400 Union Hill Road
Alpharetta, Georgia 30005
Phone: 770-642-1213
Fax: 770-752-8891

Contact: Matt Church
E-mail: mchurch@davis-church.com

Mechanical, Electrical, and Plumbing Engineer:

Jordan and Skala Engineers, Inc.
4275 Shackleford Road
Suite 200
Norcross, Georgia 30093
Phone: 770-447-5547
Fax: 770-448-0262

Contact: Regina Young
E-mail: ryoung@jordanskala.com

Direct Consultants to the Owner:

Civil Engineer:

Cox and Dinkins
724 Beltline Blvd.
Columbia, SC 29205
Phone: 803-254-0518

Contact: Laura Baker
E-mail: lbaker@coxanddinkins.com

Interior Designer:

Design Environments, Inc.
3025 Chastain Meadows Parkway
Suite 200
Marietta, Georgia 30066
Phone: 770-429-3200
Fax: 770-429-3201

Contact: Terri Reel
E-mail: treel@designenvironments.com

END OF DOCUMENT 00 01 10

DOCUMENT 00 70 00
GENERAL CONDITIONS

"The General Conditions of the Contract for Construction", AIA Document A201, 2007 Edition, Articles 1 through 15, pages 1 through 41, of the American Institute of Architects, is hereby made a part of these documents to the same extent as herein written out in full, except as specifically amended by the Owner/Contractor Agreement and/or Supplementary Conditions issued by the Owner.

END OF DOCUMENT 00 70 00

DOCUMENT 00 80 00
SUPPLEMENTARY CONDITIONS

Supplements to modify "The General Conditions of the Contract for Construction", AIA Document A201, 2007 Edition, will be issued by the Owner prior to execution of the Contract for Construction. Where a portion of the General Conditions is modified or deleted by the Supplementary Conditions, the unaltered provisions of the General Conditions shall remain in effect.

END OF DOCUMENT 00 80 00

SECTION 01 10 00
SCOPE OF THE WORK

PART 1 GENERAL

1.01 SUMMARY

A. The Project, Lullwater at Blair Stone Apartments, of which the Work of the Contract is a part, is composed of 244 residential units in 13 buildings. Also included are a clubhouse/leasing building along with miscellaneous amenity structures, such as a carwash/maintenance building, mail kiosks, and all associated site improvements.

B. Related Work: The work of other contracts is described in various contract documents, some of which are in the possession of the Owner and are available for inspection by interested parties.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 28 00
CHANGE ORDER PROCEDURE

PART 1 GENERAL

1.01 SUMMARY

A. Make such changes in the Work, in the Contract Sum, in the Contract Time of Completion, or any combination thereof, as described in the Change Orders signed by the Owner and the Contractor.

1.02 PROCESSING CHANGE ORDERS

A. Change orders will be numbered in sequence and dated. The change order will describe the changes, changes in the Contract Sum, changes in the Contract Time of Completion and will be signed by the Owner and the Contractor. Request for estimates for possible changes are not to be considered Change Orders or direction to proceed with the proposed changes.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 37 00
SCHEDULE OF VALUES

PART 1 GENERAL

1.01 SUMMARY

A. Unless stipulated in the Construction Agreement, provide a detailed breakdown of the agreed Contract Sum showing values allocated to each of the various parts of the Work, as specified herein and in other provisions of the Contract Documents.

1.02 SUBMITTALS

A. Prior to the first application for payment, submit a proposed schedule of values to the Owner.

1.03 QUALITY ASSURANCE

A. When so required by the Owner, provide copies of the subcontracts or other data acceptable to the Owner substantiating the sums described.

PART 2 PRODUCTS - NOT USED

PART3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 41 00
TESTING LABORATORY SERVICES

PART 1 GENERAL

1.01 SUMMARY

A. The Owner shall employ and pay for services of an independent testing laboratory to perform specified services and testing.

B. Related Requirements: Inspections and testing required by laws, ordinances, rules regulations, orders and/or approvals of public authorities.

1.02 QUALITY ASSURANCE

A. Testing Laboratory Qualifications:
   1. Meet “Recommended Requirements for Independent Laboratory Qualification” published by American Council of Independent Laboratories.
   2. Meet basic requirements of ASTM E329, “Recommended Practice for Inspection and Testing Agencies for Concrete, Steel, and Bituminous Materials as Used in Construction”.
   3. Authorized to operate in State of Florida.
   4. Calibrate testing equipment at reasonable intervals by devices of accuracy traceable to either:
      a. National Bureau of Standards.
      b. Accepted values of natural physical constants.

1.03 RESPONSIBILITES

A. Contractor:
   1. Cooperate with Testing Laboratory personnel and provide access to the work.
   2. Secure and store adequate quantities of representative samples of materials requiring testing, in conformance with laboratory requirements.
   3. Provide Testing Laboratory design mixes for concrete and other material mixes requiring control by laboratory.
   4. Furnish copies of product test reports.
   5. Furnish incidental labor and facilities as follows:
      a. To provide access to the work to tested.
      b. To obtain and handle samples at project site or at source of product to be tested.
      c. To facilitate inspections and tests.
      d. For storage and curing of test samples.
   6. Notify Testing Laboratory sufficiently in advance of operations to allow laboratory assignment of personnel and scheduling of tests.

B. Testing Laboratory:
   1. Cooperate with Architect and Contractor and provide qualified personnel after due notice.
   2. Perform necessary inspections, sampling, and testing of materials and methods of construction
      a. Comply with specified standards.
      b. Ascertain compliance of materials with requirements of Contract Documents.
   3. Promptly notify Architect and Contractor in writing of observed irregularities or deficiencies of work or products.

4. Promptly submit copies of written report of each test and inspection to Architect and Contractor. Include in each report the following:
    a. Date issued.
    b. Project name and address.
    c. Testing Laboratory name, address and telephone number.
    d. Name and signature of laboratory inspector.
    e. Date and time of sampling or inspection.
    f. Record of temperature and weather conditions.
    g. Date of testing.
    h. Identification of product and specification section.
    i. Location of sample or test in project.
    j. Type of inspection or test.
    k. Results of tests and compliance with Contract Documents.
    l. Interpretation of test results, when requested by the Architect.
5. Perform additional tests required by the Owner, Architect or government agencies.
6. Limitations: Testing Laboratory is not authorized to:
    a. Release, revoke alter, or enlarge on requirements of Contract Documents.
    b. Approve or accept any portion of the work.
    c. Perform duties of the Contractor.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 45 00
CUTTING AND PATCHING

PART 1 GENERAL

1.01 SUMMARY

A. This Section establishes general requirements pertaining to cutting, fitting, and patching of the Work that is required to:
   1. Make the parts fit properly;
   2. Uncover work to provide for installing and/or inspecting ill-timed work;
   3. Remove and replace work that does not conform to the Contract requirements; and
   4. Remove and replace defective work.

B. Related Work: Do not cut or alter work performed under separate contracts without the Owner's written permission.

1.02 SUBMITTALS

A. Request for Owner's consent: Prior to cutting or patching which effects structural safety, or are in any way differs from the Contract Documents obtain the Owner's written permission in the form of a Change Order before proceeding with the work.

1.03 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced and who are completely familiar with the specified requirements and methods needed for proper performance of the Work of this Section.

PART 2 PRODUCTS

2.01 MATERIALS

A. For replacement of items removed, use materials complying with pertinent Sections of these Specifications.

2.02 PAYMENT FOR COSTS

A. The Owner will reimburse the Contractor for cutting and patching performed pursuant to a written Change Order and in accordance with the payment schedule shown in the Change Order. Perform other cutting and patching needed to comply with the Contract Documents at no additional cost to the Owner.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions which are detrimental to the timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected

3.02 PREPARATION PRIOR TO CUTTING

A. Provide required protection including, but not limited to, shoring, bracing and support to maintain structural integrity of the Work.

3.03 PERFORMANCE

A. Perform cutting and demolition by methods which will prevent damage to other portions of the Work and provide proper surfaces to receive installation of repair and new work.

B. Perform fitting and adjusting of products to provide finished installation complying with the

END OF SECTION

SECTION 01 50 00
TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 SUMMARY

A. This Section describes construction facilities and temporary controls required for the Work.

B. Permanent installation and hookup of the various utility lines are described in other Sections.

1.02 SANITATION AND TEMPORARY TOILETS

A. Toilet facilities shall be provided by at the project site by the Contractor for use by those engaged in the work. Each Contractor and/or Subcontractor shall introduce and enforce among his employees such regulations in regard to cleanliness and the disposal of garbage and wastes and shall comply with all local ordinances. Additionally, the Contractor shall take such means as the Architect my direct to effectively prevent the creation of a nuisance on the work or on any part of the project site.

1.03 TEMPORARY OFFICES AND STORAGE

A. Temporary Offices: The Contractor shall provide at an approved location on the project site a temporary office structure of ample size for his use. Allow space within the office for the Owner's representatives. Temporary offices shall be complete with furnishings, water, light, and heat.

B. Temporary Storage: The Contractor shall provide storage sheds, waterproofed as required, to protect his materials, tools, and equipment, as well as Owner purchased materials.

C. Remove all temporary structures upon completion of the work.

1.04 TEMPORARY TELEPHONE SERVICE

A. The Contractor will provide a telephone on the job during his operations for his own use and the use of all Subcontractors engaged in the work. Toll charges will be paid by persons making long distance calls.

1.05 WIRING FOR TEMPORARY POWER AND LIGHTS

A. The Electrical Subcontractor shall install a temporary service and distribution center on a pole set in a convenient location at the project site, from which he shall run all necessary circuits for temporary power and lights. Temporary power and lights shall be GFI protected. Coordinate service with local utility.

B. All attachment lines for the use of the other crafts and connections to the sheds and offices of other Subcontractors will be furnished and installed by the individual Subcontractor at his own expense. Power for temporary lighting shall be paid for by the Contractor. All light bulbs shall be furnished, installed, and replaced by the Electrical Subcontractor.

C. Any Contractor or Subcontractor requiring special power service (such as 120/208, three phase or four wire, 240 or 440 volt, three phase three wire) shall pay all construction cost tariffs involved in the provision of such service and shall have such temporary service

1.06 TEMPORARY HEAT

A. Until the buildings are enclosed, each Subcontractor shall provide temporary heat as required to protect the work included under his contract. After the buildings are suitably enclosed, the Contractor shall provide suitable temporary heat as required to protect the structure and for prosecution of the work at all trades.

1.07 TEMPORARY WATER

A. The Contractor shall provide temporary water suitable for work by all trades. Water shall be potable.

PART 2 PRODUCTS

2.01 TEMPORARY FACILITIES

A. Provide such temporary sheds, sanitary facilities, enclosures, barricades, canopies, and fencing as are required for the safe and proper completion of the Work.

PART 3 EXECUTION

3.01 MAINTENANCE AND REMOVAL

A. Maintain temporary facilities and controls as long as needed for safe and proper completion of the Work.

B. Remove such temporary facilities and controls as rapidly as progress of the Work will permit, or as directed by the Owner.

END OF SECTION

SECTION 01 54 50
CONTRACTOR'S USE OF THE PREMISES

PART 1 GENERAL

1.01 SUMMARY

A. This Section applies to all situations in which the Contractor or his representatives, including suppliers, subcontractors and employees, enter upon the Owner's property.

1.02 QUALITY ASSURANCE

A. Promptly upon award of the Contract, notify all pertinent personnel regarding requirements of this Section.

1.03 TRANSPORTATION FACILITIES

A. Truck and equipment access:
   1. To avoid traffic conflict with vehicles of the Owner and to avoid overloading of streets and driveways elsewhere on or near the Owner's property, limit the access of trucks and equipment to the route specified by the Owner.
   2. Provide adequate protection for curbs and sidewalks over which trucks and equipment pass to reach the job site.

B. Contractor's vehicles:
   1. Require Contractor's vehicles, vehicles belonging to employees of the Contractor and all other vehicles entering upon the Owner's property in performance of the Work of the Contract to use only the access route specified by the Owner.
   2. Do not permit such vehicles to park on any street or other area of the Owner's property except in the parking area specified by the Owner.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 62 00
STORAGE AND PROTECTION

PART 1 GENERAL

1.01 SUMMARY

A. Protect products scheduled for use in the Work by means as described in this Section.

1.02 MANUFACTURERS' RECOMMENDATIONS

A. Except as otherwise approved by the Owner, determine and comply with manufacturers' instructions on product handling, storage and protection.

1.03 PACKAGING

A. Deliver products to the job site in their manufacturer's original container, with the labels intact and legible.
   1. Maintain packaged materials with seals unbroken and labels intact until time of use.
   2. Promptly remove damaged material and unsuitable items from the job site, and promptly replace with material meeting the specified requirements at no additional cost to the Owner.

B. The Owner may reject as non-complying such material and products that do not bear identification satisfactory to the Owner as to the manufacturer, grade, quality and other pertinent information.

1.04 PROTECTION

A. Protect finished surfaces, including jambs and soffits of openings used as passageways, through which equipment and materials are handled.

B. Provide protection for finished floor surfaces in traffic areas prior to allowing equipment and materials to be moved over such surfaces.

C. Maintain finished surfaces clean, unmarred and suitably protected until accepted by the Owner.

1.05 REPAIRS AND REPLACEMENTS

A. In event of damage, promptly make replacements and repairs to the approval of the Owner and at no additional cost to the Owner.

B. Additional time required to secure replacements and to make repairs will not be considered by the Owner to justify an extension of the Contract Time of Completion.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 63 00
PRODUCT OPTIONS AND SUBSTITUTIONS

PART 1 GENERAL

1.01 SUMMARY

A. This Section describes procedures for securing approval of proposed product substitutions.

1.02 REQUIREMENTS

A. The Contractor is advised that the Contract for construction is based on the materials, equipment, and methods described in the Contract Documents. The Architect and Owner will consider proposals for substitutions for a limited period of five (5) working days after the Notice to Proceed provided that such proposals are submitted in accordance with the stipulations outlined herein.

B. Proposals for substitutions will be considered only if said proposals increase the quality of the project, decrease the expenditure on the part of the Owner without reducing the quality, or are clearly superior to the products, materials, equipment, and methods specified herein. Proposals for substitutions which appear to be submitted only to decrease the expenditures on the part of the Contractor without a corresponding proposal for a reduction in the contract amount will not be considered. No substitutions will be accepted after the initial period for submittals of such substitutions.

C. If a substitution is proposed resulting from availability problems with the specified materials, proposals should also include consideration for modifications to the contract amount on behalf of the Owner. No request for an extension of time will be considered by the Architect or the Owner if such an extension is the result of the Contractor's lack of knowledge of the availability of the specified items.

D. As a minimum, in order to be considered, all substitution requests shall address the following issues:
   1. List the specified product to be substituted.
   2. Provide complete manufacturer's product information for both the originally specified item product as well as the proposed substitution product.
   3. If the product is equal or superior to that specified, explain in detail the advantages as well as any disadvantages.
   4. List the credit, if any, proposed to the Owner for acceptance of the substitution.
   5. Substitution requests shall be made using the Substitution Request Form.

E. All proposed substitutions shall be submitted for approval using the attached Substitution Request Form.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

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SUBSTITUTION REQUEST FORM

To: _____

Project: _____

We hereby submit for your consideration the following product instead of the specified item for this project:

Section	Paragraph	Originally Specified Item
_____	_____	_____

Attach complete technical data for the originally specified item, including laboratory tests if applicable.

Proposed Substitution: _____

Attach complete technical data for the proposed substitution item, including laboratory tests if applicable.

Submit complete information, including changes to the drawings and/or specifications which the proposed substitution requires for proper installation.

Fill in blanks below – use additional sheets if necessary:

A. Is the substitution product equal or superior to the product originally specified? Yes ___ No ___
Explain advantages and/or disadvantages:

_____

_____

_____

B. What is the proposed reduction in the Contract Amount? $ _____

C. Is the specified product no longer available? Yes ___ No ___

The undersigned states that the function, appearance and quality of the substitution product are equivalent or superior to the specified item.

Submitted By:

_____
Signature

Firm: _____

Address: _____

For Use by the Architect:

___ Accepted ___ Accepted as Noted

___ Not Accepted ___ Received Too Late

By: _____

Date: _____

_____ Remarks: _____

Phone: _____ _____

SECTION 01 70 00
CONTRACT CLOSEOUT

PART 1 GENERAL

1.01 SUMMARY

A. This Section includes administrative and procedural requirements for contract closeout, including, but not limited to the following:
   1. Inspection procedures.
   2. Warranties.
   3. Final cleaning.

B. Related Sections include the following:
   1. General and Supplementary Conditions for the general procedures for the project.
   2. Section 01 71 00 - Cleaning for progress cleaning of the project site.
   3. Section 01 72 00 - Project Record Documents for submitting record documents, record specifications and record product data.
   4. Section 01 73 00 - Operation and Maintenance Data for operation and maintenance requirements.
   5. Division 2 through 33 sections for specific closeout and special cleaning requirements for the work in those sections.

1.02 SUBSTANTIAL COMPLETION

A. Preliminary Procedures: Before requesting inspection for determining the date of Substantial Completion, complete the following:
   1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the work is incomplete.
   2. Advise Owner of pending insurance changeover requirements.
   3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
   4. Obtain and submit releases permitting Owner unrestricted use of the work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
   5. Deliver tools, spare parts, extra materials, and similar items to a location designated by the Owner. Label with manufacturer's name and model number where applicable.
   6. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
   7. Complete startup testing of systems.
   8. Submit test/adjust/balance records.
   9. Terminate and remove temporary facilities from project site, along with mock-ups, construction tools, and similar elements.
   10. Advise Owner of changeover in heat and other utilities.
   11. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
   12. Complete final cleaning requirements, including touch-up painting.
   13. Touch-up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

B. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, the Architect will either proceed with a visit to the site to observe the progress of the work or notify the Contractor of unfulfilled requirements. The Architect will prepare the Certificate of Substantial Completion after the observation of the work or will notify the

Contractor of items, either on the Contractor's list or additional items identified by the Architect, which must be completed or corrected before the certificate is issued.

1. Re-inspection: Request re-inspection when the work identified in previous inspections as incomplete is completed or corrected.

2. Results of completed inspection will form the basis of requirements for Final Completion.

1.03 FINAL COMPLETION

A. Preliminary Procedures: Before requesting final inspection for determining the date of Final Completion, complete the following:
   1. Submit a final Application for Payment.
   2. Submit a certified copy of Architect's Substantial Completion observation list of items to be completed or corrected (punch list), endorsed and dated by the Architect. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
   3. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
   4. Prepare and submit project record documents, operation and maintenance manuals, final completion photographs, damage or settlement surveys, property surveys, and similar final record information.
   5. Instruct Owner's personnel in the operation, adjustment, and maintenance of products, equipment, and systems.

B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, the Architect will either proceed with a visit to the site to observe the progress of the work or notify the Contractor of unfulfilled requirements. The Architect will execute a final Certificate for Payment after the observation of the work or will notify the Contractor of items which must be completed or corrected before the certificate is issued.
   1. Re-inspection: Request re-inspection when the work identified in previous inspections as incomplete is completed or corrected.

1.04 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Preparation: Submit three copies of the list. Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction, including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
   1. Organize list of spaces in sequential order.
   2. Organize items applying to each space by major element, including categories for ceilings, individual walls, floors, equipment, and building systems.
   3. Include the following information at the top of each page:
      a. Project name.
      b. Date.
      c. Name of Architect.
      d. Name of Contractor.
      e. Page number.

1.05 WARRANTIES

A. Submittal Time: Submit written warranties on request of the Architect for designated portions of the work where commencement of warranties other than the date of Substantial Completion is indicated.

B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the work that are completed and occupied or used by the Owner during the construction period by separate agreement with the Contractor.
C. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.

1. Bind warranties and bonds in heavy duty, 3-ring, vinyl covered, loose leaf binders, thickness as necessary to accommodate contents, and sized to receive 8 1/2" by 11" paper.
2. Provide heavy paper dividers with plastic covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address and telephone number of the installer.
3. Identify each binder on the front and spine with typed or printed title "warranties", project name, and the name of the Contractor.

D. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 PRODUCTS

2.01 MATERIALS

A. Use cleaning materials and agents as specified in Section 01 71 00 – Cleaning.

PART 3 EXECUTION

3.01 CLEANING

A. Provide final cleaning as specified in Section 01 71 00 – Cleaning.

3.02 PEST CONTROL

A. Engage an experienced, licensed exterminator to make a final inspection and rid the project of rodents, insects, and other pests. Prepare a report documenting this inspection.

END OF SECTION

SECTION 01 71 00
CLEANING

PART 1 GENERAL

1.01 SUMMARY

A. Related requirements as specified elsewhere:
   1. Supplementary Conditions – Section 00 80 00.
   2. Cleaning for specific products or work.
   3. Each specification section for the work.

B. All cleaning shall be the responsibility of the Contractor unless specifically noted otherwise.

C. Each subcontractor shall police and clean-up on a continuing basis, during his presence on the project, in all areas in which he is performing work and shall maintain premises and public properties free from accumulation of waste, debris and rubbish.

D. At the completion of the work, each subcontractor shall remove waste materials, rubbish, tools, equipment, machinery and surplus materials and clean all exposed surfaces. Leave project clean and ready for final cleaning.

PART 2 PRODUCTS

2.01 CLEANING MATERIALS

A. Use only cleaning materials recommended by a manufacturer or fabricator of the surface to be cleaned and use cleaning materials only on surfaces recommended by cleaning material manufacturer. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

A. Conduct cleaning and waste removal operations to comply with local laws and ordinances and Federal and local environmental and anti-pollution regulations.

B. Employ experienced workers or professional cleaners for cleaning operations. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer’s written instructions.

C. Comply with all applicable safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on the Owner’s property. Do no discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from project site and dispose of lawfully.

3.02 PROGRESS CLEANING

A. During construction, execute cleaning to ensure that the buildings, grounds and public properties are maintained free from accumulation of waste and rubbish.
   1. Wet down dry materials and rubbish to lay dust and prevent blowing dust.

2. At reasonable intervals during the progress of the work, clean site and public properties and dispose of waste materials, debris and rubbish.

3. Provide on-site containers for collection of waste materials, debris and rubbish.
4. Remove waste materials, debris and rubbish from the project site and legally dispose of it at a public or private dumping area off the Owner's property.
5. Handle materials in a controlled manner with as few handlings as possible. Do not drop or throw materials from heights.
6. Schedule cleaning operations so that dust and other contaminants resulting from the cleaning process will not fall on wet, newly painted surfaces.
7. Subcontractors not removing construction related waste materials or unused building materials in a timely fashion will be charged for the cost of their removal and will be responsible for replacement of building materials as needed for the project.

3.03 FINAL CLEANING

A. Complete the following cleaning operations before requesting inspection for certification of Substantial and Final Completion for the entire project or a designated portion of the project:
   1. Clean project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
   2. Sweep paved areas broom clean. Remove petrochemical spills, stains and other foreign deposits.
   3. Rake grounds that are neither planted nor paved to a smooth, even textured surface.
   4. Remove tools, construction equipment, machinery, and surplus material from the project site.
   5. Remove snow and ice to provide safe access to all buildings, if applicable.
   6. Clean exposed exterior and interior hard surfaced finishes to a dirt free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
   7. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
   8. Sweep concrete floors broom clean.
   9. Vacuum carpet and similar soft surfaces, removing debris and excess nap. Shampoo if visible soil or stains remain.
   10. Clean transparent materials, including mirrors and glass in windows and doors. Remove glazing compounds and other noticeable, vision obscuring materials. Replace chipped or broken glass and mirrors. Polish mirrors and glass, taking care not to scratch surfaces,
   11. Remove labels that are not permanent.
   12. Touch-up and otherwise repair marred exposed surfaces and finishes. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
   13. Wipe surfaces of mechanical and electrical equipment ant other similar equipment. Remove excess lubrication, paint, mortar droppings, and other foreign substances. Do not paint over UL or other similar labels, including mechanical or electrical name plates.
   14. Replace parts subject to unusual operating conditions.
   15. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
   16. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grilles.
   17. Clean ducts, blowers, and coils if units are operated without filters during construction.
   18. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned out bulbs and those noticeably dimmed by hours of use. Replace noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
   19. Maintain cleaning until project or designated portion thereof is occupied by Owner.

PART 1 GENERAL

1.01 SUMMARY

A. This Section includes administrative and procedural requirements for project record documents, including the following:
   1. Record drawings.
   2. Record specifications.
   3. Record product data.

B. Related Sections include the following:
   1. General and Supplementary Conditions for the general procedures for the project.
   2. Section 01 70 00 - Contract Closeout for submitting operation and maintenance manuals.
   3. Section 01 73 00 - Operation and Maintenance Data for operation and maintenance manual requirements.
   4. Division 2 through 33 sections for specific operations and maintenance manual requirements for the work in those sections.

1.02 SUBMITTALS

A. Record Drawings: Submit two sets of marked-up record prints.

B. Record Specifications: Submit two copies of project specifications, including addenda and contract modifications.

C. Record Product Data: Submit two copies of each product data submittal.
   1. Where record product data is required as part of operation and maintenance manuals, submit marked-up product data as an insert in manual instead of submittal as record product data.

PART 2 PRODUCTS

2.01 RECORD DRAWINGS

A. As-Built Set: Contractor shall maintain a set of an as-built set of plans and specifications, recording all construction changes and modifications.
   1. Preparation: Mark record prints to show actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is the installer, subcontractor, or similar entity, to prepare the marked-up record prints.
      a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
      b. Accurately record information in an understandable drawing technique.
      c. Record data as soon as possible after obtaining it. Record and check the mark-up before enclosing concealed installations.
   2. Content: Types of items requiring marking include, but are not limited to, the following:
      a. Dimensional changes to drawings.
      b. Revisions to details shown on the drawings.
      c. Depths of foundations below first floor.
      d. Location and depths of underground utilities.
      e. Revisions to routing of piping and conduits.

f. Revisions to electrical circuitry.
g. Actual equipment locations.
h. Duct size and routing.
i. Locations of concealed internal utilities.
j. Changes made by change order or construction change directive.
k. Changes made following Architect's written instructions.
l. Details not on the original contract drawings.
m. Field reports for variable and concealed conditions.
n. Record information on the work that is shown only schematically.

3. Mark the contract drawings or shop drawings, whichever is most capable of showing actual physical conditions, completely and accurately. If shop drawings are marked, show cross reference on the contract drawings.
4. Mark record sets with erasable red colored pencil. Use other colors to distinguish between changes for different categories of the work at same locations.
5. Mark important additional information that was either shown schematically or omitted from original drawings.
6. Note construction change directive numbers, alternate numbers, change order numbers, and similar identification, where applicable.

B. Record Reproducible Drawings: Immediately before inspection for Certificate of Substantial Completion, review mark-up record prints with Architect. When authorized, prepare a full set of corrected reproducibles of the contract drawings and shop drawings.
1. Incorporate changes and additional information previously marked on record prints. Erase, redraw and add details and notations where applicable.
2. Refer instances of uncertainty to the Architect for resolution.
3. Owner will furnish Contractor one set of reproducibles of the contract drawings for use in recording information.

C. Newly Prepared Record Drawings: Prepare new drawings instead of preparing record drawings where Architect determines that neither the original contract drawings nor shop drawings are suitable to show actual installation.
1. New drawings may be required when a change order is issued as a result of accepting an alternate, substitution, or other modification.
2. Consult Architect for proper scale and scope of detailing and notations required to record the actual physical installation and its relation to other construction. Integrate newly prepared record drawings into record drawing sets. Comply with procedures for formatting, organizing, copying, binding and submitting.

D. Format: Identify and date each record drawing. Include the designation "Project Record Drawing" in a prominent location.
1. Record Prints: Organize record prints and newly prepared record drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
2. Record Reproducibles: Organize into unbound sets matching record prints. Place reproducibles in durable tube type drawing containers with end caps. Marl end cap of each container with identification. If container does not include a complete set, identify drawings included.
3. Identification: Identify record drawings with the following information:
a. Project name.
b. Date.
c. Designation "Project Record Drawings".
d. Name of Architect.
e. Name of Contractor.

2.02 RECORD SPECIFICATIONS

A. Preparation: Mark specifications to indicate the actual product installation where installation varies from that indicated in specifications, addenda, and contract modifications.
   1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
   2. Mark copy with proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
   3. Record the name of manufacturer, supplier, installer, and other information necessary to provide a record of selections made.
   4. For each principal product, indicate whether record product data has been submitted in operation and maintenance manuals instead of submitted as record product data.
   5. Note related change orders, record product data, and record drawings where applicable.

2.03 RECORD PRODUCT DATA AND SHOP DRAWINGS

A. Preparation: Mark specifications to indicate the actual product installation where installation varies from that indicated in specifications, addenda, and contract modifications.
   1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
   2. Include significant changes in the product delivered to the project site and changes in manufacturer's written instructions for installation.
   3. Note related change orders, record product data, and record drawings where applicable.

B. Maintain one set of approved product data submittals and shop drawings.

2.04 MISCELLANEOUS RECORD SUBMITTALS

A. Assemble miscellaneous records required by other specification sections for miscellaneous record keeping and submittal in connection with actual performance of the work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

PART 3 EXECUTION

3.01 RECORDING AND MAINTENANCE

A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and modifications to project record documents as they occur. Do not wait until the end of the project.

B. Maintenance of Record Documents and Samples: Store record documents and samples in the field office apart from the contract documents used for construction. Do not use project record documents for construction purposes? Maintain record documents in good order in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Architect's reference during normal working hours.

END OF SECTION

SECTION 01 73 00
OPERATION AND MAINTENANCE DATA

PART 1 GENERAL

1.01 SUMMARY

A. This Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
   1. Operation and maintenance documentation directory.
   2. Operation for systems, sub-systems, and equipment.
   3. Maintenance manuals for the care and maintenance of products, materials, finishes, systems and equipment.

B. Related Sections include the following:
   1. General and Supplementary Conditions for the general procedures for the project.
   2. Section 01 70 00 - Contract Closeout for submitting operation and maintenance manuals.
   3. Section 01 72 00 - Project Record Documents for submitting record documents, record specifications and record product data.
   4. Division 2 through 33 sections for specific operations and maintenance manual requirements for the work in those sections.

1.02 DEFINITIONS

A. System: An organized collection of parts, equipment, or sub-systems united by regular interaction.

B. Sub-system: A portion of a system with characteristics similar to a system.

1.03 SUBMITTALS

A. Initial Submittal: Submit one draft copy of each manual at least 15 days before requesting inspection for Substantial Completion. Include a complete operation and maintenance directory. Architect will return one copy of draft and mark whether general scope and content of manual are acceptable.

B. Final Submittal: Submit one copy of each manual in final form at least 15 days before final inspection. Architect will return one copy with comments within 15 days after final inspection. Correct or modify each manual to comply with Architect's comments. Submit 3 copies of each corrected manual within 15 days of receipt of Architect's comments.

1.04 COORDINATION

A. Where operation and maintenance documentation includes information on installations by more than one factory authorized service representative, assemble and coordinate information furnished by representatives and prepare manuals.

PART 2 PRODUCTS

2.01 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

A. Organization: Include a section in the directory for each of the following:
   1. List of documents.
   2. List of systems.

3. List of equipment.
4. Table of contents.

B. List of Systems and Sub-systems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.

C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of a system, list alphabetically in a separate list.

D. Table of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, sub-system, and piece of equipment with the same designation used in the Contract Documents. If no designation exists, assign a designation according to ASRAE Guideline 4, “Preparation of Operating and Maintenance Documentation for Building Systems”.

2.02 MANUALS – GENERAL

A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and sub-system, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
1. Title page.
2. Table of contents.
3. Manual contents.

B. Title Page: Enclose title page in a transparent plastic sleeve. Include the following information:
1. Subject matter included in manual.
2. Name and address of project.
3. Name and address of Owner.
4. Date of submittal.
5. Name, address and telephone number of Contractor.
6. Name and address of Architect.
7. Cross reference to related systems in other operation and maintenance manual.

C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross referenced to specification section number in the Project Manual.
1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, sub-system, and equipment. If possible, assemble instructions for sub-systems, equipment, and components of one system into a single binder.
1. Binders: Heavy duty, 3-ring, vinyl covered, loose leaf binders, in thickness necessary to accommodate contents, sized to hold 8 ½” x 11” paper, with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
   a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by sub-system and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
   b. Identify each binder on front and spine, with printed title “Operation and Maintenance Manual”, project title or name, and subject matter of contents. Indicate volume number for multiple volume sets.

2. Dividers: Heavy paper dividers with plastic covered tabs for each section. Mark tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross referenced to the specification section number and title of Project Manual.
3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software diskettes for computerized electronic equipment.
4. Supplementary Text: Prepared on 8 ½" x 11" white bond paper.
5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
   a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
   b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.03 OPERATION MANUALS

A. Content: In addition to requirements in this section, include operation data required in individual specification sections and the following information:
   1. System, sub-system, and equipment descriptions.
   2. Performance and design criteria if Contractor is delegated design responsibility.
   3. Operating standards.
   4. Operating procedures.
   5. Operating logs.
   6. Wiring diagrams.
   7. Control diagrams.
   8. Piped system diagrams.
   9. Precautions against improper use.
   10. License requirements including inspection and renewal dates.

B. Descriptions: Include the following:
   1. Product name and model number.
   2. Manufacturer's name.
   3. Equipment identification with serial number of each component.
   4. Equipment function.
   5. Operating characteristics.
   6. Limiting conditions.
   7. Performance curves.
   8. Engineering data and tests.
   9. Complete nomenclature and number of replacement parts.

C. Operating Procedures: Include the following, as applicable:
   1. Start-up procedures.
   2. Equipment or system break-in procedures.
   3. Routine and normal operating instructions.
   4. Regulation and control procedures.
   5. Instructions on stopping.
   6. Normal shutdown instructions.
   7. Seasonal and weekend operating instructions.
   8. Required sequences for electric or electronic systems.
   9. Special operating instructions and procedures.

D. System and Equipment Controls: Describe the sequence of operation and diagram controls as installed.

E. Piped Systems: Diagram piping as installed and identify color coding where required for identification.

2.04 PRODUCT MAINTENANCE MANUAL

A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds as described below.

B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of installer or supplier and maintenance service agent, and cross reference specification section number and title in Project Manual.

C. Product Information: Include the following, as applicable:
   1. Product name and model number.
   2. Manufacture's name.
   3. Color, pattern and texture.
   4. Material and chemical composition.
   5. Recording information for specifically manufactured products.

D. Maintenance Procedures: Include manufacturer's written recommendations and the following:
   1. Inspection procedures.
   2. Types of cleaning agents to be used and methods of cleaning.
   3. List of cleaning agents and methods of cleaning detrimental to product.
   4. Schedule for routine cleaning and maintenance.
   5. Repair instructions.

E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
   1. Include procedures to follow and required notifications for warranty claims.

2.04 SYSTEMS AND EQUIPMENT MAINTENANCE MANUAL

A. Content: For each system, sub-system, and piece of equipment not part of a system, include source information, manufacturer's documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.

B. Source Information: List each system, sub-system, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of installer or supplier and maintenance service agent, and cross reference specification section number and title in Project Manual.

C. Manufacturer's Maintenance Documentation: Manufacturer's maintenance documentation including the following information for each component part or piece of equipment.
   1. Standard printed maintenance instructions and bulletins.
   2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement and assembly.
   3. Identification and nomenclature of parts and components.
   4. List of items recommended to be stocked as spare parts.

D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:

1. Test and inspection instructions.
2. Troubleshooting guide.
3. Precautions against improper maintenance.
4. Disassembly, component removal, repair and replacement, and reassembly instructions.
5. Aligning, adjusting and checking instructions.
6. Demonstration and training videotape, if available.

E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventative and routine maintenance and service with standard time allotment.
   1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semi-annual and annual frequencies.
   2. Maintenance and Service Record: Include manufacturer's forms for recording maintenance.

F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross referenced to manufacturer's maintenance documentation and local sources of maintenance materials and related services.

G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
   1. Include procedures to follow and required notifications for warranty claims.

PART 3 EXECUTION

3.01 MANUAL PREPARATION

A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to operation and maintenance manuals.

B. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated in the work.

C. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, sub-system, and piece of equipment not part of a system.
   1. Engage a factory authorized service representative to assemble and prepare information for each system, sub-system, and piece of equipment not part of a system.
   2. Prepare a separate manual for each system and sub-system, in the form of an instructional manual for use by the Owner's operating personnel.

D. Manufacturer's Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the work. If data includes more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the work and delete references to information not applicable.
   1. Prepare supplementary text if manufacturers' standard printed data is not available and where information is necessary for proper operation and maintenance of equipment or systems.

E. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record drawings to ensure correct illustration of the completed installation.
   1. Do not use original record documents as part of the operation and maintenance manuals.
   2. Comply with requirements of newly prepared record drawings in Section 01 72 00 - Project Record Documents.

F. Comply with Section 01 70 00 - Contract Closeout for schedule for submitting operation and maintenance manuals.

END OF SECTION

SECTION 02 32 00
GEOTECHNICAL INVESTIGATION

PART 1 GENERAL

1.01 SUMMARY

A. General: This section provides information resulting from subsurface investigations completed at the project site. This section contains information applicable to all sitework and other technical specifications. The Contractor is expected to review this information as part of their duty to familiarize themselves with the site. Results of the geotechnical investigation apply only to the locations where data was collected. Geotechnical conditions may differ elsewhere on the site.

B. Related Documents: Subsurface investigation titled Due Diligence Geotechnical Engineering Report, West Columbia Multi-Family Development, Project No. 73205167, dated February 18, 2021, prepared by Terracon GeoReport., attached herewith.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

Due Diligence Geotechnical Engineering Report

West Columbia Multi-Family Development
West Columbia, SC
February 18, 2021
Terracon Project No. 73205167

Prepared for:
Fickling & Company
Macon, GA

Prepared by:
Terracon Consultants, Inc.
Columbia, SC

February 18, 2021

Fickling & Company
577 Mulberry Street, Suite 1100
Macon, GA 31201

Attn: Mr. Ross Rabun, Director of Multi-Family Development
P: (478) 741 2576
E: rrabun@fickling.com

Re: Due Diligence Geotechnical Engineering Report
West Columbia Multi-Family Development
Henbet Drive
West Columbia, SC
Terracon Project No. 73205167

Dear Mr. Rabun:

We have completed the Due Diligence Geotechnical Engineering services for the above referenced project. This study was performed in general accordance with Terracon Proposal No. P73205167 dated December 15, 2020, as authorized on December 18, 2020. This report presents the findings of the subsurface exploration and provides preliminary geotechnical recommendations concerning earthwork, foundations and the seismic site class.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report or if we may be of further service, please contact us.

Sincerely,
Terracon Consultants, Inc.

Ali Soleimanbeigi, P.E.
Senior Staff Engineer
SC Registration No. 38635

Phillip A. Morrison, P.E.
Geotechnical Department Manager
SC Registration No. 17275

REPORT TOPICS

Note: This report was originally delivered in a web-based format. **Orange Bold** text in the report indicates a referenced section heading. The PDF version also includes hyperlinks which direct the reader to that section and clicking on the ***GeoReport*** logo will bring you back to this page. For more interactive features, please view your project online at client.terracon.com.

ATTACHMENTS

Note: Refer to each individual Attachment for a listing of contents.

REPORT SUMMARY

Topic [1]	Overview Statement [2]
Project Description	Given the preliminary nature of the project, little information is available regarding the proposed development. We understand that the site will be developed as an apartment complex, including multi-family buildings with parking areas and drives.
Geotechnical Characterization	The site soils consist of low to medium consistency clayey/silty sands underlain by low to medium consistency sandy elastic silts with isolated areas of surficial sandy fat clay to the 30-foot maximum depth of exploration. Very loose to loose clayey/silty sands to depth of 3 feet bgs were encountered in many areas of the site. As the site was a former farm and these locations are consistent with the former agricultural fields, the conditions may be plough zone material and could be present on a wide scale basis. Groundwater was typically observed at depths between 5 feet and 15 feet below the ground surface (bgs) during exploration. Very shallow conditions were encountered along the east side (lowest side elevations), ranging from ½ to 4 feet bgs.
Earthwork	Based on the widely spaced borings, we anticipate earthwork practices to be generally limited to recompaction of the subgrade soil to address disturbed areas associated with stump removal/root raking and demolition/removal of existing development in the central and west portions of the site. Very loose to loose soil conditions are present in many areas of the site. These soils will not be stable under a proofrolling load and subgrade repairs will be needed. The level of repair will be highly dependent of the grading scheme. Presuming these soils are not removed by the general earthwork activities, repairs may range from exposing the soil and allowing it to dry and then recompacting it in place to undercutting and replacing it with compacted structural fill. The noted sandy fat clay will require strict moisture conditioning/control to reach the optimum moisture during compaction and maintain it until additional fill is placed. The excavated clayey/silty sands can be used as structural fill if dried to within the range of structural fill. Based on the collected data, groundwater may affect the mass earthwork and excavation in the lower elevation areas. Depending on the depth, groundwater may also influence excavations on a wider scale across the site.
Shallow Foundations	Based on the widely based borings, the soil conditions are generally compatible with supporting low-rise buildings on shallow foundations.
Seismic Site Class	Based on the IBC building code and our geophysical data, a seismic site class of C can be used for the design.

Topic [1]	Overview Statement [2]
General Comments	This section contains important information about the limitations of this geotechnical engineering report.

1. If the reader is reviewing this report as a pdf, the topics above can be used to access the appropriate section of the report by simply clicking on the topic itself.
2. This summary is for convenience only. It should be used in conjunction with the entire report for design purposes.

Due Diligence Geotechnical Engineering Report

West Columbia Multi-Family Development

Henbet Drive

West Columbia, SC

Terracon Project No. 73205167

February 18, 2021

INTRODUCTION

This report presents the results of our subsurface exploration and geotechnical engineering services performed for the proposed multi-family apartment complex to be located on the east side of Henbet Drive in West Columbia, SC. The purpose of these services is to provide geotechnical data from the site and develop preliminary geotechnical engineering recommendations for project planning relative to:

- subsurface soil conditions
- earthwork
- floor slabs
- groundwater conditions
- foundations
- seismic considerations

The geotechnical engineering scope of services for this project included the advancement of fifteen test borings to depths ranging from approximately 15 to 20 feet below existing site grades (bgs) and geophysical testing to develop the shear wave velocity profile. Maps showing the site and boring locations are shown in the **Site Location** and **Exploration Plan**, respectively. The results of the laboratory testing performed on soil samples obtained from the site during the field exploration are included on the boring logs and as separate graphs in the **Exploration Results** section.

SITE CONDITIONS

The following description of site conditions is derived from our site visit in association with the field exploration and our review of publicly available geologic and topographic maps.

Item	Description
Parcel Information	The 38.67±-acre project site is located on the north side of Sunset Boulevard (US 378) between Interstates 20 and 26 in West Columbia, SC. It is further bound on the west side by Henbet Drive and Quail Lane on the east side. For additional location information see **Site Location**.
Existing Improvements	During our site visit, we observed a residence at the center of the site as well as an abandoned barn and a cabin. An asphalt driveway connects the central

Item	Description
	residence to the Sunset Boulevard. The asphalt driveway changes to gravel towards a residence on the east side. There is a series of three ponds along the north side of the site and another at the southeast site corner. Based on the topography on the Lexington County GIS system, the ponds are expected to be 10 to 15 feet deep. Based on historical information, the site has largely been farmlands/woodlands since early 1900's. The earlier noted residence was constructed in 1970. Most of the site, as well as the surrounding properties were farmland from the early 1900's to about the late 1980's when the area began to be subdivided for residential development.
Current Ground Cover	The site is primarily vegetated with trees (both deciduous and evergreen) across the majority of the site.
Existing Topography	The topographic information available on the Lexington County GIS system indicates the site grades slope downward toward the north and east toward the existing ponds. The elevations range from 344 feet amsl near the intersection of Sunset Boulevard and Henbet Drive to 300 feet to the east and 280 feet to the northeast.
Geology	The site is located in the Piedmont physiographic province of South Carolina, just north of the Fall-Line, (the transition from the Coastal Plain to the Piedmont province). The in-place chemical and mechanical weathering of the parent sedimentary and metamorphic rock forms the soils present in this region. Depending on the parent rock, a common soil profile includes a surficial clayey or silty layer transitioning to coarser material at depth. The underlying Piedmont physiographic province consists of soils generated by the in-place chemical and mechanical weathering of the parent sedimentary and metamorphic rock. A common soil profile includes a surficial clayey or silty layer transitioning to coarser material at depth. Generally dividing the soil layer from the bedrock is a very dense layer referred to as "partially weathered rock". Partially weathered rock is composed of irregular zones of very dense soil and rock. Partially weathered rock exhibits standard penetration test values of 100 blows per foot (bpf) or more. The topography of the underlying bedrock surface and the thickness of the various soil and weathered rock strata vary greatly in short, horizontal distances because of variation in mineralogy of the material, previous and present groundwater conditions, and past tectonic activity (faulting, folding, intrusions, etc.). Further, the presence of boulders and rock pinnacles is possible within the soil matrix. Fill soils are those soils that have been placed or reworked in conjunction with past construction grading or farming. Fill can be composed of different soil types from various sources and can contain debris from building demolition, organics, topsoil, trash, etc. The engineering properties of the fill depend primarily on its composition, density, and moisture content.

PROJECT DESCRIPTION

Our initial understanding of the project was provided in our proposal and was discussed during project planning. A period of collaboration has transpired since the project was initiated, and our final understanding of the project conditions is as follows:

Item	Description
Information Provided	Package - 3216 Sunset Blvd. (38.67 Acres) Layout #2
Project Description	We understand that the site will be developed as a multi-family living complex, essentially a series of apartment buildings with parking areas and drives. We assume the buildings are: ■ 4,000 to 6,000 square feet ■ Three to four stories high ■ Wood framing ■ Concrete slab-on-grade ■ Asphalt driveways We understand that no layout of the actual site is available due to the preliminary nature of the project.
Finished Floor Elevation	Not provided.
Maximum Loads	Not provided. We assume the following to be considered the maximum structural loads: ■ Columns: 75 kips ■ Walls: 4 kips per linear foot (klf) ■ Slabs: 125 pounds per square foot (psf)
Grading/Slopes	Not provided. We assume the cuts and fills will be less than 5 feet.
Below-Grade Structures	Not indicated.
Free-Standing Retaining Walls	Not indicated.
Below-Grade Areas	Not indicated.
Pavements	We assume the site drives and parking areas will be paved with asphalt. Traffic loads are not provided; however, we assume the site traffic to be typical of apartment complex traffic (mostly cars and light trucks with daily light delivery, weekly garbage pick-up and occasional tractor-trailers).
Estimated Start of Construction	Not indicated.

GEOTECHNICAL CHARACTERIZATION

We have developed a general characterization of the subsurface conditions based upon our review of the subsurface exploration, laboratory data, geologic setting and our understanding of the project. This characterization, termed GeoModel, forms the basis of our geotechnical calculations and evaluation of site preparation and foundation options. Conditions encountered at each exploration point are indicated on the individual logs. The individual logs can be found in the **Exploration Results** section and the GeoModel can be found in the **Figures** section of this report.

As part of our analyses, we identified the following model layers within the subsurface profile. For a more detailed view of the model layer depths at each boring location, refer to the GeoModel.

Model Layer	Layer Name	General Description
1	Clayey/Silty Sand	Very loose, fine to medium grained, brown
2	Clayey/Silty Sand	Medium dense to loose, fine to medium grained, brown
3	Sandy Elastic Silt	Medium stiff to stiff, tan and white

Groundwater at the time of exploration was typically encountered at depths between 5 feet and 15 feet below the ground surface (bgs) in most areas of the site. Very shallow groundwater levels were recorded in the borings near the east side of the site, ranging from ½ to 4 feet bgs. This is the lowest area of the site. These observations represent groundwater conditions at the time of the field exploration, and may not be indicative of other times, or at other locations. Groundwater levels can be expected to fluctuate with varying seasonal and weather conditions.

Many of the borings encountered very loose to loose silty/clayey sand to a depth of about 3 feet bgs. Considering the site was formerly farmland, these are likely cultivated soils and may be wide spread in the areas corresponding to the former fields.

Isolated areas of surficial sandy fat clay were encountered in Borings B-2 and B-13 to B-15. Very soft to soft zones of sandy elastic silts were encountered between depths 18-½ feet and 30 feet bgs in Borings B-4, B-6 and B-11. These deeper low consistency soils are not expected to significantly impact the proposed apartment complex development.

Laboratory testing was performed on representative samples of the various soils encountered by the borings. Based on the results, the site soils are silty/clayey sands underlain by sandy elastic silts. Isolated shallow zones of sandy fat clays were encountered in a few borings. The liquid limit values of site silts and clays ranged from 59 to 62 while the plasticity indices ranged from 18 to 23. The fines contents of the site surficial soils vary between 12 and 54 percent with the water contents between 9 and 32 percent. The water contents of surficial soils are estimated to be generally above the optimum water content levels.

GEOTECHNICAL OVERVIEW

Based on the subsurface conditions defined by the widely spaced borings, soil conditions are generally compatible with the planned development. Presuming the general soil conditions across the site are consistent with the collected data, the structures can be supported by conventional spread/strip footings with tolerable settlement estimates. There are a few geotechnical considerations that should be recognized when planning the development of the site.

One of the geotechnical considerations is the presence of very loose to loose surficial soils across much of the site. The subgrade will be further loosened during stump removal and root grubbing after clearing. The level of subgrade repair will depend on the grading plan, the actual depth of the very loose soil and the moisture content of the soil at the time of construction. Presuming these soils are not either filled over by deep fill or removed by mass excavation, they will need to be repaired. Remedial measures may range from moisture conditioning and recompaction to undercutting and replacement with compacted structural fill in the at-grade and shallow fill areas to use of a bridge lift or heavy gauge geo-grid in the moderate to deep fill areas to help facilitate structural fill placement. The project schedule and budget should consider the need for subgrade repair/reinforcement to prepare the subgrades for subsequent fill placement.

The second consideration is the presence of shallow groundwater conditions, ranging from ½ to 4 feet bgs, encountered near the east side of the site. At these depths, the groundwater will likely affect earthwork and utility installation. This area is at a low elevation relative to the rest of the site and could receive deep fill (depths of possibly 10+ feet) to achieve the final grades. Recommendations made in the **Earthwork** section must be followed to control groundwater during mass grading.

The on-site silty/clayey sands are appropriate for re-use as structural fill (compacted fill below the buildings and pavement areas) after they receive moisture conditioning. The soils are above optimum moistures at the time of our field sampling and will require drying, if conditions during construction are as now.

Isolated shallow zones of sandy fat clay with moderate plasticity levels were found by Borings B-2 and B-13 to B-15 in the south and west portions of the site. These soils can be somewhat sensitive to variation in moisture content and become unstable with typical earthwork and construction traffic, especially after precipitation events. Moisture conditioning to reach the optimum level will be needed prior compaction and proofrolling. Mixing these soils with silty/clayey sands at the site can reduce their moisture sensitivity and improve their use as structural fill.

The **General Comments** section provides an understanding of the report limitations.

EARTHWORK

The following presents general recommendations for the earthwork associated with the project. The recommendations presented for foundations and other ground-supported items are contingent upon following the recommendations outlined in this section. Grading for the structures should incorporate the limits of the proposed structure plus 5 feet beyond proposed perimeter building walls and any exterior columns.

Earthwork on the project should be observed and evaluated by Terracon. The evaluation of earthwork should include observation and testing of engineered fill, subgrade preparation, foundation bearing soils, and other geotechnical conditions exposed during the construction of the project.

Site Preparation

The majority of the proposed construction area is currently moderately to heavily wooded with medium to large sized pine trees and brush. Considerable clearing and grubbing activities will be necessary to prepare the construction area for mass grading. If conditions are as now, clearing can generally be accomplished using conventional equipment.

After razing the existing buildings, the topsoil, vegetation, pavements, stone base, and any other unsuitable materials should be stripped and removed from the construction area. Stripping should extend at least 10 feet beyond the construction limits. The topsoil thicknesses were up to 6 inches at the boring locations but will vary across the site, especially in the low-lying portions of the site where runoff may deposit eroded soils. Clean topsoil may be stockpiled for reuse in landscaped areas or pavement shoulders. Once the contractor's stripping activities nears completion, we recommend that our representative observe the subgrade to identify any remaining pockets of organics or unsuitable material that should be removed.

Special precautions should be made to remove all underground utilities and their associated backfill as the structures and pavements may overlay these materials. Care should be given to locating and addressing these items during the site preparation phase of the project. If loose soils or utilities are overlooked, they could be detrimental to the long-term performance of the structures and pavements.

Subgrade Preparation

The surficial soil conditions in the northern, eastern and southern portions of the site are very loose to loose. These conditions are probably associated with the past agricultural activities that occurred at the site. As most of the site was farmland, such conditions are likely widespread. We do not expect these soil conditions to be stable under a proofrolling load and will require remediation to improve their condition for fill placement/compaction of structural fill and construction of the planned building pads and pavements. The level of subgrade preparation

needed to prepare the site for the proposed development will be heavily dependent upon the final grades and the locations of the planned buildings and pavements.

In the areas of the site where moderate to deep fill placement will occur, subgrade stabilization options typically include the use of bridge lifts and geo-grids to facilitate fill placement. A bridge lift is essentially a thickened layer of soil placed to separate the loose native subgrade from the fill surface receiving compaction. Its thickness will vary depending on the subgrade condition at the time of construction and the total depth of the fill mass. The use of a bridge lift is appropriate for parking areas and non-structural areas where the fill depths allow (typically 5+ feet above the existing ground surface). In areas where the planned fills are more shallow as well as below the proposed structures, geo-grids are more applicable. Geo-grids strengthen and reinforce the subgrade and spread the load (compaction or otherwise) over a larger area than the soils alone.

In the areas of shallow fill, at-grade areas and areas of shallow cut, subgrade repair options will range from moisture conditioning and recompaction of the subgrade to undercutting and replacement of the subgrade soils. The type of repair will depend on the subgrade's level of instability, the moisture content of the soil and the end use of the area.

In the areas of Borings B-2 and B-13 to B-15, surficial sandy fat clays are present. If not removed as part of the planned grading plan, it should be expected that moisture conditioning of these soils will be needed along with recompaction. Depending on the location of these areas (and others as found across the site), it may be prudent to mix these materials with sandy soils to increase their strength.

The effective drainage should be completed early in the construction sequence and maintained after construction to avoid potential instability. If possible, the grading should be performed during the warmer and drier times of the year as moisture conditioning is under better control during such times. If grading is performed during the winter months, the likelihood for undercutting and replacement will increase.

After the subgrades are repaired, the conditions should be verified by proofrolling to check for any remaining areas of instability. Proofrolling should be performed with a heavily loaded tandem axle dump truck or with similar approved construction equipment under the observation of the Terracon geotechnical engineer. If conditions are found to be unstable under the proof load, the subgrade should be undercut to soils that would provide a firm base for the compaction of the structural fill. The undercut soils can then be re-placed with the excavated soils in thin lifts. Mass fill placement may commence after the compaction and proofrolling have been successfully completed.

The exposed subgrade soils will be composed of primarily silty/clayey sands which can become unstable when exposed to construction traffic after periods of inclement weather especially during colder periods of the year. This traffic exposure to wet subgrades can destabilize what would have been otherwise satisfactory conditions, requiring further repair. As a precaution, we recommend that once the planned subgrade levels have been achieved, the construction traffic

be rerouted from planned structural areas after periods of precipitation to allow them to dry. This should help to reduce the amount of subgrade repairs required later in the project. Positive drainage should be maintained at all times to prevent ponding of stormwater on exposed subgrades as filling process or during the operations life of the structure. Additionally, when inclement weather or when lengthy breaks in construction are anticipated, exposed subgrade soils should be rolled smooth to limit stormwater infiltration into prepared subgrade soils.

Fill Material Types

The silty/clayey sands at the site less organics and debris can generally be used as structural fill throughout the site. The sandy fat clays can also be used as general fills in non-structural area. If mixed with more sandy soils, a wider use of these materials is probable. The moisture of surficial site soils was higher than the optimum moisture content and some drying prior to placement will be needed to facilitate compaction. The contractor should consider this in his planning of the site grading activities.

The fill material should be placed in uniform horizontal layers that are not more than 8 inches in loose thickness and compacted to at least 95 percent of the soil's maximum dry density as determined by the standard Proctor compaction test. The moisture content of fill soils should be within +/- 2 percent of the optimum moisture content, as determined by the standard Proctor compaction test. This will require that the grading contractor control the moisture of the material closely during placement to construct a stable earth mass. These recommendations are preliminary and are subject to review of the actual grading plan.

Grading and Drainage

All grades must provide effective drainage away from the building during and after construction and should be maintained throughout the life of the structure. The roof should have gutters/drains with downspouts that discharge directly into the storm drain system.

Earthwork Construction Considerations

The boring data indicate that the site soils should generally be excavatable using conventional construction equipment. Trenches and other shallow excavations can be performed using medium to large, rubber-tired backhoes. Upon completion of filling and grading, care should be taken to maintain the subgrade moisture content prior to construction of floor slabs. Construction traffic over the completed subgrades should be avoided. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. Water collecting over or adjacent to construction areas should be removed. If the subgrade freezes, desiccates, saturates, or is disturbed, the affected material should be removed, or the materials should be scarified, moisture conditioned, and recompacted prior to floor slab construction.

The depth to groundwater was typically between 5 and 15 feet across much of the site but between ½ foot and 4 feet bgs in the east portion. Where groundwater is shallow, it will impact the utility installation and potentially the grading activities, depending on the cuts and fills. The level of impact of groundwater on earthwork and the extent of groundwater control measures depend on the grading plan. Once the preliminary grading plans are developed, the impact of the shallow groundwater can be better defined.

As a minimum, excavations should be performed in accordance with OSHA 29 CFR, Part 1926, Subpart P, "Excavations" and its appendices, and in accordance with any applicable local, and/or state regulations.

Construction site safety is the sole responsibility of the contractor who controls the means, methods, and sequencing of construction operations. Under no circumstances shall the information provided herein be interpreted to mean Terracon is assuming responsibility for construction site safety, or the contractor's activities; such responsibility shall neither be implied nor inferred.

FOUNDATION AND FLOOR SLAB RECOMMENDATION

Based on the soil conditions represented by the borings and the structural loads indicated in **Project Description**, we anticipate the proposed structures can be supported by shallow spread footings. We have performed preliminary settlement analysis based on an assumed maximum column load of 75 kips and an allowable bearing pressure of 2,500 psf. Based on the available soil data, the total settlement would be less than an inch for the noted load range for the general soil profile. The final allowable bearing pressure recommended for design of the foundations will depend on the cut/fill depths across the site, the actual structural loads and the structures' settlement criteria. This should be refined once the design is formalized. If the actual structural loads are greater than noted in **Project Description** or settlement tolerances are less, alternate foundation support could be necessary. This may include the use of stone columns or a deep foundation system.

Lightly- to moderately-loaded slabs can likely be conventionally designed, assuming adequate preparation and compaction of the subgrade is performed. Depending upon the final grades and actual structural loads, additional study may be necessary to provide specific design parameters.

SEISMIC CONSIDERATIONS

The seismic design requirements for buildings and other structures are based on Seismic Design Category. Seismic Site Classification is required to determine the Seismic Design Category for a structure. The Seismic Site Classification is based on the upper 100 feet of the site profile defined by a weighted average value of either shear wave velocity, standard penetration resistance, or

undrained shear strength in accordance with Section 20.4 of ASCE 7 and the International Building Code (IBC).

Based on the results of the geophysical testing, it is our professional opinion that the Seismic Site Classification is C. The weighted average shear wave velocity in the upper 100 feet was 1,845 fps.

PAVEMENTS

The site soils are primarily clayey/silty sands. These soils are expected to provide sufficient strength and support conditions for pavements. The appropriate pavement thicknesses for the site are based on many inputs, including the frequency and makeup of the traffic as well as any future increases in volume, the actual subgrade strength, and the drainage conditions. To avoid under estimation of the actual soil support, we recommend that strength testing of the subgrade soils be performed. This site-specific testing, coupled with a well-considered traffic estimation, can produce an economic and functional pavement system.

RECOMMENDATIONS FOR SUPPLEMENTAL EXPLORATION

Once the development plans are formulated, we recommend that a supplemental geotechnical exploration be conducted to address the specific design and construction needs. As a minimum, the supplemental geotechnical exploration should address the following in addition to the general needs of the structural design.

Grading Considerations

- More detailed evaluation of the very loose soil and shallow groundwater conditions.
- Subgrade preparation requirements for structural and non-structural areas based on the actual grading plan.
- Compaction criteria based on structural support requirements and depth of fill to be placed.

Foundation Design

- Determination of the allowable bearing pressure for foundation design based on actual structural loads, the planned cut/fill depths and structural settlement criteria defined by the project's design engineer.

Pavement Design

- Pavement design thickness using the actual strength of the site soils (based on CBR testing) and an actual estimate of the anticipated traffic volume and make-up.

GENERAL COMMENTS

Our analysis and opinions are based upon our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration. Natural variations will occur between exploration point locations or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. Terracon should be retained as the Geotechnical Engineer, where noted in this report, to provide observation and testing services during pertinent construction phases. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

Our Scope of Services does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

Our services and any correspondence or collaboration through this system are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third-party beneficiaries intended. Any third-party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client. Reliance upon the services and any work product is limited to our client, and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

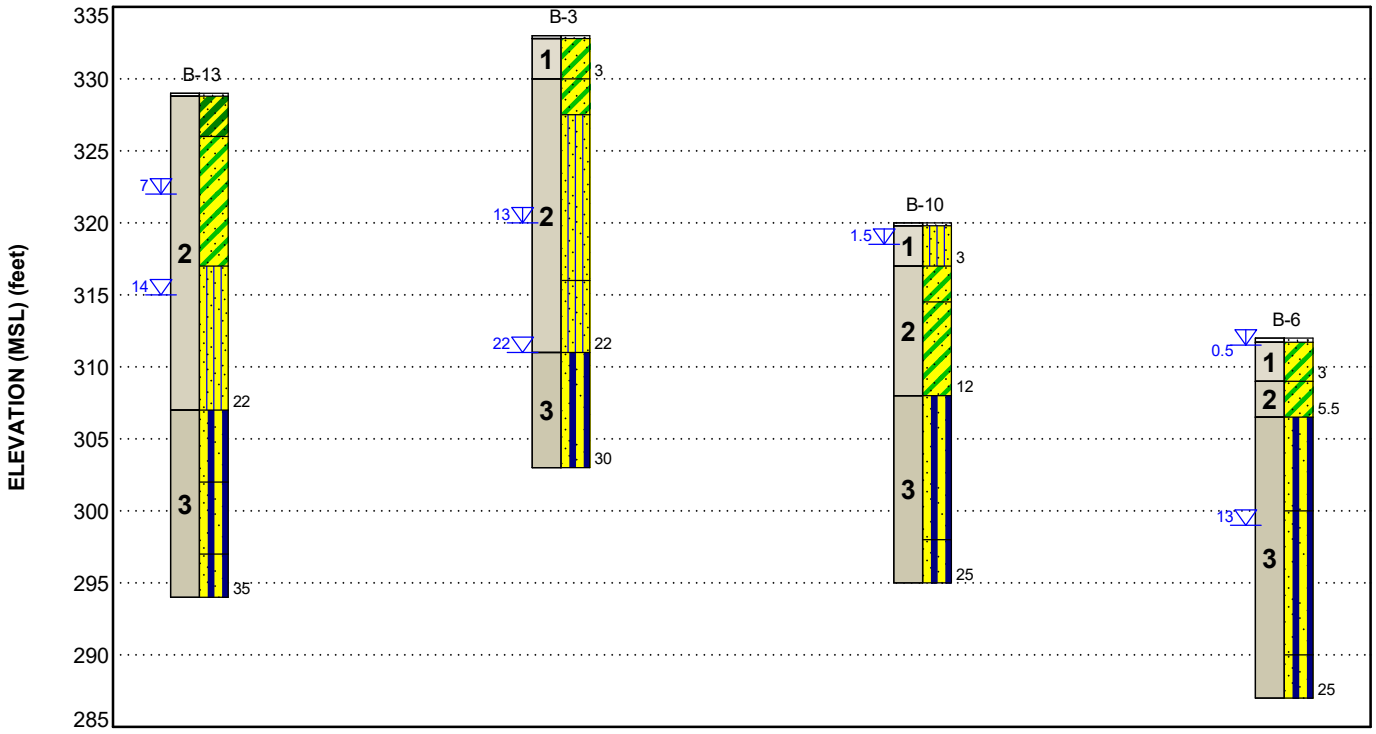
Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly impact excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety, and cost estimating including, excavation support, and dewatering requirements/design are the responsibility of others. If changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

FIGURES

Contents:

GEOMODEL

West Columbia Multi-Family Development ■ West Columbia, SC
Terracon Project No. 73205167



This is not a cross section. This is intended to display the Geotechnical Model only. See individual logs for more detailed conditions.

Model Layer	Layer Name	General Description
1	**Clayey/Silty Sand**	Very loose to loose, fine to medium grained, brown
2	**Clayey/Silty Sand**	Medium dense to loose, fine to medium grained, brown
3	**Sandy Elastic Silt**	Medium stiff to stiff, tan and white

LEGEND

- Topsoil
- Clayey Sand
- Silty Sand
- Sandy Elastic Silt
- Sandy Fat Clay

▽ First Water Observation
▽ Second Water Observation

Groundwater levels are temporal. The levels shown are representative of the date and time of our exploration. Significant changes are possible over time. Water levels shown are as measured during and/or after drilling. In some cases, boring advancement methods mask the presence/absence of groundwater. See individual logs for details.

NOTES:
Layering shown on this figure has been developed by the geotechnical engineer for purposes of modeling the subsurface conditions as required for the subsequent geotechnical engineering for this project. Numbers adjacent to soil column indicate depth below ground surface.

ATTACHMENTS

EXPLORATION AND TESTING PROCEDURES

Field Exploration

Fifteen (15) test borings were drilled at the site between January 11, 2021 and January 13, 2021. The borings were drilled to depths ranging from approximately 20 to 35 feet bgs. Approximate locations of the borings are shown on the **Exploration Plan.**

Boring Layout and Elevations: Terracon personnel provided the boring layout. Coordinates were obtained with a handheld GPS unit (estimated horizontal accuracy of about ±10 feet) and approximate elevations were obtained by interpolation from the Lexington GIS System. If more precise elevations or boring layout are desired, we recommend borings be surveyed by a licensed surveyor.

Subsurface Exploration Procedures: We advanced the borings with an ATV drill rig using continuous hollow stem flight augers. Four samples were obtained in the upper 10 feet of each boring and at intervals of 5 feet thereafter. A standard 2-inch outer diameter split-barrel sampling spoon was driven into the ground by a 140-pound automatic hammer falling a distance of 30 inches.

The number of blows required to advance the sampling spoon the last 12 inches of a normal 18-inch penetration is recorded as the Standard Penetration Test (SPT) resistance value. The SPT resistance values, also referred to as N-values, are indicated on the boring logs at the test depths. We observed and recorded groundwater levels during drilling and sampling. Select borings were left open to see whether groundwater would accumulate overnight after drilling. Once the groundwater measurements were recorded, the borings were backfilled with auger cuttings after their completion.

An automatic SPT hammer was used to advance the split-barrel sampler in the borings performed on this site. A greater efficiency is typically achieved with the automatic hammer compared to the conventional safety hammer operated with a cathead and rope. Published correlations between the SPT values and soil properties are based on the lower efficiency cathead and rope method. This higher efficiency affects the standard penetration resistance blow count (N) value by increasing the penetration per hammer blow over what would be obtained using the cathead and rope method. The effect of the automatic hammer's efficiency has been considered in the interpretation and analysis of the subsurface information for this report.

The sampling depths, penetration distances, and other sampling information was recorded on the field boring logs. The samples were placed in appropriate containers and taken to our soil laboratory for testing and classification by a Geotechnical Engineer. Our exploration team prepared field boring logs as part of the drilling operations.

These field logs included visual classifications of the materials encountered during drilling and our interpretation of the subsurface conditions between samples. Final boring logs were prepared from the field logs. The final boring logs represent the Geotechnical Engineer's interpretation of the field logs and include modifications based on observations and tests of the samples in our laboratory.

Shear Wave Velocity Testing

Terracon utilized the SeisOpt® ReMi™ method to develop the full depth shear wave velocity profile at the site for use in determining the seismic site class. This method employs non-linear optimization technology to derive one-dimensional S-wave velocities from refraction microtremor (ambient noise) recordings using a typical seismograph and standard, low frequency, refraction geophones. We utilized a series of receivers (geophones) set along a straight-line array with a 27±-foot receiver spacing for a total length of about 300 feet along Array 1 shown on **Exploration Plan**. Unfiltered, 30-second records were recorded using the background 'noise' created by the moving traffic and other ambient vibrations. The collected data, the response spectrum in the 5 to 40 Hz range, was processed using the computer software SeisOpt® ReMi™ by Optim, LLC with the results plotted as a conventional shear wave velocity vs. depth profile. The shear wave velocity profile obtained using the SeisOpt® ReMi™ data reduction method is shown in **Exploration Results**.

Laboratory Testing

The project engineer reviewed the field data and assigned laboratory tests to understand the engineering properties of the various soil strata, as necessary, for this project. Procedural standards noted below are for reference to methodology in general. In some cases, variations to methods were applied because of local practice or professional judgment. Standards noted below include reference to other, related standards. Such references are not necessarily applicable to describe the specific test performed.

- ASTM D2216 Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
- ASTM D4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
- ASTM D422 Standard Test Method for Particle-Size Analysis of Soils
- ASTM D698 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort

The laboratory testing program often included examination of soil samples by an engineer. Based on the material's texture and plasticity, we described and classified the soil samples in accordance with the Unified Soil Classification System.

SITE LOCATION AND EXPLORATION PLANS

Contents:

Site Location Plan
Exploration Plan

Note: All attachments are one page unless noted above.

SITE LOCATION

West Columbia Multi-Family Development ■ West Columbia, SC
February 18, 2021 ■ Terracon Project No. 73205167

Terracon GeoReport

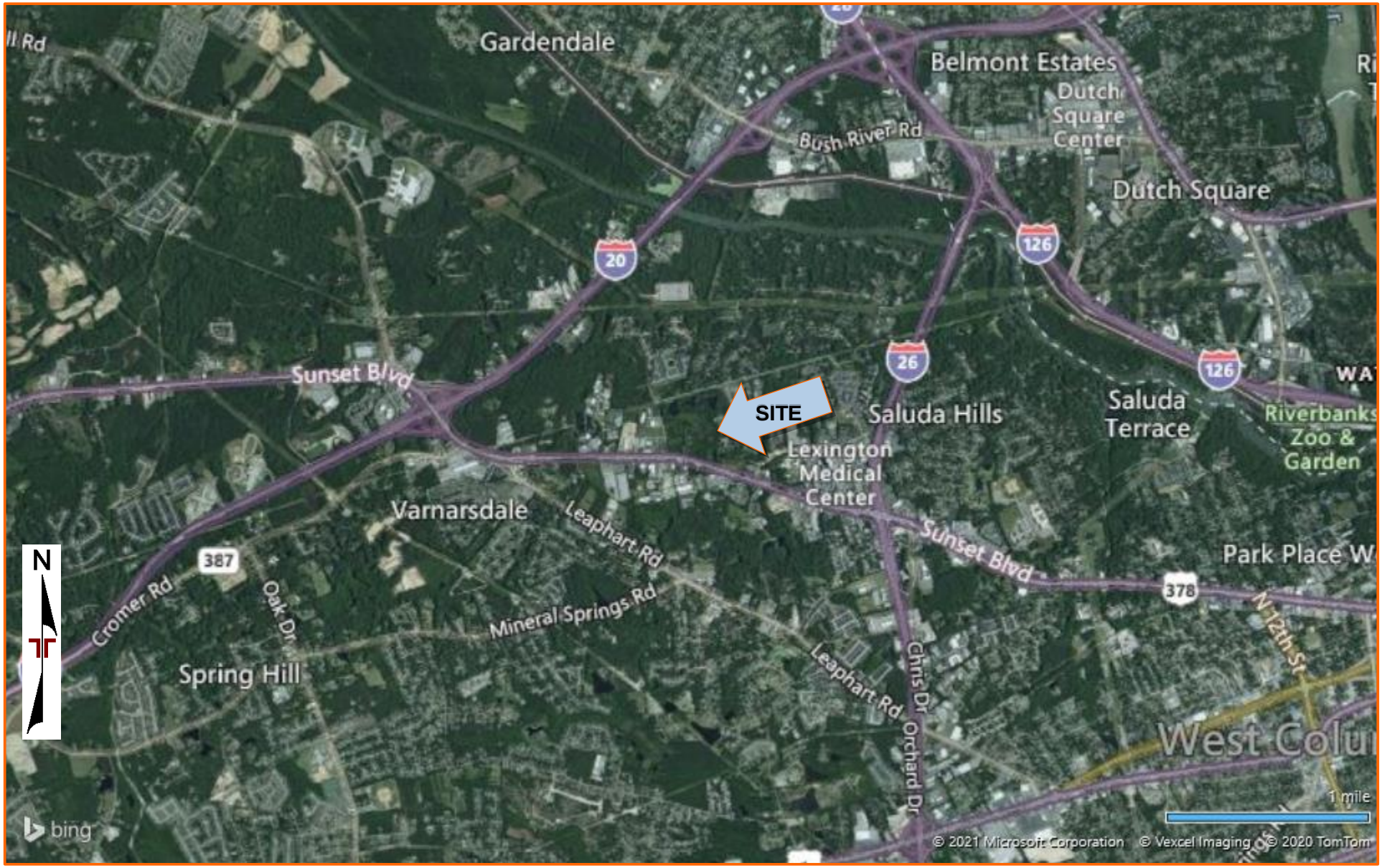


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

TOPOGRAPHIC MAP IMAGE COURTESY OF THE U.S. GEOLOGICAL SURVEY QUADRANGLES INCLUDE: IRMO, SC (1/1/1990), COLUMBIA NORTH, SC (1/1/1997), LEXINGTON, SC (1/1/1987) and SOUTHWEST COLUMBIA, SC (1/1/1994).

EXPLORATION PLAN

West Columbia Multi-Family Development ■ West Columbia, SC
February 18, 2021 ■ Terracon Project No. 73205167

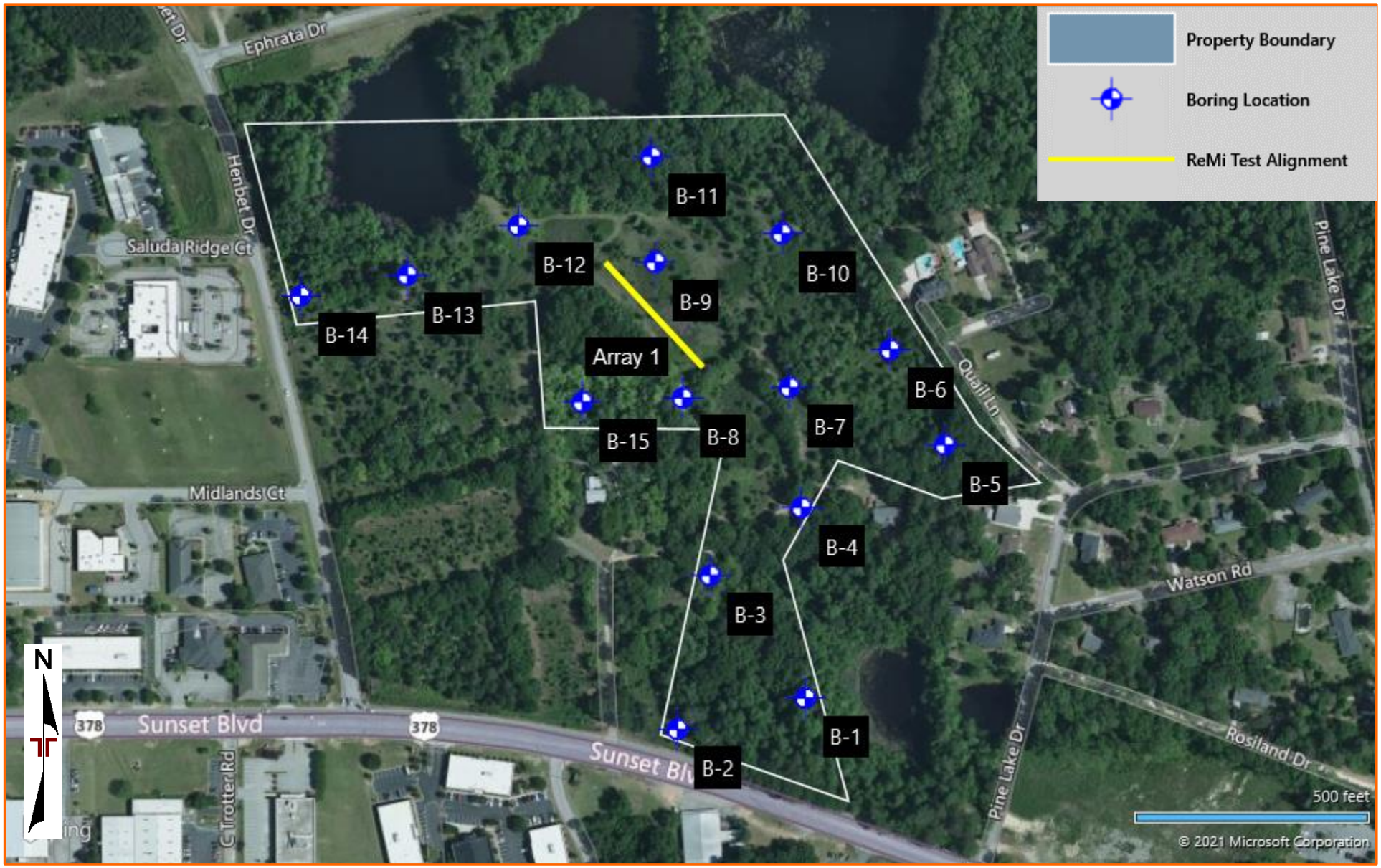


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

AERIAL PHOTOGRAPHY PROVIDED BY MICROSOFT BING MAPS

EXPLORATION RESULTS

Contents:

Note: All attachments are one page unless noted above.

BORING LOG NO. B-1

PROJECT: West Columbia Multi-Family Development

CLIENT: Fickling and Company, Inc
Macon, GA

SITE: Sunset Boulevard
West Columbia, SC

LOCATION See Exploration Plan

Latitude: 34.0081° Longitude: -81.1253°

Approximate Surface Elev.: 312 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		0.2	312+/-						
1			**TOPSOIL**, (2 inches)						
			SILTY SAND (SM), with crushed aggregate, fine to medium grained, brown, very loose				1-1-2 N=3		12
		3.0	309+/-						
2			**CLAYEY SAND (SC)**, fine to medium grained, brown, tan and gray, medium dense to loose	5	▽		3-3-7 N=10		
							5-4-5 N=9		
		8.0	304+/-						
			CLAYEY SAND (SC), fine to medium grained, tan and gray, medium dense to loose	10	▨		4-5-9 N=14		
					▽				
				15			3-3-5 N=8		
		17.0	295+/-						
3			**SANDY SILT (ML)**, tan and white, very stiff	20			5-9-12 N=21		
		22.0	290+/-						
			SILTY SAND (SM), with silt seams, fine to medium grained, tan, dense to medium dense	25			15-22-24 N=46		
		30.0	282+/-						
			Boring Terminated at 30 Feet	30			4-6-9 N=15		

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
2-1/4" Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:
Elevation was taken from Lexington GIS System

WATER LEVEL OBSERVATIONS

▽ *13' (End of day)*

▽ *5' (After 24 hours)*

▨ *10' (After 24 hours)*

Terracon
521 Clemson Rd
Columbia, SC

Boring Started: 01-13-2021 | Boring Completed: 01-14-2021

Drill Rig: Geoprobe | Driller: B. Burnett

Project No.: 73205167

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 73205167 WEST COLUMBIA MUL.GPJ TERRACON_DATATEMPLATE.GDT 2/9/21

BORING LOG NO. B-2

PROJECT: West Columbia Multi-Family Development

CLIENT: Fickling and Company, Inc
Macon, GA

SITE: Sunset Boulevard
West Columbia, SC

LOCATION See Exploration Plan

Latitude: 34.0079° Longitude: -81.1262°

Approximate Surface Elev.: 330 (Ft.) +/-

MODEL LAYER	DEPTH	ELEVATION (Ft.)		FIELD TEST RESULTS
	0.3	329.5+/-	**TOPSOIL**, (4 inches)	
2	3.0	327+/-	**SANDY FAT CLAY (CH)**, brown and tan, stiff	2-4-8 N=12
2	5.5	324.5+/-	**CLAYEY SAND (SC)**, fine to medium grained, brown, orange and tan, medium dense	6-8-10 N=18
2	12.0	318+/-	**SANDY FAT CLAY (CH)**, orange, tan and gray, very stiff to hard	11-8-11 N=19 6-13-17 N=30
3	17.0	313+/-	**SILTY SAND (SM)**, fine to medium grained, orange, medium dense	8-8-7 N=15
3	30.0	300+/-	**SANDY ELASTIC SILT (MH)**, tan and white, stiff to medium stiff	5-5-6 N=11 2-2-3 N=5 2-3-4 N=7
			Boring Terminated at 30 Feet	

DEPTH (Ft.): 5, 10, 15, 20, 25, 30

WATER LEVEL OBSERVATIONS

SAMPLE TYPE

ATTERBERG LIMITS LL-PL-PI

PERCENT FINES

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
2-1/4" Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:
Elevation was taken from Lexington GIS System

WATER LEVEL OBSERVATIONS

- *21' (End of day)*
- *11' (After 24 hours)*
- *10' (After 24 hours)*

Terracon
521 Clemson Rd
Columbia, SC

Boring Started: 01-13-2021 | Boring Completed: 01-14-2021

Drill Rig: Geoprobe | Driller: B. Burnett

Project No.: 73205167

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 73205167 WEST COLUMBIA MUL.GPJ TERRACON_DATATEMPLATE.GDT 2/9/21

BORING LOG NO. B-3

PROJECT: West Columbia Multi-Family Development

CLIENT: Fickling and Company, Inc
Macon, GA

SITE: Sunset Boulevard
West Columbia, SC

LOCATION See Exploration Plan

Latitude: 34.0088° Longitude: -81.1260°

Approximate Surface Elev.: 333 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
1		0.2	333+/-						
			TOPSOIL, (2 inches)						
			CLAYEY SAND (SC), with crushed aggregate, fine to medium grained, brown and tan, very loose				1-2-1 N=3		
		3.0	330+/-						
2			**CLAYEY SAND (SC)**, fine to medium grained, reddish brown, orange and tan, dense				5-11-26 N=37		
		5.5	327.5+/-	5					
			SILTY SAND (SM), fine to medium grained, orange, dense to very dense				15-17-16 N=33		
							10-18-18 N=36		
				10					
					▽				
							15-25-26 N=51		
				15					
		17.0	316+/-						
			SILTY SAND (SM), with silt seams and mica, fine to medium grained, tan and white, medium dense				6-10-9 N=19		
				20	▽				
		22.0	311+/-						
3			**SANDY ELASTIC SILT (MH)**, tan and white, medium stiff to stiff				3-4-4 N=8		
				25					
							5-6-7 N=13		
		30.0	303+/-	30					
			Boring Terminated at 30 Feet						

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
2-1/4" Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:
Elevation was taken from Lexington GIS System

WATER LEVEL OBSERVATIONS

▽ *22' (End of day)*

▽ *13' (After 24 hours)*

▨ *10' (After 24 hours)*

Terracon
521 Clemson Rd
Columbia, SC

Boring Started: 01-13-2021 | Boring Completed: 01-14-2021

Drill Rig: Geoprobe | Driller: B. Burnett

Project No.: 73205167

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 73205167 WEST COLUMBIA MUL.GPJ TERRACON_DATATEMPLATE.GDT 2/9/21

BORING LOG NO. B-4

PROJECT: West Columbia Multi-Family Development

CLIENT: Fickling and Company, Inc
Macon, GA

SITE: Sunset Boulevard
West Columbia, SC

LOCATION See Exploration Plan

Latitude: 34.0092° Longitude: -81.1253°

Approximate Surface Elev.: 328 (Ft.) +/-

MODEL LAYER	DEPTH	ELEVATION (Ft.)		FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
1	0.2	328+/-	**TOPSOIL**, (2 inches)			
1	3.0	325+/-	**CLAYEY SAND (SC)**, with crushed aggregate, fine to medium grained, reddish brown and tan, very loose	1-1-1 N=2		30
2	5.5	322.5+/-	**CLAYEY SAND (SC)**, fine to medium grained, reddish brown, orange and tan, very dense	20-24-30 N=54		
2	17.0	311+/-	**SILTY SAND (SM)**, fine to medium grained, orange, dense to medium dense	15-19-18 N=37 12-19-16 N=35		
3	32.0	296+/-	**SANDY ELASTIC SILT (MH)**, tan and white, soft	4-5-7 N=12 2-1-2 N=3 WOH-1-1 N=2 WOH-1-1 N=2		
3	35.0	293+/-	**SANDY ELASTIC SILT (MH)**, pink and red, stiff	3-5-7 N=12		
			Boring Terminated at 35 Feet			

DEPTH (Ft.): 5, 10, 15, 20, 25, 30, 35

WATER LEVEL OBSERVATIONS

SAMPLE TYPE

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
2-1/4" Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:
Elevation was taken from Lexington GIS System

WATER LEVEL OBSERVATIONS

- *18' (End of day)*
- *7' (After 24 hours)*
- *10' (After 24 hours)*

Terracon
521 Clemson Rd
Columbia, SC

Boring Started: 01-13-2021 | Boring Completed: 01-14-2021

Drill Rig: Geoprobe | Driller: B. Burnett

Project No.: 73205167

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 73205167 WEST COLUMBIA MUL.GPJ TERRACON_DATATEMPLATE.GDT 2/9/21

BORING LOG NO. B-5

PROJECT: West Columbia Multi-Family Development

CLIENT: Fickling and Company, Inc
Macon, GA

SITE: Sunset Boulevard
West Columbia, SC

LOCATION See Exploration Plan

Latitude: 34.0096° Longitude: -81.1243°

Approximate Surface Elev.: 318 (Ft.) +/-

MODEL LAYER	DEPTH	ELEVATION (Ft.)		FIELD TEST RESULTS
1	0.2	318+/-	**TOPSOIL**, (3 inches)	
	3.0	315+/-	**CLAYEY SAND (SC)**, with crushed aggregate, fine to medium grained, brown and tan, loose	2-2-2 N=4
2	5.5	312.5+/-	**SILTY SAND (SM)**, with mica and silt seams, fine to medium grained, orange and tan, medium dense	5-8-7 N=15
3	22.0	296+/-	**SANDY ELASTIC SILT (MH)**, yellowish tan and white, stiff to medium stiff	5-6-7 N=13 3-4-5 N=9 2-3-5 N=8 2-3-3 N=6
	27.0	291+/-	**SANDY ELASTIC SILT (MH)**, pink and purple, soft	1-2-2 N=4
	35.0	283+/-	**SANDY ELASTIC SILT (MH)**, red and pink, soft to medium stiff	WOH-2-2 N=4 2-2-4 N=6
			Boring Terminated at 35 Feet	

DEPTH (Ft.): 5, 10, 15, 20, 25, 30, 35

WATER LEVEL OBSERVATIONS

SAMPLE TYPE

ATTERBERG LIMITS: LL-PL-PI

PERCENT FINES

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
2-1/4" Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:
Elevation was taken from Lexington GIS System

WATER LEVEL OBSERVATIONS

- *13' (End of day)*
- *6' (After 24 hours)*
- *10' (After 24 hours)*

Terracon
521 Clemson Rd
Columbia, SC

Boring Started: 01-12-2021 | Boring Completed: 01-13-2021

Drill Rig: Geoprobe | Driller: B. Burnett

Project No.: 73205167

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 73205167 WEST COLUMBIA MUL.GPJ TERRACON_DATATEMPLATE.GDT 2/9/21

BORING LOG NO. B-6

PROJECT: West Columbia Multi-Family Development

CLIENT: Fickling and Company, Inc
Macon, GA

SITE: Sunset Boulevard
West Columbia, SC

LOCATION See Exploration Plan

Latitude: 34.0102° Longitude: -81.1247°

Approximate Surface Elev.: 312 (Ft.) +/-

MODEL LAYER	DEPTH	ELEVATION (Ft.)		FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	0.3	311.5+/-	**TOPSOIL**, (4 inches)			
1	3.0	309+/-	**CLAYEY SAND (SC)**, fine to medium grained, brown and tan, very loose	WOH-WOH-2 N=2	39-19-20	36
2	5.5	306.5+/-	**CLAYEY SAND (SC)**, fine to medium grained, orange, tan and gray, medium dense	6-8-11 N=19		
3	12.0	300+/-	**SANDY ELASTIC SILT (MH)**, tan and white, very stiff to stiff	4-8-10 N=18 4-4-7 N=11		
	22.0	290+/-	**SANDY ELASTIC SILT (MH)**, tan and white, soft to very soft	2-2-2 N=4	62-44-18	54
	25.0	287+/-	**SANDY ELASTIC SILT (MH)**, tan and white, stiff	WOH-WOH-1 N=1 2-5-6 N=11		
			Boring Terminated at 25 Feet			

DEPTH (Ft.): 5, 10, 15, 20, 25

WATER LEVEL OBSERVATIONS

SAMPLE TYPE

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
2-1/4" Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:
Elevation was taken from Lexington GIS System

WATER LEVEL OBSERVATIONS

- *13' (End of day)*
- *0.5' (After 24 hours)*
- *1' (After 24 hours)*

Terracon
521 Clemson Rd
Columbia, SC

Boring Started: 01-12-2021 | Boring Completed: 01-13-2021

Drill Rig: Geoprobe | Driller: B. Burnett

Project No.: 73205167

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 73205167 WEST COLUMBIA MUL.GPJ TERRACON_DATATEMPLATE.GDT 2/9/21

BORING LOG NO. B-7

PROJECT: West Columbia Multi-Family Development

CLIENT: Fickling and Company, Inc
Macon, GA

SITE: Sunset Boulevard
West Columbia, SC

LOCATION See Exploration Plan

Latitude: 34.0099° Longitude: -81.1254°

Approximate Surface Elev.: 327 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		0.2	327+/-						
			TOPSOIL, (3 inches)						
			CLAYEY SAND (SC), fine to medium grained, brown and tan, medium dense				2-5-7 N=12		
		3.0	324+/-						
			SILTY SAND (SM), fine to medium grained, orange, medium dense	5			9-10-10 N=20		
							10-12-12 N=24		
2		8.0	319+/-						
			SILTY SAND (SM), with clay seams, fine to medium grained, orange, medium dense	10			5-11-15 N=26		
		12.0	315+/-						
			SILTY SAND (SM), fine to medium grained, yellowish tan, loose		▽				
				15	▨		3-2-3 N=5		
		17.0	310+/-						
3			**SANDY ELASTIC SILT (MH)**, tan and white, stiff				4-6-7 N=13		
		20.0	307+/-	20					
			Boring Terminated at 20 Feet						

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
2-1/4" Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:
Elevation was taken from Lexington GIS System

WATER LEVEL OBSERVATIONS

▽ *13' (End of day)*

▽ *13' (After 24 hours)*

▨ *14' (After 24 hours)*

Terracon
521 Clemson Rd
Columbia, SC

Boring Started: 01-12-2021 | Boring Completed: 01-13-2021

Drill Rig: Geoprobe | Driller: B. Burnett

Project No.: 73205167

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 73205167 WEST COLUMBIA MUL.GPJ TERRACON_DATATEMPLATE.GDT 2/9/21

BORING LOG NO. B-8

PROJECT: West Columbia Multi-Family Development

CLIENT: Fickling and Company, Inc
Macon, GA

SITE: Sunset Boulevard
West Columbia, SC

LOCATION See Exploration Plan

Latitude: 34.0099° Longitude: -81.1262°

Approximate Surface Elev.: 336 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DESCRIPTION
		0.2	336+/-	**TOPSOIL**, (3 inches)
2		3.0	333+/-	**CLAYEY SAND (SC)**, fine to medium grained, brown and tan, medium dense
2		5.5	330.5+/-	**CLAYEY SAND (SC)**, fine to medium grained, pink, orange and tan, medium dense
2		12.0	324+/-	**SILTY SAND (SM)**, fine to medium grained, orange, medium dense
2		22.0	314+/-	**SILTY SAND (SM)**, with mica and silt seams, fine to medium grained, yellowish tan and white, medium dense
3		30.0	306+/-	**SANDY ELASTIC SILT (MH)**, tan and white, very stiff
				Boring Terminated at 30 Feet

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
5			2-2-9 N=11		
			8-9-10 N=19		
			5-8-9 N=17		
10	▽		6-10-10 N=20		
15			11-14-12 N=26		
20			6-7-7 N=14		
25			5-9-12 N=21		
30			7-10-13 N=23		

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
2-1/4" Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:
Elevation was taken from Lexington GIS System

WATER LEVEL OBSERVATIONS

▽ *10' (After 24 hours)*

11' (After 24 hours)

Terracon
521 Clemson Rd
Columbia, SC

Boring Started: 01-12-2021 | Boring Completed: 01-13-2021

Drill Rig: Geoprobe | Driller: B. Burnett

Project No.: 73205167

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 73205167 WEST COLUMBIA MUL.GPJ TERRACON_DATATEMPLATE.GDT 2/9/21

BORING LOG NO. B-9

PROJECT: West Columbia Multi-Family Development

CLIENT: Fickling and Company, Inc
Macon, GA

SITE: Sunset Boulevard
West Columbia, SC

LOCATION See Exploration Plan

Latitude: 34.0107° Longitude: -81.1264°

Approximate Surface Elev.: 332 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		0.3	331.5+/-						
			TOPSOIL, (4 inches)						
1			**CLAYEY SAND (SC)**, with crushed aggregate, fine to medium grained, brown and tan, loose				1-2-3 N=5		
		3.0	329+/-						
			CLAYEY SAND (SC), fine to medium grained, brown, orange and tan, dense				9-15-15 N=30		
				5			14-14-16 N=30		
		8.0	324+/-						
2			**SILTY SAND (SM)**, fine to medium grained, pink, tan and gray, medium dense				10-13-13 N=26		
				10	▽				
							6-10-13 N=23		
				15					
		20.0	312+/-				5-6-10 N=16		
			Boring Terminated at 20 Feet	20					

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
2-1/4" Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:
Elevation was taken from Lexington GIS System

WATER LEVEL OBSERVATIONS

▽ *12' (After 24 hours)*

▨ *15' (After 24 hours)*

Terracon
521 Clemson Rd
Columbia, SC

Boring Started: 01-12-2021 | Boring Completed: 01-13-2021

Drill Rig: Geoprobe | Driller: B. Burnett

Project No.: 73205167

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 73205167 WEST COLUMBIA MUL.GPJ TERRACON_DATATEMPLATE.GDT 2/9/21

BORING LOG NO. B-10

PROJECT: West Columbia Multi-Family Development

CLIENT: Fickling and Company, Inc
Macon, GA

SITE: Sunset Boulevard
West Columbia, SC

LOCATION See Exploration Plan

Latitude: 34.0109° Longitude: -81.1255°

Approximate Surface Elev.: 320 (Ft.) +/-

MODEL LAYER	DEPTH	ELEVATION (Ft.)		FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	0.2	320+/-	**TOPSOIL**, (3 inches)			
1	3.0	317+/-	**SILTY SAND (SM)**, with crushed aggregate, fine to medium grained, brown, very loose	WOH/18"		15
2	5.5	314.5+/-	**CLAYEY SAND (SC)**, fine to medium grained, brown and tan, medium dense	WOH-4-6 N=10		
2	12.0	308+/-	**CLAYEY SAND (SC)**, fine to medium grained, pink, orange and tan, medium dense	7-11-12 N=23 6-9-12 N=21		
3	22.0	298+/-	**SANDY ELASTIC SILT (MH)**, tan and white, medium stiff	2-3-5 N=8 WOH-2-2 N=4		
	25.0	295+/-	**SANDY ELASTIC SILT (MH)**, tan, pink and white, stiff	2-5-8 N=13		
			Boring Terminated at 25 Feet			

DEPTH (Ft.): 5, 10, 15, 20, 25

WATER LEVEL OBSERVATIONS

SAMPLE TYPE

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
2-1/4" Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:
Elevation was taken from Lexington GIS System

WATER LEVEL OBSERVATIONS

1.5' (After 24 hours)

2' (After 24 hours)

Terracon
521 Clemson Rd
Columbia, SC

Boring Started: 01-12-2021 | Boring Completed: 01-13-2021

Drill Rig: Geoprobe | Driller: B. Burnett

Project No.: 73205167

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 73205167 WEST COLUMBIA MUL.GPJ TERRACON_DATATEMPLATE.GDT 2/9/21

BORING LOG NO. B-11

PROJECT: West Columbia Multi-Family Development

CLIENT: Fickling and Company, Inc
Macon, GA

SITE: Sunset Boulevard
West Columbia, SC

LOCATION See Exploration Plan

Latitude: 34.0113° Longitude: -81.1264°

Approximate Surface Elev.: 320 (Ft.) +/-

MODEL LAYER	DEPTH	ELEVATION (Ft.)		DEPTH (Ft.)	SAMPLE TYPE	FIELD TEST RESULTS
	0.5	319.5+/-	**TOPSOIL**, (6 inches)			
1	3.0	317+/-	**CLAYEY SAND (SC)**, with crushed aggregate, fine to medium grained, brown and tan, loose			1-2-2 N=4
2	5.5	314.5+/-	**CLAYEY SAND (SC)**, fine to medium grained, brown, orange and gray, medium dense	5		5-10-17 N=27
3	12.0	308+/-	**SANDY ELASTIC SILT (MH)**, pink, tan and yellow to tan and white, stiff to medium stiff			4-6-7 N=13
				10		1-2-3 N=5
	22.0	298+/-	**SANDY ELASTIC SILT (MH)**, tan and white, soft to very soft	15		2-2-2 N=4
				20		WOH/18"
	27.0	293+/-	**SANDY ELASTIC SILT (MH)**, pink and tan, soft	25		WOH-1-1 N=2
	30.0	290+/-	**SANDY ELASTIC SILT (MH)**, yellowish brown and tan, very stiff	30		5-11-13 N=24
			Boring Terminated at 30 Feet			

ATTERBERG LIMITS: LL-PL-PI

PERCENT FINES

WATER LEVEL OBSERVATIONS

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
2-1/4" Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:
Elevation was taken from Lexington GIS System

WATER LEVEL OBSERVATIONS

- *18.5 (End of day)*
- *4.5 (After 24 hours)*
- *7' (After 24 hours)*

Terracon
521 Clemson Rd
Columbia, SC

Boring Started: 01-12-2021 | Boring Completed: 01-13-2021

Drill Rig: Geoprobe | Driller: B. Burnett

Project No.: 73205167

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 73205167 WEST COLUMBIA MUL.GPJ TERRACON_DATATEMPLATE.GDT 2/9/21

BORING LOG NO. B-12

PROJECT: West Columbia Multi-Family Development

CLIENT: Fickling and Company, Inc
Macon, GA

SITE: Sunset Boulevard
West Columbia, SC

LOCATION See Exploration Plan

Latitude: 34.0109° Longitude: -81.1273°

Approximate Surface Elev.: 329 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		0.3	328.5+/-						
			TOPSOIL, (4 inches)						
1			**CLAYEY SAND (SC)**, with crushed aggregate, fine to medium grained, brown and tan, loose				1-2-3 N=5		
		3.0	326+/-						
			SILTY SAND (SM), with rock fragments, fine to medium grained, orange, very dense				16-31-21 N=52		
		5.5	323.5+/-	5					
			SILTY SAND (SM), fine to medium grained, orange, medium dense				7-7-8 N=15		
		8.0	321+/-						
			SILTY SAND (SM), fine to medium grained, pink, tan and gray, dense				8-23-21 N=44		
2				10	▽				
		12.0	317+/-						
			SILTY SAND (SM), with mica, fine to medium grained, tan and white, medium dense				6-4-8 N=12		
				15	▽				
		20.0	309+/-				5-10-10 N=20		
			Boring Terminated at 20 Feet	20					

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
2-1/4" Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:
Elevation was taken from Lexington GIS System

WATER LEVEL OBSERVATIONS

▽ *18.5 (End of day)*
▽ *12 (After 24 hours)*
▨ *13' (After 24 hours)*

Terracon
521 Clemson Rd
Columbia, SC

Boring Started: 01-11-2021 | Boring Completed: 01-12-2021
Drill Rig: Geoprobe | Driller: B. Burnett
Project No.: 73205167

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 73205167 WEST COLUMBIA MUL.GPJ TERRACON_DATATEMPLATE.GDT 2/9/21

BORING LOG NO. B-13

PROJECT: West Columbia Multi-Family Development

CLIENT: Fickling and Company, Inc
Macon, GA

SITE: Sunset Boulevard
West Columbia, SC

LOCATION See Exploration Plan

Latitude: 34.0106° Longitude: -81.1281°

Approximate Surface Elev.: 329 (Ft.) +/-

MODEL LAYER	DEPTH	ELEVATION (Ft.)		DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
2	0.2	329+/-	**TOPSOIL**, (2 inches)						
			SANDY FAT CLAY (CH), brown and tan, very stiff				5-8-11 N=19		
	3.0	326+/-							
			CLAYEY SAND (SC), fine to medium grained, orange and tan, medium dense	5			8-10-13 N=23		
					▽		8-11-11 N=22		
				10			6-6-11 N=17		
	12.0	317+/-							
			SILTY SAND (SM), with mica and silt seams, fine to medium grained, tan and white, medium dense		▨		5-8-8 N=16		
				15					
				20			5-8-10 N=18		
	22.0	307+/-							
3			**SANDY ELASTIC SILT (MH)**, yellow, tan and white, very stiff				4-4-12 N=16		
	27.0	302+/-		25					
			SANDY ELASTIC SILT (MH), yellow, tan and white, soft				WOH-WOH-3 N=3		
	32.0	297+/-		30					
			SANDY ELASTIC SILT (MH), yellow, tan and white, very stiff				4-7-10 N=17		
	35.0	294+/-		35					
			Boring Terminated at 35 Feet						

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
2-1/4" Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:
Elevation was taken from Lexington GIS System

WATER LEVEL OBSERVATIONS

▽ *14 (End of day)*

▽ *7 (After 24 hours)*

▨ *14' (After 24 hours)*

Terracon
521 Clemson Rd
Columbia, SC

Boring Started: 01-11-2021 | Boring Completed: 01-12-2021

Drill Rig: Geoprobe | Driller: B. Burnett

Project No.: 73205167

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 73205167 WEST COLUMBIA MUL.GPJ TERRACON_DATATEMPLATE.GDT 2/9/21

BORING LOG NO. B-14

PROJECT: West Columbia Multi-Family Development

CLIENT: Fickling and Company, Inc
Macon, GA

SITE: Sunset Boulevard
West Columbia, SC

LOCATION See Exploration Plan

Latitude: 34.0105° Longitude: -81.1289°

Approximate Surface Elev.: 332 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		0.2	332+/-						
			TOPSOIL, (2 inches)						
			SANDY FAT CLAY (CH), brown and tan, very stiff				4-8-10 N=18	59-26-33	52
		3.0	329+/-						
			CLAYEY SAND (SC), fine to medium grained, orange and tan, medium dense to dense	5			4-7-8 N=15		
					▽		16-16-16 N=32		
		8.0	324+/-		▽				
			CLAYEY SAND (SC), fine to medium grained, orange and tan, loose				1-1-5 N=6		
		12.0	320+/-	10					
2			**SILTY SAND (SM)**, with mica and silt seams, fine to medium grained, yellow, tan and white, medium dense to dense	15			8-9-8 N=17		
				20			6-7-9 N=16		
				25			11-15-16 N=31		
		27.0	305+/-						
3			**SANDY ELASTIC SILT (MH)**, tan and white, medium stiff						
		30.0	302+/-	30			3-3-4 N=7		
			Boring Terminated at 30 Feet						

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
2-1/4" Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:
Elevation was taken from Lexington GIS System

WATER LEVEL OBSERVATIONS

- ▽ *8.5 (End of day)*
- ▽ *6.5 (After 24 hours)*
- *10.5' (After 24 hours)*

Terracon
521 Clemson Rd
Columbia, SC

Boring Started: 01-11-2021 | Boring Completed: 01-12-2021

Drill Rig: Geoprobe | Driller: B. Burnett

Project No.: 73205167

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 73205167 WEST COLUMBIA MUL.GPJ TERRACON_DATATEMPLATE.GDT 2/9/21

BORING LOG NO. B-15

PROJECT: West Columbia Multi-Family Development

CLIENT: Fickling and Company, Inc
Macon, GA

SITE: Sunset Boulevard
West Columbia, SC

LOCATION See Exploration Plan

Latitude: 34.0099° Longitude: -81.1269°

Approximate Surface Elev.: 340 (Ft.) +/-

MODEL LAYER	DEPTH	ELEVATION (Ft.)	
2	0.2	340+/-	**TOPSOIL**, (3 inches)
			SANDY FAT CLAY (CH), brown and tan, stiff
	3.0	337+/-	
			SILTY SAND (SM), fine to medium grained, orange and tan, medium dense to dense
	17.0	323+/-	
			CLAYEY SAND (SC), fine to medium grained, gray, medium dense
	30.0	310+/-	
			Boring Terminated at 30 Feet

DEPTH (Ft.)	SAMPLE TYPE	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		1-3-6 N=9		
5		7-13-16 N=29		
		9-9-14 N=23		
10		4-7-8 N=15		
		12-17-14 N=31		
15				
		9-10-10 N=20		
20				
		5-8-9 N=17		
25				
		4-6-6 N=12		
30				

WATER LEVEL OBSERVATIONS

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
2-1/4" Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:
Elevation was taken from Lexington GIS System

WATER LEVEL OBSERVATIONS

- *25 (End of day)*
- *20.5 (After 24 hours)*
- *21' (After 24 hours)*

Terracon
521 Clemson Rd
Columbia, SC

Boring Started: 01-12-2021 | Boring Completed: 01-13-2021

Drill Rig: Geoprobe | Driller: B. Burnett

Project No.: 73205167

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 73205167 WEST COLUMBIA MUL.GPJ TERRACON_DATATEMPLATE.GDT 2/9/21

REMI ARRAY PROFILE

West Columbia Multi-Family Development ■ West Columbia, SC

February 18, 2021 ■ Terracon Project No. 73205167

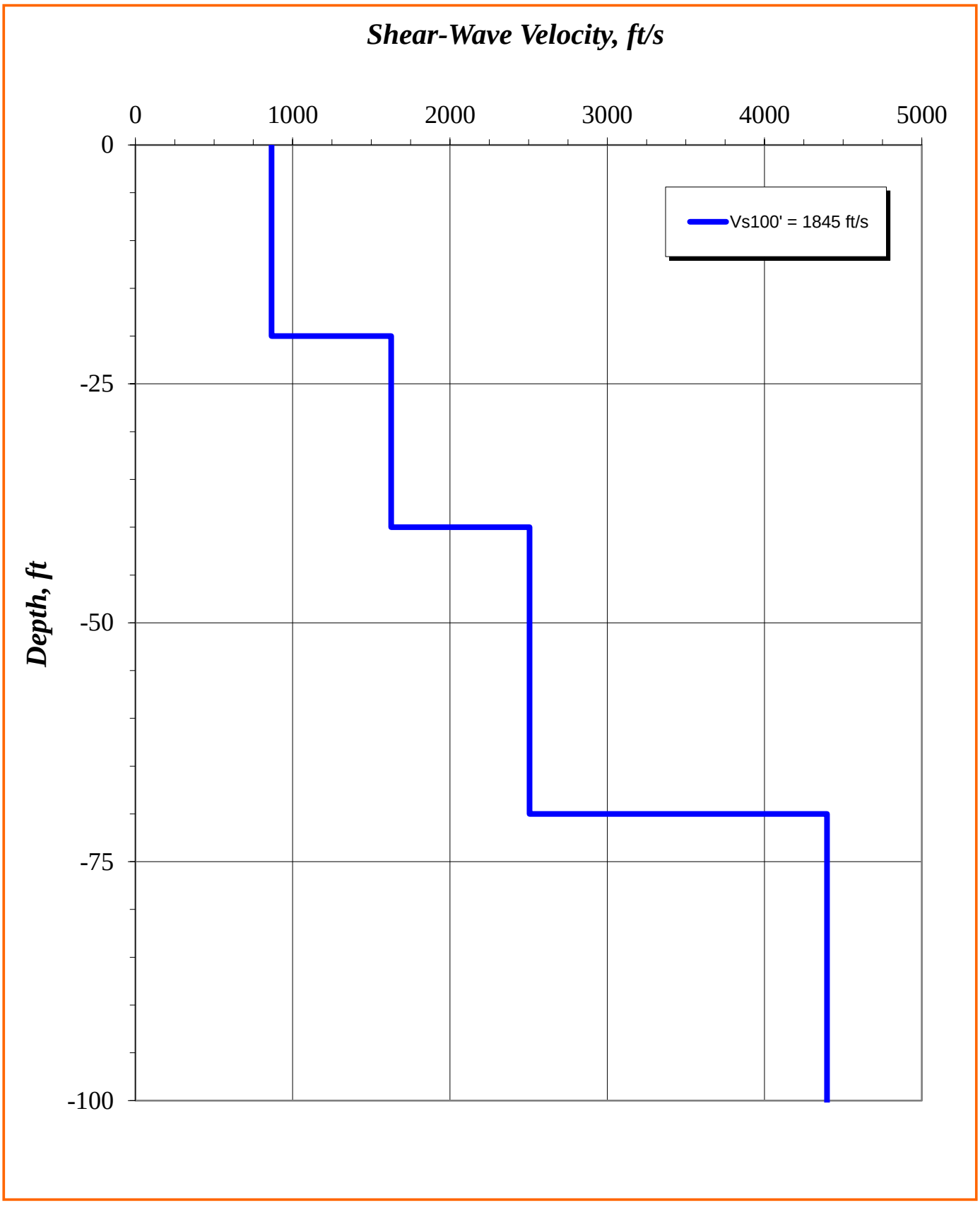


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS
NOT INTENDED FOR CONSTRUCTION PURPOSES

Summary of Laboratory Results

BORING ID	Depth (Ft.)	Liquid Limit	Plastic Limit	Plasticity Index	% Fines	Water Content (%)
B-1	1 - 2.5				12.2	7.7
B-2	1 - 2.5					26.6
B-4	1 - 2.5				30.3	17.3
B-5	1 - 2.5					9.3
B-6	1 - 2.5	39	19	20	36.5	21.1
B-6	13.5 - 15	62	44	18	53.6	31.5
B-8	1 - 2.5					16.9
B-9	1 - 2.5					18.3
B-10	1 - 2.5				14.8	16.6
B-11	1 - 2.5					9
B-12	1 - 2.5					20.9
B-13	1 - 2.5					21.6
B-14	1 - 2.5	59	26	33	52.2	23.6

PROJECT: West Columbia Multi-Family Development

SITE: Sunset Boulevard
West Columbia, SC

Terracon
521 Clemson Rd
Columbia, SC

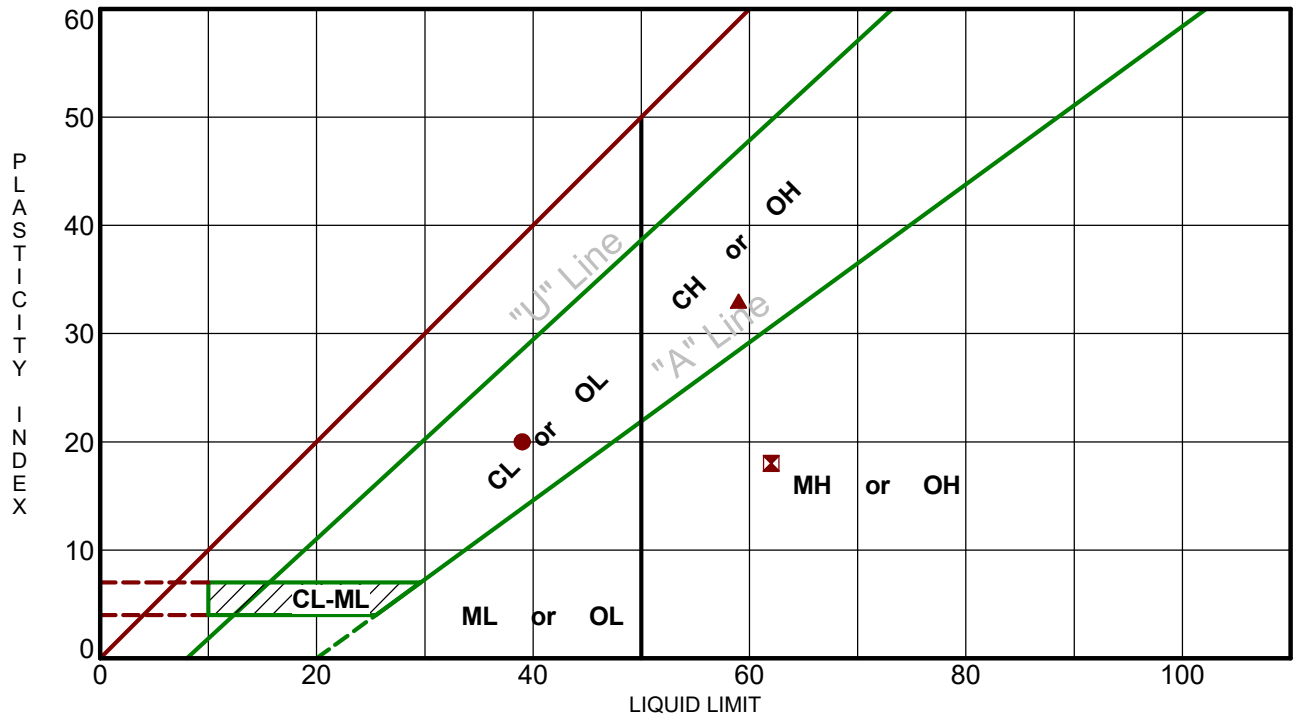
PROJECT NUMBER: 73205167

CLIENT: Fickling and Company, Inc
Macon, GA

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. SMART LAB SUMMARY-PORTRAIT 73205167 WEST COLUMBIA MUL.GPJ 02195238 US 50 AND CHIPMAN.GPJ 1/21/21

ATTERBERG LIMITS RESULTS

ASTM D4318



Boring ID		Depth	LL	PL	PI	Fines	USCS	Description
●	B-6	1 - 2.5	39	19	20	36.5	SC	CLAYEY SAND
⧓	B-6	13.5 - 15	62	44	18	53.6	MH	SANDY ELASTIC SILT
▲	B-14	1 - 2.5	59	26	33	52.2	CH	SANDY FAT CLAY

PROJECT: West Columbia Multi-Family Development

SITE: Sunset Boulevard
West Columbia, SC

Terracon
521 Clemson Rd
Columbia, SC

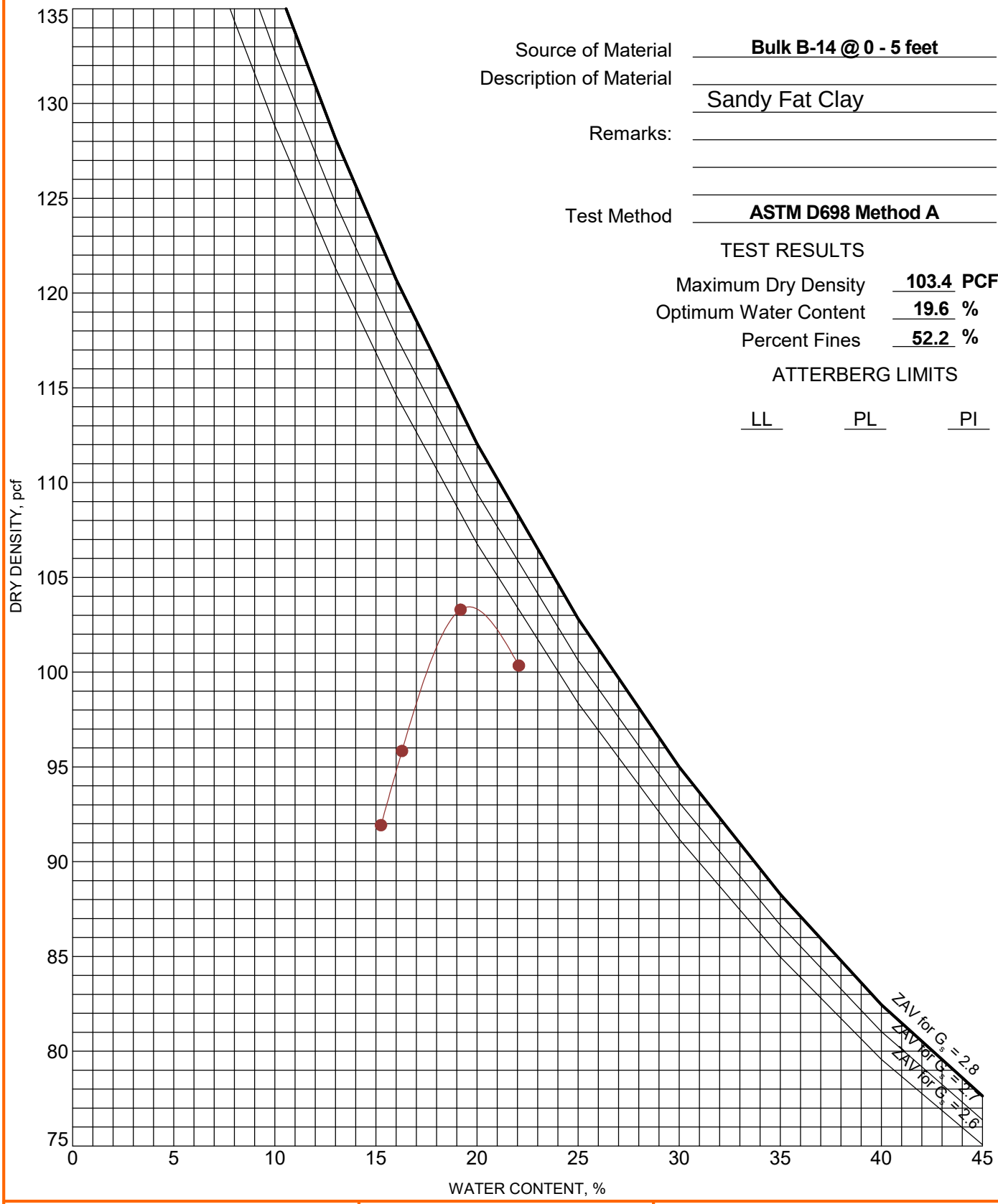
PROJECT NUMBER: 73205167

CLIENT: Fickling and Company, Inc
Macon, GA

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. ATTERBERG LIMITS 73205167 WEST COLUMBIA MUL.GPJ 02195238 US 50 AND CHIPMAN.GPJ 1/21/21

MOISTURE-DENSITY RELATIONSHIP

ASTM D698/D1557



Source of Material: **Bulk B-14 @ 0 - 5 feet**

Description of Material: Sandy Fat Clay

Remarks:

Test Method: **ASTM D698 Method A**

TEST RESULTS

Maximum Dry Density	**103.4**	**PCF**
Optimum Water Content	**19.6**	**%**
Percent Fines	**52.2**	**%**

ATTERBERG LIMITS

LL	PL	PI

PROJECT: West Columbia Multi-Family Development

SITE: Sunset Boulevard
West Columbia, SC

Terracon
521 Clemson Rd
Columbia, SC

PROJECT NUMBER: 73205167

CLIENT: Fickling and Company, Inc
Macon, GA

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. COMPACTION - V2 73205167 WEST COLUMBIA MUL.GPJ 02195238 US 50 AND CHIPMAN.GPJ 1/21/21

SUPPORTING INFORMATION

Contents:

Note: All attachments are one page unless noted above.

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]					Soil Classification	
					Group Symbol	Group Name [B]
Coarse-Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$ [E]		GW	Well-graded gravel [F]
			$Cu < 4$ and/or [Cc<1 or Cc>3.0] [E]		GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH		GM	Silty gravel [F, G, H]
			Fines classify as CL or CH		GC	Clayey gravel [F, G, H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$ [E]		SW	Well-graded sand [I]
			$Cu < 6$ and/or [Cc<1 or Cc>3.0] [E]		SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH		SM	Silty sand [G, H, I]
			Fines classify as CL or CH		SC	Clayey sand [G, H, I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	PI > 7 and plots on or above "A"		CL	Lean clay [K, L, M]
			PI < 4 or plots below "A" line [J]		ML	Silt [K, L, M]
		Organic:	Liquid limit - oven dried	< 0.75	OL	Organic clay [K, L, M, N]
			Liquid limit - not dried			Organic silt [K, L, M, O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above "A" line		CH	Fat clay [K, L, M]
			PI plots below "A" line		MH	Elastic Silt [K, L, M]
		Organic:	Liquid limit - oven dried	< 0.75	OH	Organic clay [K, L, M, P]
			Liquid limit - not dried			Organic silt [K, L, M, Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor				PT	Peat

[A] Based on the material passing the 3-inch (75-mm) sieve.

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay.

[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15% sand, add "with sand" to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.

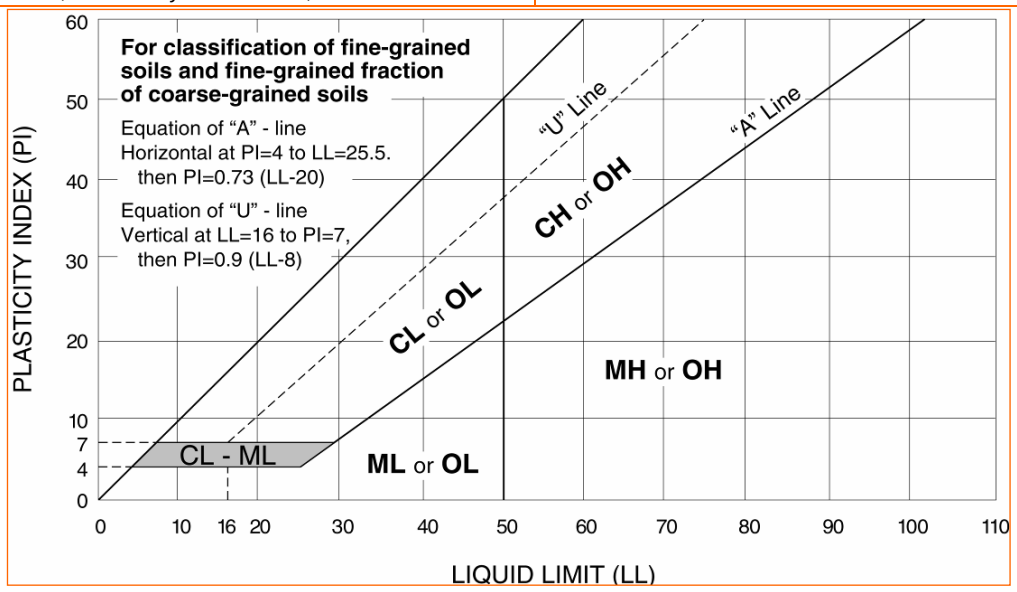
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] PI ≥ 4 and plots on or above "A" line.

[O] PI < 4 or plots below "A" line.

[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.



GENERAL NOTES
DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

Terracon GeoReport

SAMPLING	WATER LEVEL	FIELD TESTS
 Grab Sample  Split Spoon	Water Initially Encountered Water Level After a Specified Period of Time Water Level After a Specified Period of Time Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.	N Standard Penetration Test Resistance (Blows/Ft.) (HP) Hand Penetrometer (T) Torvane (DCP) Dynamic Cone Penetrometer UC Unconfined Compressive Strength (PID) Photo-Ionization Detector (OVA) Organic Vapor Analyzer

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance		CONSISTENCY OF FINE-GRAINED SOILS (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance		
Descriptive Term (Density)	**Standard Penetration or N-Value Blows/Ft.**	**Descriptive Term (Consistency)**	**Unconfined Compressive Strength Qu, (tsf)**	**Standard Penetration or N-Value Blows/Ft.**
Very Loose	0 - 3	Very Soft	less than 0.25	0 - 1
Loose	4 - 9	Soft	0.25 to 0.50	2 - 4
Medium Dense	10 - 29	Medium Stiff	0.50 to 1.00	4 - 8
Dense	30 - 50	Stiff	1.00 to 2.00	8 - 15
Very Dense	> 50	Very Stiff	2.00 to 4.00	15 - 30
		Hard	> 4.00	> 30

RELATIVE PROPORTIONS OF SAND AND GRAVEL		RELATIVE PROPORTIONS OF FINES	
Descriptive Term(s) of other constituents	Percent of Dry Weight	**Descriptive Term(s) of other constituents**	**Percent of Dry Weight**
Trace	<15	Trace	<5
With	15-29	With	5-12
Modifier	>30	Modifier	>12

GRAIN SIZE TERMINOLOGY		PLASTICITY DESCRIPTION	
Major Component of Sample	**Particle Size**	**Term**	**Plasticity Index**
Boulders	Over 12 in. (300 mm)	Non-plastic	0
Cobbles	12 in. to 3 in. (300mm to 75mm)	Low	1 - 10
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)	Medium	11 - 30
Sand	#4 to #200 sieve (4.75mm to 0.075mm	High	> 30
Silt or Clay	Passing #200 sieve (0.075mm)		

SECTION 03 01 00
CONCRETE TESTING

PART 1 – GENERAL

1.1 DESCRIPTION

A. Concrete testing includes verifying subcontractor's proposed mix designs; inspecting of concrete mixing, sampling and testing concrete at frequencies specified and conducting core tests and other additional testing, when required.

1.2 TESTING AGENCY

A. Concrete testing shall be performed by an independent Testing Agency selected by the Owner and paid by the subcontractor.

B. Duties: Testing Agency will perform the following functions:
1. Verify mix designs for concrete classes specified.
2. Review concrete materials for compliance with specifications.
3. Sample concrete at project site and prepare compressive strength test specimens, tests for slump, air content and unit weight.
4. Maintain test data sheet for each set of concrete specimens.
5. Perform specified laboratory tests.
6. Notify Contractor immediately of any test specimens that do not meet design compressive strength at 28 days or 2/3 of design strength at seven days.
7. Distribute copies of test data sheets to Architect and Contractor.

C. Subcontractor's duties relative to testing:
1. Deliver materials to Testing Agency's laboratory for use in verifying design mixes.
2. Advise Testing Agency sufficiently in advance of operations to allow for completion of quality tests and for assignment of personnel.
3. Store cylinders at project site in storage box for 24 hours after molding. Provide labor to assist in obtaining and handling samples.
4. Deliver cylinders to Testing Agency's laboratory.

D. Subcontractor shall designate one individual in his organization to be responsible for conducting subcontractor's duties relative to testing. Testing Agency will instruct individual in his duties. Individual shall not be changed without notice to Architect.

1.3 ACCEPTANCE OF CONCRETE

A. Compressive strength of concrete will be considered satisfactory if averages of all sets of three compressive strength test results equal or exceed the required design compressive strength and no individual strength test result falls below design compressive strength by more than 500 psi.

1.4 REFERENCES

A. American Concrete Institute (ACI):
1. ACI 301 Specification for Structural Concrete for Buildings.
2. ACI 304R Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.

B. American Society for Testing and Materials (ASTM):
1. ASTM C31 Making and Curing Concrete Test Specimens in the Field.
2. ASTM C39 Test Method for Compressive Strength of Cylindrical Concrete Specimens.
3. ASTM C94 Ready-Mixed Concrete.
4. ASTM C143 Test Method for Slump of Hydraulic Cement Concrete.

5. ASTM C172 Sampling Freshly Mixed Concrete
6. ASTM C173 Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
7. ASTM C231 Air Content of Freshly Mixed Concrete by the Pressure Method.

PART 2 – PRODUCTS

2.1 EQUIPMENT

A. Testing Agency will maintain supplies, apparatus, tools and devices at project site to obtain specimens and perform on-site test as indicated, including:
1. Molds for compressive strength test specimens.
2. Slump comes with rod for slump test.
3. Scale and unit weight measure.
4. Thermometers.
5. Concrete thermometer.
6. Air meters.

B. Subcontractor shall provide stable, lockable, insulated store box, thermostatically controlled to maintain temperature between 60 and 80 degrees F. for storage of cylinders for first 24 hours after molding. Box shall have minimum capacity of 40 cu. ft. Locate box in a permanent lockable are of approximately 100 sq. ft. Limit access to Testing Agency personnel and Contractor's designated agent.

PART 3 – EXECUTION

3.1 FREQUENCY AND QUALITY OF SAMPLES

A. Specimens will be taken for acceptance testing for each concrete mix design not less than once a day nor less than once for each 100 cubic yards of concrete or for each 5000 sq. ft. of surface area. Each specimen will consist of four molded cylinders.

B. Specimens will be taken for each concrete mix design on each day in which concrete of the mix design is place.

C. When the frequency of testing will provide less than five acceptance tests for a given mix design, tests will be made from at least five batches selected at random or from each batch.

D. Field specimens for acceptance testing and initial 24-hour period curing will be performed in accordance with ASTM C172.

E. Slump tests will be conducted each time a set of specimens is prepared for compressive strength testing. Testing will be in accordance with ASTM C231 for normal weight concrete.

F. Test for air content will be conducted each time a set of specimens if prepared for compressive strength testing. Testing will be in accordance with ASTM C173.

G. Specimens will be laboratory cured in accordance with ASTM C31.

3.2 LABORATORY TESTING

A. Laboratory compressive strength tests will be performed on cured specimens in accordance with ASTM C39.

B. Testing of one cylinder per specimen will be performed at three days for post-tensioned concrete.

C. Acceptance testing will be performed using two cylinders per specimen at 28 days. Each acceptance test result will be the average of the two cylinders.

D. If one test cylinder for a specimen indicates improper sampling, molding, curing or testing, the questionable cylinder will be discarded and remaining cylinders tested to obtain acceptance test results.

E. Extra test cylinders not used in acceptance testing will be discarded.

3.3 ADDITIONAL TESTING

A. Additional testing, including core tests, load tests, non-destructive or other tests, testing as designated by Architect will be required whenever concrete fails to meet acceptance criteria. Testing will be conducted in accordance with ACI 301. Cost of additional testing for non-conforming work shall be borne by subcontractor.

END OF SECTION

SECTION 03 20 00
CONCRETE REINFORCEMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Reinforcing steel bars, wire fabric and accessories for cast-in-place concrete.

1.2 RELATED SECTIONS

A. Section 03 01 00 - Concrete Testing.

B. Section 03 30 00 - Cast-in-Place Concrete.

1.3 REFERENCES

A. American Concrete Institute (ACI):
   1. ACI 301 Specification for Structural Concrete for Buildings.
   2. ACI 315 Detailing Manual

B. American Society for Testing and Materials (ASTM):
   1. ASTM A108 Steel Bar, Carbon and Alloy, Cold Finished.
   2. ASTM A1064 Carbon Steel Wire and Welded Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
   3. ASTM A615 Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
   4. ASTM A706 Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement.
   5. ASTM D1751 Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).

C. American Welding Society (AWS):
   1. ANSI/AWS D1.1 - Structural Welding Code-Steel.
   2. ANSI/AWS D1.4 - Structural Welding Code-Reinforcing Steel.

D. Concrete Reinforcing Steel Institute (CRSI):
   1. CRSI MSP - Manual of Standard Practice, Latest Edition
   2. CRSI Recommended Practice For Placing Reinforcing Bars, Latest Edition.
   3. CRSI Reinforcement Anchorage and Splices, Latest Edition.

1.4 SUBMITTALS

A. Shop Drawings:
   1. Indicate bar size, spacing, location, placement and quantity of reinforcing steel and wire fabric.
   2. Bending and cutting schedules.
   3. Supporting and spacing devices.
   4. Use the same designation numbers for slabs and footings as used on the Drawings.
   5. Detail walls in elevation.

B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

C. Submit manufacturer's data and installation instructions for:
   1. Mechanical splice device.
   2. Headed concrete anchor.
   3. Deformed bar anchor.

D. Welder's qualification certificates.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with CRSI Manual of Practice ACI 301 and ACI 315.

B. Submit certified copies of mill test report of reinforcement materials analysis.

C. Employ welders on the Work that have successfully qualified for the welding positions required in accordance with Chapter 6, Qualification, AWS D1.4 within the last 12 months. Welders are required to carry proof of their qualification on their person.

1.6 COORDINATION

A. Coordinate with placement of formwork, formed openings and other Work.

PART 2 - PRODUCTS

2.1 REINFORCEMENT

A. Reinforcing Steel: ASTM A615, 60 ksi yield grade; deformed billet steel bars.

B. Reinforcing Steel: ASTM A706, 60 ksi yield grade; deformed low-alloy steel bars.

C. Welded Steel Wire Fabric: ASTM A1064 Plain Type; flat sheets.

D. Deformed Bar Anchors:
1. Flux filled.
2. Made from cold drawn steel in accordance with ASTM A-108, yield strength, 70 ksi.
3. Deformed in accordance with ASTM A-496.

2.2 ACCESSORY MATERIALS

A. Tie Wire: Minimum 16 gage annealed type.

B. Bar Support: Includes spacers, chairs, bolsters, ties and other devices for spacing, supporting and fastening reinforcement in place.
1. General: In accordance with CRSI Manual of Standard Practice.
2. Factory made.
3. Use bar support heights that produce the concrete cover called for on the Drawings.
4. Use bar supports capable of supporting construction loads without permanent deflection.
5. Spacing: At 4 feet maximum with first support 2 feet from end of bar supported.
6. Exposed Concrete: Provide supports in contact with formwork that are:
   a. High density all plastic (CRSI Class 1).
7. Typical support types and minimum configurations.
   a. Slab Bolsters: continuous, type 7 ga. wire or cementitious fiber reinforced.
   b. Individual high chairs:
      1) Legs 5 inch and under: 2 ga. wire, or high density all plastic.
      2) Legs 5 to 12 inches: 0 ga. wire.
      3) Do not use individual high chairs with legs over 12 inches.
   c. Vertical reinforcement: wheel type, high density all plastic.
   d. Supports bearing on earth.
      1) Precast concrete blocks.
      2) Support specifically designed for this purpose, e.g. with sand plates.

C. Slab-On-Grade Expansion Joint Filler: Non-extruded bituminous type conforming to ASTM D1751.

D. Slab-On-Grade Construction Joint: Minimum 24 ga. galvanized steel with formed tongue and groove keyed joint, full depth of slab. Furnish complete with stake pins.

E. Expansion Bolts:
1. Install in strict accordance with manufacturer's recommendations.
2. See Structural drawings for acceptable manufacturers

F. Adhesive Anchors:
1. Install in strict accordance with manufacturer's recommendations.
2. See Structural drawings for acceptable manufacturers

2.3 FABRICATION

A. Fabricate concrete reinforcing in accordance with CRSI Manual of Standard Practice.

B. Locate reinforcing splices where indicated on Drawings.

PART 3 - EXECUTION

3.1 PLACEMENT

A. Place, support and secure reinforcement against displacement. Do not deviate from required position.

B. Do not displace or damage vapor barrier.

C. Accommodate placement of formed openings.

D. Conform to ACI 318 for concrete cover over reinforcement.

3.2 WELDING

A. Reinforcing Bars:
1. General: Welding of reinforcing bars is only permitted at locations expressly detailed or permitted in writing by the Structural Engineer.
2. Execute all welding in accordance with AWS D1.4.
3. Provide reinforcing bars conforming to ASTM A 706 for welding unless permitted in writing by the Structural Engineer.
4. Welding of crossing bars (tack welding) is prohibited.

B. Headed concrete anchors and deformed bar anchors:
1. Install in strict accordance to manufacturer's recommendations, and in accordance with Chapter 7, Stud Welding, AWS D1.1.

3.3 FIELD QUALITY CONTROL

A. Notify the Contractor 24 hours, minimum, prior to concrete placement to allow time for review of installation of all concrete reinforcement.

B. Correction of reinforcement not installed in accordance with the Contract Documents is the subcontractor's responsibility.

C. Inspect installation of headed concrete anchors and deformed bar anchors in accordance with Chapter 7, Stud Welding, AWS D1.1.

END OF SECTION

SECTION 03 30 00
CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. This Section specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.
   1. Included is normal weight concrete and lightweight structural concrete for:
      a. Soil supported slabs-on-grade
      b. Foundation walls
      c. Curbs supporting wood walls
      d. Topping slabs.

B. Related sections:
   1. Section 03 01 00, Concrete Testing
   2. Section 03 20 00, Concrete Reinforcement

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Design Mixtures: For each concrete mixture.

C. Shop Drawings: For steel reinforcement.

D. Material test reports and certificates.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
   1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

B. Comply with the following publications unless modified by requirements in the Contract Documents:
   1. American Concrete Institute (ACI):
      a. ACI 301 Specification for Structural Concrete.
      b. ACI 302.1R Guide for Concrete Floor and Slab Construction.
      c. ACI 304R Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.
      d. ACI 304.2R Placing Concrete by Pumping Methods.
      e. ACI 305R Hot Weather Placing concrete.
      f. ACI 306R Cold Weather Placing concrete.
      g. ACI 308 Standard Practice for Curing Concrete.
      h. ACI 318 Building Code Requirements for Structural Concrete.
      i. MNL-15 Field Reference Manual, Specifications for Structural Concrete, ACI 301 with selected ACI references.
   2. American Society for Testing and Materials (ASTM):
      a. ASTM C31 Making and Curing Concrete Test Specimens in the Field.
      b. ASTM C33 Concrete Aggregates.
      c. ASTM C94 Ready-Mixed Concrete.
      d. ASTM C143 Test Method for Slump of Hydraulic Cement Concrete.
      e. ASTM C150 Portland Cement.
      f. ASTM C171 Sheet Materials for Curing Concrete.

g. ASTM C173 Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
h. ASTM C230 Flow Table for Use in Tests of Hydraulic Cement.
i. ASTM C231 Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
j. ASTM C260 Air-Entraining Admixtures for Concrete.
k. ASTM C330 Lightweight Aggregates for Structural Concrete.
l. ASTM C494 Chemical Admixtures for Concrete.
m. ASTM C618 Coal Fly Ash and Raw or Calcinated Natural Pozzolan for Use as a Mineral Admixture in Concrete.
n. ASTM D1751 Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).
o. ASTM E1155 Determining Floor Flatness and Floor Levelness Numbers.

3. Department of the Army, U.S. Army Corps of Engineers (USACE)
   a. CRD-C 621 Specification for Non-Shrink Grout.

C. Preinstallation Conference: Conduct conference at Project site with concrete supplier, subcontractor, Contractor, and testing agency.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

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

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

2.2 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
   1. Galvanized Reinforcing Bars: ASTM A 767/A 767M, Class [I] [II] zinc coated after fabrication and bending.
   2. Epoxy-Coated Reinforcing Bars: ASTM A 775/A 775M, epoxy coated, with less than 2 percent damaged coating in each 12-inch bar length.

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

C. Deformed-Steel Welded Wire Reinforcement: ASTM A 497, flat sheet.

D. Galvanized-Steel Welded Wire Reinforcement: ASTM A 185, plain, fabricated from galvanized steel wire into flat sheets.

E. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice."

2.3 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
   1. Portland Cement: ASTM C 150, Type I or III. Supplement with the following:

a. Fly Ash: ASTM C 618, Class C or F and not to exceed 25% of cement content by weight.
b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

B. Normal-Weight Aggregates: ASTM C 33
1. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Lightweight Aggregate: ASTM C 330, aggregate shall be composed entirely of lightweight cellular inorganic material.

D. Water: ASTM C 94/C 94M clean and potable.

E. Air-Entraining Admixture: ASTM C 260.

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

G. Synthetic Fiber: Monofilament or fibrillated polypropylene fibers engineered and designed for use in concrete pavement, complying with ASTM C 1116, Type III.

2.4 VAPOR RETARDERS

A. Plastic Vapor Retarder: ASTM E 1745, Class A. Include manufacturer's recommended adhesive or pressure-sensitive tape.

B. Plastic Vapor Retarder: ASTM E 1745, Class B. Include manufacturer's recommended adhesive or pressure-sensitive tape.

C. Plastic Vapor Retarder: ASTM E 1745, Class C, or polyethylene sheet, ASTM D 4397, not less than 10 mils thick. Include manufacturer's recommended adhesive or pressure-sensitive joint tape.

D. Seal all penetrations with pressure sensitive joint tape.

2.5 CURING MATERIALS

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

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

F. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.

G. Clear, Solvent-Borne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

H. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

2.6 RELATED MATERIALS

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

2.7 CONCRETE MIXTURES

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301. Mix concrete in accordance with ACI 304.

B. Proportion normal-weight concrete mixture as follows:
1. Minimum Compressive Strength: As indicated on the Drawings at 28 days.
2. Slump Limit: As indicated on the Drawings.
3. Air Content: As indicated on the Drawings. Do not allow air content of troweled finished floors to exceed 3 percent.
4. Synthetic Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate.

C. Proportion structural lightweight concrete mixture as follows:
1. Minimum Compressive Strength: As indicated on the Drawings at 28 days.
2. Calculated Equilibrium Unit Weight: 110 lb/cu. ft., plus or minus 3 lb/cu. ft. as determined by ASTM C 567.
3. Slump Limit: As indicated on the Drawings.
4. Air Content: As indicated on the Drawings. Do not allow air content of troweled finished floors to exceed 3 percent.
5. Synthetic Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate.

D. Proportion concrete topping slab mixture as follows:
1. Minimum Compressive Strength: As indicated on the Drawings at 28 days.
2. Slump Limit: As indicated on the Drawings.
3. Air Content: As indicated on the Drawings. Do not allow air content of troweled finished floors to exceed 3 percent.
4. Synthetic Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate.

2.8 FABRICATING REINFORCEMENT

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

2.9 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.

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

PART 3 - EXECUTION

3.1 FORMWORK

A. Design, erect, shore, brace, and maintain formwork according to ACI 301 to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Chamfer exterior corners and edges of permanently exposed concrete.

3.2 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

3.3 VAPOR RETARDERS

A. Plastic Vapor Retarders: Place, protect, and repair vapor retarders according to ASTM E 1643 and manufacturer's written instructions.
1. Lap joints 6 inches and seal with manufacturer's recommended tape.

3.4 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

3.5 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

3.6 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
   1. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.

C. Cold-Weather Placement: Comply with ACI 306.1.

D. Hot-Weather Placement: Comply with ACI 301.

3.7 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
   1. Apply to concrete surfaces not exposed to public view.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
   1. Apply to concrete surfaces exposed to public view and noted on the Drawings

C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:
   1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
   2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one part portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white Portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.
   3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix one part Portland cement and one part fine sand with a 1:1 mixture of bonding agent and water. Add white Portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.

D. 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.

3.8 FINISHING FLOORS AND SLABS

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

B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in 1 direction.
   1. Apply scratch finish to surfaces to receive concrete floor toppings.

C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.
   1. Apply float finish to surfaces indicated.

D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
   1. Apply a trowel finish to surfaces indicated.

E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom.
   1. Apply a trowel and fine-broom finish to surfaces indicated.

F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.

3.9 FLOOR FINISH TOLERANCE

A. Interior Slabs
   1. General:
      a. In accordance with ACI 302 and ASTM E 1155.
      b. Testing laboratory to perform all tests and prepare reports for floor finish tolerance.
      c. When ambient or slab temperatures are less than 40° (F.) or more than 100° (F.) obtain individual slab elevations manually. Electronic recording of readings outside of this temperature range is not acceptable unless a submittal from the manufacturer of the recording device stating a different accurate operating range is submitted to the engineer for review before using the equipment.
   2. Test layout: In accordance with ASTM E 1155.
      a. Test area: Area of concrete placed in a continuous pour.
      b. Test sections: Area bounded by grid lines, slab edges, or construction joints.
      c. Sample measurement lines: As defined in ASTM E 1155.
   3. Flatness and levelness tolerance:
      a. Specified overall value (SOV):
         1) Floor flatness = F_F (SOV) = 20.
         2) Floor levelness = F_L (SOV) = 15.
      b. Minimum local value (MLV):
         1) Floor flatness = F_F (MLV)= 15.
         2) Floor levelness = F_L (MLV)= 10.
   4. Timeliness of tests:
      a. Obtain floor tolerance measurements within 24 hours after slab installation.
      b. Obtain measurements prior to removal of shores and forms supporting floor being measured.
   5. Test reports for floor finish tolerance:
      a. Provide report of test results to contractor and architect within 72 hours after slab installation.

b. Include in the report a running tabulation of all overall F_F and overall F_L values of slabs installed to date.

6. Acceptance criteria: Remedial work may be required if either of the following is not met.
   a. The composite value of the entire test area must be equal or greater than either the entire specified overall F-numbers.
   b. The values for any test section must be equal or greater than either of the minimum local F-numbers.
7. Remedial work:
   a. Remedial work may include grinding, planning, skimming, re-topping, or removal and replacement.
   b. Subcontractor shall submit method and materials proposed for remedial work at each location to the architect for review.
   c. Retest is required for all repaired work within two weeks to confirm conformance with floor finish criteria.
   d. The contractor is responsible for correction of floors finished out of tolerance.

B. Exterior slabs
1. Finish exterior slabs to drain freely.
2. Cut out and replace depressions that hold water.

3.10 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h 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. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
1. Moisture Curing: Keep surfaces continuously moist for not less than seven days.
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, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
   a. After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.
4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions.
   a. Recoat Areas subjected to heavy rainfall within three hours after initial application are to be recoated thus within a day of when the slab dries.
5. Interior floors that are scheduled to be exposed concrete are to be cleaned and re coated with the same curing and sealing compound just prior to Substantial Completion.
   a. Auto parking level.
   b. Storage, mechanical, electrical and plumbing equipment rooms.

c. Other floors indicated.

3.11 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

3.12 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
1. Testing Services: Tests shall be performed according to ACI 301.

END OF SECTION

SECTION 03 51 00
GYPSUM CONCRETE FLOOR UNDERLAYMENT

PART 1 GENERAL

1.01 SUMMARY

A. Provide gypsum concrete floor underlayment where shown on the Drawings, as specified herein and as needed for a complete and proper installation.

1.02 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Provide products with a HUD Material Release for the use specified herein.

PART 2 PRODUCTS

2.01 MATERIALS

A. Acceptable manufacturers:
   1. Allied Custom Gypsum
   2. Maxxon Corporation
   3. Hacker Industries, Inc.
   4. United States Gypsum Company

B. Components:
   1. Gypsum cement:
      a. Allied Custom Gypsum: AccuCrete Floor Underlayment.
      b. Maxxon Corporation: Gyp-Crete 2000 Floor Underlayment.
      c. Hacker Industries, Inc.: Firm-Fill 2010 Gypsum Concrete.
      d. United States Gypsum Company: LevelRock Brand Floor Underlayment 2500.
   2. Fine aggregate: Meeting ASTM C33-86.
   3. Water: Clean and potable, free from deleterious amounts of alkalies, acids, and organic materials.

C. Primer: Type recommended by gypsum cement manufacturer for project conditions.

D. Surface conditioner: Type recommended by gypsum cement manufacturer for project conditions.

E. Sealer: Type recommended by gypsum cement manufacturer for project conditions.

2.02 MIXES

A. Mix ingredients in accordance with manufacturer's product data.

B. Design Criteria:
   1. Compressive strength: 2000 PSI, minimum. Test in accord with ASTM C472-84.
   2. Density: 115 PCF dry density.

2.03 SOUND ATTENUATION:

A. Provide sound attenuation mat, perimeter isolation material and acoustical sealant compatible with selected gypsum concrete floor underlayment material.
   1. Acoustical mat:
      a. Allied Custom Gypsum: AccuQuiet D18 Sound Mat.
      a. Maxxon Corporation: Acousti-Mat LPR.
      b. Hacker Industries, Inc.: Firm-Fill SCM.
      c. United States Gypsum Company: LevelRock Brand Sound Attenuation Mat SAM-N12.
   2. Accessories: Provide perimeter isolation material and acoustical sealant as recommended by gypsum concrete underlayment and acoustical mat manufacturer for a complete and proper installation

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

B. Do not commence installation until subfloors are clean, level and in accordance with gypsum cement manufacturer's recommendations and printed instructions

3.02 INSTALLATION

A. Priming:
   1. Prime subfloors in accordance with manufacturer's recommendations.

B. Sound attenuation:
   1. Install sound attenuation mat, perimeter isolation material and acoustical sealant in accordance with manufacturer's recommendations.

C. Topping:
   1. Pour gypsum topping to depth indicated on Drawings. Spread and screed to smooth surface.
   2. Place slurry continuously until each unit is complete and in a manner to prevent any slurry being placed against any topping that has taken initial set.
   3. Float finish level without ridges in areas to receive carpet; steel trowel areas indicated to receive sheet vinyl or other hard finishes.
   4. Avoid splashing slurry on walls or other finished surfaces; remove slurry completely while still plastic.
   5. Allow topping to cure in accord with manufacturer's product data.

3.03 FIELD QUALITY CONTROL

A. Testing: Perform tests in accord with ASTM C472-84 testing procedures for 2" by 2" cube molds.

B. Protection: Protect areas from traffic until system has obtained sufficient set in accordance with manufacturer's recommendations and printed instructions.

C. Repairs: Repair areas damaged from early traffic on unprotected areas at no additional cost. Repair damaged areas prior to installation of finish materials. Use materials recommended by manufacturer for repair.

END OF SECTION

SECTION 04 20 00
REINFORCED MASONRY

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Concrete Block.

B. Mortar and Grout.

C. Reinforcement and Anchorage.

D. Flashings.

E. Lintels.

F. Accessories.

G. Embeds

1.2 RELATED SECTIONS

A. Section 03 30 00 – Cast-in-Place Concrete

B. Section 05 12 00 – Structural Steel

C. Section 06 10 00 - Rough Carpentry

1.3 REFERENCES

A. ACI 530/ASCE 5/TMS 402 - Building Code Requirements for Masonry Structures; American Concrete Institute International.

B. ACI 530.1/ASCE 6/TMS 602 - Specification For Masonry Structures; American Concrete Institute International.

C. ASTM A 615/A 615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

D. ASTM A 641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire (Metric).

E. ASTM C 55 - Standard Specification for Concrete Brick.

F. ASTM C 67 - Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile.

G. ASTM C 90 - Standard Specification for Loadbearing Concrete Masonry Units.

H. ASTM C 94/C 94M - Standard Specification for Ready-Mixed Concrete.

I. ASTM C 140 - Standard Test Methods of Sampling and Testing Concrete Masonry Units and Related Units.

J. ASTM C 144 - Standard Specification for Aggregate for Masonry Mortar.

K. ASTM C 150 - Standard Specification for Portland Cement.

L. ASTM C 207 - Standard Specification for Hydrated Lime for Masonry Purposes.

M. ASTM C 216 - Standard Specification for Facing Brick (Solid Masonry Units Made From Clay or Shale).

N. ASTM C 270 - Standard Specification for Mortar for Unit Masonry.

O. ASTM C 404 - Standard Specification for Aggregates for Masonry Grout.

P. ASTM C 476 - Standard Specification for Grout for Masonry.

Q. ASTM C 780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.

R. ASTM D 226 - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.

1.4 SUBMITTALS

A. Product Data (For Contractor's Record): Provide data for masonry units, fabricated wire reinforcement, and mortar and grout.

B. Submit 2 samples of exposed brick required. Include in each set the full range of color and texture to be expected in the completed work. Architects review will be for color and texture only. Compliance with all other requirements is the exclusive responsibility of the subcontractor.

C. Manufacturer's Certificate (For Architect's Record): Certify that masonry units meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

A. Comply with provisions of ACI 530.1/ASCE 6/TMS 602, except where exceeded by requirements of the contract documents.

1.6 MOCK-UP

A. Erect sample wall panel of brick and block at project site. Build panel as directed. Panel shall show proposed material, method of laying, workmanship, installation of reinforcing, and color of mortar. Contractor shall be responsible for maintaining sample panel throughout the construction period and the removal of panel after the job is completed. Panel shall be the standard of construction of all brick masonry.

B. Locate where directed by Contractor.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store materials under cover, in dry place, and in manner to prevent damage or intrusion of foreign matter. During freezing weather, protect masonry units with tarpaulins or other suitable materials.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Maintain materials and surrounding air temperature to minimum 40 degrees F prior to, during, and 48 hours after completion of masonry work.

B. Maintain materials and surrounding air temperature to maximum 90 degrees F prior to, during, and 48 hours after completion of masonry work.

C. Temporary heat by subcontractor.

1.9 PROTECTION

A. Drop Cloths: During erection, keep walls dry by covering at end of each day or during shutdown period. Protect partially completed walls (not being worked on) similarly. At all times covering shall overhang at least two feet on each side of wall and shall be anchored securely.

B. Protection of Adjacent Areas: During erection, protect new and existing wall surfaces from the accumulation of excess mortar and mud during masonry installation. Protection of new and existing walls shall be maintained until all masonry work is complete.

PART 2 – PRODUCTS

2.1 CONCRETE MASONRY UNITS

A. Concrete masonry units shall be of modular dimensions and units shall be of the same appearance and shall be cured by the same process delivered to the project site in an air-dry condition. Units shall be a minimum of 21 days old prior to delivery to the site.

B. Standard Concrete Block: Comply with referenced standards and as follows:
1. Size: Standard units with nominal face dimensions and nominal depths as indicated on the drawings for specific locations.
2. Special Shapes: Provide non-standard blocks configured for corners.
3. Load-Bearing Units: ASTM C 90, normal weight.
   a. Both hollow and solid block, as indicated.
   b. Exposed faces: Manufacturer's standard color and texture.

C. Lightweight Concrete Masonry Units:
1. Lightweight concrete masonry units shall conform to the requirements of ASTM Specification C-90, Type II, for load bearing concrete masonry units. All units shall be free of organic impurities that will cause rusting, staining or pop outs, and shall contain no combustible matter. The use of coal cinder aggregate/bottom ash, or similar waste products will not be allowed.
2. All aggregate used in the concrete units shall be 100% Solite, Stalite, or approved equal, shall conform to ASTM Specification C 331 "Lightweight Aggregates for Concrete Masonry Units", shall be expanded shale produced by rotary kiln process, and shall be graded to assure constant texture.
3. The air dry weights of all units shall not exceed the following:
   a. 4 x 8 x 16 - 16 pounds; 4 x 8 x 16 - 75% solid - 22 pounds
   b. 6 x 8 x 16 - 20 pounds; 6 x 8 x 16 - 75% solid - 29 pounds
   c. 8 x 8 x 16 - 26 pounds; 8 x 8 x 16 - 75% solid - 38 pounds
   d. 12 x 8 x 16 - 37 pounds; 12 x 8 x 16 - 75% solid - 56 pounds
4. All 8 inch or larger units shall meet U.L. U905 requirements for two hours or better rating (as required) and certificates shall be furnished to the architect prior to any concrete masonry work.
5. The producer of the concrete masonry units will furnish a letter of certification stating that all aggregate used in the manufacturer of the units was expanded and produced by rotary kiln process, 100% Solite or approved equal conforming to ASTM C 331.
6. A random sample of the concrete masonry units may be taken and tested by an independent lab to assure that the concrete masonry units conform to all specifications.

2.2 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C 150, Type I; color as required to produce approved color sample.
1. Hydrated Lime: ASTM C 207, Type S.
2. Mortar Aggregate: ASTM C 144.
3. Grout Aggregate: ASTM C 404.

B. Pigments for Colored Mortar: Iron or chromium oxides with demonstrated stability and colorfastness.
1. Colors: As required to match Architect's color samples.

C. Water: Clean and potable.

2.3 REINFORCEMENT AND ANCHORAGE

A. Reinforcing Steel: ASTM A 615/A 615M Grade 60 (420).
1. Deformed billet-steel bars.
2. Unfinished.

B. Single Wythe Joint Reinforcement (Exterior Walls): Ladder type; ASTM A 82 steel wire, hot dip galvanized after fabrication to ASTM A 153/A 153M, Class B; 0.1875 inch side rods with 0.1483 inch cross rods; width as required to provide not more than 1 inch and not less than 1/2 inch of mortar coverage on each exposure.
1. Manufacturers:
a. Dur-O-Wal: www.dur-o-wal.com.
b. Hohmann & Barnard, Inc: www.h-b.com.
c. Masonry Reinforcing Corporation of America: www.wirebond.com.

C. Single Wythe Joint Reinforcement (Interior Walls): Ladder type; ASTM A 82 steel wire, mill galvanized to ASTM A 641/A 641M; 0.1875 inch side rods with 0.1483 inch cross rods; width as required to provide not more than 1 inch and not less than 1/2 inch of mortar coverage on each exposure.
1. Manufacturers:
a. Dur-O-Wal: www.dur-o-wal.com.
b. Hohmann & Barnard, Inc: www.h-b.com.
c. Masonry Reinforcing Corporation of America: www.wirebond.com.

D. Strap Anchors: Welded bent steel shape, sized as required x 1/4 inch thick, hot dip galvanized to ASTM A 153/A 153M, Class B-2.
1. Manufacturers:
a. Dur-O-Wall Model D/A 709.
b. Heckman Model 315.
c. Hohmann & Barnard Model 359.
d. Masonry Reinforcing Corporation of America Model 1000.

E. Cavity Wall Reinforcement: Reinforcement shall be manufactured from cold-drawn steel wire conforming to ASTM A 82. Reinforcement shall be eye & pintel ladder type. Longitudinal wires and tabs shall be 9 x 9 gauge with 3/16 inch ties. Reinforcement and ties shall be hot-dipped galvanized in accordance with ASTM A 153, Class B-2 (1.5 oz./sq. ft.).
1. Manufacturers:
a. Dur-O-Wall Model D/A360.
b. Hohman & Barnard Model Lox All No. 270.
c. Masonry Reinforcing Corporation of America Series 800.
2. Substitutions: See Section 01600 - Product Requirements.

F. Masonry Veneer Wall Ties: 14 gauge anchors with formed steel wire, 3/16 inch thick,

adjustable, hot dip galvanized to ASTM A 153/A 153M, Class B-2 with co-polymer coated screws.

1. Manufacturers:
   a. Dur-O-Wall Model D/A210 and D/A701.
   b. Heckman Model 315-C and 316
   c. Hohman & Barnard Model DW-10 and VWT.
   d. Masonry Reinforcing Corporation of America Model 1004 and 1100.

2.4 FLASHINGS

A. Self-Adhering Wall Flashing: Flashing shall be a 40 mil self-adhesive, cold-applied sheet consisting of 32 mil of rubberized asphalt integrally bonded to an 8 mil, high-density, cross-laminated polyethylene film. Provide "Perm-A-Barrier" wall flashing manufactured by W. R. Grace or approved equal.

2.5 ACCESSORIES

A. Horizontal Expansion Joint Material: Material shall be prefabricated neoprene joint material, 1/4 inch thick by approximately 2-3/4 inches wide with an adhesive surface on one side. Neoprene material shall conform to ASTM D 1056, Class RE41. Horizontal expansion joint material shall be "Rapid Soft-Joint" as manufactured by Dur-O-Wall.

B. Vertical Expansion Joint Material: Material shall be prefabricated neoprene joint material, 3/8 inch thick by approximately 3 inches wide. Neoprene material shall conform to ASTM D 1056, Class RE41. Joint material shall be "Rapid Expansion Joint" as manufactured by Dur-O-Wall.

C. Control Joint Material: Control joint material for exterior walls shall be rubber and shall be "Rapid Control Joint" by Dur-O Wal or approved equal. Width shall be as required.

D. Joint Filler: Closed cell polyvinyl chloride; oversized 50 percent to joint width; self expanding; 5/8 inch wide x by maximum lengths available.

1. Manufacturers:
   a. Dur-O-Wall, Inc.
   b. Heckmann.
   c. Hohmann & Barnard, Inc.
   d. Masonry Reinforcing Corporation of America.
   e. Substitutions: See Section 01600 - Product Requirements.

E. Weeps: Galvanized steel and plastic tubes.

F. Building Paper: ASTM D 226, Type I ("No. 15") asphalt felt.

G. Cavity Drainage Material: 1 inch thick, reticulated, nonabsorbent mesh, made from polyethylene strands and shaped to maintain drainage at weep holes without being clogged by mortar droppings. Provide "Mortar Net" manufactured by Mortar Net.

H. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials. Cleaning agent for exposed masonry surfaces shall be as recommended by the masonry manufacturer.

2.6 LINTELS

A. Provide CMU lintels at all door and window openings.

B. Reinforce as indicated on the drawings

2.7 MORTAR MIXES

A. Mortar for Unit Masonry: ASTM C 270, using the Proportion Specification.
   1. Masonry below grade and in contact with earth: Type M.
   2. All other masonry: Type S.

B. Colored Mortar: Proportion selected pigments and other ingredients to match Architect's sample, without exceeding manufacturer's recommended pigment-to-cement ratio.

2.8 MORTAR MIXING

A. Thoroughly mix mortar ingredients using mechanical batch mixer, in accordance with ASTM C 270 and in quantities needed for immediate use.

B. Maintain sand uniformly damp immediately before the mixing process.

C. Do not use anti-freeze compounds to lower the freezing point of mortar.

D. If water is lost by evaporation, re-temper only within two hours of mixing.

E. Use mortar within two hours after mixing at temperatures of 90 degrees F, or two-and-one-half hours at temperatures under 40 degrees F.

2.9 GROUT MIXES

A. Bond Beams and Lintels: 3,000 psi strength at 28 days; 8-10 inches slump; provide premixed type in accordance with ASTM C 94/C 94M.
   1. Fine grout for spaces with smallest horizontal dimension of 2 inches or less.
   2. Coarse grout for spaces with smallest horizontal dimension greater than 2 inches.

B. Grouted Cells: 3,000 psi strength at 28 days; 8-10 inches slump; provide premixed type in accordance with ASTM C 94/C 94M.
   1. Fine grout for spaces with smallest horizontal dimension of 2 inches or less.
   2. Coarse grout for spaces with smallest horizontal dimension greater than 2 inches.

2.10 GROUT MIXING

A. Mix grout in accordance with ASTM C 94/C 94M.

B. Thoroughly mix grout ingredients in quantities needed for immediate use in accordance with ASTM C 476 for fine and coarse grout.

C. Add admixtures in accordance with manufacturer's instructions; mix uniformly.

D. Do not use anti-freeze compounds to lower the freezing point of grout.

2.11 PRECONSTRUCTION TESTING

A. Testing will be conducted by an independent test agency.

B. Concrete Masonry: Test each type, class, and grade of concrete masonry unit in accordance with ASTM C 140 for conformance to requirements of this specification.

C. Mortar Mixes: Test mortars pre-batched by weight in accordance with ASTM C 780 recommendations for preconstruction testing.

PART 3 – EXECUTION

3.1 EXAMINATION TO BE DOCUMENTED IN WRITING

A. Verify that field conditions are acceptable and are ready to receive masonry.

B. Verify that related items provided under other sections are properly sized and located.

C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

3.2 PREPARATION

A. Direct and coordinate placement of metal anchors supplied for installation under other sections.
B. Clean reinforcement of loose rust.

C. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

3.3 COURSING

A. Establish lines, levels, and coursing indicated. Protect from displacement.

B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.

C. Concrete Masonry Units:
1. Bond: Running unless otherwise noted on the Drawings.
2. Coursing: One unit and one mortar joint to equal 8 inches.
3. Mortar Joints: Concave unless otherwise noted. Provide flush joints for masonry below grade.

D. Brick Units:
1. Bond: Running unless otherwise noted on the Drawings.
2. Coursing: Three units and three mortar joints to equal 8 inches.
3. Mortar Joints: Concave unless noted otherwise. Provide flush joints for masonry below grade.

3.4 PLACING AND BONDING

A. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.

B. Lay hollow masonry units with face shell bedding on head and bed joints.

C. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.

D. Remove excess mortar as work progresses.

E. Interlock intersections and external corners.

F. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.

G. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.

H. Lay masonry plumb and true to line. Lay with courses level and spaced accurately.

I. Break each course joint with course below, unless shown otherwise. Keep bond plumb throughout.

J. Lay corners and reveals plumb and true.

3.5 REINFORCEMENT AND ANCHORAGE

A. Reinforcement Bars: Secure at locations indicated and to avoid displacement during grouting. Minimum spacing between bars or to masonry surfaces shall be one bar diameter.

B. Joint Reinforcement: Install horizontal joint reinforcement 16 inches on center.
1. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.
2. Place continuous joint reinforcement in first and second joint below top of walls.
3. Lap joint reinforcement ends minimum 6 inches.

C. Anchors: Reinforce joint corners and intersections with strap anchors 16 inches on center.

D. Reinforced Hollow Unit Masonry: Keep vertical cores to be grouted clear of mortar, including bed area of first course.
1. Bond Beams: At bond beams or other locations for horizontally reinforced masonry, provide special masonry units or saw to accommodate reinforcement.

3.6 MASONRY FLASHINGS

A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.
1. Extend flashings full width at such interruptions and at least 8 inches into adjacent masonry or turn up at least 6 inches to form watertight pan at non-masonry construction.
2. Remove or cover protrusions or sharp edges that could puncture flashings.
3. Seal lapped ends and penetrations of flashing before covering with mortar.

B. Extend metal flashings through exterior face of masonry and turn down to form drip.

C. Extend laminated flashings to within 1/4 inch of exterior face of masonry.

D. Concrete and masonry surfaces shall be primed with asphalt primer prior to receiving any trowel mastic.

E. Lap end joints of flashings at least 4 inches and seal watertight with mastic or elastic sealant.

3.7 GROUTING

A. Use either high-lift or low-lift grouting techniques, at Contractor's option, subject to other limitations of contract documents and ACI 530.

3.8 CONTROL AND EXPANSION JOINTS

A. Do not continue horizontal joint reinforcement through control and expansion joints.

B. Form control joint with a sheet building paper bond breaker fitted to one side of the hollow contour end of the block unit. Fill the resultant core with grout fill. Rake joint at exposed unit faces for placement of backer rod and sealant.

C. Size control joint in accordance with sealant performance.

3.9 BUILT-IN WORK

A. As work progresses, install built-in metal door frames and other items to be built into the work and furnished under other sections.

B. Install built-in items plumb, level, and true to line.

C. Do not build into masonry construction organic materials that are subject to deterioration.

3.10 TOLERANCES

A. Maximum Variation from Alignment of Columns: 1/4 inch.

B. Maximum Variation from Unit to Adjacent Unit: 1/16 inch.

C. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft and 1/2 inch in 20 ft or more.

D. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.

E. Maximum Variation from Level Coursing: 1/8 inch in 3 ft and 1/4 inch in 10 ft; 1/2 inch in 30 ft.

F. Maximum Variation of Joint Thickness: 1/8 inch in 3 ft.

G. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch.

3.11 CUTTING AND FITTING

A. Cut and fit for chases, pipes, conduit, and sleeves. Coordinate with other sections of work to provide correct size, shape and location.

B. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.12 CLEANING

A. Methods and materials used to clean masonry shall be approved by Manufacturer of masonry unit to be cleaned.

B. Before applying any cleaning agent to entire wall, apply agent to a sample wall area approximately 20 sq. ft. Apply in a location approved by the Architect. After approval by Architect, clean remaining wall area with same cleaning materials and methods used on sample area.

C. Clean masonry from top down.

D. Use non-metallic tools in cleaning operations.

3.13 PROTECTION OF FINISHED WORK

A. Without damaging completed work, provide protective boards at exposed external corners which are subject to damage by construction activities.

END OF SECTION

SECTION 04 73 00
MANUFACTURED STONE VENEERS

PART 1 GENERAL

1.01 SUMMARY

A. Provide manufactured stone veneers where shown on the Drawings, as specified herein and as needed for a complete and proper installation.

1.02 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section. Installer to have a minimum of 3 years experience in the installation of manufactured stone veneers

PART 2 PRODUCTS

2.01 MANUFACTURED UNITS

A. Acceptable manufacturers:
1. Boral USA.
2. Centurion Products, Inc.
3. Owens Corning Masonry Products, LLC.
4. Coronado Stone Products.
5. Eldorado Stone Corporation.
6. Horizon Stone, LLC.
7. Premier Stone.
8. Summit Masonry Products, Inc.

B. Manufactured stone veneer:
1. Material: Portland cement, lightweight aggregates and iron oxide pigments.
2. Pattern and color: Up to two patterns and/or colors to be selected by Owner from manufacturer's standards.
3. Special shapes: Provide special shapes of same quality color and texture as manufactured stone veneer, including, but not limited to, capstones, keystones, corners and lintels.

2.02 ACCESSORIES

A. Mortar:
1. Portland cement, ASTM C150, Type 1 or masonry cement, ASTM C91, Type N.
2. Masonry sand.
3. Lime, ASTM C207
4. Iron oxide pigments.

B. Metal lath: 18 gauge galvanized woven wire mesh or galvanized 2.5 lb. flat diamond mesh.

C. Weather resistant barrier: Kraft waterproof building paper, UBC Standard No 14-1.

D. Masonry sealer: Breather type, non-film forming sealer.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

B. Substrate preparation: Install one layer of weather-resistant barrier with lap joints 4 inch shingle fashion. Apply code approved metal lath, attach with galvanized nails or staples which penetrate a minimum of 1". Apply 6" O.C. vertically and 16" O.C. horizontally. Wrap weather-resistant barrier and metal lath 16" minimum around all outside and inside corners.

3.02 INSTALLATION

A. Environmental requirements: Laying masonry is prohibited when temperature of surrounding air has dropped below 45 degrees Fahrenheit, unless temperature is rising, and at no time when temperature has dropped below 40 degrees Fahrenheit, except by written permission from the Architect.

B. Installation:
1. Install manufactured stone veneer in accordance with manufacturer's instructions and product data.
2. Apply 1/2" to 3/4" of mortar to lath, covering a maximum of 10 square feet at one time. Press units firmly into mortar bed, wiggle and apply slight pressure to unit to ensure bonding, causing mortar to extrude slightly around edges of units.
3. Place units with uniform mortar joints. Pre-fitted stone textured units should be fitted tightly against each other with no allowance for mortar joints.
4. Plan work to minimize cutting. Perform necessary cutting with proper tools to provide uniform edges. Take care to prevent breaking of unit corner or edges.
5. Remove excess mortar. Do not allow mortar to set on face of units. Point and tool joints before mortar has set. Clean and finish joints in accordance with manufacturers.

END OF SECTION

SECTION 05 51 00
METAL STAIRS

PART 1 GENERAL

1.01 SUMMARY

A. Provide metal stairs as shown on the Drawings, as specified herein and as needed for a complete and proper installation.

B. Design Requirements:
1. NAAMM minimum standards for fixed metal stairs.
2. Stair loading requirement:
a. Live load: 100 PSF uniformly distributed.
b. Minimum concentrated loads: 300 PSF on four sq. in. at tread center.
c. Railing system vertical and horizontal forces: 300 lb. point load or 50 lbs. per lineal foot applied at railing top, whichever is greater.

1.02 SUBMITTALS

A. Complete Shop Drawings showing all members, proposed cuts, connections, holes and similar data.

B. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication, where possible, without delaying job progress.

1.03 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Perform welding with electric arc process and in accordance with AWS "Code for Arc and Gas Welding in Building Construction."

C. In addition to complying with pertinent codes and regulations, comply with:
1. AISC "Specifications for Design, Fabrication, and Erection of Structural Steel for Buildings";
2. AISC "Code of Standard Practice";
3. AISC "Specification for Structural Joints Using ASTM A325 or A490 Bolts."

1.04 DELIVERY, STORAGE AND HANDLING

A. Delivery and storage:
1. Deliver materials to the job site properly marked to identify the location for which they are intended.
2. Use markings corresponding to markings shown on the approved Shop Drawings.

PART 2 PRODUCTS

2.01 MATERIALS

A. Rolled steel plates, bars and other shapes as noted on the Drawings: ASTM A36.

B. Steel pipe: ASTM A53, grade B.

C. Bolts, nuts, washers: ASTM A325, with square or hexagonal heads as selected by the Contractor.

D. High strength bolts: ASTM A325.

E. Arc welding electrodes: ASTM A233, series as required for conditions of intended use.

F. Primer: SSPC 15, Type I, red oxide.

G. Anchor bolts: ASTM A307.

H. Tread Finish Material: 3000 PSI precast concrete treads

2.02 FABRICATION

A. Fabricate items in accordance with AISC specifications.

B. Where finishing is required, complete the assembly, including welding of units, before start of finishing.

C. Provide finish surfaces of members exposed in the final structure free from burrs, markings and other defects.

D. Assemble and weld built-up sections by methods which will produce true alignment of axes without warp.

E. Miscellaneous metal accessories:
1. Metal framing, hangers, struts, clips, brackets, bearing plates, and other components for stairs and platforms support.
2. Brackets and bearing surfaces to anchor and/or attach stairs and railings to supporting structure. Provide complete perimeter welds at all sections subject to moisture penetration.
3. Provide welded bar cross-bracing at underside of all stair runs.

2.03 SHOP PAINTING

A. Thoroughly clean structural steel, removing all loose mill scale, grease, dirt and other foreign matter by scraping or sandblasting.

B. Apply the specified primer and paint to a dry film thickness of not less than 1.5 mils. Touch-up primer application at all surfaces, blemishes, welds and connections for complete coverage prior to painting.

C. Do not paint:
1. Contact surfaces of high strength bolted members.
2. Steel scheduled to be covered by sprayed-on fireproofing, scheduled to be concealed, or scheduled to be in contact with concrete.
3. Prefinished fabrications.

2.04 OTHER MATERIALS

A. Provide other materials not specifically described but required for a complete and proper installation as selected by the Contractor subject to the approval of the Owner.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.02 PREPARATION

A. Establish permanent benchmarks necessary for accurate erection.

B. Check elevations of concrete surfaces and locations of anchor bolts and similar items before erection proceeds.

3.03 FIELD ASSEMBLY

A. Erect stair work to be plumb, square, level, and true in accord with reviewed shop drawings.

B. Attach preformed tread material in accord with reviewed shop drawings.

END OF SECTION

SECTION 05 52 00
ALUMINUM RAILINGS AND FENCING

PART 1 GENERAL

1.01 SUMMARY

A. Provide miscellaneous metal fabrications as shown on the Drawings, as specified herein and as needed for a complete and proper installation.

B. Design Requirements:
1. Prefabricated railing system vertical and horizontal forces: 300 lb. point load or 50 lbs. per lineal foot applied at railing top, whichever is greater.
2. Prefabricated metal fencing system vertical and horizontal forces: 300 lb. point load or 50 lbs. per lineal foot applied at railing top, whichever is greater.

1.02 SUBMITTALS

A. Shop Drawings: Provide complete shop drawings showing all members, proposed cuts, connections, holes and similar data.

B. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication, where possible, without delaying job progress.

1.03 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Manufacturer Qualifications: Minimum five years in producing aluminum railing and fencing systems.

1.04 DELIVERY, STORAGE AND HANDLING

A. Delivery and storage:
1. Deliver materials to the job site properly marked to identify the location for which they are intended.
2. Use markings corresponding to markings shown on the approved Shop Drawings.

PART 2 PRODUCTS

2.01 MATERIALS

A. Extruded aluminum rails, tubes, profiles, pipes and brackets: 6063 extruded aluminum alloy.

B. Bolts, nuts, washers: Stainless steel with square or hexagonal heads as recommended by the system manufacturer.

C. Anchor bolts: Stainless steel.

C. Fasteners for interconnecting components: Stainless steel screws of type and size recommended by the system manufacturer.

D. End caps: Provide aluminum end cap at exposed open ends of rails, tubes and profiles.

2.02 FABRICATION

A. Fabricate picket style railings and fencing in conformance with profiles indicated on the drawings.

B. Where finishing is required, complete the assembly, including welding of units, before start of finishing.

C. Provide finish surfaces of members exposed in the final structure free from burrs, markings and other defects.

D. Assemble and weld built-up sections by methods which will produce true alignment of axes without warp.

E. Miscellaneous metal accessories: Metal framing, hangers, struts, clips, brackets, bearing plates, and other components for attaching railings and fencing to supporting structure. Provide complete perimeter welds at all sections subject to moisture penetration.

2.03 FINISH

A. Shop finish: Powder coat aluminum components in compliance with AAMA 2604.

B. Color: To be selected from manufacturer's standard colors.

2.04 OTHER MATERIALS

A. Provide other materials not specifically described but required for a complete and proper installation as selected by the Contractor subject to the approval of the Owner.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.02 PREPARATION

A. Establish permanent benchmarks necessary for accurate erection.

B. Check elevations of concrete surfaces and locations of anchor bolts and similar items before erection proceeds.

3.03 FIELD ASSEMBLY

A. Erect work to line, plumb, square, and true with runs registering level with floor, decks and platform levels in accord with reviewed shop drawings.

END OF SECTION

SECTION 05 70 00
ARCHITECTURAL METALWORK

PART 1 GENERAL

1.01 SUMMARY

A. Provide miscellaneous metal fabrications as shown on the Drawings, as specified herein and as needed for a complete and proper installation.

B. Design Requirements:
1. Railing system vertical and horizontal forces: 300 lb. point load or 50 lbs. per lineal foot applied at railing top, whichever is greater.

1.02 SUBMITTALS

A. Shop Drawings: Provide complete shop drawings showing all members, proposed cuts, connections, holes and similar data.

B. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication, where possible, without delaying job progress.

1.03 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Perform welding with electric arc process and in accordance with AWS "Code for Arc and Gas Welding in Building Construction."

C. In addition to complying with pertinent codes and regulations, comply with:
1. AISC "Specifications for Design, Fabrication, and Erection of Structural Steel for Buildings";
2. AISC "Code of Standard Practice";
3. AISC "Specification for Structural Joints Using ASTM A325 or A490 Bolts."

1.04 DELIVERY, STORAGE AND HANDLING

A. Delivery and storage:
1. Deliver materials to the job site properly marked to identify the location for which they are intended.
2. Use markings corresponding to markings shown on the approved Shop Drawings.

PART 2 PRODUCTS

2.01 MATERIALS

A. Rolled steel plates, bars and other shapes as noted on the Drawings: ASTM A36.

B. Steel pipe: ASTM A53, grade B.

C. Bolts, nuts, washers: ASTM A325, with square or hexagonal heads as selected by the Contractor.

D. High strength bolts: ASTM A325.

E. Arc welding electrodes: ASTM A233, series as required for conditions of intended use.

F. Primer: SSPC 15, Type I, red oxide.

G. Anchor bolts: ASTM A307.

2.02 FABRICATION

A. Fabricate items in accordance with AISC specifications.

B. Where finishing is required, complete the assembly, including welding of units, before start of finishing.

C. Provide finish surfaces of members exposed in the final structure free from burrs, markings and other defects.

D. Assemble and weld built-up sections by methods which will produce true alignment of axes without warp.

E. Miscellaneous metal accessories: Metal framing, hangers, struts, clips, brackets, bearing plates, and other components for attaching railings and fencing to supporting structure. Provide complete perimeter welds at all sections subject to moisture penetration.

2.03 SHOP PAINTING

A. Thoroughly clean structural steel, removing all loose mill scale, grease, dirt and other foreign matter by scraping or sandblasting.

B. Apply the specified primer and paint to a dry film thickness of not less than 1.5 mils. Touch-up primer application at all surfaces, blemishes, welds and connections for complete coverage prior to painting.

C. Do not paint:
1. Contact surfaces of high strength bolted members.
2. Steel scheduled to be covered by sprayed-on fireproofing, scheduled to be concealed, or scheduled to be in contact with concrete.
3. Prefinished fabrications.

2.04 OTHER MATERIALS

A. Provide other materials not specifically described but required for a complete and proper installation as selected by the Contractor subject to the approval of the Owner.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.02 PREPARATION

A. Establish permanent benchmarks necessary for accurate erection.

B. Check elevations of concrete surfaces and locations of anchor bolts and similar items before erection proceeds.

\3.03 FIELD ASSEMBLY

A. Erect work to line, plumb, square, and true with runs registering level with floor, decks and platform levels in accord with reviewed shop drawings.

END OF SECTION

SECTION 06 10 00
ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
1. Framing with dimension lumber.
2. Framing with engineered wood products.
3. Wood blocking and nailers.
4. Wood furring
5. Sheathing.
6. Subflooring and underlayment.
7. Plywood backing panels.
8. Building wrap and tape.

B. Related Sections include the following:
1. Section 06 17 53 – Shop-Fabricated Wood Trusses

1.3 DEFINITIONS

A. Rough Carpentry: Carpentry work not specified in other Sections and not exposed, unless otherwise indicated.

B. Lumber grading agencies, and the abbreviations used to reference them, include the following:
1. NELMA - Northeastern Lumber Manufacturers Association.
2. NLGA - National Lumber Grades Authority.
3. SPIB - Southern Pine Inspection Bureau.
4. WCLIB - West Coast Lumber Inspection Bureau.
5. WWPA - Western Wood Products Association.

1.4 SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used, net amount of preservative retained, and chemical treatment manufacturer's written instructions for handling, storing, installing, and finishing treated material.
2. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
3. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, with the experience and capability to conduct the testing indicated, as documented according to ASTM E 329.

B. Source Limitations for Engineered Wood Products: Obtain each type of engineered wood product through one source from a single manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber, plywood, and other panels; place spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 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. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
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 thickness or less, unless otherwise indicated.

B. Engineered Wood Products: Provide 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: Provide engineered wood products with allowable design stresses, as published by the manufacturer, which meet or exceed those indicated. Manufacturer's published values shall be 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: DOC PS 1 unless otherwise indicated
2. Oriented Strand Board: DOC PS 2.
3. Thickness: As needed to comply with requirements specified but not less than thickness indicated.
4. Comply with "Code Plus" provisions in APA Form No. E30K, "APA Design/Construction Guide: Residential & Commercial."
5. Factory mark panels according to indicated standard.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

A. Preservative Treatment by Pressure Process: AWPA Standard U1, except that lumber that is not in contact with the ground and is continuously protected from liquid water may be treated according to AWPA UC2 with inorganic boron (SBX).
1. Preservative Chemicals: Acceptable to authorities having jurisdiction and one of the following:
a. Inorganic Boron (SBA).
b. Alkaline Copper Quaternary Type C (ACQ-C).
c. Alkaline Copper Quaternary Type D (ACQ-D).
d. Copper Azole, Type B (CA-B).
e. Copper Azole, Type C (CA-C)

B. Kiln-dry material after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood. Do not use material that is warped or does not comply with requirements for untreated material.

C. Mark each treated item with the 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 floor plates that are installed over concrete slabs directly in contact with earth.

2.3 DIMENSION LUMBER

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

B. Non-Load-Bearing Interior Partitions: Standard, Stud, or No. 3 grade of the same species indicated on the drawings.

C. Exterior and Load-Bearing Walls:
   1. See structural drawings for species and grade

2.4 MISCELLANEOUS LUMBER

A. General: Provide lumber for support or attachment of other construction, including the following:
   1. Blocking.
   2. Nailers.
   3. Furring.
   4. Grounds.
   5. Panels.

B. For items of dimension lumber size, provide grade and species indicated on the drawings with 19 percent maximum moisture content.

C. For concealed boards, provide grade and species indicated on the drawings with 15 percent maximum moisture content.

D. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.5 ENGINEERED WOOD PRODUCTS

A. Wood Trusses: Pre-engineered wood trusses shall comply with ANSI/TPI 1-2007 and other requirements as specified on the structural drawings.

2.6 WALL AND ROOF SHEATHING

A. Plywood or Oriented-Strand-Board Wall Sheathing: Exposure 1, APA Rated Sheathing.
   1. Span Rating: As indicated.
   2. Thickness: As indicated.

B. Plywood or Oriented-Strand-Board Roof Sheathing: Exposure 1, APA Rated Sheathing.
   1. Span Rating: As indicated.
   2. Thickness: As indicated.

2.7 SUBFLOORING AND UNDERLAYMENT

A. Plywood or Oriented-Strand-Board Subflooring: Exposure 1, APA Rated Sheathing.
1. Span Rating: As indicated.
2. Thickness: As indicated.

2.8 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 7/16 inches thick.

2.9 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.
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

B. Nails, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: CABO NER-272.

D. Wood Screws: ASME B18.6.1.

E. Screws for Fastening to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.

F. Lag Bolts: ASME B18.2.1.

G. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.

H. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.
1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.
2. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2.

2.10 METAL FRAMING ANCHORS

A. General: Provide framing anchors made from metal indicated, of structural capacity, type, and size indicated, and as follows:
1. 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.
2. Allowable Design Loads: Provide products with allowable design loads, as published by the manufacturer, which meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

B. Galvanized Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 coating designation.

C. Joist Hangers: U-shaped joist hangers with 2-inch- long seat and 1-1/4-inch- wide nailing flanges at least 85 percent of joist depth.

D. I-Joist Hangers: U-shaped joist hangers with 2-inch- long seat and 1-1/4-inch- wide nailing flanges full depth of joist. Nailing flanges provide lateral support at joist top chord.

E. Top Flange Hangers: U-shaped joist hangers, full depth of joist, formed from metal strap with tabs bent to extend over and be fastened to supporting member.

F. Bridging: Rigid, V-section, nailless type, 0.062 inch thick, length to suit joist or truss size and spacing.

G. Post Bases: As indicated.

H. Roof Truss Tie-Downs (Hurricane or Seismic Ties): As indicated.

I. Floor-to-Floor Ties: As indicated.

J. Hold-Downs: As indicated.

2.11 MISCELLANEOUS MATERIALS

A. 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.

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

C. Sill-Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to suit width of sill members indicated.

D. Adhesives for Field Gluing Panels to Framing: Formulation complying with APA AFG-01 or ASTM D 3498 that is approved for use with type of construction panel indicated by both adhesive and panel manufacturers.

E. Water-Repellent Preservative: NWWDA-tested and -accepted formulation containing 3-iodo-2-propynyl butyl carbamate, combined with an insecticide containing chlorpyrifos as its active ingredient.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

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. Subcontractor to provide a QA/QC documented framing inspection at completion of each building/floor level prior to moving to next area.

C. Do not use materials with defects that impair quality of rough carpentry or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

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

E. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated in the Nailing Schedule on the structural drawings.

F. Use common wire nails, unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood; pre-drill as required.

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

3.2 WOOD GROUND, SLEEPER, BLOCKING, AND NAILER INSTALLATION

A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated. Build anchor bolts into masonry during installation of masonry work. Where possible, secure anchor bolts to formwork before concrete placement.

C. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.3 WOOD FURRING INSTALLATION

A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.
   1. Fire block furred spaces of walls, at each floor level and at ceiling, with wood blocking or noncombustible materials accurately fitted to close furred spaces.

B. Furring to Receive Plywood or Hardboard Paneling: Install 1-by-3-inch nominal- size furring horizontally and vertically at 24 inches o.c.

C. Furring to Receive Gypsum Board: Install 1-by-2-inch nominal- size furring vertically at 16 inches o.c.

3.4 INSTALLATION, GENERAL

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

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

C. Do not splice structural members between supports.

D. Where built-up beams or girders of 2-inch nominal- dimension lumber on edge are required, fasten individual plys together as indicated in the Nailing Schedule on the structural drawings.

3.5 WALL AND PARTITION FRAMING INSTALLATION

A. General: Arrange studs so wide face of stud is perpendicular to direction of wall or partition and narrow face is parallel. Provide single bottom plate and double top plates using members of 2-inch nominal thickness whose widths equal that of studs, except single top plate may be used for non-load-bearing partitions. Anchor [or nail] plates to supporting construction, unless otherwise indicated.
   1. For exterior walls, provide 2-by-4-inch nominal- size wood studs spaced as indicated on the structural plans.
   2. For interior partitions and walls, provide 2-by-4-inch nominal- size wood studs spaced as indicated on the structural plans.

B. Construct corners and intersections with three or more studs. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
   1. Provide continuous horizontal blocking at mid-height of bearing partitions, using members of 2-inch nominal thickness and of same width as wall or partitions.

C. Fire block concealed spaces of wood-framed walls and partitions at each floor level and at ceiling line of top story. Where fire blocking is not inherent in framing system used, provide closely fitted wood blocks of 2-inch nominal- thick lumber of same width as framing members.

D. Frame openings with multiple studs and headers as follows:
   1. For load-bearing walls, provide load bearing header members as indicated on the structural drawings with 1/2 inch thick plywood or OSB flitch plates as necessary to match width of supporting jamb studs. Set headers on edge and support on jamb studs as indicated on the structural drawings.

E. Provide full height bracing in walls at locations indicated on the structural drawings.

3.6 FLOOR JOIST FRAMING INSTALLATION

A. General: Install floor joists with crown edge up and support ends of each member with not less than 1-1/2 inches of bearing on wood or metal, or 3 inches on masonry. Attach floor joists as follows:
   1. Where supported on wood members, by using metal framing anchors.
   2. Where framed into wood supporting members, by using wood ledgers as indicated or, if not indicated, by using metal joist hangers.

B. Members framing from opposite sides and bearing on beams, girders, or partitions shall be lapped not less than 4 inches and be securely tied together. Provide solid blocking of 2-inch nominal thickness by depth of joist over supports.

C. Provide solid blocking between joists under jamb studs for openings.

D. Under non-load-bearing partitions, provide double joists separated by solid blocking equal to depth of studs above.

3.7 CEILING JOIST AND RAFTER FRAMING INSTALLATION

A. Provide special framing as indicated for eaves, overhangs, dormers, overbuild framing of trusses and similar conditions, if any.

3.8 MISC FRAMING INSTALLATION

A. Plywood backing for all low voltage.

END OF SECTION

SECTION 06 17 53
SHOP-FABRICATED WOOD TRUSSES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Shop fabricated wood trusses for roof and floor framing.

B. Bridging, bracing, and anchorage.

C. Preservative treatment of wood.

D. Fire treatment of wood.

1.2 RELATED SECTIONS

A. Section 06 10 00 – Rough Framing

1.3 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM A446, "Specification for Sheet Steel, Zinc Coated (Galvanized) by Hot-Dip Process, Structural (Physical) Quality."

B. American Wood Preservers Association (AWPA):

1. C1, "All Timber Products Preservative Treatment by Pressure Process."

C. National Forest Products Association (NFPA):

1. National Design Specification for Wood Construction, 2015 Edition.
2. Supplement to the National Design Specification for Wood Construction, 2015 Edition.

D. Truss Plate Institute (TPI)

1. HIB-91 Booklet, "Handling, Installing and Bracing Metal Plate Connected Wood Trusses."
2. HET-80, "Handling and Erecting Wood Trusses."
3. ANSI/TPI 1, "National Design Standard for Metal Plate Connected Wood Truss Construction."
4. QST-88, "Metal Plate Connected Wood Trusses."

1.4 SYSTEM DESCRIPTION

A. Design live load and deflection limits: As indicated on the drawings.

B. Minimum truss depth to accommodate mechanical ducts 10 inches in diameter.

1.5 SUBMITTALS

A. Shop Drawings: Submit individual truss designs contain all criteria as listed on the structural drawings.

B. Design Calculations: Submit design calculations sealed by an Engineer registered in the State of South Carolina.

C. Product Data: Provide truss configurations, bearing and anchor details, bridging and bracing.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with the following agencies:

1. Lumber Grading Agency: Certified by ALSC.
2. Plywood Grading Agency: Certified by APA.

B. Truss Design, Fabrication, and Installation: In accordance with Truss Plate Institute HIB-91, HET-80, PCT-80 including Supplement, ANSI/TPI 1-2007, QST-88.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

B. Design trusses under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in the State of South Carolina.

1.8 REGULATORY REQUIREMENTS

A. Conform to Building Code for gravity loads, wind loads, seismic zoning, and other governing load criteria.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect, and handle products to site under provisions of Section 01600.

B. Handle and erect trusses in accordance with TPI HET-80.

C. Store trusses in vertical position resting on bearing ends.

1.10 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on shop drawings.

PART 2 -PRODUCTS

2.1 MATERIALS

A. Lumber Grading Rules: SPIB.

B. Wood Members: Single top and bottom chord, Southern Pine species, No.2 grade, 19 percent maximum moisture content.

C. Steel Connectors: ASTM A445-72 steel, Grade A, hot dip galvanized with ASTM A525, G90 coating.

D. Truss Bridging: Type, size and spacing recommended by truss manufacturer.

2.2 ACCESSORIES

A. Wood Blocking, Plating, Support Members, Framing for Openings: as specified on the drawings

B. Fasteners: Hot dip galvanized steel, type to suit application.

C. Bearing Plates: Hot dip galvanized.

D. Hurricane Ties and Anchors: as specified on the structural drawings.

2.3 FABRICATION

A. Fabricate trusses to achieve structural requirements specified.

B. Brace wood trusses in accordance with TPI HIB-91.

2.4 WOOD TREATMENT

A. Wood Preservative (Pressure Treatment): AWPA Treatment C1 using water borne preservative with 0.25 percent retainage.

PART 3 -EXECUTION

3.1 EXAMINATION

A. Verify that supports and openings are ready to receive trusses.

3.2 PREPARATION

A. Coordinate placement of support items.

3.3 ERECTION

A. Install trusses in accordance with manufacturer's instructions.

B. Set members level and plumb, in correct position.

C. Make provisions for erection loads, and for sufficient temporary bracing to maintain structure plumb, and in true alignment until completion of erection and installation of permanent bracing.

D. Do not field cut or alter structural members without approval of Architect/Engineer.

E. Place headers and supports to frame openings required.

F. Frame openings between trusses with lumber in accordance with Section 06114.

G. Coordinate placement of decking with work of this section.

H. After erection, touch-up galvanized surfaces with zinc primer.

3.4 SITE APPLIED WOOD TREATMENT

A. Apply preservative treatment in accordance with manufacturer's instructions.

B. Brush apply two coats of preservative treatment on wood in contact with cementitious materials. Treat site-sawn cuts.

C. Allow preservative to dry prior to erecting members.

3.5 TOLERANCES

A. Framing Members: 1/2 inch maximum, from true position.

END OF SECTION

SECTION 06 20 00
FINISH CARPENTRY

PART 1 GENERAL

1.01 SUMMARY

A. Provide wood, nails, screws and other items, and perform finish carpentry for the construction shown on the Drawings, as specified herein and as needed for a complete and proper installation.

1.02 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Perform work in accordance with Architectural Woodwork Institute Quality Standards.

1.03 REGULATORY REQUIREMENTS

A. Comply with local code requirements for fire-resistive construction.

1.04 SUBMITTALS

A. Manufacturer's Data: Provide material specifications and installation instructions for specified products. Include instructions for handling, storage and protection for each product.

B. Shop drawings: Provide shop drawings for fabrications, specified herein, of sufficient detail to show fabrication, installation, anchorage, and interface of the work of this Section with work of other trades. Include plans and elevations at not less than 3/8" = 1'-0" scale, and details at not less than 3/4" = 1'-0".

PART 2 PRODUCTS

2.01 LUMBER MATERIALS

A. General
1. Dimensions: indicated lumber dimensions are nominal.
2. Moisture content: 12% maximum
3. Surfacing: Surface four sides, S4S, unless otherwise indicated.

B. Species and grades:
1. Unexposed millwork framing and blocking: 2 x 4: Standard Grade West Coast Lumber.
2. Semi-exposed millwork components: Custom Grade Poplar or equal
3. Exposed and semi-exposed interior painted millwork and trim: Custom Grade White Pine, Fir, or Spruce, kiln dried (KD)
4. Exterior trim: Nominal 1 x 4 to 1 x 12 and 2 x 4 to 4 x 4 trim, No. 2 Spruce, Cedar or Redwood, smooth.

C. Soffit System:
1. Type: Fiber-cement non-perforated soffit panels.
2. Nominal size: 12 ft. long by 16 in. wide, 1/4 in. thick.
3. Finish: Smooth texture, factory primed.
4. Acceptable manufacturers:
   a. James Hardie Building Products: HardiSoffit soffit panels.
   b. Cemplank: Cemsoffit soffit panels.

c. CertainTeed Corporation: WeatherBoards soffit panels.
d. MaxiTile, Inc.: MaxiSoffit soffit panels.
e. Nichiha USA, Inc.: NichiSoffit non-vented smooth soffit panels.

5. Fasteners: Stainless steel, aluminum, or hot-dip galvanized; as recommended by panel manufacturer.
6. Soffit vents: 3" PVC or metal continuous vent providing 15 square inches of free area per linear foot of soffit material.

D. Exterior Ceiling Panels:
1. Type: Fiber-cement ceiling panels.
2. Nominal size: 8 ft. long by 4 ft. wide, 1/4 in. thick.
3. Finish: Smooth texture, factory primed.
4. Acceptable manufacturers:
a. James Hardie Building Products: HardiSoffit soffit panels.
b. Cemplank: Cemsoffit soffit panels.
c. CertainTeed Corporation: WeatherBoards soffit panels.
d. MaxiTile, Inc.: MaxiSoffit soffit panels.
e. Nichiha USA, Inc.: NichiSoffit non-vented smooth soffit panels.
5. Fasteners: Stainless steel, aluminum, or hot-dip galvanized; as recommended by panel manufacturer.

2.03 EXTERIOR SIDING AND TRIM

A. Exterior Siding:
1. Type: Fiber-cement horizontal lap siding, single board pattern.
2. Nominal size: 12 ft. long by 5 1/4 and 8 1/4 in. wide, 5/16 in. thick; 7 in. exposure.
3. Finish: Woodgrain texture with straight edge, factory primed.
4. Acceptable manufacturers:
a. James Hardie Building Products: Prevail lap siding.
b. Cemplank: Cemplank lap siding.
c. CertainTeed Corporation: WeatherBoards lap siding.
d. MaxiTile, Inc.: MaxiPlank lap siding.
e. Nichiha USA, Inc.: NichiBoard cedar lap siding.

B. Exterior Vertical Panel Siding:
1. Type: Fiber-cement vertical panel siding.
2. Nominal size: 4 ft. wide by 10 ft. long, 5/16 in. thick.
3. Finish: Smooth texture with straight edge, factory primed.
4. Acceptable manufacturers:
a. James Hardie Building Products: HardiPanel vertical panel siding.
b. Cemplank: Cempanel vertical panel siding.
c. CertainTeed Corporation: WeatherBoards smooth vertical panel siding.
d. MaxiTile, Inc.: MaxiPanel vertical panel siding.
e. Nichiha USA, Inc.: NichiPanel smooth panel siding.

C. Exterior trim:
1. Nominal 1 x 4 to 1 x 12 trim: 3/4" nominal fiber-cement trim.
2. Nominal 1 x 3 battens: 3/4" x 2 1/2" fiber cement battens.
3. Finish: Smooth finish, factory primed.
4. Acceptable manufacturers:
a. James Hardie Building Products: HardiTrim exterior trim.
b. Cemplank: Cemtrim exterior trim.
c. CertainTeed Corporation: WeatherBoards exterior trim.
d. MaxiTile, Inc.: MaxiTrim exterior trim.
e. Nichiha USA, Inc.: NichiTrim smooth exterior trim.

D. Accessories:
   1. Mounting blocks: Provide 5/4 thick fiber cement mounting blocks with integral plastic flange at all receptacles, dryer vents, hydrants, line sets and other penetrations.
   2. Finish: Smooth finish, factory primed.
   3. Acceptable manufacturer: SturdiBuild, LLC.

E. Fasteners: Stainless steel, aluminum, or hot-dip galvanized; as recommended by siding manufacturer.

2.04 INTERIOR WOOD TRIM

A. Provide paint grade, finger jointed, pine interior wood trim in colonial profiles as selected by the Owner and/or the Owner's Interior Designer.

2.05 PREFABRICATED WOOD GABLE VENTS

A. Gable vents:
   1. Characteristics: Provide primed, paint grade, smooth spruce or cedar, prefabricated functional wood gable vents in sizes and configurations indicted on drawings.
   2. Finish: Primed, paint grade, smooth spruce or cedar,
   3. Accessories: Include integral insect screens.

2.05 OTHER MATERIALS

A. Building wrap: Polyolefin fabric.
   1. Acceptable manufacturers:
      a. Manufacturer of products specified as standard of quality is E.I. du Pont de Nemours and Company.
      b. Products of the manufacturers listed below, meeting indicated standards and specified manufacturer's product data characteristics, are also acceptable for use:
         1) Fiberweb, Inc.; Typar Housewrap.
         2) Owens Corning Foam Insulation; TruWrap Housewrap.
         3) Partiv; Green Guard Classic Wrap.
   2. Acceptable products:
      a. Building wrap: DuPont Tyvek HomeWrap.
      b. Accessories and flashing systems:
         1) Seam tape: DuPont Tyvek Tape.
         2) Sealant: DuPont Weatherization Sealant.
         3) Window flashing: DuPont StraightFlash.
         4) Flexible flashing: DuPont FlexWrap.

B. Provide other materials not specifically described but required for a complete and proper installation as selected by the Contractor subject to the approval of the Owner.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.02 WORKMANSHIP

A. Produce joints that are true, tight and well fastened with all members assembled in accordance with the Drawings.

B. Make joints to conceal shrinkage. Miter exterior joints. Cope interior joints. Miter or scarf end-to-end joints.

C. Install trim using pieces as long as possible.

D. Fastening:
   1. Install items straight, true, level, plumb and firmly anchored in place.
   2. Nail trim with finish nails of proper dimension to hold the member firmly in place without splitting the wood.
   3. Nail exterior trim with galvanized nails, making joints to exclude water and setting in waterproof glue or sealant.
   4. On exposed work, set nails for putty.
   5. Blind nail exterior siding in accordance with manufacturer's instructions.

3.03 FINISHING

A. Sand finished wood surfaces thoroughly as required to produce a uniformly smooth surface. Do not sand wood that is designed to be left rough.

B. Acceptable finish: No sandpaper mark, hammer mark, or other imperfection.

3.04 CLEANING

A. At the end of each working day, and more often if necessary, thoroughly sweep surfaces where refuse from this portion of the Work has settled.

B. At the completion of the work of this Section, thoroughly broom clean all surfaces.

END OF SECTION

SECTION 06 60 00
VINYL RAILINGS AND HANDRAILS

PART 1 GENERAL

1.01 SUMMARY

A. Provide structurally reinforced polyvinyl chloride (PVC) railing system as specified herein and as needed for a complete and proper installation.

B. Design Requirements:
1. Railing system vertical and horizontal forces: 300 lb. point load or 50 lbs. per lineal foot applied at railing top, whichever is greater.

1.02 SUBMITTALS

A. Shop Drawings: Provide complete shop drawings showing all members, proposed cuts, connections, holes and similar data.

B. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication, where possible, without delaying job progress.

1.03 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

1.04 DELIVERY, STORAGE AND HANDLING

A. Delivery and storage:
1. Deliver materials to the job site properly marked to identify the location for which they are intended.
2. Use markings corresponding to markings shown on the approved Shop Drawings.

PART 2 PRODUCTS

2.01 VINYL RAILING SYSTEMS

A. Vinyl Railing System: Provide structural extruded polyvinyl chloride (PVC) railing system:
1. Acceptable product: Product specified as standard of quality for extruded polyvinyl chloride (PVC) railing system is 42” Commercial Vinyl Rail Systems as manufactured by Tek-Rail, Inc.
2. Products of manufacturers listed below meeting indicated standards and specified manufacturer's product data characteristics are acceptable for use, subject to approval by Owner:
a. CertainTeed Corporation; EverNew Vinyl Railing Systems.
b. Mid-Atlantic Vinyl Products; WeatherWise Vinyl Railing Systems.
c. Poly Rail Systems, a division of Digger Specialties, Inc.; Cardinal Vinyl Railing Systems.
3. Components:
a. Railings, pickets, brackets, posts, and post caps: Structurally reinforced extruded virgin polyvinyl chloride (PVC). Color, finish and profiles to be selected from manufacturer’s standard colors.
b. Accessories: Manufacturer’s standard hardware, anchors, brackets and reinforcement as required to meet code and design requirements.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.02 PREPARATION

A. Establish permanent benchmarks necessary for accurate erection.

B. Check elevations of concrete surfaces and locations of anchor bolts and similar items before erection proceeds.

3.03 FIELD ASSEMBLY

A. Erect railing system to line, plumb, square, and true with runs registering level with floor and platform levels in accord with reviewed shop drawings.

END OF SECTION

SECTION 07 11 00
SHEET MEMBRANE WATERPROOFING

PART 1 GENERAL

1.01 SUMMARY

A. Provide adhered sheet membrane waterproofing as shown on the Drawings, as specified herein and as needed for a complete and proper installation.

1.02 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

1.03 ENVIRONMENTAL REQUIREMENTS

A. Maintain the substrate to be waterproofed at or above 40˚F for a minimum of 24 hours before application.

1.04 WARRANTY

A. Provide 5 year warranty including coverage for waterproofing failing to resist penetration of water.

PART 2 PRODUCTS

2.01 SHEET MEMBRANE

A. Acceptable products:
   1. Product specified as standard of quality is Tamko TW-60 self-adhering sheet waterproofing membrane, manufactured by Tamko Asphalt Products.
   2. Products of manufacturers listed below meeting indicated standards and specified manufacturer's product data characteristics are acceptable for use, subject to approval by Owner:
      a. W.R. Grace and Company
      b. Polyguard Products, Inc.
      c. Tremco Barrier Solutions, Inc.

B. Sheet Membrane Thickness: .060"

C. Concrete primer, mastic, and liquid flashing: Type recommended by system manufacturer.

D. Protection board: Type recommended by system manufacturer.

E. Liquid Membrane: Use liquid membrane that is compatible with sheet membrane being used.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

B. The surface must be clean, dry and reasonably smooth. Rough spots, rock pockets, spalls, and other surface imperfections should be smoothed or repaired. Brick or block surfaces should be rendered smooth. Concrete should be at least 7 days old and free of form oil and non-fugitive curing agents. Wood must be dry.

3.02 INSTALLATION

A. Priming: Primer must be applied to a smooth surface by either spray or roller and in accordance with manufacturer's instructions.

B. Establish a starting point by snapping a chalk line. Apply membrane in a straight line, avoiding wrinkles and over-correcting.

C. While the membrane is being rolled out, follow with a stiff broom or a wide roller and press the surface to achieve total contact and eliminate air bubbles. Side laps should be 2-1/2 inches minimum and end laps should be 5 inches minimum.

D. Double cover all inside and outside corners using a 12 inch strip of membrane.

E. All terminations of membrane should receive a bead of mastic.

F. On vertical surfaces more than 8 feet high, membrane should be applied in vertical strips no longer than 8 feet.

3.03 PROTECTION

A. The applied membrane must be protected from damage. Use 1/8 inch protection board or No. 30 roofing felt held in place by mastic.

3.04 SPECIAL CONDITIONS

A. For the waterproofing of drains, penetrations, corners and other locations where adhered membrane would be difficult to apply, use liquid-applied membrane compatible with sheet membrane.

END OF SECTION

SECTION 07 12 00
LIQUID MEMBRANE WATERPROOFING

PART 1 GENERAL

1.01 SUMMARY

A. Provide liquid membrane waterproofing as shown on the Drawings, as specified herein and as needed for a complete and proper installation.

1.02 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

1.03 ENVIRONMENTAL REQUIREMENTS

A. Maintain the substrate to be waterproofed at or above 40˚F for a minimum of 24 hours before application.

1.04 WARRANTY

A. Provide 5 year warranty including coverage for waterproofing failing to resist penetration of water.

PART 2 PRODUCTS

2.01 LIQUID MEMBRANE

A. Acceptable products:
   1 Product specified as standard of quality is Tuff-N-Dri H8 cold applied liquid waterproofing membrane, manufactured by Tremco Barrier Solutions, Inc.
   2. Products of manufacturers listed below meeting indicated standards and specified manufacturer's product data characteristics are acceptable for use, subject to approval by Owner:
      a. Pecora Corporation
      b. Sonneborn-ChemRex
      c. W.R. Meadows, Inc.

B. Finished Liquid Membrane Thickness: Per manufacturer's recommendation

2.02 ACCESSORIES

A. Concrete primer, mastic, and liquid flashing: Type recommended by system manufacturer.

B. Protection board: Type recommended by system manufacturer.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.
B. All surfaces to be covered shall be smooth, dry, firm and free of voids, projections, loose materials, oil, grease, curing compounds and other foreign matter.

3.02 APPLICATION

A. Do not apply membrane unless ambient air temperature is 40˚F and rising.

B. Apply using spray or roller as recommended by manufacturer.

C. Apply one or two coats as recommended by manufacturer in order to achieve a uniform finish thickness.

D. Protect membrane from damage after curing by covering with protection board and fabric.

END OF SECTION

SECTION 07 19 00
VAPOR RETARDER

PART 1 GENERAL

1.01 SUMMARY

A. Provide vapor retarder as shown on the Drawings, as specified herein and as needed for a complete and proper installation.

1.02 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

PART 2 PRODUCTS

2.01 MATERIALS

A. Vapor Retarder: Ten mil thickness polyethylene sheeting; meet requirements of ASTM E154-68 (1979) for serviceability.

B. Adhesive or tape: Acceptable to manufacturer of vapor retarder material.

PART 3 EXECUTION

3.01 INSTALLATION

A. General
1. Install vapor retarder over compacted, clean subgrade material, free of debris and protrusions.
2. Lay vapor retarder over interior building area to receive concrete slab; lap edges 6 in. Lay membrane with seams perpendicular to and lapped in direction of pour. Turn membrane edges up to within 1/2 in. of slab top at vertical surfaces intersection.
3. Lay vapor retarder continuous under joint filler where expansion or control joints are indicated in slab.
4. Minimize openings in vapor retarder around pipes and other protrusions. Fold at corners to form envelope.

B. Protect vapor retarder installation from damage until concrete slab is in place. Seal all penetrations prior to installing concrete.

END OF SECTION

SECTION 07 21 00
BUILDING INSULATION

PART 1 GENERAL

1.01 SUMMARY

A. Provide building insulation as shown on the Drawings, as specified herein and as needed for a complete and proper installation.

1.02 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

PART 2 PRODUCTS

2.01 INSULATION MATERIALS

A. Batt insulation: Kraft faced Type II, Class C, meeting ASTM C665-86.
   1. Exterior walls: R-15
   2. Floors: R-13
   3. Ceilings and vaults: R-38

B. Alternate attic insulation: Glass fiber loose fill, blown-in type.
   1. Type: Cubed mineral fiber for pneumatic placement; meet ASTM C764-84, Type I, Category 1.
   2. Thickness and density recommended by manufacturer to achieve R-38 rating thermal resistance.

2.02 OTHER MATERIALS

A. Attic insulation baffle: Pre-formed ABS plastic with 1" deep troughs between framing members.

B Provide other materials not specifically described but required for a complete and proper installation as selected by the Contractor subject to the approval of the Owner.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.02 INSTALLATION - BATT INSULATION

A. Install insulation and vapor barrier in accordance with manufacturer's instructions.

B. Install in exterior walls, floor, roof and ceiling spaces without gaps or voids.

C. Install with factory applied membrane facing warm side of building spaces. Attach flanges of facing to framing members.

3.03 INSTALLATION - BLOWN-IN INSULATION

A. Install insulation and vapor barrier in accordance with manufacturer's instructions.

B. Install in exterior walls, roof and ceiling spaces without gaps or voids.

END OF SECTION

SECTION 07 31 00
SHINGLES

PART 1 GENERAL

1.01 SUMMARY

A. Provide granular surfaced composition shingle roofing as shown on the Drawings, as specified herein and as needed for a complete and proper installation.

1.02 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Perform work in accordance with ARMA Residential Asphalt Roofing Manual and NRCA Steep Roofing Manual.

1.03 ENVIRONMENTAL REQUIREMENTS

A. Do not install shingles when ambient temperatures are below that required by the product manufacturer.

PART 2 PRODUCTS

2.01 SHINGLES

A. Acceptable products:
   1. Product specified as standard of quality is Heritage 30 dimensional shingles, with 30 year warranty, manufactured by Tamko Asphalt Products.
   2. Products of manufacturers listed below meeting indicated standards and specified manufacturer's product data characteristics are acceptable for use, subject to approval by Owner:
      a. CertainTeed Corporation.
      b. GAF Elk, a division of GAF Materials Corporation
      c. Owens Corning Fiberglass Corporation.

B. Use self-sealing shingles complying with:
   1. Meeting UL Class "A" for fire resistance
   2. Meet UL standards for wind resistance.
   3. Provide shingles with self-sealing strips.
   4. Colors: Color to be selected from manufacturer’s standard colors.

2.02 UNDERLAYMENT

A. Acceptable products:
   1. No. 30 asphalt saturated roofing felt.
   2. Products of manufacturers listed below meeting indicated standards and specified manufacturer's product data characteristics are acceptable for use, subject to approval by Owner:
      a. CertainTeed Corporation.
      b. GAF Materials Corporation.
      c. Owens Corning Fiberglass Corporation.

2.03 ACCESSORIES

A. Nails: Hot dipped zinc coated steel type, of sufficient length to penetrate roof sheathing 3/4" minimum. Roofing felt nails: #9 ring shank with plastic top.

B. Plastic cement: Use asphalt type with mineral fiber components.

C. Flashing:
1. Drip edge: Install drip edge at rake of roof and at all eaves. Fasten to substrate at 1'-6" o.c.; lap sections in direction of flow.
2. Valley flashing: Install polyester ice and water shield at all valley conditions (one full width – 36").
   a. Acceptable product: Guardian Roof Armor Poly Ice & H2O manufactured by Guardian Building Products.
   b. Products of manufacturers listed below meeting indicated standards and specified manufacturer's product data characteristics are acceptable for use, subject to approval by Owner:
      1) CertainTeed Corporation.
      2) GAF Materials Corporation.
      3) Owens Corning Fiberglass Corporation.
      4) ABC Supply.
3. Eave Protection Underlayment: Install polyester ice and water shield at all eave conditions. Extend two widths (+/- 66") up roof from fascia.
   a. Acceptable product: Guardian Roof Armor Poly Ice & H2O manufactured by Guardian Building Products.
   b. Products of manufacturers listed below meeting indicated standards and specified manufacturer's product data characteristics are acceptable for use, subject to approval by Owner:
      1) CertainTeed Corporation.
      2) GAF Materials Corporation.
      3) Owens Corning Fiberglass Corporation.
      4) ABC Supply.

D. Attic Vents: Install ridge vents and off-ridge vents per drawings in black or color to match shingles.
1. Ridge vents: Product to be Roll Vent continuous ridge vent by Tamko Building Products.
   a. Net free area: 18 square inches per linear foot.
2. Off ridge vents: Product to be Model No. 750 by Lomanco.
3. Products of manufacturers listed below meeting indicated standards and specified manufacturer's product data characteristics are acceptable for use, subject to approval by Owner:
   a. Airvent, Inc.
   b. GAF Materials Corporation.
   c. Mid-America Building Product Corporation.
   d. Trimline Building Products.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.02 PREPARATION

A. Verify that plumbing stacks and roof penetrations are flashed to deck surface.

B. Verify roof deck surfaces are dry, free from ridges, warps or voids. Broom clean surfaces.

3.03 FLASHING FABRICATION

A. Form flashings to protect roofing materials from physical damage and shed water. Form sections in maximum possible lengths, free from distortion or defects.

B. Hem exposed edges of flashings minimum of 1/4 inch on underside.

3.04 INSTALLATION - EAVE PROTECTION

A. Place eave and gable end metal flashings tight with fascia boards. Weather lap joints and seal with plastic cement. Secure flange with nails.

B. Install eave underlayment at all eaves. Extend two courses (+/- 66”) up roof from fascia.

C. Provide double course of shingles at eaves.

3.05 INSTALLATION - UNDERLAYMENT

A. Install underlayment perpendicular to slope of roof.

B. Place one ply of underlayment over valleys lapped and nailed. Extend underlayment 12” minimum up each side of valley.

C. Place one ply of underlayment over unprotected area with ends and edges weather lapped and nailed. Stagger end laps of each consecutive layer.

D. Seal items projecting through roof watertight using weather lap with plastic cement.

3.06 INSTALLATION - SHINGLES

A. Install shingles in accordance with manufacturer's instructions.

B. Use double course of shingles at eaves.

C. Place shingles in straight coursing pattern with 5” weather exposure so as to produce double thickness over entire roof area.

D. Extend shingles 3/4 inch over eaves and 1/2 inch over gable end fascia boards.

E. Valleys: Closed, lapped shingle valleys. Provide additional continuous felt underlayment strip, 36 inches minimum width, for full length of valley. Extend all shingle strips 12 inches minimum beyond centerline of valley.

F. Cap hips and ridges with individual shingles, maintaining weather exposure. Place so as to avoid exposed nails.

G. Complete installation to provide weather tight roofing system.

END OF SECTION

SECTION 07 41 00
PREFORMED METAL ROOFING

PART 1 GENERAL

1.01 SUMMARY

A. Provide preformed metal roofing system as shown on the Drawings, as specified herein and as needed for a complete and proper installation.

1.02 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. In addition to complying with applicable codes and regulations, comply with the following:
   1. Underwriter's Laboratories Class A fire rating.
   2. Applicable recommendations in SMACNA "Architectural Sheet Metal Manual."
   3. Applicable standards of the Aluminum Association (AA) and National Association of Architectural Metal Manufacturers (NAAMM).

1.03 SUBMITTALS

A. Manufacturer’s Data: Provide material and fabrication specifications and installation instructions for specified products. Include instructions for handling, storage and protection for each product.

B. Samples: Submit two samples of preformed metal roof material showing texture, color and character of the work. Samples shall be a reasonable size and match the color and texture of panels to be provided. Approved samples shall serve as the standard of quality.

C. Shop drawings: Submit shop drawings for fabrication and erection of preformed metal roofing. Include plans and elevations at not less than 1/8” = 1’-0” scale, and details at not less than 3/4” = 1’-0”. Indicate anchorage and accessory items, gauges, metal types, flashings and finishes.

PART 2 PRODUCTS

2.01 PREFORMED METAL ROOFING

A. Acceptable products:
   1. Product specified as standard of quality is UNA-CLAD UC-4 Roofing Panel standing seam roof system manufactured by Firestone Building Products.
   2. Products of manufacturers listed below meeting indicated standards and specified manufacturer's product data characteristics are acceptable for use, subject to approval by Owner:
      a. Atlanta Metal Products, Inc..
      b. Berridge Manufacturing Company.
      c. Centria Architectural Systems.
      d. Englert, Inc.
      e. Follansbee Steel.
      f. PAC-CLAD/Petersen Aluminum Corporation

2.02 SYSTEM REQUIREMENTS

A. Design preformed metal roofing panels, supports, connections and associated items to the following criteria:
   1. Air infiltration at 20 psf: 0.003 cfm per square foot of panel, maximum.
   2. Water infiltration at 3.9 psf for 15 minutes: 0.0.

B. Characteristics:
   1. Panel material: Roll-formed aluminum sheet, alloy 3003-H4 conforming to ASTM B209, 0.040" minimum thickness.
   2. Profile: 1 1/2" nominal seam height with 16" o.c. nominal seam spacing.
   3. Finish:
      a. Panel face: Fluoropolymer coating, minimum 1.0 DFT, color to be selected from manufacturer's standard colors.
      b. Panel back: Manufacturer's standard clear epoxy resin primer, minimum 1.0 DFT, compatible with panel face finish.
   4. Fastening system: Mechanically crimped field formed continuous seam with snap-on batten.
   5. Preformed trim, flashing, closures, corners and drips: Same material, gauge and finish as panel material.

2.03 UNDERLAYMENT

A. Acceptable products: Vycor Ultra 30 mil ice and water shield manufactured by Grace Construction Products.

2.04 ACCESSORIES

A. Sub-girts: Minimum 18 gauge ASTM A525 C90 galvanized steel.

B. Panel fasteners: Panel manufacturer's standard self-tapping non-corroding screws, type as required for substrate.

C. Panel clips: Panel manufacturer's standard stainless steel panel clips.

D. Tape: Closed cell, foam type tape requiring minimal compressibility to insure a weather-tight panel or to separate panel from dissimilar type metals.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.02 PREPARATION

A. Verify that the substrate is sound, dry, properly sloped for drainage and completely secured in position.

B. Verify that provision has been made for roof drains, scuppers, flashings and all other interface items attaching to or penetrating through the work of this Section.

3.03 FLASHING FABRICATION

A. Form flashings to protect roofing materials from physical damage and shed water. Form sections in maximum possible lengths, free from distortion or defects.

B. Hem exposed edges of flashings minimum of 1/4 inch on underside.

3.04 INSTALLATION

A. Coordinate with the installers of the approved roofing system to ensure that the installed insulation is not permitted to become wet or damaged prior to installation of the work of this Section.

B. Install the work of this Section in strict accordance with the manufacturer's instructions, anchoring all components firmly in position as a completely watertight and weather-tight installation.

C. Anchoring and fastening: Provide for thermal and structural movement; anchor and fasten components to prevent buckling of metal, opening of joints, undue stress to fasteners, and other detrimental effects to roof assembly.

D. Isolate dissimilar metals to prevent corrosive or electrolytic action between metals.

END OF SECTION

SECTION 07 62 00
FLASHING AND SHEET METAL

PART 1 GENERAL

1.01 SUMMARY

A. Provide flashing and sheet metal not specifically described in other Sections of these Specifications but required to prevent water penetration through the exterior shell of the building and as needed for a complete and proper installation.

1.02 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Perform work in accordance with the following:
1. Aluminum Association - Aluminum Construction Manufacturer: Aluminum Sheet Metal Work and Building Construction.
2. National Roofing Contractors Association Roofing Manual.
3. SMACNA Architectural Sheet Metal Manual.

1.03 DELIVERY, STORAGE AND HANDLING

A. Stack preformed material to prevent twisting, bending or abrasion and to provide ventilation.

PART 2 PRODUCTS

2.01 SHEET MATERIALS

A. Galvanized metal: Minimum 26 gauge, uncoated thickness, commercial grade galvanized steel, continuous galvanized in accord with ASTM A525-87, coating designation G140; coated with not less than 1.2 oz. zinc.

B. Aluminum gutters and downspouts.
1. Thickness: 0.027 in. minimum thickness.
2. Type: White baked enamel, 5" ogee with 2" x 3" downspouts.

2.02 ACCESSORIES

A. Fasteners: Finish exposed fasteners same as flashing metal.

B. Gutter and downspout anchorage devices: Type recommended by fabricator.

C. Gutter supports: Brackets, straps or spikes and ferrules.

D. Downspout supports: Brackets or straps.

E. Underlayment: No. 30 asphalt saturated felt.

2.03 COMPONENTS

A. Gutters: .027 gauge aluminum, OG or K style profile.

B. Downspouts: .027 gauge aluminum, rectangular profile.
C. End caps, downspout outlets: Profiled to suit gutters and downspouts.
D. Splashblocks: Fiberglass or concrete type of sizes and profiles indicated.

2.04 FABRICATION

A. Form components true to shape, accurate in size, square and free from distortion or defects. Form pieces in longest practical lengths.

B. Hem exposed edges 1/2 inch on underside; miter and seal corners. Fabricate vertical faces with bottom edge formed outward 1/4 inch and hemmed to form drip.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.02 INSTALLATION

A. Install starter and edge strips and cleats.

B. Secure flashings, gutters and downspouts in place using specified fasteners.

C. Apply plastic cement compound between metal work and felt flashings.

D. Fit components tight in place. Make corners square, surfaces true and straight in planes and lines accurate to profiles.

E. Slope gutters 1/4 inch per foot.

F. Set splashblocks under downspouts.

G. Seal joints watertight.

END OF SECTION

SECTION 07 92 00
SEALANTS AND CAULKING

PART 1 GENERAL

1.01 SUMMARY

A. Throughout the Work, seal and caulk joints where shown on the Drawings and elsewhere as required to provide a positive barrier against passage of moisture and air.

1.02 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

1.03 DELIVERY, STORAGE AND HANDLING

A. Do not retain at the job site any material which has exceeded the shelf life recommended by the manufacturer.

PART 2 PRODUCTS

2.01 SEALANTS

A. Provide the following sealants, or equal, where called for on the Drawings or otherwise required for a complete and proper installation.
   1. Silicone Bath Sealant:
      a. One part silicone rubber; mildew and stain resistant, ASTM C920-86, grade NS, class 25; color; white
      b. Acceptable products:
         1) Dow Corning: #786 Mildew Resistant
         2) General Electric Company, Silicone Products Division; #SCS 1702
         3) Pecora Corp.; #863
   2. Two-part Non-Sag Polyurethane Sealant:
      a. Two-part polyurethane based sealant, ASTM C910-86, type M, grade NS, class 25;
      b. Color to be selected by Architect
      c. Acceptable products:
         1) Pecora Corp., Dynatrol II
         2) Sonneborn-Rexnord; NP-II
         3) Tremco, Inc.; Dymeric
   3. One-part Polyurethane Sealant:
      a. Meet ASTM C910-86, type M, grade NS, class 25
      b. Color to be selected by Architect
      b. Acceptable products:
         1) Pecora Corp., Dynatrol I
         2) Sonneborn-Rexnord; NP-I
         3) Tremco, Inc.; Dymonic
   4. Acrylic-latex Caulking Compound:
      a. Acrylic latex, flexible, paintable, non-staining, non-bleeding, meeting ASTM C834-76
      b. Acceptable products:
         1) Pecora Corp.; AC-20
         2) Sonneborn-Rexnord; Sonolac
         3) Tremco, Inc.; Acrylic Latex Caulk

   5. Two-Part Bitumen Modified Polyurethane Sealant:

a. Type: For horizontal, traffic bearing surfaces
b. Meets Fed. Spec. SS-S-00200D, Type H and TT-S-00227E, Type I, Class A
c. Color: Black
d. Acceptable products:
1) Pecora Corp.; Dynatred
2) Sonneborn-Rexnord; Wide Joint Sealant
3) Tremco, Inc.; THC900

6. Butyl Caulk:
a. Type: One part butyl rubber caulk meeting Fed. Spec. TT-S-001657, Type I; Color: black
b. Acceptable products:
1) Pecora Corp., BC-158
2) Protective Treatments, Inc.; PTI 757
3) Tremco, Inc.; Butyl Sealant.

B. Colors: Colors for each sealant installation will be selected by the Owner from standard colors normally available from the specified manufacturer.

2.02 ACCESSORIES

A. Primer: Non-staining type recommended by sealant manufacturer.

B. Joint cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint compounds.

C. Bond breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.02 PREPARATION

A. Verify that surfaces are ready to receive work and that joint measurements and surface conditions are as recommended by sealant manufacturer.

B. Remove loose materials and foreign matter which may affect adhesion of sealant.

3.03 INSTALLATION

A. Clean joints and install sealant in accordance with manufacturer's instructions.

B. Apply sealant within recommended temperature ranges.

C. Tool joints concave.

3.04 SCHEDULE

A. Schedule below indicates general sealant locations and usage type. Submittals to indicate exact location of each sealant.

1. Silicone Bath Sealant:
   a. Perimeter of all plumbing fixtures mounted on walls and adjacent materials.
   b. Top and edges of backsplashes at all countertops.
   c. Locations requiring NSF, USDA, or other sanitary code requirements.
2. One Part Polyurethane Sealant: Exterior perimeter of all door and window frames to adjacent materials.
3. Two Part Polyurethane Sealant: Interior vertical working expansion and control joints.
4. Two Part Pourable Polyurethane Sealant: Interior horizontal traffic joints.
5. Acrylic Latex Caulk: All interior non-working joints between dissimilar adjacent materials.
6. Butyl Caulk: Use double bead at sill or threshold of all exterior doors.

END OF SECTION

SECTION 08 11 00
METAL DOORS AND FRAMES

PART 1 GENERAL

1.01 SUMMARY

A. Provide metal doors and frames as shown on the Drawings, as specified herein and as needed for a complete and proper installation.

1.02 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
B. Applicable standards:
   1. Steel Door Institute (SDI), Technical Data Series.

PART 2 PRODUCTS

2.01 METAL DOORS

A. Acceptable products:
   1. Product specified as standard of quality is Masonite HD Steel Doors manufactured by Masonite Corporation.
   2. Products of manufacturers listed below meeting indicated standards and specified manufacturer's product data characteristics are acceptable for use, subject to approval by Owner:
      a. Jeld-Wen, Inc.; Energy Saver Steel Doors
      b. Therma-Tru Doors; Traditions Steel Entry Door Systems.
      c. TruTech Doors; Executive Series Entry Doors.

B. Non-rated Insulated Doors:
   1. Type: Raised panel.
   2. Door materials:
      a. Faces: 25 gauge galvanized steel, primed.
      b. Stiles and rails: Wood, roll formed steel.
      c. Core: CFC free polyurethane.
      d. Style: Raised 2-panel.
   3. Frames:
      a. Material: Ponderosa pine, finger joint exterior with weatherstripping.
      b. Provide rated anchors for stud wall jamb conditions.
   4. Hinges:
      a. Three total; three 4 in. template, self-closing, butt type hinges per operating panel, fully mortise to door and jamb.
      b. Finish: US26D satin chrome.

C. Fire-Rated Insulated Doors:
   1. Type: Raised panel.
   2. Door materials:
      a. Faces: 25 gauge galvanized steel, primed.
      b. Stiles and rails: Wood, roll formed steel.
      c. Core: CFC free polyurethane.
      d. Style: Raised 2-panel.
      e. Label: UL factory applied label, rating as indicated on the door schedule.

   3. Frames:
      a. Material: Ponderosa pine, finger joint exterior with weatherstripping.
      b. Provide rated anchors for stud wall jamb conditions.

c. Label: UL factory applied label, rating as indicated on the door schedule.

4. Hinges:
   a. Three total; three 4 in. template, self-closing, butt type hinges per operating panel, fully mortise to door and jamb.
   b. Finish: US26D satin chrome.

D. Patio Doors:
1. Type: Raised panel.
2. Door materials:
   a. Faces: 25 gauge galvanized steel, primed.
   b. Stiles and rails: Wood, roll formed steel.
   c. Core: CFC free polyurethane.
   d. Style: Full single lite, with insulated tempered glass.
3. Frames:
   a. Material: Ponderosa pine, finger joint exterior with weatherstripping.
   b. Provide rated anchors for stud wall jamb conditions.
4. Hinges:
   a. Three total; three 4 in. template, self-closing, butt type hinges per operating panel, fully mortise to door and jamb.
   b. Finish: US26D satin chrome.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.02 INSTALLATION

A. Where practicable, place frames prior to construction of enclosing walls and ceilings.

B. Set frames accurately in position, plumbed, aligned and braced securely.

C. After wall construction is completed, remove temporary braces, leaving surfaces undamaged.

D. When installed in prepared openings in concrete construction, use sealant between frame and concrete.

3.03 ADJUSTMENT

A. Check and adjust operating doors and adjust as necessary.

3.04 CLEANING

A. Immediately after installation, sand smooth any rusted and damaged areas and apply touch-up of primer.

END OF SECTION

SECTION 08 21 50
PREHUNG DOORS

PART 1 GENERAL

1.01 SUMMARY

A. Provide wood doors complete in place with finish hardware installed as shown on the Drawings, as specified herein and as needed for a complete and proper installation.

1.02 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. In addition to complying with applicable codes and regulations, comply with "Architectural Woodwork Quality Standards" of the Architectural Woodwork Institute, for the grade or grades specified.

1.03 DELIVER, HANDLING AND STORAGE

A. Deliver doors to the site after plaster and cement are dry and after the building has reached the average prevailing humidity of its locale.

B. Seal edges of doors immediately after delivery, unless doors are factory sealed.

C. Protect doors with breathable waterproof cover.

PART 2 PRODUCTS

2.01 Molded Interior Doors:

A. Characteristics: Interior hollow core type:
1. Meet NWWDA I.S. 1-86, Grade II, Type II.
2. Faces: Two panel hardboard, paint grade.
3. Thickness: 1-3/8 in.

B. Acceptable products:
1. Product specified as standard of quality is Masonite 2 Panel molded interior doors manufactured by Masonite Corporation.
2. Products of manufacturers listed below meeting indicated standards and specified manufacturer's product data characteristics are acceptable for use, subject to approval by Owner:
   a. Craftmaster Interior Doors.
   b. Ledco, Inc.
   c. Jen-Weld, Inc.

C. Frames:
1. Interior units: One piece or split jamb frame type, paint grade.

D. Trim:
1. Interior: Provide white pine finger jointed trim, both sides; colonial style.

E. Hinges:
   a. Three total; three 4 in. template, butt type hinges per operating panel, fully mortise to door and jamb.
   b. Finish: US26D satin chrome.

2.02 Wood Interior Doors:

A. Characteristics: Interior solid core type:
   1. Meet NWWDA I.S. 1-86, Grade II, Type II.
   2. Style: Single lite French door with tempered glass, paint grade.
   3. Thickness: 1-3/8 in.

B. Acceptable products:
   1. Product specified as standard of quality is Wood French Door Series manufactured by Masonite Corporation.
   2. Products of manufacturers listed below meeting indicated standards and specified manufacturer's product data characteristics are acceptable for use, subject to approval by Owner:
      a. Craftmaster Interior Doors.
      b. Jeld-Wen, Inc.
      c. Stallion Doors and Millwork.

C. Frames:
   1. Interior units: One piece or split jamb frame type, paint grade.

D. Trim:
   1. Interior: Provide white pine finger jointed trim, both sides; colonial style.

E. Hinges:
   a. Three total; three 4 in. template, butt type hinges per operating panel, fully mortise to door and jamb.
   b. Finish: US26D satin chrome.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.02 INSTALLATION

A. Fitting: Unless doors are completely fitted at the mill, fir them for width by planing and fit them for height by sawing to the following clearances:
   1. Bottom: 1/2 inch maximum;
   2. Top: 1/8 inch maximum;
   3. Lock and hinge edges: Bevel 1/8 inch in 2 inches maximum.

B. Install finish hardware in accordance with the manufacturer's instructions.

END OF SECTION

SECTION 08 33 30
OVERHEAD DOORS

PART 1 GENERAL

1.01 SUMMARY

A. Provide overhead doors as shown in the Door Schedule, on the Drawings, as specified herein and as needed for a complete and proper installation.

1.02 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

1.03 SYSTEM DESCRIPTION

A. Provide electric operating system with the following characteristics: 1/2 horsepower operating system with safety stops, automatic light, and remote controls; manually operable in the event of power failure.

PART 2 PRODUCTS

2.01 MATERIALS

A. Acceptable products:
   1. Product specified as standard of quality is 8100 Series raised panel insulated steel door, colonial style with decorative windows manufactured by Wayne-Dalton Corporation.
      a. Windows: Stockton I windows.
      b. Decorative hardware: Spear hardware.
   2. Products of manufacturers listed below meeting indicated standards and specified manufacturer's product data characteristics are acceptable for use, subject to approval by Owner:
      a. Overhead Door Corporation.
      b. Raynor Garage Doors.
      c. Windsor Door Corporation.

B. Sheet steel: ASTM A526; galvanized; flat or roll formed with v-groove for ribbed effect.

C. Metal primer: Zinc chromate type.

D. Weatherstripping: Resilient neoprene strip.

E. Wind resistance: Reinforced for coastal locations.

2.02 COMPONENTS

A. Steel panels: Raised panel steel construction.

B. Track: Rolled steel track, continuous vertical mounted; galvanized steel mounting brackets. Provide 1/4” thick neoprene isolation pads at all brackets at all garages in residential buildings.

C. Hinge and roller assemblies: Heavy duty hinges and adjustable rollers of galvanized steel.

D. Lift mechanism: Torsion springs with braided steel lift cables.

E. Electric operator: Door manufacturer’s standard belt drive operator with integral overhead light.

F. Electric control station: Standard button type control with separate control/switch for each operator and separate control/switch for integral overhead light. Provide key switch at exterior location.

G. Hand held transmitter: Digital control, resettable; 2 units per operator.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.02 PREPARATION

A. Verify that wall openings are ready to receive work and opening dimensions and tolerances are within limits.

3.03 INSTALLATION

A. Install door unit in accordance with manufacturer's instructions.

B. Anchor components securely to existing construction without distortion or stress. Secure tracks to structural members only.

C. Fit and align door unit including hardware, level and plumb, to provide smooth operation.

END OF SECTION

SECTION 08 51 13
VINYL WINDOWS

PART 1 GENERAL

1.01 SUMMARY

A. Provide vinyl windows and screens as listed on the Window Schedule, as shown on the Drawings, as specified herein and as needed for a complete and proper installation.

1.02 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Applicable standards:
1. ANSI/AAMA 101-86: Specification for Architectural Windows and Doors.
2. CPSC: Safety Standard for Architectural Glazing Materials, 16CFR1201, January 1986.
3. HUD UM 111 Fenestration Products.

PART 2 PRODUCTS

2.01 VINYL WINDOWS

A. Acceptable products:
1. Products specified as standard of quality are Series 2900 single hung windows manufactured by Silver Line Windows.
2. Products of manufacturers listed below meeting indicated standards and specified manufacturer's product data characteristics are acceptable for use, subject to approval by Owner:
a. Atrium Windows and Doors.
b. CertainTeed Corporation.
c. General Aluminum Company of Texas, LP.
d. Milguard Manufacturing, Inc.
e. PlyGem Windows.
f. YYK AP America, Inc.

B. Design Pressure Rating: DP 35.

C. Frame: Frame: Unplasticized polyvinylchloride (uPVC), finish to be selected from manufacturer’s standard colors.

D. Glazing: Laminated insulating glass, 15/16 in. total thickness, minimum, (1/8 in. exterior, 7/16” air space, 3/8” laminated interior), clear color, low E2 insulating glass units; units meeting ASTM 1896 and 1996, Class D.

E. Applied Grilles: Manufacturer’s standard grilles in mullion pattern indicated on drawings.

F. Screen Panel: Reversible unit of formed aluminum with acrylic coating. Mesh shall be fiberglass 18 x 16 fiberglass mesh, held in frame by extruded flat retainer spline.

G. Weatherstripping: Full perimeter, woven pile.

H. Window opening control devices: Provide window opening control devices complying with ASTM F2090 at all operable windows with sills located more than 72 inches above finished grade.

I. U-value: 0.4 maximum.

J. SHGC value: 0.25 maximum.

K. Window sizes: As indicated on drawings.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.02 INSTALLATION

A. Install the windows in accordance with the selected manufacturer's instructions.

3.03 CLEANING

A. Labels: Leave labels in place, intact and legible, until reviewed and approved by the Owner.

B. Upon completion of installation and inspection, thoroughly clean all exposed surfaces of windows and screens in accordance with Section 01 71 00 of these Specifications.

END OF SECTION

SECTION 08 71 00
FINISH HARDWARE

PART 1 GENERAL

1.01 SUMMARY

A. Provide finish hardware, trim attachments and fastenings required to complete the Work as shown on the Drawings, as specified herein and as needed for a complete and proper installation.

1.02 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Locksets shall meet the performance criteria of ANSI A156.2 for series and grades as follows:
   1. Residential unit entrance doors: Series 4000, Grade 2.
   2. Doors within residential units: Series 4000, Grade 3.
   3. Common area doors: Series 4000, Grade 2

PART 2 PRODUCTS

2.01 FINISH HARDWARE

A. Acceptable manufacturers:
   1. Manufacturer of products specified as standard of quality is manufactured by Schlage Lock Company.
   2. Products of manufacturers listed below, meeting indicated standards and specified manufacturer's product data characteristics, are also acceptable for use, subject to approval by Owner:
      a. Better Home Products.
      b. DesignHouse by DHI Corp.
      c. Kwikset Corporation.
      d. Pamex, Inc.
      e. Sargent and Company.
      f. Stanley Hardware.
      g. The Delaney Company.
      h. Weiser.
      i. Westlock.

B. Locksets:
   1. Apartment units:
      a. Entry doors: Schlage Series F residential hardware with US15 satin nickel finish.
      b. Interior doors: Schlage Dexter Series residential hardware with US15 satin nickel finish.
   2. Leasing office and storage closets: Schlage Series A heavy-duty residential hardware/medium-duty commercial hardware with US15 satin nickel finish.
   3. Hardware style to meet applicable accessibility standards.
      a. Lever type: All residential units, leasing office and storage closets.
   4. Hardware schedule as indicated on Drawings.

C. Fasteners:
   1. Furnish necessary screws, bolts and other fasteners of suitable size and type to anchor the hardware in position.
   2. Use fasteners which are consistent with the hardware as to finish and material.

D. Where butt hinges are required to swing 180 degrees, use hinges of sufficient throw to clear door trim.

2.02 KEYING

A. Keys: Final keying requirements will be furnished by the Owner.
B. Construction keying:
   1. Provide a construction master key system with five keys. Unauthorized use of master keys by the Contractor is prohibited.
   2. Upon Completion of the Work, void the construction key system and, in the presence of the Owner, demonstrate that the specified keying system is operating properly.

C. Identification and delivery: Identify permanent keys with tags and deliver directly to the Owner.

2.03 OTHER MATERIALS

A. Hinges:
   1. Type: 3 1/2” x 3 1/2” residential hinges.
   2. Finish: US26D satin chrome finish.
   3. Provide non-removable pins at all exterior doors.
   4. Provide self closing hinges at all residential unit entrance doors.
   5. Acceptable manufacturers:
      a. Hager Hinge Company
      b. McKinney Manufacturing Company
      c. Stanley Works.

B. Door closers:
   1. Surface-mounted door closers: Hydraulic door closers with non-ferrous cover, high strength cast iron cylinder having full rack and pinion operation, non-critical and independent tamper-proof regulating screws for adjustment of latch speed, general speed, back check and spring power.
   2. Provide all closers as products of one manufacturer.
   3. Acceptable manufacturers:
      a. LCN.
      b. Norton.
      c. Sargent and Company.
      d. Dorma Door Controls, Inc.
   4. Finish: US26D satin chrome finish.

C. Provide other materials not specifically described but required for a complete and proper installation as selected by the Contractor subject to the approval of the Owner.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.02 INSTALLATION

A. Install all finish hardware in accordance with the manufacturer's instructions.

B. Upon completion of installation adjust all hardware as required to assure smooth and proper operation.

END OF SECTION

SECTION 08 80 00
GLAZING

PART 1 GENERAL

1.01 SUMMARY

A. Provide glazing and glazing accessories as shown on the Drawings, as specified herein and as needed for a complete and proper installation.

1.02 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. In addition to complying with applicable codes and regulations, comply with:
   1. Flat Glass Marketing Association:
      a. Glazing Sealant Manual.
      b. Glazing Manual.
   2. HUD UM 82a Sealed Insulating Glass.

1.03 DELIVERY, STORAGE AND HANDLING

A. During storage and handling of glass, provide cushions at edges to prevent impact damage.

1.04 WARRANTY

A. Special Warranty:
   1. Thermal insulating units: Warrant from failure due to loss of edge seal for ten year period.
   2. Unframed mirrors: Warrant against silver spoilage for five year period.
   3. Begin warranty at Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Glass Products Fabricators:
   1. Tempered glass:
      a. Cardinal IG
      b. Ford Motor Company, Glass Division
      c. PPG Industries, Inc. Glass Group
      d. Viracon.

   2. Mirror glass: Float glass, mirror quality, 1/4 in. thickness. Grind edges evenly and flat polish with no wheel laps.
      a. Carolina Mirror Company
      b. Consolidated Glass & Mirror Corp.
      c. Gardner Mirror Corporation.

2.03 OTHER MATERIALS

A. Provide other materials not specifically described but required for a complete and proper installation as selected by the Contractor subject to the approval of the Owner.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

B. Clean glazing channels, stops, and rabbets to receive the glazing materials. Remove any deleterious substances which might impair the work.

3.02 INSTALLATION

A. Locate setting blocks at sills one quarter of the width of the glass in from each end of the glass, unless otherwise instructed by the manufacturer. Use blocks of the proper size in accordance with the manufacturer's instructions.

B. Set glass in a manner which produces the greatest possible degree of uniformity in appearance.

C. Do not use two different glazing materials in the same joint system.

D. Miter cut and seal the joints of glazing gaskets in accordance with the manufacturer's instructions to provide watertight and airtight seal.

3.03 PROTECTION

A. Protect glass from breakage after installation by promptly installing streamers or ribbons, suitably attached to framing and held free from the glass. Do not apply warning markings directly to the glass.

END OF SECTION

SECTION 09 29 00
GYPSUM WALLBOARD SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. Provide gypsum drywall and accessories where shown on the Drawings, as specified herein and as needed for a complete and proper installation.

1.02 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

PART 2 PRODUCTS

2.01 GYPSUM WALLBOARD

A. Gypsum board types: Thickness as shown on the Drawings. If no thickness is shown use 1/2" standard type and 5/8" fire rated type; maximum permissible length; complying with the following:
   1. Standard type: ASTM C36 and Fed. Spec. SS-L-30D, Type III, Grade R, Class1, with tapered edges.
   2. Fire rated type: ASTM C36 (fire resistive) and Fed. Spec. SS-L-30D, Type III, Grade X, Class 1, with tapered edges. Provide proprietary Type X product as required for UL Rating
   3. Moisture resistant type: ASTM C630 and Fed. Spec. SS-L-30D, Type VII, Grade W or X, Class 2, with tapered edges.
   4. Exterior sheathing board: ASTM C79, fire resistant, 5/8" thickness, exterior gypsum board sheathing.

B. Finishes:
   1. Interior walls: Light orange peel texture.
   2. Interior ceilings: Heavy orange peel texture, white.

2.02 ACCESSORIES

A. Acoustical insulation: ASTM C665, preformed mineral wool, friction type fit, unfaced.

B. Acoustical sealant: Non-hardening, non-skinning, specified for use with gypsum board.

C. Joint materials: ASTM C475, reinforcing tape, joint compound, adhesive and water.

D. Corner beads: Metal.

E. Fasteners: ASTM C1002 type S12 hardened screws.

2.03 OTHER MATERIALS

A. Provide other materials not specifically described but required for a complete and proper installation as selected by the Contractor subject to the approval of the Owner.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.02 INSTALLATION

A. Install gypsum board in accordance with manufacturer's instructions.

B. Fasten gypsum board to furring or framing with screws.

C. Place control joints consistent with lines of building spaces as directed.

D. Place corner beads at external corners. Place edge trim where gypsum board abuts dissimilar materials.

3.03 JOINT TREATMENT

A. Tape, fill and sand exposed joints, edges and corners to a smooth surface ready to receive finish.

B. Taping and filling is required on surfaces behind adhesive applied ceramic tile.

3.04 CLEANING

A. Use necessary care to prevent scattering gypsum wallboard scraps, plaster, dust and to prevent tracking plaster materials onto floor surfaces.

B. At the completion of installation promptly pick up and remove from the working area all scrap, debris and surplus material.

END OF SECTION

SECTION 09 31 00
CERAMIC TILE

PART 1 GENERAL

1.01 SUMMARY

A. Provide ceramic tile as shown on the Drawings, as specified herein and as needed for a complete and proper installation.

1.02 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

PART 2 PRODUCTS

2.01 CERAMIC TILE

A. Ceramic tile - Residential units:
   1. Acceptable manufacturers:
      a. American Olean Tile Company
      b. Dal-Tile Corp.
      c. Florida Tile Division
      d. Interceramic, USA
      e. Mid-State Tile Company
      f. United States. Ceramic Tile Company
   2. Characteristics:
      a. Use ceramic wall tile and accessories complying with Tile Council of America Specifications A137.1, Section 6.1, Standard Grade, non-vitreous, bright glazed.
      b. Edges: Cushion.
      c. Color: To be selected by the Interior Designer from manufacturer's standard colors.
      d. Nominal face size: 6" x 6".
      e. Thickness: 5/16".
      f. Furnish tile with edge spacer lugs.
      g. Trim shapes: Match tile color and size for thin-set application. Include base, bullnose caps, beads, and corner units as required.

B. Ceramic tile - Leasing center and amenity buildings:
   1. Acceptable products: See drawings and schedules provided by the Interior Designer.
   2. Acceptable manufacturers:
      a. American Olean Tile Company.
      b. Amtico International Limited.
      c. Architectural Systems, Inc.
      d. Dal-Tile Corporation.
      e. Iris Ceramica.
      f. Florida Tile Division.
      g. Interceramic, USA.
      h. Mid-State Tile Company.
      i. Shaw Home Foundations Flooring.
      j. United States Ceramic Tile Company.

3. Characteristics:
   a. Color: See drawings and schedules provided by the Interior Designer.
   b. Nominal face size: See drawings and schedules provided by the Interior Designer.
   c. Trim shapes: Match tile color and size for thin-set application. Include base, bullnose caps, beads, and corner units as required.

2.02 SETTING MATERIALS

A. Comply with ANSI A136.1, using Type I where exposed to prolonged water presence and using Type II at all other locations.

2.03 GROUT

A. Use commercially prepared grouting composition, meeting ANSI A118.1-1985 with latex additive, not requiring damp curing, and with high flexibility and stain resistance. See drawings and schedules provided by Owner's Interior Designer for colors.

2.04 OTHER MATERIALS

A. Provide other materials not specifically described but required for a complete and proper installation as selected by the Contractor subject to the approval of the Owner.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.02 INSTALLATION

A. Install adhesive, tile, and grout in accordance with the manufacturer's instructions.

B. Lay tile and accessories to pattern indicated on the Drawings. Do not interrupt tile pattern through openings.

C. Cut and fit tile tight to penetrations. Form corners and bases neatly.

D. Grout tile joints. Make joints watertight, without voids, cracks excess mortar or excess grout.

E. Apply sealant to interface of tile and dissimilar materials.

3.03 CLEANING

A. Upon completion of installation, clean the work of this Section in accordance with the manufacturer's instructions.

B. Provide tile surfaces clean and free from cracked, broken, chipped, unbonded and otherwise defective units.

END OF SECTION

SECTION 09 64 33
ENGINEERED WOOD FLOORING

PART 1 GENERAL

1.01 SUMMARY

A. Provide wood strip flooring as shown on the Drawings, as specified herein and as needed for a complete and proper installation.

1.02 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

PART 2 PRODUCTS

A. Acceptable products:
   1. Product specified as standard of quality is Century Farm Collection Hardwood Flooring manufactured by Armstrong World Industries, Inc.
   2. Products of manufacturers listed below meeting indicated standards and specified manufacturer's product data characteristics are acceptable for use, subject to approval by Owner:
      a. Bruce Hardwood Floors.
      b. Harris Wood.
      c. HomerWood Premium Hardwood Flooring.
      d. Shaw Industries.

B. Characteristics:
   1. Construction: Engineered multi-ply laminated construction with tongue and grove sides and end matched.
   2. Dimensions:
      a. Total thickness: 1/2".
      b. Size: 5” planks.
      c. Wear layer: 1/12”
   3. Colors/patterns: Selected by Owner's Interior Designer from manufacturer's standard colors/patterns.

C. Thresholds/reducer strips: Provide solid wood threshold/reducer strips at intersections with other flooring materials. Slope/bevel to comply with all applicable accessibility requirements.

D. Base: Use base material as indicated on Interior Design drawings.

E. Fasteners: Provide fastening system as recommended by the engineered wood flooring manufacturer and/or the Owner’s Interior Design Consultant.

F. Isolation pad: Provide isolation pad as recommended by the engineered wood flooring manufacturer and/or the Owner’s Interior Design Consultant.

G. Maintenance materials: Urethane wood and laminate flooring cleaner as recommended by the engineered wood flooring manufacturer.

2.02 OTHER MATERIALS

A. Provide other materials not specifically described but required for a complete and proper installation as selected by the Contractor subject to the approval of the Owner.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.02 INSTALLATION

A. Thoroughly clean the substrate, removing debris, dust and other foreign matter and leaving a smooth surface.

B. Fill and level all concrete subfloors.

C. Anchor each piece firmly into position, drawn snugly against the preceding piece with tight mating edges.

3.03 PROTECTION

A. Cover the finished work with reinforced paper covering until all of the Work has been completed.

SECTION 09 65 00
RESILIENT FLOORING

PART 1 GENERAL

1.01 SUMMARY

A. Provide resilient flooring as shown on the Drawings, as specified herein and as needed for a complete and proper installation.

1.02 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

PART 2 PRODUCTS

2.01 GENERAL

A. Provide colors and patterns as selected by the Owner's Interior Designer as indicated on the Interior Finish Schedule or on the Drawings.

B. Adhesives: Use waterproof and stabilized type adhesive as recommended by the manufacturer of the material being installed.

C. Concrete slab primer: Use non-staining type as recommended by the manufacturer of the material being installed.

2.02 VINYL TILE

A. Acceptable products:
1. Product specified as standard of quality is Standard Excelon manufactured by Armstrong World Industries, Inc.
2. Products of manufacturers listed below meeting indicated standards and specified manufacturer's product data characteristics are acceptable for use, subject to approval by Owner:
   a. Congoleum Corporation.
   b. GAF Corp., Floor Products Division.
   c. Mannington Industries, Inc.

.

B. Characteristics:
1. Total thickness: 0.080 in.
2. Size: 12” x 12”.
3. Wear layer: 0.050 in., no wax.
4. Colors/patterns: Selected by the Interior Designer from manufacturer's standard colors/patterns.

2.03 VINYL STRIP FLOORING

A. Acceptable products:
1. Product specified as standard of quality is Array Cameron Plank manufactured by Shaw Industries.
2. Products of manufacturers listed below meeting indicated standards and specified manufacturer's product data characteristics are acceptable for use, subject to approval by Owner:
   a. Armstrong World Industries, Inc.
   b. Congoleum Corporation
   c. Mannington Industries, Inc.

B. Characteristics:
   1. Total thickness: 2-mm.
   2. Size: 7” x 36”.
   3. Wear layer: 6-mil, no wax.
   4. Colors/patterns: Selected by the Interior Designer from manufacturer's standard colors/patterns.

2.04 OTHER MATERIALS

A. Provide other materials not specifically described but required for a complete and proper installation as selected by the Contractor subject to the approval of the Owner.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.02 PREPARATION

A. Subfloors: Verify that substrate is smooth level and at required finish elevation and varies no more than 1/8 inch in 10 feet. Broom clean or vacuum the surfaces to be covered.

B. Priming: Apply concrete slab primer as recommended by the manufacturer of the material being used.

3.03 INSTALLATION

A. Install materials only after finishing operations, including painting have been completed and after permanent heating system is operating.

B. Verify that the moisture content of concrete slabs, building air temperature and relative humidity are within the limits recommended by the manufacturer of the materials being used.

C. Place materials using adhesive cement in accordance with the manufacturer's instructions.

3.04 CLEANING

A. Remove excess adhesive and other blemishes from exposed surfaces using neutral cleaner recommended by the flooring manufacturer.

END OF SECTION

SECTION 09 68 00
CARPETING

PART 1 GENERAL

1.01 SUMMARY

A. Provide carpeting and carpet accessories as shown on the Drawings, as specified herein and as needed for a complete and proper installation.

1.02 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Applicable standards:
1. HUD UM 44d Product Standards and Certification Program for Carpet.
2. HUD UM 72a Carpet Cushion.

C. Notice of Carpet Certification: Provide Notice of Carpet Certification for each product to be installed.

PART 2 PRODUCTS

2.01 CARPET

A. Acceptable products - Residential units:
1. Product specified as standard of quality is Powerball carpet manufactured by Shaw Industries.
2. Products of manufacturers listed below meeting indicated standards and specified manufacturer's product data characteristics are acceptable for use, subject to approval by Owner:
   a. Atlas Carpet Mills, Inc.
   b. Armstrong World Industries, Inc.
   c. Cabin Craft Carpet
   d. Mohawk Group.
3. Characteristics:
   a. Type and class: Type I, Class 1.
   b. Face yarn: 100% domestic nylon, continuous filament
   c. Face yarn weight: 25 oz. PSY, minimum
   d. Primary backing: Polypropylene.
   e. Secondary backing: Stainless jute
   f. Colors and patterns: To be selected by the Interior Designer.
   g. Flame spread, fuel contribution, and smoke development: Meeting ASTM E84-80 and NFPA 101-76
   h. Carpet pad: 7/16” rebond polyurethane pad.

B. Acceptable products - Leasing center:
1. Products: See drawings and schedules provided by Owner's Interior Designer.
2. Products of manufacturers listed below meeting indicated standards and specified manufacturer's product data characteristics are acceptable for use, subject to approval by Owner:
   a. Armstrong World Industries, Inc.
   b. Atlas Carpet Mills, Inc.
   c. Cabin Craft Carpet.
   d. Mohawk Group.
   e. Shaw Industries.

3. Characteristics – Leasing center offices, conference room, cyber café and storage closets:
   a. Type and class: Type I, Class 2.
   b. Face yarn: Nylon.
   c. Face yarn weight: 34 oz. PSY, minimum.
   d. Primary backing: Polyolefin composite.
   e. Secondary backing: Polyolefin composite.
   f. Colors and patterns: See drawings and schedules provided by the Interior Designer.
   g. Flame spread, fuel contribution, and smoke development: Meeting ASTM E84-80 and NFPA 101-76
   h. Carpet pad: As selected by the Interior Designer.
4. Characteristics – Leasing center gathering room:
   a. Type and class: Type I, Class 2.
   b. Face yarn: Triexta synthetic strand.
   c. Face yarn weight: 36 oz. PSY, minimum.
   d. Primary backing: Polypropylene.
   e. Secondary backing: Polypropylene.
   f. Colors and patterns: See drawings and schedules provided by the Interior Designer.
   g. Flame spread, fuel contribution, and smoke development: Meeting ASTM E84-80 and NFPA 101-76
   h. Carpet pad: As selected by the Interior Designer.

2.02 OTHER MATERIALS

A. Provide other materials not specifically described but required for a complete and proper installation as selected by the Contractor subject to the approval of the Owner.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.02 PREPARATION

A. Ensure that substrate is level and free from irregularities.

3.03 INSTALLATION

A. General:
   1. Install the approved pad in strict accordance with the manufacturer's instructions, lightly butting joints and providing a smooth underlayment.
   2. Scribe the carpet accurately to vertical surfaces.
   3. Align the lines of the carpet. Do not use fill strips less than 6 inches wide. Lay all carpet in the same direction.

B. Seams: Locate seams out of the way of traffic to the maximum extent possible. Fabricate seams using a butt joint and properly bead and seal. Do not stretch seams.

3.04 PROTECTION

A. Provide protection for installed carpet in the form of heavy non-staining paper or plastic as required.

3.05 SURPLUS MATERIAL

A. Allow the Owner to inspect and select from scrap carpet remaining after the installation.

END OF SECTION

SECTION 09 91 00
PAINTING

PART 1 GENERAL

1.01 SUMMARY

A. Paint and finish exposed surfaces using the combination of materials listed on the Painting Schedule in Part 3 of this Section, as specified herein and as needed for a complete and proper installation.

B. Definitions:
1. "Paint," as used herein, means coating systems materials including primers, emulsions, epoxy, enamels, sealers, fillers and other applied materials whether used as a prime, intermediate or finish coat.

1.02 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Paint coordination:
1. Use finish coat materials which are compatible with the prime coats actually used.
2. Provide barrier coats over non-compatible primers, or remove the primer and reprime as necessary.

C. Indoor air quality standards for site applied interior coatings: VOC content compliance shall conform to California Air Resources Board (CARB) suggested control measures for architectural coatings.

1.03 ENVIRONMENTAL CONDITIONS

A. Do not apply solvent-thinned paints when the temperature of surfaces to be painted and the surrounding air temperatures are below 45 degrees F, unless permitted by the materials manufacturer.

B. Do not apply paint in snow, rain, fog or mist; or when relative humidity exceeds 85 percent; or to damp or wet surfaces.

1.04 MAINTENANCE

A. Upon completion of the work of this Section, deliver to the Owner and extra stock equaling 10 percent of each color, type, and gloss of paint used. Tightly seal each container and label contents and location where used.

PART 2 PRODUCTS

2.01 PAINT MATERIALS

A. Acceptable products:
1. Products specified as standard of quality are manufactured by Sherwin Williams Company and Arkema Group.

2. Products of manufacturers listed below meeting indicated standards and specified manufacturer's product data characteristics are acceptable for use, subject to approval by Owner:
a. Benjamin Moore and Company.

b. Duron Paints and Wallcoverings.
c. ICI Paints
d. Porter Paints.
e. Pratt & Lambert Paints.

B. Undercoats and thinners:
1. Use undercoat paint produced by the same manufacturer as the finish coat.
2. Use only thinners recommended by the paint manufacturer, and use only to the recommended limits.
3. Use undercoat, finish coat and thinner as parts of a unified system of paint finish.

2.02 COLOR SCHEDULES

A. The Owner and/or the Owner's Interior Designer will prepare a color schedule with samples for guidance in painting.

2.03 APPLICATION EQUIPMENT

A. Use only equipment approved for application by the paint manufacturer of the particular paint being used.

2.04 OTHER MATERIALS

A. Provide other materials not specifically described but required for a complete and proper installation as selected by the Contractor subject to the approval of the Owner.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.02 MATERIALS PREPARATION

A. Mix and prepare paint materials in accordance with the manufacturer's instructions.

3.03 PREPARATION

A. Verify that substrate conditions are ready to receive work.

B. Correct minor defects and clean surfaces which affect work of this Section.

C. Remove or mask electrical plates, hardware, light fixture trim, escutcheons and fittings prior to preparing surfaces or finishing.

D. Gypsum board surfaces: Fill minor defects with latex compounds. Spot prime defects after repair.

E. Galvanized surfaces: Remove surface contamination and oils and wash with solvent. Apply coat

F. Concrete and concrete unit masonry surfaces scheduled to be painted: Remove foreign material.

G. Uncoated metal surfaces: Remove scale by wire brushing or sandblasting. Prime paint after repairs.
H. Shop primed metal surfaces: Sand and scrape to remove loose primer, rust and other foreign materials. Prime paint bare steel surfaces.

I. Interior wood scheduled to receive paint finish: Wipe off grit and dust, seal knots, pitch streaks and sappy sections with sealer. Fill nail holes and cracks after primer has dried.

J. Interior wood scheduled to receive transparent finish: Wipe off grit and dust, seal knots, pitch streaks and sappy sections with sealer. Fill nail holes and cracks after primer has dried.

K. Exterior siding and trim: Wipe off grit, dust and other foreign materials. Fill nail holes with tinted exterior caulking compound after prime coat has been applied.

3.04 APPLICATION

A. Apply products in accordance with the manufacturer's instructions.

B. Sand transparent finishes lightly between coats to achieve the required finish.

C. Where clear finishes are required, tint fillers to match wood.

D. Back prime interior and exterior woodwork scheduled to receive paint finish using prime paint.

E. Back prime interior woodwork scheduled to receive stain or varnish finish with gloss varnish reduced 25 percent with mineral spirits.

3.05 PAINTING SCHEDULE

A. Exterior wood trim (acrylic latex):
1. Primer: A-100 Alkyd Exterior Wood Primer at 1.4 mils DFT.
2. First Coat: A-100 Acrylic Latex Semi-Gloss Exterior at 1.4 mils DFT.
3. Second Coat: A-100 Acrylic Latex Semi-Gloss Exterior at 1.4 mils DFT.
4. Color to be selected from manufacturer’s standard colors.

B. Pre-primed fiber cement exterior siding (acrylic latex):
1. First Coat: A-100 Acrylic Latex Satin Exterior at 1.4 mils DFT.
2. Second Coat: A-100 Acrylic Latex Satin Exterior at 1.4 mils DFT.
3. Color to be selected from manufacturer’s standard colors.

C. Pre-primed fiber cement exterior trim (acrylic latex):
1. First Coat: A-100 Acrylic Latex Semi-Gloss Exterior at 1.4 mils DFT.
2. Second Coat: A-100 Acrylic Latex Semi-Gloss Exterior at 1.4 mils DFT.
3. Color to be selected from manufacturer’s standard colors.

D. Exterior metal, preprimed:
1. First Coat: Kem Kromik Universal Metal Primer at 2.0 mils DFT.
2. Second coat: Hi-Solids Polyurethane at 2.0 mils DFT.
3. Color to be selected from manufacturer’s standard colors.

E. Alkyd semi-gloss enamel on preprimed metal doors:
1. First coat: SWP Gloss House & Trim at 3 to 4 mils DFT.
2. Second coat: SWP Gloss House & Trim at 3 to 4 mils DFT.
3. Color to be selected from manufacturer’s standard colors.

F. Interior latex paint:
1. On gypsum drywall:
a. First coat: Property Solutions Latex Wall Paint at 1.5 mils DFT.
b. Second coat: Property Solutions Latex Wall Paint at 1.5 mils DFT.

2. Color/sheen:
   a. Walls: SW7036 Accessible Beige, eggshell.
   c. Ceilings: SW7005 Pure White, flat.

G. Interior semi-gloss enamel:
   1. On doors, frames, and trim.
      a. Primer: DTM Acrylic Primer/Finish at 1.5 mils DFT.
      b. Second coat: Property Solutions Latex Semi-Gloss at 1.5 mils DFT.
   2. On preprimed metal doors:
      a. First coat: Property Solutions Alkyd Satin Enamel at 1.5 mils DFT.
      b. Second coat: Property Solutions Alkyd Semi-Gloss Enamel at 1.5 mils DFT.
   3. Color/sheen: SW7005 Pure White, semi-gloss.

H. Exterior metal and plastic vents: Kynar ADS PVDF resin coating, color to match adjacent surfaces.

END OF SECTION

SECTION 10 05 00
MISCELLANEOUS SPECIALTIES

PART 1 GENERAL

1.01 SUMMARY

A. Provide miscellaneous specialties and accessories as shown on the Drawings, as specified herein and as needed for a complete and proper installation.

1.02 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

1.03 SUBMITTALS

A. Manufacturer's Data: Provide material and fabrication specifications and installation instructions for specified products. Include instructions for handling, storage and protection for each product.

PART 2 PRODUCTS

2.01 VENTILATED WIRE SHELVING

A. Acceptable Products:
   1. Manufacturer of products specified as standard of quality is Newell Rubbermaid.
   2. Products of other manufacturers listed below meeting indicated standards and specified manufacturer's product data characteristics, are also acceptable for use, subject to approval by Owner:
      a. ClosetMaid Corporation.
      b. Elfa International AB.
      c. Lee Rowan Company

B. Product types:
   1. Closets: FreeSlide 12" shelf and rod.
   2. Linen and pantry closets: TightMesh 16" shelving.

C. Accessories: Provide support brackets, wall clips, end caps and all other accessories required for complete installation.

D. Color: White.

2.02 FIRE EXTINGUISHERS

A. Multi-purpose dry chemical extinguishers – Breezeways: Provide extinguishers complete with nozzle, pressure gauge and surface mounted cabinet at center of each level of each breezeway.
   1. Characteristics:
      a. Capacity: 5 lbs.
      b. UL rating: 3A-40BC.
      c. Breezeway extinguisher cabinet: Surface mounted cabinet with cover, lock and labels.

b. Multi-purpose dry chemical extinguishers – Residential units: Provide extinguishers complete with nozzle, pressure gauge and mounting bracket, mounted in kitchen sink base cabinet at all residential units

1. Characteristics:
   a. Capacity: 2½ lbs.
   b. UL rating: 1A-10BC.

C. Acceptable manufacturers:
1. J. L. Industries.
2. Larsen's Manufacturing Company.
3. Walter Kidde - The Fire Extinguisher Company.
4. Products of other manufacturers meeting indicated standards and specified manufacturer's product data characteristics are acceptable for use, subject to approval by Owner.

2.03 CAR WASH EQUIPMENT

A. Acceptable Products:
1. Manufacturer of products specified as standard of quality is J.E. Adams Industries, LTD.
2. Products of other manufacturers listed below meeting indicated standards and specified manufacturer's product data characteristics, are also acceptable for use, subject to approval by Owner:
   a. A-OK Equipment and Supply Company.
   b. Bozeman Distributors.
   c. Jim Coleman Company.

B. Product types:
1. Vacuum: 1.6 HP/120 volt stainless steel vacuum with lighted dome and hose; Model No. 8600LD.
2. Hose and washing wand: CWI 360 degree boom and gun kit.
3. Trash receptacle: 30 gallon wood slat trash container.

C. Accessories: Provide support brackets, wall clips, hoses, nozzles and all other accessories required for complete installation.

2.04 BARBECUE GRILLS

A. Acceptable Products:
1. Product specified as standard of quality is Cal Flame Model No. BBQ09G870 drop-in charcoal grill manufactured by Cal Spas, Inc.
2. Products of other manufacturers listed below meeting indicated standards and specified manufacturer's product data characteristics, are also acceptable for use, subject to approval by Owner:
   a. Bull Outdoor Products, Inc.
   b. OCI, Inc.
   c. Fire Magic Barbecue Grills.
3. Accessories: Provide natural gas conversion kit and automatic grill timer safety shut off valve.

2.05 RENT DROP BOX

A. Acceptable Products:
1. Product specified as standard of quality is Model WDC-160 wall drop box with adjustable chute, manufactured by Protex Safe Co.
2. Products of other manufacturers meeting indicated standards and specified manufacturer's product data characteristics, are also acceptable for use, subject to approval by Owner.

2.06 PET WASTE STATIONS

A. Acceptable Products:
1. Product specified as standard of quality is the Sentry Pet Waste Station, with roll bag dispenser, manufactured by Zero Waste USA.
2. Products of other manufacturers listed below meeting indicated standards and specified manufacturer's product data characteristics, are also acceptable for use, subject to approval by Owner:
a. Barco Products.
b. Crown Products.
c. Dogipot, Inc.
d. Pet Waste Eliminator Systems.

2.07 SIGNS

A. Site, parking, and building informational, directional and address signage: To be designed by the Owner's Graphic Design Consultant and provided by the Owner.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.02 INSTALLATION

A. Install fixtures, accessories, signs and other items in accordance with manufacturer's instructions.

B. Install plumb and level, securely and rigidly anchored to substrate.

C. Natural gas grills to be installed by manufacturer's authorized installer and service technician.

END OF SECTION

SECTION 10 28 00
TOILET AND BATH ACCESSORIES

PART 1 GENERAL

1.01 SUMMARY

A. Provide toilet accessories as shown on the Drawings, as specified herein and as needed for a complete and proper installation.

1.02 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

PART 2 PRODUCTS

2.01 ACCESSORIES

A. Acceptable manufacturers:
   1. Manufacturers of products specified as standard of quality are Bobrick Washroom Equipment, Inc. and DesignHouse by DHI, Corp.
   2. Products of other manufacturers listed below meeting indicated standards and specified manufacturer's product data characteristics, are also acceptable for use, subject to approval by Owner:
      a. American Specialties, Inc.
      b. Bradley Corporation.
      c. Better Home Products
      d. Franklin Brass Manufacturing Co.
      e. Miami-Carey Corporation.
      f. Pamex, Inc.
      g. Taymor Industries.

B. Fixture Schedule - Residential Units:
   1. Grab Bars
      a. Horizontal or Vertical: Bobrick #B-6206 by lengths indicated.
      b. Provide #256 Series anchor plate at stud walls.
   2. Towel Bars:
      a. Shower surround mounted: 18" to match prefabricated tub/shower surround panel.
      b. Wall mounted: DesignHouse Calisto Model No. 538322, with satin nickel finish length as indicated on drawings.
   4. Shower and Tub Soap Dish: Match prefabricated tub/shower surround panel.
   5. Toilet paper holder: DesignHouse Calisto Model No. 538363, with satin nickel finish.
   6. Bathtub Rod: DesignHouse Model No. 533620, adjustable curved iron with satin nickel finish.

C. Fixture Schedule - Leasing Center/Recreation Building and Maintenance Building:
   1. Grab Bars
      a. Horizontal or Vertical: Bobrick #B-6206 by lengths indicated.
      b. Provide #256 Series anchor plate at stud walls.
   2. Paper Towel Dispenser/Receptacle: Bobrick #B-369.
   3. Soap Dispenser: Bobrick #B-822.
   3. Surface Mounted Double Paper Towel Holder: #B-686.

D. Fixture Schedule - Mail Kiosk:
   1. Recessed Trash Receptacle: Bobrick #B3644.

2.02 TOILET PARTITIONS

A. Acceptable manufacturers:
   1. Manufacturer of products specified as standard of quality is Bobrick Washroom Equipment, Inc.
   2. Products of other manufacturers listed below meeting indicated standards and specified manufacturer's product data characteristics, are also acceptable for use, subject to approval by Owner:
      a. Bradley Corporation.
      b. General Partitions Manufacturing Corp.
      c. Global Partitions.

B. Style: Floor mounted plastic laminated partitions. See Section 12 36 23 for plastic laminate.

C. Color: To be selected by Owner’s Interior Design Consultant from manufacturer’s standard colors.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.02 INSTALLATION

A. Install fixtures, accessories, partitions and items in accordance with manufacturer's instructions.

B. Install plumb and level, securely and rigidly anchored to substrate.

END OF SECTION

SECTION 10 31 00
MANUFACTURED FIREPLACES

PART 1 GENERAL

1.01 SUMMARY

A. Provide listed factory-built gas fireplaces and chimneys, tested in accordance with UL 127 as shown on the Drawings, as specified herein and as needed for a complete and proper installation.

1.02 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

PART 2 PRODUCTS

2.01 FIREPLACE UNITS:

A. Characteristics: Nominal 48” direct vent gas fireplace insert with manufacturer’s standard linear burner.

B. Acceptable Products:
1. Product specified as standard of quality is Fire Ribbon Direct Vent, Model No. 48 manufactured by Spark Modern Fires.
2. Products of other manufacturers listed below meeting indicated standards and specified manufacturer's product data characteristics, are also acceptable for use, subject to approval by Owner:
   a. Heatilator, Inc.; Rave Series.
   b. Lenox Hearth Products; Merit Series.
   c. Montigo Fireplaces; R-Series.
   d. Napoleon Fireplaces; LHD Series.

2.02 OTHER MATERIALS

A. Provide 250 gallon buried propane fuel tank and all required gas piping to fireplace inserts. See Section 22 16 05 for specific requirements.

B. Provide manufacturer’s standard Type B flue and roof cap for vented installation.

C. Provide other materials not specifically described but required for a complete and proper installation in accordance with UL listings, as selected by the Contractor subject to the approval of the Owner.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.02 INSTALLATION

A. Install fireplace and chimney components in accordance with UL standards and manufacturer's instructions.

B. Secure the fireplace unit in place, plumb and level.

END OF SECTION

SECTION 10 55 00
POSTAL SPECIALTIES

PART 1 GENERAL

1.01 SUMMARY

A. Provide postal specialties as shown on the Drawings, as specified herein and as needed for a complete and proper installation.

1.02 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Verify that items provided under this Section comply with pertinent USPS postal regulations.

PART 2 PRODUCTS

2.01 MATERIALS

A. Acceptable products:
   1. Mail boxes, parcel lockers, and collection box specified as standard of quality is Versatile 4C Suite, front loading, manufactured by Auth-Florence Manufacturing Company.
   2. Products of manufacturers listed below meeting indicated standards and specified manufacturer's product data characteristics are acceptable for use, subject to approval by Owner:
      a. American Device Manufacturing Company.
      b. Bommer Industries.
      c. Cutler Manufacturing Corporation.
      d. Salsbury Industries.

B. Accessories: Provide other materials not specifically described but required for a complete and proper installation as selected by the Contractor subject to the approval of the Owner.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.02 INSTALLATION

A. Coordinate as required with other trades to assure proper and adequate provision for the installation of the products of this Section.

B. Install the work of this Section in strict accordance with the Drawings and pertinent requirements of postal authorities. Anchor all components firmly into position, level and plumb.

END OF SECTION

SECTION 11 15 00
PARKING CONTROL EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

A. Provide parking control equipment as shown on the Drawings, as specified herein and as needed for a complete and proper installation.

1.02 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

1.03 SUBMITTALS

A. Manufacturer's Data: Provide material and fabrication specifications and installation instructions for specified products. Include instructions for handling, storage and protection for each product.

B. Shop drawings: Submit shop drawings for fabrication and installation of parking control equipment. Include plans and elevations at not less than 3/8" = 1'-0" scale, and details at not less than 3/4" = 1'-0". Indicate anchorage and accessory items, gauges, metal types and finishes. Provide location template drawings for anchorage locations in supporting members.

PART 2 PRODUCTS

2.01 PARKING CONTROL SYSTEM

A. Acceptable manufacturers:
   1. Manufacturer of products specified as standard of quality is DoorKing.
   2. Products of the manufacturers listed below, meeting indicated standards and specified manufacturer's product data characteristics, are also acceptable for use:
      a. Amtel Security Systems.
      b. Cincinnati Time.
      c. Federal Signal Corporation.
      d. Parking Products, Inc..

B. System requirements:
   1. Control gates: Pre-finished metal gates, as indicated on drawings, see Section 05 70 00 Architectural Metalwork.
   2. Gate operators: 1/2 HP heavy duty swing gate operators.
   3. Gate controls:
      a. Remote controls: Receiver mounted in control pedestal. Provide two hand held transmitters for each residential unit.
      b. Code control panel: Entry control panel with 500 entry code capacity, metal keypad, hands-free operation, battery back-up, fire department lock box, automatic rebound with timer, programmable timer, in pre-finished aluminum housing. Provide all required control and communication wiring. Provide spare conduits from control panel to leasing office for control and communication wiring for future system upgrades.
      c. Detector loops: Presence, open and close detector loops, #14 AWG stranded copper wire. Detector loop wire shall not be spliced. Loop size shall be 4' x 6'.
      d. Emergency operation: Provide Knox key switch and emergency unlock and operation controls or other devices required by local government agencies.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

B. Verify that all openings and utility services are ready to receive work and opening dimensions are in accordance with the manufacturer's instructions.

3.02 INSTALLATION

A. Install equipment in accordance with the manufacturer's instructions.

B. Set and adjust units and controls level and plumb.

C. Activate and test all units and controls to confirm proper operation.

D. Prior to paving, install all conduit for power supply, control wiring and telephone lines.

E. After paving, install and connect all control gates and devices.

END OF SECTION

SECTION 11 31 00
RESIDENTIAL KITCHEN EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

A. Provide residential equipment as shown on the Drawings, as specified herein and as needed for a complete and proper installation.

1.02 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

PART 2 PRODUCTS

2.01 APPLIANCES

A. Acceptable manufacturers:
   1. Manufacturers of products specified as standard of quality is General Electric Company.
   2. Products of the manufacturers listed below, meeting indicated standards and specified manufacturer's product data characteristics, are also acceptable for use:
      a. Frigidaire USA.
      b. Hotpoint Distribution Sales Operation.
      c. Sears Major Appliances Division.
      d. Whirlpool Corporation.

B. Acceptable products – Residential units:
   1. Refrigerator: 17.5 cu. ft. with optional icemaker; GE Model No. GTS18GTHBB.
   2. Refrigerator (HC Units): 18.2 cu. ft. with icemaker; GE Model No. GIE18ETHBB.
   3. Range: 30" free standing, self-cleaning, with glass front and anti-tip bracket; GE Model No. JB255DJBB.
   4. Range (HC Units): 30" free standing, standard cleaning, front controls, with anti-tip bracket; GE Model No. JB450DFBB.
   5. Microwave: Under cabinet with recirculating exhaust range hood; GE Model No. JNM3163DJBB.
   6. Microwave (HC Units): Countertop oven; GE Model No. PEB7226DFBB.
   7. Range Hood (HC Units): Under cabinet recirculating range hood; GE Model No. JV338HBB.
   8. Dishwasher: Under counter; five level wash; GE Model No. GSD33000KBB.
   9. Dishwasher (HC Units): Under counter; tall tub; five level wash; Model No. GLDT690JBB.
   10. Disposal: 1/2 horsepower continuous feed; GE Model No.GFC525V.

C. Acceptable products – Leasing center breakroom:
   1. Refrigerator: 18.2 cu. ft. with icemaker; GE Model No. GIE18ETHBB.
   2. Microwave: Countertop oven; Model No. PEB7226DFBB.
   3. Dishwasher: Under counter; tall tub; five level wash; Model No. GLDT690JBB.
   4. Disposal: 1/2 horsepower continuous feed; Model No.GFC525V.

D. Acceptable products – Leasing center bar/kitchen:
   1. Refrigerator: ADA compliant under counter refrigerator; Summit Model No. AL652BBISSHH.
   2. Icemaker: ADA compliant under counter icemaker; Summit Appliance Model No. BIM44GADA.
   3. Wine Cooler: ADA compliant under counter refrigerator; Summit Model No. SWC530LBISTADA.
   4. Dishwasher: Under counter; tall tub; four cycle wash; GE Model No. GLDA696FSS.
   5. Microwave: Countertop oven; Model No. PEB7226SFSS.
   6. Disposal: 1/2 horsepower continuous feed; GE Model No.GFC525V.

E. Color:
   1. Kitchen appliances:
      a. Residential units and leasing center breakroom: Black.
      b. Leasing center bar/kitchen: Stainless.
   2. Laundry appliances: White.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

B. Verify that all openings and utility services are ready to receive work and opening dimensions are in accordance with the manufacturer's instructions.

3.02 INSTALLATION

A. Install equipment in accordance with the manufacturer's instructions.

B. Set and adjust units level and plumb.

C. Activate units to confirm proper operation.

D. Turn refrigerators on and set to moderate temperature.

E. Touchup scratches and abrasions to be completely invisible to the unaided eye from a distance of five feet.

F. Promptly remove from the job site all cartons and packing material associated with the work of this Section.

END OF SECTION

SECTION 12 21 00
BLINDS

PART 1 GENERAL

1.01 SUMMARY

A. Provide horizontal blinds at all window openings at all residential units, as specified herein. Provide blinds and accessories as needed for a complete and proper installation.

1.02 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
B. Verify cutouts and preparatory work are correctly done prior to installation.

PART 2 PRODUCTS

2.01 BLINDS

A. Acceptable manufacturers:
   1. Products specified as standard of quality is Visions Faux Wood 2” Blinds by Levolor Window Fashions.
   2. Products of the manufacturers listed below, meeting indicated standards and specified manufacturer's product data characteristics, are also acceptable for use:
      a. Comfortex Window Fashions; Woodwinds Reed Wood Alloy Blinds.
      b. Hunter Douglas Inc.; EverWood 2” Blinds.
      c. Kirsch; Classique Collection Blinds.

B. Product characteristics:
   1. Horizontal Blinds: 2” wide prefinished faux wood horizontal slats with mounting rails, controls and accessories.
      a. Finish: Manufacturer’s standard finish; color to be selected by the Interior Designer from the manufacturer’s standard colors.
      b. Tilt Control: Manufacturer’s standard clear plastic rod.

PART 3 EXECUTION

3.01 GENERAL

A. Provide horizontal blind system at all residential units, complete with operating hardware and attachments. Install at all window openings and patio doors.

3.02 INSTALLATION

A. Install blinds in window sash in accordance with blind manufacturer’s printed instructions. Provide templates where necessary for preparation of sash for installation of blinds.

B. Secure in place with flush countersunk mechanical fasteners.

C. Adjust parts for smooth operation.

END OF SECTION

SECTION 12 35 30
CABINETS AND FIXTURES

PART 1 GENERAL

1.01 SUMMARY

A. Provide prefinished cabinets as shown on the Drawings, as specified herein and as needed for a complete and proper installation.

1.02 SUBMITTALS

A. Provide Owner with the following product data:
   1. Samples of the proposed materials;
   2. Shop Drawings of sufficient detail to show fabrication, installation, anchorage, and interface of the work of this Section with work of other trades.

1.03 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. In addition to complying with applicable codes and regulations, perform work in accordance with the Architectural Woodwork Institute Quality Standards.

C. All cabinet units shall conform to ANSI/KCMA A161.1 or AWI Custom or Premium grade standards. Provide certification labels on all cabinet units.

1.04 DELIVERY, STORAGE AND HANDLING

A. Provide protection as needed to assure that the work of this Section remains undamaged during fabrication, installation and the final acceptance of the total Work.

B. Do not deliver cabinets and fixture materials or products to the job site until concrete and plaster installations are completed and dry, nor until the building interior has attained a relative humidity of 50-55 percent at 70 degrees F.

PART 2 PRODUCTS

2.01 MANUFACTURED UNITS – INTERIOR CABINETS

A. Produce all cabinets by a single manufacturer.

B. Acceptable manufacturers:
   1. Products specified as standard of quality for the interior cabinet package are wood kitchen and bath cabinets manufactured by Leedo Manufacturing Company.
   2. Products of manufacturers listed below meeting indicated standards and specified manufacturer's product data characteristics are acceptable for use, subject to approval by Owner:
      a. Bridgewater International Trend Architectural Components.
      b. Carbide Industries, LLC.
      c. Mid-Continent Cabinetry, Inc.
      d. Republic Industries, Inc.
      e. Saco Industries, Inc.
      f. Smart Cabinetry.
      g. Sweetwater Cabinets.
      h. Welborne Cabinets.

C. Finish:

1. Cabinet exterior: Factory applied finish.
2. Cabinet interior: Factory applied finish.
3. Door and drawer style: Door and drawer style to be Shaker recessed panel doors. All door and drawer color within each residential unit to match.
4. Color/finish: To be selected by the Owner's Interior Design Consultant from manufacturer's standard finishes.

D. Hardware:
1. Drawer slides: Double track type with nylon roller.
2. Hinges: Self-closing wraparound type, semi-concealed.
3. Bumpers: Felt at each door and drawer.
4. Pulls: Manufacturer's standard pulls, finish to be selected by Owner's Interior Design Consultant from manufacturer's standard finishes.
5. Shelf supports: Manufacturer's standard adjustable shelf supports.

2.02 COMPONENTS

A. Granite countertops - Leasing center reception desk, toilets, service bar and selected residential kitchens:
1. Material: 3cm thick polished granite with bullnose edge and 4" high, square cut back and side splashes.
2. Color/finish: To be selected by the Interior Design Consultant.

B. Plastic laminate countertops - Residential kitchens and built-in desks and leasing center built-in desks:
1. Plastic laminates: See Section 12 36 23.
2. Countertops: Post formed plastic laminate over 3/4 in. particleboard with integral backsplash. Provide end splashes at each wall.

A. Cultured marble countertops - Residential unit baths:
1. Material: 3/4" thick manufactured cultured marble with 4" high, square cut back and side splashes.
2. Color/finish: To be selected by the Interior Design Consultant.

2.03 OTHER MATERIALS

A. Provide other materials not specifically described but required for a complete and proper installation as selected by the Contractor subject to the approval of the Owner.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.02 INSTALLATION

A. Install the work of this Section at the locations shown on the Drawings and in accordance with the approved Shop Drawings.

B. Coordinate the time of installation with availability of other trades to make required utility connections.

C. Upon completion of the installation, thoroughly clean each item using only the cleaning materials recommended by the manufacturer of the item being cleaned.

END OF SECTION

SECTION 12 36 23
PLASTIC LAMINATE

PART 1 GENERAL

1.01 SUMMARY

A. Provide laminated plastic as shown on the Drawings, as specified herein and as needed for a complete and proper installation.

1.02 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

PART 2 PRODUCTS

2.01 LAMINATED PLASTICS

A. Use general purpose type, 0.050 inches thick, complying with NEMA LD3.

B. Colors and patterns: As shown on the finish schedule or as selected and specified by the Interior Design Consultant.

C. Acceptable manufacturers:
   1. Product specified as standard of quality for countertops and toilet partitions is Formica manufactured by Formica Corporation.
   2. Products of manufacturers listed below meeting indicated standards and specified manufacturer's product data characteristics are acceptable for use, subject to approval by Owner:
      a. ITW; Arborite.
      b. Panolam Industries International, Inc.; Nevamar.
      c. Wilsonart International; Wilsonart

2.02 ADHESIVES

A. Use only rigid set (urea-resin) or semi-rigid set (PVC acetate) adhesives.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.02 INSTALLATION

A. Install the specified plastic laminate in accordance with the manufacturer’s instructions.

END OF SECTION

SECTION 13 15 00
SWIMMING POOL

PART 1 GENERAL

1.01 SUMMARY

A. Provide swimming pool, fountain and equipment design, engineering and construction for swimming pool configuration indicated on the hardscape drawings, as specified herein and as needed for a complete and proper installation including but not limited to:
   1. Complete swimming pool and equipment design and installation, meeting the approval of the Owner and all governmental agencies having jurisdiction.
   2. Excavation and disposal of excess earthwork materials.
   3. Reinforcement, gunite and plaster.
   4. Ceramic tile, depth markers, and coping.
   5. Pool deck pavers.
   6. Underwater lighting and subsystem electrical.
   7. Supply and return lines from the pool equipment.
   8. Fountain jets.
   9. Filtering, cleaning and chlorinating systems.
   10. Ladders and handrails.
   11. All required safety equipment and devices.
   12. Operation and maintenance supplies and manuals.
   13. All other accessories required for a complete and proper installation.

B. While the swimming pool and equipment design, engineering and construction is included as part of the construction contract, this work is not part of the Architect prepared work.

1.02 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Code requirements: Swimming pool and pool equipment design and installation shall comply with all pertinent requirements of the State of Florida, City of Tallahassee, Leon County, 2014 Florida Building Code - 5th Edition, and Virginia Graeme Baker Pool and Spa Safety Act.

1.03 SUBMITTALS

A. Provide complete engineering and construction drawings, prepared and sealed by an engineer licensed in the State of Florida, for review and approval of the Owner and all governmental agencies having jurisdiction prior to installation.

B. Provide all required permits and approvals from all governmental agencies having jurisdiction prior to installation.

PART 2 PRODUCTS

2.01 DESIGN

A. Provide the services of an engineer properly licensed to perform such work in the State of Georgia as required for complete design and engineering design in accordance with the shape, configuration, and dimensions indicated on the drawings.

2.02 MATERIALS

A. Gunite: Use gunite having a compressive strength of 3,000 psi, minimum, or as required to meet the pool engineering design.
B. Steel reinforcement: As required to meet the pool engineering design.

C. Finish coat: Provide complete pool finish coating system with smooth, pebble surface. Color to be selected from finish coating manufacturer's standard colors.

D. Ceramic tile: Provide frost proof ceramic mosaic tile as indicated on the drawings. Provide depth marker tiles as necessary to meet the requirements of local governmental agencies.

E. Coping: Provide cast-in-place concrete coping as indicated on the drawings.

F. Pool deck pavers: Provide concrete pavers as indicated on the drawings.

2.03 EQUIPMENT

A. Pool equipment: Provide pumps, motors, filters, skimmers, and other pool equipment as required to meet the pool engineering design and to provide a complete and proper installation.

B. Plumbing: Provide all supply, return and drain lines, drains, valves and other plumbing devices as required to meet the pool engineering design and to provide a complete and proper installation.

C. Lighting: Provide underwater pool lighting and pool deck lighting as required to meet the pool engineering design and to provide a complete and proper installation.

2.04 OTHER MATERIALS

A. Provide other materials not specifically described but required for complete and proper installation and operation of the swimming pool and pool equipment.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.02 EXCAVATION

A. Excavate pool area in strict accordance with the provisions of Section 02220, removing excavated material and disposing of it as directed by the Owner and Contractor.

B. Perform the final shaping of the pool excavation by hand.

3.03 PLACING REINFORCEMENT

A. Place reinforcement in strict accordance with the approved pool engineering drawings.

3.04 PLACING GUNITE

A. General: Perform guniting in a steady uninterrupted flow, at right angles to the surface except when enclosing reinforcement, and at a distance of 30 to 36 inches. Provide gunite thickness in accordance with the approved pool engineering drawings.

B. Enclosing reinforcement: When enclosing reinforcement, blow out rebound and sand which may have lodged behind the reinforcement.

3.05 UTILITY LINES

A. Place plumbing and electrical lines in strict accordance with the approved pool engineering drawings.

3.06 EQUIPMENT

A. Install pool equipment in strict accordance with the approved pool engineering drawings and make all required hook-ups. Provide suction entrapment avoidance devices and/or covers at suction outlets, drains, skimmers and other devices in accordance with the requirements of the 2014 Florida Building Code - 5th Edition and Virginia Graeme Baker Pool and Spa Safety Act.

3.07 FINISH SYSTEM

A. General: Do not begin installation of pool finish system until at least 20 days after completion of the gunite. Do not plaster during rainy or windy conditions.

B. Application: Uniformly trowel smooth finish coat of specified pebble finish system in strict accordance with the approved pool engineering drawings and the requirements of the finish system manufacturer.

3.08 TILE AND COPING

A. Install waterline tile and coping in strict accordance with the approved pool engineering drawings, anchoring components firmly in place, square, true and level.

3.09 POOL FILLING

A. Upon completion of the installation of the pool finish system, waterline tile, and coping, immediately commence filling operations by steady stream of potable water introduced through a hose equipped with a dampening nozzle.

B. Do not interrupt the flow of water until the pool is filled above the centerline of the waterline tile.

3.10 ADJUSTMENTS

A. Put all equipment through at least five (5) cycles of operation, insuring that each item is operating properly. Make any required adjustments to achieve optimum operation.

3.11 WATER BALANCE

A. Upon completion of the installation, chlorinate and properly balance the pH level of the water.

3.12 INSTRUCTION

A. Instruct the Owner’s personnel in the proper operation and maintenance of all installed equipment.

END OF SECTION

SECTION 21 00 00
FIRE PROTECTION GENERAL

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. General Conditions: Refer to the General Conditions, the Supplementary General Conditions and the Special Conditions, all provisions of which apply to work under this section as if written in full herein.

B. The scope of work described in these Specifications and/or indicated on the Drawings shall be designed/engineered by the Contractor as a Delegated Design Responsibility. All professional engineering services related to the Fire Protection system shall be delegated to the Contractor.

C. The scope of work described in these Specifications and/or indicated on the Drawings shall include (except where otherwise noted) the furnishing of all materials, equipment, appurtenances, accessories, connections, labor, etc. required and/or necessary to completely install, clean, inspect, adjust, test, balance and leave in safe and proper operating condition all systems. All work shall be accomplished by workmen skilled in the various trades involved.

D. The Drawings and Specifications are complementary to each other and what is called for by one shall be as binding as if called for by both. If a discrepancy exists between the Drawing and Specifications, the higher cost shall be included, and the Architect shall be notified of the discrepancy.

E. All work performed under this specification shall be accomplished in accordance with the requirements and provisions of the following sections:

1. Section 22 00 00 - Plumbing General
2. Section 23 00 00 - HVAC General
3. Section 26 00 00 - Electrical General

1.02 SYSTEMS

A. Systems to be provided under the Fire Protection design section shall be as listed below. The connection point to the site utility service for the fire protection system shall be at 5'-0" from the exterior of the building unless specifically otherwise noted.

1. Automatic Sprinkler Systems
2. Painting of exposed piping

1.03 QUALIFICATION OF CONTRACTORS

A. The Contractor for the fire protection installation shall be a certified fire protection contractor, licensed for the installation of automatic fire sprinkler systems and other fire protection equipment.

1.04 DESIGN STANDARDS

A. Fire Protection systems shall be designed and installed in accordance with the requirements of the following codes, standards and design guides:

1. The South Carolina Fire Code, 2018 Edition
2. The International Building Code, 20xx Edition, with most current _____ Amendments
3. National Fire Protection Association (NFPA) Standards:
   a. NFPA 101 - Life Safety Code - 2018 Edition
   b. NFPA 13 - Installation of Sprinkler Systems - 2016 Edition
   c. NFPA 13R - Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height - 2016 Edition
   d. NFPA 14 - Installation of Standpipe and Hose Systems - 2016 Edition
   e. NFPA 24 - Installation of Private Fire Service Mains - 2016 Edition
   f. NFPA 25 - Inspection, Testing, and Maintenance of Water-based Fire Protection Systems - 2017 edition
4. Factory Mutual (FM) Approval Guide
5. Underwriters Laboratories Inc. (UL)
6. Owner's Insurance Underwriter Requirements

B. Design Criteria

1. Upon award of the Contract, a new flow test from the two (2) hydrants nearest the site service entry is to be performed by the Contractor to confirm the flow and pressure characteristics of the existing water service. The completed flow test data along with a utility service map of the area is to be forwarded to the Engineer for confirmation of the existing water service.
2. The entire facility will be protected by an automatic sprinkler system supplied by combination fire standpipe/automatic sprinkler systems located within the building stairwells.
3. Automatic sprinkler systems shall be designed to the available domestic water pressure available and shall be hydraulically calculated for the following design standards:
   a. NFPA 13 Systems

Area/Usage	Hazard Classification	Density GPM/Sq. Ft.	Remote Area	Maximum Head Spacing	Interior Hose Stream
Public Spaces, Lobbies, Corridors, Offices, Lounges, Meeting Rooms and Dwelling Units	Light	.10	1,500 sq. ft.	225 sq. ft.	100 gpm
Mechanical Rooms, Electrical Rooms, Maintenance / Storage Rooms, Kitchen / Food Service Areas and Laundry	Ordinary Group 1	.15	1,500 sq. ft.	130 sq. ft.	250 gpm

   b. NFPA 13R Systems:
      1) Residential Sprinklers
         a) The system shall provide at least the flow required for the multiple and single sprinkler operating criteria specified by the sprinkler listing.
         b) The system shall provide at least the flow required to produce a minimum discharge density of 0.05 gpm/sq. ft. (2.04 mm/min) to the design sprinklers.

c) Number of Design Sprinklers. The number of design sprinklers under flat, smooth, horizontal ceilings shall include all sprinklers within a compartment that requires the greatest hydraulic demand, up to a maximum of four adjacent sprinklers.

4. The fire protection systems shall not be designed to operate if the residual pressure of the existing water service falls to 20 psi or lower at design flow requirements.
5. The fire protection system design shall include a minimum of 10 psi safety factor to allow for future losses in the water service pressure characteristics.
6. The maximum allowable system velocities shall not exceed 20 fps unless alternate criteria are required by the Owner's Insurance Underwriter.
7. The Dwelling Units automatic sprinkler design criteria may be hydraulically calculated for the room design method as outlined in NFPA 13 if acceptable to the local governing authorities and the Owner's Insurance Underwriter.
8. Dwelling Units shall be completely protected by automatic sprinklers.
9. Reasonable efforts shall be made to identify water supplies that could lead to microbial induced corrosion (MIC). When conditions are found that may result in MIC contamination of the fire protection piping, corrective measures shall be designed.

C. Fire Protection System Alarms

1. The fire protection contractor shall coordinate location and function of all flow, air pressure, supervisory switches, and other dry contacts with the fire alarm contractor.
2. All control valves in the fire protection system shall be provided with supervisory switches wired for annunciation at the main FACP.
3. Automatic sprinkler system connections shall be provided with flow switches adjacent to the zone control valve wired for annunciation at the main FACP.
4. Automatic sprinklers will be provided in all elevator shafts and elevator machine rooms as required. The service to each of these spaces shall be provided with an individual control valve with a supervisory switch and a flow switch (with no retard built into it) located in an adjacent room and wired for annunciation at the main Fire Alarm Control Panel (FACP).

1.05 ORDINANCES, PERMITS AND DRAWING APPROVALS

A. The Contractor shall file all requisite plans relating to this section of the specifications with the proper authorities, secure all permits and approvals and pay all resultant fees for work done under this section.

B. All fire protection work shall comply with all laws, ordinances, rules, regulations and standards of the City, County, State and the Owner's Insurance Underwriter; all applicable sections of the National Fire Codes and the Codes and Standards of the National Fire Protection Association.

C. If code or other requirements exceed the provisions shown on the Contract Documents, the Architect shall be notified in writing. Where requirements of the Contract Documents exceed Code requirements, work shall be furnished and installed in accordance with the Contract Documents. Any work done contrary to these requirements shall be removed and replaced at the Contractor's expense.

1.06 EQUIPMENT, MATERIALS, BID BASIS

A. Manufacturers' names, model numbers, etc. as specified on the Drawings and herein are for the purpose of describing type, capacity, function and quality of equipment and materials required.

B. Unless "approved equal" is specifically stated, bids shall be based on equipment named in the Specifications or on the Drawings as "base" products.

C. "Equal product" and "approved equal" items listed shall conform to specified base items and shall be substantially equal in size, weight, construction quality and capacities. The alternate equipment and materials shall be submitted as full equivalent to the equipment and materials specified, with sufficient supportive documentation and technical literature to demonstrate quality, performance, and workmanship without doubt or question.

D. The Contractor shall coordinate the installation of all fire protection equipment proposed for use in this project with all building trades (architectural, structural and electrical). Coordination shall be accomplished prior to, and shall be reflected in, the submittal of shop drawings for approval. Any modifications or revisions required by other trades as a result of the use of equipment other than the basis of design shall be made at no additional cost.

1.07 EXAMINATION OF EXISTING PREMISES

A. Prior to the ordering or purchasing of any equipment or materials or the layout or installation of any work, the Contractor shall examine the premises and verify any and all of the existing conditions under which he will be obliged to operate, or that will in any manner affect the work under this Contract. No allowance will be made subsequently in this connection in behalf of the Contractor.

1.08 PAINTING

A. All piping exposed to public sight such as standpipe and drain piping in stairwells, or exposed to exterior or moisture conditions such as piping in parking decks, shall be primed and painted with two coats of an enamel-based paint. The color shall be as directed by the Architect.

B. Contractor shall touch-up to match original finish any equipment scratched in shipment or installation.

1.09 TRANSPORTATION, DELIVERY, STORAGE AND PROTECTION

A. The Contractor shall provide and pay for all transportation, delivery, and storage required for all equipment and materials. Upon receipt of all equipment and materials, they shall be properly stored in their original shipping container to protect them from vandalism, theft, the elements, and other harm or damage. Any equipment or materials received in a damaged condition, or damaged after receipt, shall not be installed. Only new undamaged equipment in first-class operating condition shall be installed.

B. All equipment and piping shall be protected to prevent entrance of foreign matter and debris by covering exposed openings during construction.

C. The Contractor shall closely coordinate the ordering and delivery of all mechanical equipment with other trades to assure that equipment will be delivered in time to be installed in the building without requiring special or temporary access or building modifications. Certain equipment may have to be installed prior to the erection of the building walls or roofs.

1.10 GUARANTY

A. All fire protection work described in the Contract Documents shall be guaranteed for a period of one (1) year from the date of final acceptance. This guaranty shall apply to all equipment, materials and workmanship. During the guaranty period, all defects shall be corrected in an acceptable manner, consistent with the quality of materials and workmanship of original construction, at no expense to the Owner.

1.11 SHOP DRAWINGS

A. It is the responsibility of the Contractor to coordinate the design with the work of all other disciplines so as to avoid conflicts. Where necessary piping shall be offset around ducts, structural members or other obstructions, while maintaining effective coverage, drains shall be provided per NFPA requirements.

B. Review of the Drawings and hydraulic calculations by Jordan & Skala Engineers, Inc. (JSE) is for coordination with the design concept for the project, and for assurance that they have been prepared in a timely manner. JSE is entitled to rely on the technical sufficiency and timely delivery of these documents, as well as on the computations performed by the subcontractor. JSE shall not be required to review or verify those computations or designs for compliance with applicable laws, statutes, ordinances, building codes, and rules and regulations.

C. All required submittals shall be transmitted electronically (e.g. pdfs, etc.) with the associated specification section and the item submitted clearly identified. The Contractor shall provide an itemized listing, which indicates the horsepower and voltage of each piece of equipment that requires electrical service. The itemized list is to be signed by the project managers of the Contractor, Electrical Contractor and General Contractor to ensure coordination of the electrical requirements for the project. Review of the equipment submittal will not begin until the electrical coordination document is provided.

D. All fire protection drawing submittals shall be at 1/8" scale as a minimum.

E. Fire Protection shop drawings shall include all data required by NFPA Section 13. Shop drawing plans shall indicate all lights, grilles, soffits, alarms, speakers and other ceiling components, as well as hydraulic node points, to ensure coordination. Substitutions or alterations to the design included in the Contract Documents shall be clearly stated on the shop drawing submittal. The Contractor shall submit shop drawings to and secure approval of the Authority having Jurisdiction, as well as Owner’s Underwriter if required, prior to submission to the Engineer. The Contractor shall not commence work, purchase, or provide any materials to the job site without obtaining shop drawing approval. Shop drawings shall include copies of all hydraulic calculations providing design densities, where applicable. In addition, shop drawings submittals shall include printed catalog specifications and data sheets for all of the following as applicable:

1. Fire department valves
2. Sprinkler heads and accessories
3. Siamese Fire Department connection
4. Fire valve cabinets
5. Test header
6. Roof manifold
7. Backflow preventer
8. Cutting oil indicating compatibility with the CPVC sprinkler piping

F. A letter signed by an officer of the Contractor's company shall be included in the submittal book that states the following items meet or exceed the requirements of the specifications:

1. Pipe and fittings
2. Valves
3. Pipe supports
4. Pipe accessories
5. Pipe labels and valve tags
6. Flow switches
7. Tamper switches

G. All design drawings and calculations shall be prepared by the Contractor's Delegated Design Engineer/Designer and shall bear the seal of the registered professional or fire protection engineer or NICET Level IV certification licensed in the state of the project or equivalent fire sprinkler contractor's certificate seal.

H. Included with submittals of fire protection equipment requiring electrical connections shall be a written statement confirming coordination of voltage requirements, bearing the names and signatures of the fire protection and electrical contractors. A photocopied reproduction of the below statement is acceptable.

VOLTAGE COORDINATION STATEMENT

This statement is to confirm that the voltages of the equipment provided under this specification have been coordinated with the electrical drawings, as well as with the electrical contractor.

Fire Protection Contractor:_____

Project Manager Name:_____

Project Manager Signature/Date:_____

Electrical Contractor:_____

Project Manager Name:_____

Project Manager Signature/Date:_____

I. Provide Material Safety Data Sheet (MSDS) or letter from manufacturer certifying the VOC content for each adhesive, sealant, paint and coating.

J. VOC Content: Submit adhesive and sealants product information or MSDS showing VOC Content information for all applicable products specified under this section. All applicable products in this section must meet low VOC content as specified by LEED Specification Section 01 81 13 Sustainable Design Requirements.

1.12 AS-BUILT DRAWINGS

A. The Contractor shall maintain a record set of drawings indicating all changes in the work from that shown in the Contract Documents. Prior to final acceptance by the Owner, the Contractor shall assemble the complete set of as-built drawings that accurately reflects all changes to indicate actual final construction. All concealed piping shall be dimensionally located from at least two (2) column lines or major building structure elements. Drawings shall be a minimum of 1/8" scale.

B. The original set of “as-built” drawings shall be scanned and transmitted to the Architect in CD or flash drive format along with the original “as-built” documents.

1.13 OPERATING AND MAINTENANCE INSTRUCTIONS

A. Prior to final acceptance by the Owner, the Contractor shall provide three (3) copies of an Operations and Maintenance Manual, Bound, indexed, and titled in three-ring, loose-leaf binders and one flash drive. These manuals shall each contain the following:

1. Clear and concise instructions for operation, maintenance, adjustment, lubrication, wiring diagrams and trouble-shooting data for all mechanical equipment. This information shall be prepared by the manufacturer for particular size and model of equipment furnished.
2. Parts list of all parts for equipment, with catalog numbers and other data necessary for ordering of replacement parts.
3. Provide a competent manufacturer’s service engineer for a minimum of two (2) days to instruct the operating personnel including the interpretation of all equipment diagrams. A diary of the training sessions shall be made by the instructing manufacturer’s service engineer and witnessed by the Owner’s representative and shall be included in the as-built submittal.
4. Copies of all approved equipment shop drawings, sprinkler layout drawings, hydraulic calculations and as-built plans shall be submitted with the Operation and Maintenance manual.
5. Index shall include type of equipment, manufacturer, and local representative with address and phone number.

PART 2 - PRODUCTS

2.01 FIRE PROTECTION SYSTEM MATERIALS

A. All materials, pipe, valves and equipment furnished under this section shall be new and approved by NFPA, Underwriters Laboratories Inc. (UL), Factory Mutual (FM) and American Water Works Association (AWWA) where applicable.

B. The proposal submitted shall include all materials and equipment as specified or shown on the Drawings. Proposed substitutions with difference in price, if any, shall be listed separately on the bid form at the time of submittal.

C. Required materials not covered by the detailed specifications shall be of a suitable class, grade and type and shall be subject to the approval of the Engineer. Where two or more units of the same class or type of equipment are required, these units shall be the products of a single manufacturer.

2.02 PIPE, JOINTS AND FITTINGS

A. Underground Piping

1. Class 50 and 51 ductile iron pipe, bituminous coated outside, cement lined interior, ANSI A21.51 and A21.4
   a. Push-on or mechanical joints with neoprene gasket, 250 psi rating, ANSI A21.11
   b. Ductile iron mechanical joint fittings with neoprene gasket, bituminous coated outside, cement lined interior, 250 psi rating, ANSI A21.10

c. Ductile iron flanged joints for all piping in vaults, red rubber gaskets, 250 psi rating, ANSI A21.15. Cadmium plated heavy hex machine bolts and nuts with bituminous coating field applied.

2. Class 150 polyvinyl chloride (PVC) DR 18 pressure pipe, NSF and Factory Mutual approved, AWWA C900
   a. Push-on or mechanical joints with neoprene gasket, ASTM D3139 and ANSI A21.11
   b. Ductile iron mechanical joint fittings with neoprene gasket, bituminous coated outside, cement lined interior, 250 psi rating, ANSI A21.10
   c. Ductile iron flanged joints for all piping in vaults, red rubber gaskets, 250 psi rating, ANSI A21.15. Cadmium plated heavy hex machine bolts and nuts with bituminous coating field applied.
3. Underground piping and installation shall be in accordance with the Insurance Underwriter's requirements and NFPA-24 and shall be installed with a minimum of 2'-6" of cover.
   a. Trenching conditions for ductile iron pipe shall be Type 1 laying condition, ANSI A21.50.
   b. Trenching conditions for PVC pipe shall be Class C bedding, ASCE Manual #37, and manufacturer's recommendations.

B. Aboveground Piping

1. Schedule 40 welded or seamless steel pipe, ASTM A53 and A135, and A795. In accordance with NFPA 13, piping with threaded joints 6" and smaller shall be Schedule 40, piping 8" and larger may be Schedule 30 minimum. For welded or roll-grooved joints, wall thickness shall be Schedule 7 minimum for piping 4" and smaller, 0.134" for 6" pipe, and 0.188 for 8" and 10" pipe. Schedule 80 pipe shall be used when working pressures exceed 300 psi.
   a. Class 125 and 250 cast iron threaded fittings, ANSI B16.4
   b. Class 150 and 300 malleable iron threaded fittings, ANSI B16.3
   c. Class 125 and 250 cast iron flanged fittings, ANSI B16.1
   d. Schedule 40, 150 psi, forged steel buttweld fittings, ANSI B16.9
   e. Grooved mechanical couplings and fittings with EPDM center-leg gasket, ductile iron, 300 psi minimum rating ASTM A536, UL Listed, FM Approved
      1) In applicable sizes, fittings shall be short-pattern, with flow equal to standard pattern fittings. Basis of Design: Victaulic FireLock or approved equal.
      2) Installation-Ready™ fittings for Schedule [40] [10] grooved end steel piping in fire protection applications sizes NPS 1-¼ thru 2½. Fittings shall consist of a ductile iron housing conforming to ASTM A-536, Grade 65-45-12, with Installation-Ready™ ends, [orange enamel coated] [red enamel coated] [galvanized]. Fittings complete with prelubricated Grade "E" EPDM Type 'A' gasket; and ASTM A449 electroplated steel bolts and nuts. System shall be UL listed for a working pressure of 300 psi and FM approved for working pressure 365 psi.
   f. All cutting oils, thread sealants and other products must be compatible with the CPVC piping installed.
2. Schedule 10 minimum lightwall welded or seamless steel pipe with corrosion resistant coating, CRR Value of 1 minimum, ASTM A53 and A135
   a. Grooved mechanical couplings and fittings with EPDM center-leg gasket, ductile iron, 300 psi minimum rating ASTM A536, UL Listed, FM Approved
      1) In applicable sizes, fittings shall be short-pattern, with flow equal to standard pattern fittings. Basis of Design: Victaulic FireLock or approved equal.

2) Installation-Ready™ fittings for Schedule [40] [10] grooved end steel piping in fire protection applications sizes NPS 1-¼ thru 2½. Fittings shall consist of a ductile iron housing conforming to ASTM A-536, Grade 65-45-12, with Installation-Ready™ ends, [orange enamel coated] [red enamel coated] [galvanized]. Fittings complete with prelubricated Grade "E" EPDM Type 'A' gasket; and ASTM A449 electroplated steel bolts and nuts. System shall be UL listed for a working pressure of 300 psi and FM approved for working pressure 365 psi.

b. Lightwall, 150 psi, buttweld fittings, ANSI B16.9

3. Chlorinated polyvinyl chloride (CPVC) pipe, ASTM D1784 and F442, UL Listed, plenum rated
   a. Schedule 40 & 80 chlorinated polyvinyl chloride (CPVC), solvent welded socket, ASTM F439, UL Listed, plenum rated
   b. Schedule 40 & 80 chlorinated polyvinyl chloride (CPVC), threaded, ASTM F437, UL Listed, plenum rated
   c. CPVC piping is not to be installed in areas of exposed construction. Provide steel pipe and fittings in all areas where piping is exposed.
4. Flexible stainless-steel piping connection, UL Listed and FM Approved, 1" NPS corrugated braided stainless-steel hose assembly, a bend radius to 2", UL Listed to 175 psi rating and FM Approved to 200 psi.
   a. Victaulic Vic-Flex Series or approved equal.

C. All interior sprinkler piping shall meet the requirements of applicable sections of NFPA, and the Owner's Underwriter. All pipe, fittings, valves, and sprinkler system components shall be rated for working pressures as required by system design.

D. Grooved Joint Couplings: Couplings consist of two ductile iron housing segments, pressure responsive elastomer gasket, and ASTM A449 compliant bolts and nuts.
   1. Rigid Type: Housings cast with offsetting, angle-pattern, bolt pads to provide system rigidity and support and hanging in accordance with NFPA-13, fully installed at visual pad-to-pad offset contact. (Couplings that require exact gapping at specific torque ratings are not permitted.). Installation-Ready for complete installation without field disassembly. Basis of Design: Victaulic Style 009N and 107N or approved equal.
   2. Flexible Type: For use in locations where vibration attenuation and stress relief are required: Basis of Design: Victaulic Installation-Ready Style 177 or Style 77 or approved equal.

E. All pipe, supports and hanger assemblies shall be in accordance with NFPA-13 and shall be UL Listed or FM Approved.

F. All work shall be designed and installed to comply with the requirements for the seismic design category and use group for the area in which the building is constructed. All protective measures shall be in accordance with NFPA 13 requirements.

G. All sprinkler hangers and support rods installed in areas exposed to exterior conditions, including parking decks, are to be fully galvanized or painted with two coats of Adsil Microguard corrosion prohibitor.

H. Coordinate required drain locations for the lower level test assemblies with the plumbing contractor prior to shop drawing submittals. Drains at grade level may be hard piped for discharge at the exterior subject to approval of the location during the submittal review.

2.03 VALVES AND ACCESSORIES

A. Valves shall be installed where shown on the Drawings and elsewhere as required by codes or standards. All valves shall be UL Listed or FM Approved for fire protection service. All valves shall be provided with remote alarm tamper switches compatible with the Owner's central alarm system to monitor valve tampering. All switches and systems shall be Class B supervised. Provide 250 and 300 psi rated components at all locations as required by system pressure.

1. Gate Valves
   a. 2-1/2" and larger, Class 175 or 300, iron body, bronze mounted, solid wedge, outside screw and yoke, flanged or grooved ends, Stockham G-634 or F-670, or Victaulic Series 771 rated to 250 psi listed for fire service
   b. 2" and smaller, Class 175, bronze body and trim, solid wedge, outside screw and yoke, threaded ends, Stockham B-133
   c. Provide UL Listed pressure regulating valves at all locations required due to system pressure. Valves shall be Potter Roemer Series 4000 or approved equal.
2. Butterfly Valves
   a. 2" through 12", 300-psi, grooved-end ductile iron body, electroless-nickel coated ductile iron disc, pressure responsive elastomer seat, with stainless steel stem. (Stem shall be offset from the disc centerline to provide complete 360-degree circumferential seating.) Weatherproof actuator housing with handwheel and supervisory switches. Valve shall be Victaulic Series 705.
   b. 4" and larger, Class 175, iron body, aluminum bronze disc, wafer or lug style, EPDM gasket, Stockham LG-52U
   c. 2" and smaller, Class 175, bronze body, stainless steel disc threaded ends, Milwaukee BB-FP
3. Check Valves
   a. 2-1/2" and larger, Class 125, iron body, bronze disc, flanged or threaded ends, Stockham G-931 and G-927
   b. 2-1/2" and larger, Class 125, iron body, bronze trim, flanged ends, Milwaukee 1800 series, flanged, UL Listed for fire service
   c. 2" through 12", 250-psi, grooved-end ductile iron body, stainless steel spring and shaft for vertical or horizontal installation. Valves shall be Victaulic Series 717.
   d. 4" and larger, Mission fig. U-12 HMP, wafer body, UL Listed for fire service
4. Backflow Preventers
   a. Double check assembly shall be a complete assembly with two (2) independently operating check valves mounted in a common body, two (2) gate valves and four (4) test cocks, designed for horizontal installation. All valves shall be provided with tamper switches. The complete assembly shall be UL Listed, FM Approved, designed to specifications and/or requirements of USC, CCCL, AWWA and ASSE and shall be sized for the full fire flow demand at a maximum of 6 psi pressure drop.
      1) Double check backflow preventers shall be ASSE 1015 certified and equal to Ames Maxim M200, Watts Series 757, Zurn 350A or approved equal.
      2) Double detector check backflow preventers shall be provided where required by local authorities, ASSE 1048 certified and equal to Ames Maxim M300, Watts Series 757DCDA, Zurn 350DA or approved equal.
5. Fire Department Valves
   a. Fire Department valve shall be 2-1/2" cast brass body, 300 lb. rating, female N.P.T. inlet, male hose thread outlet, complete with cap and chain, brass finish. Valve shall be Potter Roemer Fig. 4065 or approved equal.

b. Provide UL Listed pressure regulating valves at all locations as required by system pressure. Valve shall be Potter Roemer 4000 Series or approved equal.

6. Floor Control Valve
   a. The floor control valve assembly shall be provided with a valve with supervisory switch. A check valve, pressure gauge, water flow switch and test connection with drain shall be provided downstream. The installation shall be per NFPA 13 requirements.
   b. Provide UL Listed pressure regulating valves at all locations as required by system pressure. Valve shall be Potter Roemer 4000 Series or approved equal.
7. Siamese Fire Department Connection
   a. Fire department connection shall be 2-way exposed Siamese type, 2-1/2" x 2-1/2" x 4" size, cast brass body, polished chrome finish for all exposed surfaces, cast brass escutcheon, and brass female hose inlets having individual clapper valves, plugs, and chains. Assembly shall be located with the center line of the hose inlets at 2'-6" above adjacent grade. Inlet threading shall be National Standard or same as municipal fire department, as required. Assembly shall be UL Listed, FM Approved. Wall Mounted: Potter Roemer 5710 series or approved equal.
   b. Free Standing: Potter Roemer 5760 series or approved equal.
   c. At the low point near each fire department connection, install a 90-degree elbow with drain connection to allow for localized system drainage. Basis of Design: Victaulic #10-DR.
   d. Provide anti-theft protection cap for fire department connections as approved by the Authority Having Jurisdiction.
8. Fire Valve Cabinet
   a. Cabinet shall be 20-gauge steel with polyester coating, recessed with flush full metal hinged door with cam catch and integral shelf for fire extinguisher. Cabinet shall be Potter-Roemer 1870 series or approved equal.
9. Roof Manifold
   a. Wall mount manifold to be three outlet horizontal configuration, cast brass body with threaded 2-1/2" male outlets complete with valves, chains and caps, rough brass finish. Provide accessible indicating type shut off valve with supervisory switch (normally closed) and automatic ball drip to roof. Roof manifold to be Potter-Roemer 5880 series or approved equal.

2.04 AUTOMATIC SPRINKLER SYSTEM MATERIALS

A. The underground fire protection service shall be provided with thrust blocks and rods and clamps at the service entry.

B. Automatic sprinklers shall be provided as follows:

1. Dwelling Units
   a. Small frame glass element, semi-recessed and sidewall sprinklers shall be provided in all areas with ceilings unless otherwise noted. Temperature rating of sprinklers shall be 155 - 165 degrees. Sprinkler and escutcheon to be white finish. Sprinkler to be Viking Freedom Residential series or equal with listed and/or approved semi-recessed escutcheon.
2. Dwelling Unit Corridors
   a. Small frame glass element, semi-recessed and sidewall sprinklers shall be provided in all areas with ceilings unless otherwise noted. Temperature rating of sprinklers shall be 155 - 165 degrees. Sprinkler and escutcheon

to be white finish. Sprinkler to be Viking Freedom Residential series or equal with listed and/or approved semi-recessed escutcheon.

3. Public Spaces and Corridors with Gypsum Ceilings
   a. Fully flat plate concealed type sprinklers, glass element, or fusible link style, quick response sprinklers shall be provided in all areas with gypsum ceilings unless otherwise noted. Temperature rating of sprinklers shall be 155 – 165 degrees. Concealed cover plate shall be factory painted to match the adjacent ceiling color; submit painted sample to the Architect for approval. Sprinkler to be Viking Mirage or equal concealed sprinkler or approved equal.
   b. Small frame glass element, semi-recessed, quick response pendent sprinklers shall be provided in all areas with gypsum ceilings unless otherwise noted. Temperature rating of sprinklers shall be 155 – 165 degrees. Sprinkler and escutcheon to be white finish. Sprinkler to be Viking Microfast series or equal with listed and/or approved semi-recessed escutcheon.
4. Public and Back-of-House Spaces with Lay-in Ceilings
   a. Small frame glass element, semi-recessed, quick response pendent sprinklers shall be provided in all areas with lay-in ceilings unless otherwise noted. Temperature rating of sprinklers shall be 155 – 165 degrees. Sprinkler and escutcheon to be white painted finish. Sprinkler to be Viking Microfast series or equal with listed and/or approved semi-recessed escutcheon.
5. Back-of-House Spaces and Unfinished Spaces with no Ceiling
   a. Quick response upright pendent sprinklers shall be provided in all areas with no ceiling. Temperature rating is to be 165 degrees unless conditions require higher temperature. Finish of sprinkler to be rough brass. Sprinkler to be Viking Microfast or equal.
6. Exterior Overhangs
   a. Quick response chrome plated dry horizontal sidewall or upright sprinklers are to be provided. Barrel length shall be a minimum of 12". Sprinkler and escutcheon shall have UL Listed ENT, polyester or Teflon corrosion protection at exterior overhangs and rough brass finish at elevator shafts. Sprinkler shall be Viking Microfast or equal.
7. Exterior Balcony or Breezeway
   a. Victaulic VicFlex™ dry horizontal sidewall or pendant sprinkler, Model VS1. The sprinkler shall provide a vertical or horizontal flexible connection with a bend radius to 2”, and allow for up to 4 bends.
8. Alternate acceptable manufacturers with equivalent sprinkler are Victaulic, Reliable, or Globe.
9. Sprinkler guards shall be installed on all sprinklers 7'-0" or less above floor.
10. Escutcheons and guards shall be listed, supplied, and approved for use with the sprinkler by the sprinkler manufacturer.
11. Provide sprinklers at the highest and lowest level of all stairwells.
12. Provide sprinklers at the top of all closets that contain air handlers and water heaters. Where a solid shelf is installed and sealed between the air handler and water heater to create separate spaces, a sprinkler head shall be provided under the shelf in addition to the head protecting the top of the closet.
13. Provide sprinklers in electrical rooms and elevator machine rooms unless specifically prohibited by local authorities; the sprinkler supply to each space shall be provided with a supervised valve and flow switch. Coordinate the intermediate temperature rating of the sprinkler head in all elevator machine rooms with the electrical contractor to ensure sprinkler operation will not occur prior to activation of the heat detector and the shunt trip circuit breaker.

14. Sidewall sprinklers shall be installed in all electrical rooms, electrical closets and elevator machine rooms where adequate coverage is provided. Upright sprinklers shall be installed in these spaces when coverage limitations of the sidewall sprinklers are exceeded. Piping shall not be installed above any electrical equipment, switchboard or panelboard. Piping shall offset around surface mounted light fixtures where possible, provide a minimum of 6" clearance below the bottom of the light fixtures at all locations.
15. The property is to be fully sprinklered throughout per the requirements of NFPA unless specifically noted otherwise. Elimination of sprinklers in electrical rooms, elevator shafts and elevator machine rooms shall be clearly indicated on the shop drawing submittal noting the exception applied for the deletion of sprinklers in these spaces.
16. The Contractor shall furnish and install a cabinet located in the fire service entry room with the quantity of each type of sprinklers and wrenches as required by NFPA 13:
    a. facilities with less than 300 sprinklers 6 minimum
    b. facilities with 300 to 1000 sprinklers 12 minimum
    c. facilities with over 1000 sprinklers 24 minimum
17. The Contractor shall provide and place suitable signs indicating the purpose of each control valve, test connection, main and auxiliary drain, etc., as required.
18. Provide higher intermediate temperature rated sprinklers in all areas required due to service conditions and as required by NFPA 13.
19. Provide sprinklers at the top floor and on alternating floors below in all linen and trash chutes.

2.05 HEAT TRACING CABLE FOR FREEZE PROTECTION OF PIPING

A. Provide pipe insulation with water proof covering and listed electric heat tracing cable on all fire protection standpipe, cross main, feed main and branch piping located within areas exposed to temperatures below 40° F and as indicated on the Contract Documents.

B. Provide a complete UL Listed or FM Approved system of self-regulating heating cables, pipe insulation, controllers and components to maintain exposed fire protection piping at or above 40°F.

C. Electric heat cable shall be installed linearly along the bottom of the pipe and allowance shall be made for all fittings, valves, pipe supports, etc. Cable shall be installed prior to insulation of the piping system.

D. Electric cable shall be capable of maintaining a minimum water temperature of 40 degrees F at an ambient air temperature of 0 degrees F.

E. The electric cable shall be the self-regulating type that responds to varying localized temperature conditions by varying the heat output along its length. This shall be accomplished by a self-regulating core which varies its resistance continuously with changes in temperature. A constant wattage heater is not acceptable.

F. Provide single or multiple circuit digital controller as required by the project, connected to and monitored by the building BAS system. All enclosures shall be NEMA 4X.

G. All heat tracing systems shall be supervised as required by NFPA 13.

H. Provide a thermostat control, which de-energizes the heating cable when the ambient air temperature is above 40 degrees F (adjustable). While energized, the heat cable shall be entirely self-regulating.

I. Provide all power connection hardware, splices, end seals, etc., to accomplish installation. All hardware shall be by the same manufacturer as the cable.

J. Electric heating cable and accessories shall be UL Listed. Electric heating cable shall conform to all requirements of Division 26.

K. Electric heating cable shall be Raychem XL or Engineer approved equal.

L. All piping shall be insulated with 1" thick fiberglass insulation with factory applied all-service jacket. Piping exposed to exterior conditions shall be provided with 0.016" minimum corrugated aluminum metal jacketing with bands on 3'-0" centers.

M. Heating-cable circuit shall be protected by a ground-fault device for equipment protection. This requirement is in accordance with section 427-22 of the NEC-2005.

N. All heating cable components shall be UL Listed, CSA Certified, or FM Approved for use as part of the system to provide pipe freeze protection. Component enclosures shall be rated NEMA 4X to prevent water ingress and corrosion. Installation shall not require the installing contractor to cut into the heating-cable core to expose the bus wires. Connection systems that require the installing contractor to strip the bus wires or that use crimps or terminal blocks, shall not be acceptable.

2.06 TESTS AND DRAINS

A. The Contractor shall provide test connections as required and as indicated on the Drawings. Inspector's test connections shall be fitted with sight glasses and the discharge of the drain riser shall be terminated above an adjacent hub drain with an air gap fitting. All tests shall have approved sight test assemblies as required by NFPA.

2.07 ELECTRIC MOTORS AND RELAYS

A. Design, type and ratings of electric motors shall comply with the National Electrical Code, NEMA and Underwriters Laboratories Inc.

B. Unless otherwise noted, or required for special applications, motors shall be equipped with sealed ball bearings.

C. The Contractor shall be responsible for coordinating and furnishing equipment of voltage shown on the electrical documents.

D. Electric motors shall be NEMA Premium Efficiency open drip proof type. Motors shall meet NEMA MG1 Table 12-12 of EISA, 2010. Motors shall be selected with a minimum of 15% safety factor greater than the fan brake/horsepower (e.g. 4.75 BHP would require a nominal 7½ HP motor). The motor service factor shall not be used as part of the safety factor. All motors shall have thermal overload protection. Motors shall be capable of operating at $\pm$ 10% of the design voltage without voiding the manufacturer's warranty.

E. Motors controlled by a variable frequency drive (VFD) shall be inverter duty motors designed according to the requirements of NEMA MG 1, Part 31, "Definite Purpose, Inverter Fed Motors" and shall be compatible with the particular manufacturer's drive that is used.

1. Shaft Grounding Rings - All motors controlled by variable frequency drives shall be equipped with a maintenance free, conductive micro fiber, shaft grounding ring

with a minimum of two rows of circumferential micro fibers to discharge damaging shaft voltages away from the bearings to ground.

a. Motors up to 100HP shall be provided with one shaft grounding ring installed either on the drive end or non-drive end. Motors over 100HP shall be provided with an insulated bearing on the non-drive end and a shaft grounding ring on the drive end of the motor. Grounding rings shall be provided and installed by the motor manufacturer or contractor and shall be installed in accordance with the manufacturer's recommendations.

b. Shaft grounding rings shall be AEGIS bearing protection ring by Electro Static Technology-ITW.

2. High Frequency Grounding Straps - All motors controlled by variable frequency drives shall be bonded from the motor foot to the system ground with a high frequency ground strap fabricated of flat braided, tinned copper with terminations to accommodate motor foot and system ground connection.

a. Proper grounding of motor frame for all inverter-driven induction motors shall be in accordance with ABB Technical Guide No.5 and Allen Bradley Publication 1770-4.1 Application Data Industrial Automation Wiring and Grounding Guidelines

b. High frequency bonding strap shall be AEGIS high frequency ground strap by Electro Static Technology-ITW.

F. All motors to be mounted on equipment supplied under this section shall be as manufactured by General Electric, Westinghouse, or Louis Allis.

2.08 PIPING AND EQUIPMENT IDENTIFICATION

A. A marker showing the service and an arrow indicating the direction of flow shall be applied on the following equipment installed under this section of the Specifications:

1. All above ground fire protection standpipe and sprinkler piping
2. All above ground sprinkler drainage piping

B. Piping identification shall be applied in areas of exposed construction and in areas with accessible or lay-in ceilings. The piping shall be labeled at each valve, wall and floor penetrations (both sides) and at connections to equipment. In addition, straight runs of piping shall be labeled at intervals not greater than 25 feet.

C. Equipment and component parts thereof shall bear manufacturer's nameplate, giving manufacturer's name, size, type model number or serial number, and electrical characteristics, to facilitate maintenance and replacements. Nameplates of distributors or subcontractors are not acceptable. Electrical equipment shall be UL Listed as applicable.

D. The letter size and background color shall conform to the Identification of Pipe System ANSI A-13-1. The vinyl plastic markers shall be as manufactured by Seton Name-Plate Company, W.H. Brady Company, or Westline Products.

E. All valves shall have a 1-1/2" diameter laminate plastic tag, engraved, black and white marking and a brass hook for attaching to valve stem. Tags shall have letters as large as practical, the number of the valve and the service such as indicated on the "Legend." The numbers of service shall be consecutive. Tags shall be similar to Seton 2961.

F. All valves on pumps shall be similar to the valve tags specified above, except they shall be 2-1/2" in diameter, black with white number 2" high for attaching to valve stem by means of brass hook or small solid link brass chain. Tags shall be similar to Seton 2961-25.

G. These numbers shall correspond with numbers indicated for valves and controls on two printed detailed lists and locational diagrams. These printed lists and locational diagrams shall state the numbers and locations of each valve and control and the section which it controls.

H. The printed lists shall be prepared by Wrico pencil lettering or typed and shall be framed under glass, and mounted as directed by the Owner.

PART 3 - EXECUTION

3.01 INSTALLATION

A. The Drawings are diagrammatic and the final arrangement of the work shall suit field conditions, the characteristics of the materials used and coordination with all other disciplines and the building components and finishes. Verify all dimensions in the field. Access and clearances must be provided and maintained for the proper operation, maintenance service and repair of the work.

B. No sprinklers are to be installed prior to the building being completely sealed in from external moisture and conditions.

C. All standpipe, sprinkler and drain piping exposed to sight in stairwells is to be painted with two coats of an epoxy based paint, color to be selected by the Architect.

D. All equipment and materials shall be installed according to manufacturer’s recommendations and shall meet the requirements of NFPA and the Owner’s Insurance Underwriter.

E. All sprinklers in spaces visible to public view shall be located symmetrically in relation to ceiling design elements, lighting fixtures, speakers, diffusers, etc. All ceiling components are to be indicated on the submittal drawings as noted previously to ensure coordination with all ceiling elements and devices. Piping to sprinklers in these areas is to be provided with arm-overs or flexible sprinkler drops to allow for exact placement of sprinklers.

F. Sprinklers shall be installed at the centerpoint of all 2' x 2' lay-in ceiling tiles, and at the centerpoint or 1' from the ends of 4' x 2' ceiling tiles.

G. Do not install sprinklers that have been dropped, damaged, show a visible loss of fluid, or a cracked bulb.

H. The sprinkler bulb protector shall be removable by hand, without tools or devices that may damage the bulb.

I. Where pipe is installed above suspended ceilings, it shall be located in the clear space above the suspended ceiling and the pendent sprinklers shall be located to clear the ceiling supporting grid system, the ceiling mounted fixtures, and air conditioning ducts and outlets.

J. The Contractor shall install additional pendent sprinkler heads under all ductwork or other obstructions which are over 48" wide in accordance with NFPA-13 in areas of exposed construction.

K. All sprinklers located in areas that are to be painted shall be protected prior to painting.

L. Provide a pressure gauge at the top level of all standpipes.

M. Where wet fire protection standpipe, cross main, feed main and branch piping are located within areas exposed to temperatures below 40° F, listed electric heat tracing and pipe insulation shall be installed in accordance with the requirements of Section 2.06 – Heat Tracing Cable for Freeze Protection of Piping.

N. Grooved joints shall be installed in accordance with the manufacturer's latest published instructions. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service. Gaskets shall be molded and produced by the grooved coupling manufacturer. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove. Grooved coupling manufacturer's factory trained field representative shall provide on-site training for contractor's field personnel in the proper use of grooving tools, application of groove, and installation of grooved piping products. Factory trained representative shall periodically visit the jobsite to ensure best practices in grooved product installation are being followed. Contractor shall remove and replace any improperly installed products.

3.02 PREPARATION

A. Arrangements shall be made to have the openings, inserts, sleeves, blockouts, and such other incidentals set in place ahead of the construction work, where practical, to eliminate the need of cutting and patching. If coring becomes necessary for installation of the work, it shall be done under this section. All holes shall be neatly patched and finished to match the adjoining work in a manner approved by the Architect. All coring shall be performed in a manner not to weaken the structural parts and the manner and method shall be submitted to the Structural Engineer for approval.

3.03 SLEEVES AND ESCUTCHEONS

A. The Contractor shall furnish and set pipe sleeves and inserts for all work under this section and shall be responsible for their proper and permanent location. In the event that failure to do so requires cutting and patching, the remedial work shall be the responsibility of the Contractor.

B. All pipes passing through floors, walls or partitions shall be provided with sleeves having an internal diameter 1-1/2" (3/4" annular space) larger than the outside diameter of the pipe or insulation on covered lines, except as otherwise specified herein.

C. Sleeves for all pipes through walls, beams and partitions shall finish flush with the finish line of the walls, beams and partitions.

D. Sleeves for all piping shall extend 1/2" above finish floor, (except where under partitions, the sleeves shall be flush with the bottom of the partition) and after the installation of pipe shall be packed and made watertight with fire stopping sealant to maintain separations and fire ratings.

E. Where pipes pass under footings and through exterior walls, sleeves shall be of galvanized steel pipe and shall be not less than 4" larger than the pipe being sleeved. Sleeves shall be made watertight where passing through waterproofed surfaces, exterior wall, and floor slabs on grade. Waterproofing shall be done by means of a steel slip on welding flange, continuously welded at the center of the sleeve and shall be painted with one coat of bitumastic paint inside and outside. The space between sleeve and pipe shall be packed with oakum to within 2" of each face of the wall; (to within 2" of the top of sleeve at floors). The remaining space shall be packed and made watertight with a waterproof mastic. Mechanical expansion type rubber seals such as manufactured by Calpico Ind. and

Thunderline Corporation are acceptable as alternate method of water proofing piping penetrations.

F. Sleeves through floors or interior masonry walls shall be of galvanized steel pipe or wrought iron pipe size except where located in concealed pipe spaces where they may be of 22 gauge galvanized sheet steel if fire rating is maintained.

G. Sleeves through interior masonry partitions shall be of 22-gauge galvanized sheet steel.

H. Sleeves for piping to receive insulation shall be large enough to allow continuous insulation through sleeves.

I. Spacing between or location of pipe sleeves in floor slabs, structural beams or structural walls shall be subject to the Structural Engineer's approval.

J. Where pipes pass under load bearing footings they shall pass through a coated steel pipe sleeve as described above and extend past a 45 degree line out from the bottom of the load bearing structure. Concrete shall be used as backfill in the portions of trench within the 45 degree pressure line.

K. Escutcheons shall be provided around all exposed pipe passing through walls, partitions, ceilings and floors in finished spaces. Escutcheons shall be of sufficient outside diameter to cover the sleeve opening and shall fit snugly around the insulated or bare pipe and to the wall, partition, floor or ceiling.

3.04 WORKMANSHIP

A. All work shall be coordinated with the work to be performed or installed under other sections of these Specifications.

B. All work shall be executed in a workmanlike manner by workmen skilled in this type of work and shall present a neat appearance when completed.

C. Offsets shall be provided as required to avoid interference and conflicts with other work, to maximize headroom, or to improve the appearance of pipe runs. All pipe supports, structural members, hangers and other apparatus necessary to support firmly and substantially the various components of the systems shall be provided under this section.

D. Nameplates, catalog numbers and rating identifications shall be securely attached to equipment with screws or rivets. Adhesives or cements will not be permitted.

E. The subcontractor shall be responsible for the protection of the work from injury and shall protect all apparatus with suitable enclosures.

3.05 ERECTION AND INSTALLATION

A. Installation and workmanship requirements are specified hereinafter.

B. This subcontractor shall be responsible for the furnishing and installing of all support steel, hangers, rods, clamps, etc., to provide adequate support of all Fire Protection equipment specified herein. All support assemblies shall be UL Listed or FM Approved.

3.06 CLEANING OF SYSTEMS AND PREMISES

A. At all times, keep the premises clear of undue accumulation of rubbish.

B. On completion of the work, remove all rubbish and debris resulting from this Contract, and dispose of same.

C. All equipment shall be thoroughly cleaned and left in a satisfactory condition for proper operation at project completion. All equipment shall be partially or fully re-painted as required to provide an appearance of new equipment.

3.07 TESTS

A. Tests of all fire protection systems and equipment, underground and inside piping including alarm and detection devices shall be scheduled with one (1) week prior notification to a local representative of the Underwriter and the Architect. All tests and test procedures shall be in accordance with the applicable NFPA standards. After completion of all tests, the “Contractor’s Materials and Test Certificate” shall be submitted to the Architect.

B. The Contractor shall supply all materials, labor, utilities and power required for testing. Preliminary tests shall be performed to prove work is satisfactory prior to requesting a test inspection. Sectional tests shall be made before insulation or concealing any piping.

C. Repair all defects disclosed by tests or, if required by the Architect, replace defective work with new systems and materials at no additional cost to the Owner. Repairs to piping systems shall be made with new material. No caulking of screwed joints, cracks or holes will be accepted. Make tests in stages to facilitate work of others.

D. The Contractor shall be responsible for the repair and/or replacement cost installed and finishes damaged by leaks, tests and/or repair and replacement of his work at no additional expense to the Owner.

E. Prior to final acceptance by the Owner, submit the “Contractor’s Material and Test Certificates” indicating system compliance with all applicable sections of NFPA.

3.08 SUBCONTRACTOR’S WARRANTY

A. The Contractor shall warrant all equipment and the installation to function properly for a period of one year from date of final acceptance of the work.

B. Defects becoming apparent within the warranty period shall be repaired by the Contractor. In addition, all damages to installed work and finishes resulting from such defects shall be the responsibility of this Contractor either to repair or replace to equal the existing installation.

C. This warranty shall in no way obligate the Contractor to repair any and all damages resulting from accident or improper operation or care on the part of the Owner.

END OF SECTION

SECTION 22 00 00
PLUMBING GENERAL

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. General Conditions: Refer to the General Conditions, the Supplementary General Conditions and the Special Conditions, all provisions of which apply to work under this section as if written in full herein.

B. The scope of work described in these Specifications and/or indicated on the Drawings shall include (except where otherwise noted) the furnishing of all materials, equipment, appurtenances, accessories, connections, labor, etc. required and/or necessary to completely install, clean, inspect, adjust, test, balance and leave in safe and proper operating condition all systems. All work shall be accomplished by workmen skilled in the various trades involved.

C. The Drawings and Specifications are complementary to each other and what is called for by one shall be as binding as if called for by both. If a discrepancy exists between the Drawing and Specifications, the higher cost shall be included, and the Engineer shall be notified of the discrepancy.

D. All work performed under this specification shall be accomplished in accordance with the requirements and provisions of the following sections:

1. Section 22 00 00 - Plumbing General
2. Section 23 00 00 - HVAC General
3. Section 26 00 00 - Electrical General

1.02 STANDARDS

A. All Plumbing systems shall conform to all ordinances and regulations of the City, County, State and/or other authorities having jurisdiction in accordance with the requirements of the following codes, standards and design guides.

1. The South Carolina Plumbing Code, 2018 Edition
2. The South Carolina Building Code, 2018 Edition
3. The South Carolina Fuel Gas Code, 2018 Edition
4. International Energy Conservation Code, 2009 Edition
5. Americans with Disabilities Act (ADA)
6. ANSI/NSF 61 compliance is required for all components of the domestic water system.
7. American Society of Plumbing Engineers (ASPE) Data Books
8. National Fire Protection Association (NFPA) Standards:
   a. NFPA 13R – 2016
   b. NFPA 54 - National Fuel Gas Code
   c. NFPA 58 – 2017 – Liquefied Petroleum Gas Code
9. Plumbing Drainage Institute (PDI)
10. Underwriters Laboratories Inc. (UL)
11. National Sanitation Foundation (NSF)
12. Local and State Fire Marshal requirements
13. Local Building and Inspection Department requirements
14. Local Health Department requirements
15. ASHRAE 90.1-2010

B. If code or other requirements exceed the provisions shown on the Contract Documents, the Engineer shall be notified in writing. Where requirements of the Contract Documents exceed code requirements, work shall be furnished and installed in accordance with the Contract Documents. Any work done contrary to these requirements shall be removed and replaced at the Contractor's expense.

1.03 PERMITS

A. The Contractor shall obtain all permits and inspections required for the installation of this work and pay all charges incident thereto. He shall deliver to the Architect all certificates of said inspection.

1.04 WORK INCLUDED

A. Systems

1. The Plumbing Systems installed and work performed under this Division of the Specifications shall include, but not necessarily be limited to, the following as noted below. The connection point for all systems from the site utilities shall be as 5'-0" from the exterior of the building unless specifically otherwise noted.
   a. Domestic cold, hot and hot water recirculation systems
   b. Sanitary, drainage, waste and vent systems
   c. Propane gas system
   d. Primary and emergency storm drainage systems

1.05 DRAWINGS

A. The Drawings are diagrammatic and do not necessarily depict exact conditions. The indicated locations of equipment, ductwork, piping, etc. are approximate only. The Drawings are schematic in nature and are not to be scaled. Scales are shown for reference and approximation only. Refer to the architectural drawings for dimensional data of building components.

B. The locations, arrangement and extent of equipment, devices, and other appurtenances related to the installation of work shown on the Drawings are approximate. The Contractor shall not scale drawings but shall refer to the architectural drawings for exact dimensions of building components. Should a conflict exist between the architectural and engineering drawings regarding dimensions and scale, the Contractor shall notify the Architect of the discrepancy for resolution.

C. Materials, equipment or labor not indicated but which can be reasonably inferred to be necessary for a complete installation shall be provided. Drawings and Specifications do not undertake to indicate every item of material, equipment, or labor required to produce a complete and properly operating installation.

1.06 OPERATION AND MAINTENANCE MANUALS

A. The Contractor shall prepare a minimum of two (2) instruction manuals, one of which shall be submitted to the Architect for the Engineer's review, describing installation, operation and maintenance of all Plumbing equipment. Manuals shall include copies of control schematics, sequences of operations, indicate the function and operations of all components, as well as the Contractor's name, address, and telephone number. Manuals shall also contain one copy of all manufacturers' drawings, pamphlets, data, parts lists and instructions manual for each piece of equipment. Upon approval, one copy shall be delivered to the Owner; one copy shall be kept by the Contractor. The pamphlets and drawings are to be neatly bound in a 3-ring binder(s).

B. The Contractor shall give detailed instructions for a period of not less than two (2) days to the responsible personnel designated by the Owner in the operation and maintenance of all equipment furnished under this Contract. A letter containing the name of the person or persons to whom the instructions were given and the dates of instruction period shall be submitted to the Engineer in the as-built submittal.

C. Prior to final acceptance by the Owner, the Contractor shall submit a complete as-built drawing submittal for the Engineer's review, three (3) sets of operating and maintenance manuals, spare parts lists, drawings, wiring diagrams, troubleshooting data, manufacturer's bulletins, and other pertinent data on all equipment furnished under this Contract. Each set shall be enclosed in a suitable hard cover binder.

D. A complete set of reproducible as-built drawings shall be provided indicating the location of all piping dimensionally located from a minimum of two column lines or major building structures. Drawings shall be a minimum of 1/8" scale.

E. Provide name, address and telephone numbers of the manufacturer's representative and service company for each piece of equipment installed in the as-built submittal package.

F. Provide all loose keys for supply valves, wall hydrants and hose bibbs installed.

G. Provide a full repair kit set (total relief valve kit, first check and second check kits) for each reduced pressure backflow preventer installed.

1.07 AS-BUILT DRAWINGS

A. The Contractor shall maintain a record set of drawings indicating all changes in the work from that shown in the Contract Documents. Prior to final acceptance by the Owner, the Contractor shall assemble the complete set of as-built drawings that accurately reflects all changes to indicate actual final construction. All concealed piping shall be dimensionally located from at least two (2) column lines or major building structure elements. Drawings shall be a minimum of 1/8" scale.

B. The original set of "as-built" drawings shall be scanned and transmitted to the Architect in electronic (pdf) format.

1.08 EQUIPMENT, MATERIAL BID BASIS

A. Manufacturers' names, model numbers, etc. as specified on the Drawings and herein are for the purpose of describing type, capacity, function and quality of equipment and materials required.

B. Unless "approved equal" is specifically stated, bids shall be based on equipment named in Specifications or on Drawings as "base" products. Proposed alternate equipment and materials may be submitted along with the "base" products, provided deductive pricing is included with the alternate.

C. Alternate "approved equal" items listed shall conform to specified base items and shall be substantially equal in quality, size, weight, construction, capacities and performance. The alternate equipment and materials shall be submitted as full equivalent to the equipment and materials specified, with sufficient supportive documentation and technical literature to demonstrate quality, performance, and workmanship without doubt or question. The Engineer shall consider the use of the alternate equipment based on the supportive documentation and other information available to him and shall approve or disapprove any alternates. The decision of the Engineer shall in all cases be final.

D. The Contractor shall coordinate the installation of all plumbing equipment proposed for use in this project with all building trades (architectural, structural, mechanical and electrical). Coordination shall be accomplished prior to, and shall be reflected in, the submittal of shop drawings for approval. Any modifications or revisions required by other trades as a result of the use of equipment other than the basis of design shall be made at no additional cost. When substitution of equipment is made, the Contractor shall be responsible for the costs of any item and engineering and construction revisions necessary in his or any other contract or trade that may be required to satisfy plans and specifications.

1.09 START-UP-SERVICE

A. The service of a factory-trained representative shall be provided on the jobsite for a minimum of one (1) day to provide the manufacturer's certification and start-up of all major equipment and systems including water heaters, sewage ejectors, lift stations, fuel oil systems, etc. A formal report is to be issued indicating any revisions required for certification of the assembly by the manufacturer. Instruction and training of the operator's personnel shall be provided following certification of the assembly.

1.10 SUBMITTALS

A. The Contractor shall prepare, submit, and obtain Engineer's review of manufacturers' submittals on the following equipment and systems prior to ordering, purchasing, or installation of any equipment or materials. All required submittals shall be transmitted electronically (e.g. pdfs, etc.) with the associated specification section and the item submitted clearly identified. Partial submittals will be returned without review. Submittals, as a minimum, shall include:

1. Plumbing fixtures, faucets and trim
2. Water heaters and storage tanks
3. Insulation
4. Floor drains and drainage accessories
5. Hydrants and hose bibbs
6. Mixing valves
7. Submersible pumps
8. Hot water return pumps
9. Backflow preventers
10. Grease/oil interceptors
11. Pipe and fittings
12. Grooved joint couplings
13. Valves
14. Pipe supports
15. Piping accessories
16. Pipe labels and valve tags

B. All approvals required by any code or enforcement authority, insurance underwriter, etc. shall be obtained prior to equipment being submitted to the Engineer.

C. Quality Assurance/Control Submittals: Submit the following:

1. Test Reports: Upon request, submit test reports from recognized testing laboratories.
2. Certificates: Submit the following:
   a. Manufacturer's certificate that products comply with specified requirements.

b. Certificate indicating that the installer is authorized to install the manufacturer's products

D. Review of submittals by the Engineer does not relieve the Contractor from the responsibility for complying with all requirements of the Contract Documents. Furthermore, it shall be the responsibility of the Contractor to coordinate the requirements of all approved equipment with other trades and disciplines such as roof openings, wall openings, electrical characteristics, etc.

E. All submittals shall be identified by the equipment mark or tag identification numbers shown on the Contract Drawings. Each individual submittal item shall be marked to show which specification section pertains to the item.

F. Submittals shall clearly indicate selection of model numbers, sizes, dimensions, electrical characteristics, etc. of the proposed equipment. Any proposed deviations from specified equipment shall be clearly indicated on the submittal.

G. Included with submittals of plumbing equipment requiring electrical connections shall be a written statement confirming coordination of voltage requirements, bearing the names and signatures of the plumbing and electrical contractors. A photocopied reproduction of the below statement is acceptable.

VOLTAGE COORDINATION STATEMENT

This statement is to confirm that the voltages of the equipment provided under this specification have been coordinated with the Electrical Drawings, as well as with the electrical contractor.

Plumbing Contractor:_____

Project Manager Name:_____

Project Manager Signature/Date:_____

Electrical Contractor:_____

Project Manager Name:_____

Project Manager Signature/Date:_____

H. Provide Material Safety Data Sheet (MSDS) or letter from manufacturer certifying the VOC content for each adhesive, sealant, paint and coating.

I. VOC Content: Submit adhesive and sealants product information or MSDS showing VOC Content information for all applicable products specified under this section. All applicable products in this section must meet low VOC content as specified by LEED Specification Section 01 81 13 Sustainable Design Requirements.

1.11 COORDINATION OF TRADES

A. The Contractor shall give full cooperation to other trades and shall furnish all information necessary to permit the work of all trades to be installed satisfactorily and with least possible interference or delay.

B. Piping and other plumbing equipment shall not be installed without first coordinating the installation of same with other trades. The Contractor, at his own expense, shall relocate all uncoordinated piping and other plumbing equipment installed should they interfere with the

proper installation and mounting of electrical, HVAC equipment, ceilings and other architectural or structural finishes.

C. The Contractor shall coordinate the elevations of all piping and equipment above ceilings and in exposed areas with the work of all other disciplines prior to installation.

D. In areas where more than one trade is required to use common openings in beams, joists, chases, shafts and sleeves for the passage of conduits, raceways, piping, ductwork and other materials, the Contractor must coordinate the positions of all piping and equipment to be furnished under this section so that all items including the materials and equipment of other trades may be accommodated within the space available.

E. The Contractor shall confirm that work installed under this section does not interfere with the clearances required for finished columns, pilasters, partitions, walls or other architectural or structural elements as shown on the Contract Documents.

F. Work that is installed under this Contract which interferes with the architectural design or building structure, shall be removed and relocated as required at no additional cost to the Contract.

G. All offsets, fittings, valves, devices and accessories which may be required are to be provided under this Contract. The Contractor shall examine the entire set of Contract Documents and carefully investigate the structural and finish conditions affecting all his work and shall arrange such work accordingly for the complete satisfactory operation of all systems, providing such fittings, traps, valves, devices and accessories as may be required to meet such conditions.

1.12 WARRANTY

A. All equipment furnished and installed under this Contract shall be provided with the manufacturer's standard warranty unless otherwise noted.

B. The Contractor shall make good all defects in material, equipment, or workmanship disclosed within a period of one (1) year from date of building acceptance by the Owner. The phrase "make good" shall mean to furnish promptly, without charge, all work necessary to remedy the defects to the satisfaction of the Engineer.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS

A. All equipment, materials, accessories, etc. used shall be new and of current production unless specified otherwise. Equipment not specified in the Contract Documents shall be suitable for the intended use and shall be subject to approval by the Engineer.

B. All equipment, products and materials shall be free of defects and shall be constructed to operate in a safe manner without excessive noise, vibration, leakage, or wear.

C. All equipment shall bear the inspection label of Underwriters Laboratories Inc.

D. All equipment and material for similar applications or systems shall be provided from the same manufacturer unless noted otherwise.

E. Cast iron soil pipe and fittings shall bear the collective trademark of the Cast Iron Soil Pipe Institute.

2.02 ELECTRICAL WORK

A. Except as otherwise specified or noted, electrical equipment used for plumbing systems shall be as specified herein.

B. Motor controls, system controls, starters, disconnects, pilot lights, push buttons, etc. shall be furnished by the Contractor compatible with the apparatus that it operates. Electrical equipment shall be wired for the voltage, as shown on the Electrical Drawings.

C. The Contractor shall be responsible for coordinating and furnishing equipment of voltage shown on the electrical documents.

D. Electric motors shall be NEMA Premium Efficiency open drip proof type. Motors shall meet NEMA MG1 Table 12-12 of EISA, 2010. Motors shall be selected with a minimum of 15% safety factor greater than the fan brake/horsepower (e.g. 4.75 BHP would require a nominal 7½ HP motor). The motor service factor shall not be used as part of the safety factor. All motors shall have thermal overload protection. Motors shall be capable of operating at ± 10% of the design voltage without voiding the manufacturer's warranty.

E. Motors controlled by a variable frequency drive (VFD) shall be inverter duty motors designed according to the requirements of NEMA MG 1, Part 31, "Definite Purpose, Inverter Fed Motors" and shall be compatible with the particular manufacturer's drive that is used.

1. Shaft Grounding Rings - All motors controlled by variable frequency drives shall be equipped with a maintenance free, conductive micro fiber, shaft grounding ring with a minimum of two rows of circumferential micro fibers to discharge damaging shaft voltages away from the bearings to ground.
   a. Motors up to 100HP shall be provided with one shaft grounding ring installed either on the drive end or non-drive end. Motors over 100HP shall be provided with an insulated bearing on the non-drive end and a shaft grounding ring on the drive end of the motor. Grounding rings shall be provided and installed by the motor manufacturer or contractor and shall be installed in accordance with the manufacturer's recommendations.
   b. Shaft grounding rings shall be AEGIS bearing protection ring by Electro Static Technology-ITW.
2. High Frequency Grounding Straps - All motors controlled by variable frequency drives shall be bonded from the motor foot to the system ground with a high frequency ground strap fabricated of flat braided, tinned copper with terminations to accommodate motor foot and system ground connection.
   a. Proper grounding of motor frame for all inverter-driven induction motors shall be in accordance with ABB Technical Guide No.5 and Allen Bradley Publication 1770-4.1 Application Data Industrial Automation Wiring and Grounding Guidelines
   b. High frequency bonding strap shall be AEGIS high frequency ground strap by Electro Static Technology-ITW.

F. Starters for motors 1/3 HP and smaller shall be manual type, and for 1/2 HP and larger, shall be magnetic type. Starters shall be minimum size 0, combination type (with disconnect and lockable handle) with molded case circuit breaker. Starters for motors with remote or automatic control shall be magnetic. Relays, interlocks and auxiliary contacts shall be provided as specified and required.

G. Magnetic motor starters shall be across-the-line, full voltage, non-reversing type unless otherwise indicated on the Drawings or specified herein.

H. Motor controls shall be either “Hand-Off-Auto” switches or “On-Off” push buttons with one indicating light. “Hand-Off-Auto” switches shall be provided for automatically controlled apparatus.

I. Motor starters that are not an integral part of equipment shall be installed in conformance with Division 26 - Electrical Requirements.

J. All “loose” disconnects and starters shall be installed by Division 26.

K. Power wiring to disconnects, starters, and equipment shall be provided and installed by Division 26. All equipment requiring electrical power shall be provided with a disconnect switch at each piece of equipment. Coordinate switch type (fused or non-fused) with equipment characteristics, manufacturer’s recommendations and the electrical drawings.

L. Provide all system controls and associated control and interlock wiring for complete and operable systems. 120 volt and higher wiring shall be MC cable or in conduit in accordance with local codes and the materials and installation requirements of Division 26 - Electrical.

M. All starters for 3-phase equipment shall have overload devices in each phase.

N. All starters and variable frequency drives shall be labeled on the face of the device with a semi-rigid plastic laminate nameplate with 1" high white letters on a black background securely affixed to the equipment. The label shall indicate equipment served (equipment tag used on the Drawings). Labels shall be furnished and installed by the Contractor.

O. Wiring diagrams shall be furnished by the Contractor.

P. Acceptable manufacturers shall be General Electric, Square D, Eaton, Siemens and Allen Bradley.

2.03 PIPING SYSTEMS

A. General

1. The various piping systems are classified as follows, and materials of construction shall be as specified unless otherwise noted on the Drawings.
2. Piping, valves and equipment used in similar applications shall be provided from the same manufacturer unless noted otherwise.

B. Domestic Cold-Water System, Underground, 3 Inches and Larger, Suitable for Working Pressure of 125 psig to 5'-0" Outside Building

1. Piping Systems
   a. Basis of Design
      1) Ductile iron thickness Class 51 for 3 inch and 4 inch size thickness, Class 50 for 6 inches and larger, ANSI A21.51, ASTM A746 with bituminous coating outside and cement mortar lining inside. Ductile iron mechanical or push-on joints and fittings ANSI/AWWA C110/A21.10.
   b. Deductive Alternates
      1) Mains where pressure is no greater than 100 psi: Polyvinyl Chloride (PVC), 160 psi water piping, ASTM D2241, SDR26 with mechanical or push-on joints with neoprene “O” rings, ASTM D3139.
      2) Mains where pressure is greater than 100 psi: Polyvinyl chloride (PVC), 200 psi water piping, AWWA C900, 200 psi, with

mechanical or push-on joints with neoprene “O” rings, ASTM D3139.

2. All valves, fittings, and changes in direction or elevation shall have joints restrained in accordance with NFPA-24.
3. Trenching Conditions: Class B1 bedding with 4" minimum thickness of clean granular fill. Recesses shall be provided at all pipe barrels to ensure no loads are transmitted at the joint connections.

C. Domestic Water System Branch Piping, Underground, 2 Inches and Smaller, Suitable for a Working Pressure of 125 psig

1. Piping Systems
   a. Copper Type K, soft annealed, conforming to Federal Specification WWT-799. Joints and fittings are not permitted below floor slabs with copper Type K soft annealed pipe.
   b. Multi-layer CPVC over aluminum composite middle layer bendable piping, ASTM D2846, solvent cement joints and fittings, ASTM F493. Noveon FlowGuard Gold Bendable.

D. Domestic Cold Water and Hot Water Systems Above Ground

1. Piping Systems
   a. Basis of Design
      1) Polypropylene piping, Aquatherm Green pipe SDR 7.4 for cold & hot water systems 3" and smaller, or SDR 11 for hot water systems 4" and larger and all cold-water systems based on the required minimum pressure rating and use temperature, see chart below. Piping, fittings, and joints to comply with NSF 61-G, NSF 61, and NSF 372. Provide pipe wrap or insulation for piping in all plenum applications that meet the requirements of ASTM E84. When piping will be exposed to UV light for more than 30 days a factory UV protection must be provided per the manufacturer’s recommendations. Fittings/Joints: Shall be aquatherm green pipe electro-fusion welded PP-R joints and fittings, ASTM F2389, NSF 61certified.

Temperature	Pipe Sizes	SDR 7.4 Green Pipe Permissible working pressure (psi)	SDR 11 Green Pipe Permissible working pressure (psi)
50	(All pipe sizes)	415	220
80	(All pipe sizes)	340	180
100	(All pipe sizes)	255	135
120	(All pipe sizes)	213	112
140	(All pipe sizes)	180	93
160	(All pipe sizes)	120	-
180	(All pipe sizes)	100	-

   b. Deductive Alternates
      1) Hot and Cold-Water Systems: Chlorinated Polyvinyl Chloride (CPVC) Schedule 40, ASTM F-441 and D-2846 (100 psi at 180 degrees F). Piping, fittings, and joints to comply with NSF 61-G, NSF 61, and NSF 372. Fittings: Schedule 40 socket type CPVC, ASTM F-439 and F-441. Joints: Solvent cement and primer for CPVC piping, ASTM F-493. All metal thread connections to

fixtures and fittings (tub spout, showerhead, etc.) shall be connected with a brass transition fitting. All cutting oils, thread sealants and other products must be compatible with the CPVC piping installed.

Temperature	Pipe Sizes	SDR 11 FlowGuard Gold CPVC Permissible working pressure (psi) ½"-2" (max size)	Schedule 80 Corzan (for Pipe Sizes greater 2") Permissible working pressure (psi) 2½"	3"	4"	6"	8"
73-80		400	420	370	320	280	250
100		325	344	303	262	229	205
120		260	273	240	208	182	162
140		200	210	185	160	140	125
160		160	168	148	128	112	100
180		100 (max. temp)	105	92	80	70	62
200			84 (max. temp)	74	64	56	50

1) For pipe sizes 3"and smaller: Hot and Cold-Water Systems within Living Units: Cross-linked polyethylene (PEX) plastic tubing, PEX-a grade, ASTM F-876; ASTM F-877 (100 psi at 180 degrees F). Brass, copper or engineered lastic (EP) fittings, ASTM F-1960. Piping, fittings, and joints to comply with NSF 61-G, NSF 61, and NSF 372. Fittings/Joints: Cold expansion fitting with PEX reinforcing rings, ASTM F-1960.
   a) All PEX tubing and fittings shall be from the same manufacturer. Fittings shall be third party certified to NSF-14, and ASTM-F1960 and shall comply to ASTM-F876 & ASTM-F877.
   b) All cold-water piping shall be blue in color. All hot water piping shall be red in color. All hot water return piping shall be white in color.
   c) Galvanized pipe and nipples are not acceptable for any portions of the domestic water system.
   d) Galvanized pipe and nipples are not acceptable for any portions of the domestic water system.
   e) Acceptable PEX manufacturers/systems:
      (1) Uponor Wirsbro Aquapex tubing with ProPEX fittings
      (2) Viega PEX tubing
      (3) Rehau PEX tubing and fittings
   f) All PEX tubing and fittings shall be from the same manufacturer.

Temperature	Pipe Sizes	SDR 9 PEX piping

		Permissible working pressure (psi)
73-80	3/8"-4"	160
120	3/8"-4"	130
180	3/8"-4"	100
200 (max temp)	3/8"-4"	80

E. Sanitary, Waste and Vent and Storm Drain Systems, Below Ground to 5'-0" Outside Building

1. Piping Systems
   a. Basis of Design
      1) Schedule 40 DWV SOLID WALL PVC pipe, ASTM D1785. Install per ASTM D2321. Fittings: Schedule 40 DWV PVC, socket type fittings, ASTM D2665. Joints: Solvent joints for PVC, ASTM D2564. (PVC piping is not acceptable for waste piping receiving discharge higher than 130 degrees F, cast iron piping is to be installed at the central plant, mechanical rooms and at all laundry and kitchen equipment discharges.)
   b. Single and double sanitary tee fittings are not allowed for the piping to any plumbing fixture; combination wye and eighth bend fittings shall be installed.
   c. Double combination fittings shall not be used for connections to horizontal drainage piping; single wye and eighth bend fittings shall be used for all connections.
   d. Foam core PVC piping is not acceptable for any drainage system.
   e. All cast iron pipe and fittings shall carry an NSF International listing.

F. Sanitary, Waste and Vent Systems and Storm Drainage Systems Above Ground

1. Piping Systems
   a. Basis of Design
      1) Polyvinyl Chloride (PVC), schedule 40 DWV PVC pipe, ASTM D1784. Fittings: Schedule 40 DWV PVC, socket type fittings, ASTM D2665. Joints: Solvent joints for PVC, ASTM D2564. PVC piping is not acceptable in plenum ceilings or for waste piping receiving waste discharge higher than 130 degrees F, such as from laundry and kitchen equipment.
   b. Single and double sanitary tee fittings are not allowed for the piping to any plumbing fixture; combination wye and eighth bend fittings shall be installed.
   c. Double combination fittings shall not be used for connections to horizontal drainage piping; single wye and eighth bend fittings shall be used for all connections.
   d. Foam core PVC piping is not acceptable for any drainage system.
   e. All cast iron pipe and fittings shall carry an NSF International listing.
   f. In all buildings, PVC sanitary stacks shall include an expansion coupling listed for building expansion and shrinkage of building materials. Coupling shall be solvent welded and capable of 3"-8" travel. Coupling shall be installed every 30'-0" of vertical stack. Acceptable manufacturers include IPEX. Pipe clamps shall be included and installed at top plate and sill plate above fitting.
   g. All piping and fittings shall be from same manufacturer.

G. ProSet Fittings

1. Cast in place fire penetration sleeves such as ProSet and Holdrite Hydro Flame may be installed in lieu of block-outs and/or steel sleeves only in areas where the design ceiling clearances are maintained.
2. Code Red stack assemblies manufactured by ProSet Systems are not an acceptable fire stopping method for any system.

H. Pumped Discharge Piping

1. Piping Systems
   a. Type “L” hard drawn copper tubing per ASTM B-88 and Federal Specification WWT-799. Fittings: Grooved end, solder or brazed joint copper fittings per B16.18 or 16.22. Victaulic Installation-Ready Style 607H (300 psi).
   b. Hot and Cold-Water Systems: Chlorinated Polyvinyl Chloride (CPVC) Schedule 40, ASTM F-441 and D-2846 (100 psi at 180 degrees F). Piping, fittings, and joints to comply with NSF 61-G, NSF 61, and NSF 372. Fittings: Schedule 40 socket type CPVC, ASTM F-439 and F-441. Joints: Solvent cement and primer for CPVC piping, ASTM F-493.

2.04 VALVES, FLANGES AND UNIONS

A. General

1. All systems under this section shall be provided with valves to permit complete and sectional control of the system. They shall be located to permit easy operation, replacement and repair. Valves to comply with NSF 61-G, NSF 61, and NSF 372. They shall be installed where shown on the Drawings, or as herein specified. Valves shall be as manufactured by one of the following companies: American, Anvil International, Conbraco, FNW, Jomar, Kennedy, Kitz, Milwaukee, Nibco, Powell, Stockham, Victaulic, Watts, or approved equal, and shall conform to description listed below.
2. Control valves shall be provided for the domestic hot and cold-water supply to all risers and specific areas such as restrooms, fixture groups, equipment, hose bibbs and wall hydrants, food service areas and building separations. Valves shall be located in back-of-house or service areas with access panels or above lay-in ceilings. Access panels will be permitted in public spaces with gypsum ceilings. The tower riser control valves will be provided with an access panel concealed below the lowest guestroom vanity or above the ceiling in the closet in the lowest level unless specifically noted otherwise.

B. Valve Description

1. Gate Valves
   a. 2-1/2" and larger, Stockham G-634, 175 lb. flanged OS&Y.
   b. 2" and smaller, Milwaukee Fig. UP149, 125 lb., sweat connection. 2-1/2" and larger, Milwaukee Fig. F-2885, 125 lb., flanged or Milwaukee CW 223 Butterfly valve with 10 pos. lever handle.
   c. 8" and larger, Milwaukee CW 323 Butterfly valve with gear operator.
   d. 2-1/2" and smaller, Milwaukee No. BB-SC100, threaded.
2. Check Valves
   a. 2" and smaller, Milwaukee Fig. UP509, 200 lb., threaded.
   b. 2-1/2" and larger, Milwaukee Fig. F-2974, 125 lb. flanged.
   c. 2-1/2" and larger, Stockham G-939, 175 lb. flange.
3. Ball Valves
   a. 2" and smaller, Milwaukee UPBA 100.
4. Plug Valves (Natural/Propane Gas System)

a. 1/2" and larger, Rockwell Nordstrom Fig. 142 or 143 lubricated plug valve, threaded or flanged as required, wrench operated.
b. 1/2" through 2", two-piece full port brass ball valve, FM and AGA approved, Watts series FBV-3 or equal.

5. Balancing Valves (Hot Water Recirculation)
   a. Balancing valves shall be automatic, constant flow valves that are scale-resistant, made with low-noise polymer, built-in check valve, union end connections, and 300 psi minimum working pressure. Two shutoff ball valves shall be installed for servicing of the valve.
   b. Balancing valves shall be Caleffi FlowCal+ with temperature gauge or engineer approved equal that is ANSI/NSF 61 and NSF/ANSI 372 compliant.
   c. Ball valves or manual balancing valves are not acceptable for balancing the hot water return system.
   d. Circuit Solver thermal balancing vales with integral ball valves and strainer shall be allowed in all recirculation systems.
6. Backflow Preventers
   a. Backflow preventers shall be installed at all locations required by code and local authorities, at all connections to mechanical equipment, and elsewhere as shown on the Drawings. Backflow preventers shall be reduced pressure principle type and shall be a complete assembly including tight-closing shutoff valves before and after the device. The design shall include test cocks and a pressure-differential relief seating check valves. The device shall meet the requirements of and be certified by ASSE Standard 1013, AWWA Standard C-506, and USC Foundation for Cross-Connection Control. A strainer shall be located upstream of the device. Route relief outlet from cone receptor to an air gap fitting for discharge to sanitary sewer. Backflow preventers mounted in the vertical orientation shall be listed and approved for vertical installation.
   b. Acceptable manufacturers are Ames Company, Apollo Valves, Hersey Products, Watts Regulator, and Zurn-Wilkins.
7. Class II turbine type water meters shall be installed downstream of the backflow preventer, on the domestic water supply to HVAC equipment make-up, irrigation supply, and pool/fountain supply to allow for a reduction in sewer rate charges.

8. Pressure Reducing Valves
   a. A duplex pressure reducing valve station shall be provided on all domestic water systems greater than 80 psi.
   b. Direct acting pressure reducing valves shall be used in residential, OEM, and commercial applications, where diameters smaller than 3” or less. Direct acting pressure reducing valves shall be Watts LF223S series or engineer approved equal.
   c. Pilot activated automatic control valves (ACV) shall be used in applications and installations that require more consistent pressure control over wide flow ranges. Projects utilizing central plants shall use ACV’s. ACV shall be Watts LFF115 series or engineer approved equal.
9. Flanges
   a. All flanges shall be faced and drilled for not less than 125 pounds steam working pressure complete with necessary adapter and shall be of size and material of adjacent piping. All flanges shall be faced (raised or flat) to be compatible with connecting valves, equipment, etc. The connection of one raised face flange to a flat face flange shall not be permitted.
10. Unions and Joints
    a. Unions on drainage pipes on fixture side of traps may be slip or flanged joints with soft rubber washers or gaskets. Unions 2" and smaller on copper pipe shall be all brass with ground joint and shall be 250# copper to copper.

Unions above 2" shall be flanged with gaskets. Provide union at water and gas connection to all equipment, except plumbing fixtures.

b. Bathtub waste and overflow joints shall be soldered if required by local authorities to eliminate the requirement for an access panel to bathtub drain connection.

2.05 REMOTE READ WATER METERS

A. A remote read water sub-meter shall be provided for each dwelling unit.

1. Basis of Design

The domestic water sub-metering system shall be H2O Degree provided by ION Energy Solutions. The meter shall comply with all H2O Degree requirements, including, but not limited to:

a. Hourly or daily water meter readings should be sent from the water meters in individual apartments with the use of the wireless sub-metering system
b. Wireless communication shall occur between a transmitter/receiver, less than 24 cu. in., connected to a water meter and the Aqura Cloud gateway. The gateway and a coordinator should be “Plug and Play” with no configuration required.
c. The coordinator should interface with the Aqura Cloud gateway using a USB 2.0 cable
d. The data from the gateway should be retrievable automatically via an Internet connection.
e. The system must utilize **bi-directional wireless communication** technology (i.e. radio frequency based) and should use Direct Sequence Spread Spectrum (DSSS) in conjunction with the Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA) technique.
f. The wireless smart-metering equipment should support multiple billing companies (often called Read, Bill and Collect - RBC)

2.06 CLEANOUTS

A. Cleanouts shall be provided where indicated on Drawings and elsewhere as required by code.

1. Cleanouts in pipelines shall consist of Schedule 40 PVC DWV cleanout plug with square head as scheduled on the Drawings. Where piping is concealed in floors or walls cleanouts shall be installed in or near surface of floor or walls and have countersunk plugs with covers.

B. Cleanouts shall be provided at the base of the stack on all sanitary, waste and drainage stacks. Base of stack cleanouts on piping located within walls or partitions shall be cast iron cleanout tee with countersunk plug and chromium-plated round access cover, J.R. Smith figure 4530 or approved equal.

C. Base of stack cleanouts on hotel, condominium student housing, multi-family projects, etc. shall have the stack located behind the water closet at the lowest level to allow for concealing the base of stack cleanout behind the tank of the water closet.

D. Brass cleanouts shall be solid nut construction.

E. Provide Owner with three (3) wrenches for removing flush cleanout plugs.

2.07 FLOOR DRAINS

A. Setting Grades

1. The plumbing contractor shall obtain exact elevation of finished grade at the top of the drains prior to setting any drains. Drains installed in excess of 1/4" below the adjacent finished floor shall be removed and reset to the correct elevation.

B. Drain Types

1. All floor drain outlets shall be of size noted on the Drawings. All drains shall be equal to the assembly specified. Acceptable manufacturers are as follows: Josam Co., Zurn Co., J.R. Smith Co., Wade, or approved equal. Drains shall be acid-resisting where indicated.
2. Floor drains noted as FD “DD” for use in deck drainage applications shall be Jay R. Smith Figure 1412-HP, C.I. drain with 13" square heel proof grate, D.I. undergrate with nickel bronze strainer.
3. Floor drains noted as FD “G” for use in public spaces such as Restrooms, Locker Rooms, Showers, etc., shall be general purpose type. Drains shall be cast iron with 6" square nickel bronze strainer and trap primer connection. Drains shall be Jay R. Smith Figure 2005B-L-B6-P050 or approved equal.
4. Floor drains noted as FD “M” for use in mechanical rooms shall be heavy duty type. Drains shall be cast iron shallow type, 12" diameter with ductile iron tractor grate, sediment bucket, and trap primer connection. Secured funnels shall be provided on all drains receiving condensate discharge to eliminate overflow or spillage. Drains shall be Jay R. Smith Figure 2141 series or approved equal. Drains located within rooms considered to be a plenum are to be provided with a deep seal trap and trap primer.
5. Floor drains noted as FD “P” for use in planter drains with standpipes shall be Jay R. Smith Figure 2685, C.I. drain with bronze standpipe and dome, field-verify exact height required.
6. Floor or hub drains located within rooms considered to be a plenum are to be provided with a deep seal trap and trap primer.
7. Unless otherwise noted, acceptable manufacturers shall be Josam, Jay R. Smith, Mifab, Watts, and Zurn.

C. Trap Primers

1. Drains not receiving a continuous discharge are to be provided with an automatic trap primer.
2. Trap primers shall be in-line type actuated by flow independent of pressure, pressure activated primers are not acceptable. Josam models 88250 and 88300.
3. Proset Trap Guards or equal can be used in lieu of trap primers where approved by local authorities having jurisdiction.

2.08 ACCESS PANELS

A. Group valves together above suspended ceilings, walls, furred spaces to minimize the number of access panels, but with all valves freely accessible for maintenance. Locate all valves within 1'-0" of access point.

B. Furnish access panels of proper size to service concealed valves and cleanouts. Panels shall be of the proper type for material in which they occur and are to be furnished by the Contractor but installed by the particular trade for the material within which the access panel is installed.

C. Panels shall have flush doors with No.14 USCG steel door and trim No. 16 USCG steel frame, metal wings for keying into construction, concealed hinges, and screwdriver operated

stainless steel cam lock. Panels shall be shop coated with one coat of zinc chromate primer. Valves above removable ceilings shall have tile clips by the Contractor for identification.

2.09 INSULATION

A. The following shall be insulated:

1. All piping subject to freezing.
2. All hot water and hot water return piping.
3. All horizontal storm drain piping and roof drain bodies.
4. All sanitary traps exposed to areas subject to freezing, refer to “Heat Cable for Freeze Protection of Piping” under Part 2 of Section 22 00 00 for additional requirements.

B. Domestic hot, cold, hot water recirculation, primary storm drainage, and waste drainage piping shall be insulated with black-pigmented, longitudinally pre-slit tubular pipe insulation with closure system consisting of pressure sensitive adhesive and protective release tape applied at the factory. Allows precision-cut angles and pre-cut pieces to be joined by the application of industry standard contact adhesives. Outdoor installation shall require jacketing. All joints and seams shall be sealed vapor tight. All seams and staples shall then be covered with “All Service Jacket” three-inch wide tape.

C. All interior horizontal storm drainage piping systems and roof drain bodies are to be insulated with blanket type glass fiber bonded with thermosetting resin with white vinyl vapor retarding facing, 2" wide stapling/taping tab. Pipe (tubular) insulation must display the ASTM E84 (25/50) flame spread and smoke developed ratings. Any material submitted claiming to be a similar, like, or equal must demonstrate (meet or exceed) the same physical characteristics as Nomaco Insulation manufactured insulation (i.e., pre-slit/pre-glued products, non-porous, and non-fibrous). In addition, materials must meet the following criteria:

1. Material shall have a density ranging from 1.5 to 1.8 lb/ft^3 (ASTM D1622).
2. Material must have a maximum thermal conductivity (k) of 0.25 Btu-in/hr-ft2-°F @ 75°F mean temperature (ASTM C518, ASTM C177 or ASTM C335).
3. Material must have a maximum Water Vapor Transmission rate of 0.00 Perm-in (ASTM E96, Desiccant Method).
4. Material up to 1" thick, when tested in accordance with ASTM E84, shall have a flame spread rating not greater than 25 and a smoke developed rating not greater than 50.

D. Piping insulation exposed to weather shall be protected from damage, including that caused by sunlight, moisture, equipment maintenance and wind. The protection shall provide shielding from solar radiation that can cause degradation of the material. Adhesive tape shall be prohibited.

E. Materials as specified in this section shall be manufactured by Thermacell, Kflex, CertainTeed, Johns Manville, Knauf, Owens Corning or equal. Insulation thicknesses shall be as shown in the following table:

Minimum Pipe Insulation			**Insulation Thickness for Pipe Sizes**				
Piping System Types	Fluid Temperature Range		Less than 1in.	1in. to <1-1/2 in.	1-1/2 to <4 in.	4 and <8 in.	8 in. and Larger
	°C	°F	In.	In.	In.	In.	In.
PLUMBING							
Domestic Water	Ambient	Ambient	0.5	1.0	1.0	1.0	--

Domestic Hot Water and Hot Water Recirculation	43-71	105-140	1.0	1.0	1.5	1.5	1.5
Above Grade Drains and Piping Receiving Condensate or Ice Machine Discharge	4.5-15.5	40-60	0.5	1.0	1.0	1.5	--
Horizontal Storm Drainage	Ambient	Ambient	--	--	1.0	1.0	1.0

2.10 HEAT TRACE CABLE FOR PROTECTION OF PIPING (FREEZING AND FOG)

A. Provide electric heat tracing on all domestic water piping and sanitary traps exposed to areas subject to freezing.

B. Provide heat tracing on all grease waste piping above and below ground.

C. Provide a complete UL Listed, CSA Certified, or FM Approved system of heating cables, components, and controls to prevent pipes from freezing.

D. Electric heat cable shall be installed linearly along the bottom of the pipe and allowance shall be made for all fittings, valves, pipe supports, etc. Cable shall be installed prior to insulation of the piping system.

E. Electric cable shall be capable of maintaining a minimum water temperature of 40 degrees F at an ambient air temperature of 0 degrees F for freeze protection.

F. Electric cable shall be capable of maintain a minimum water temperature of 110 degrees F for grease waste piping to keep grease from solidifying.

G. The electric cable shall be the self-regulating type that responds to varying localized temperature conditions by varying the heat output along its length. This shall be accomplished by a self-regulating core, which varies its resistance continuously with changes in temperature. A constant wattage heater is unacceptable.

H. Provide a thermostat control, which de-energizes the heating cable when the ambient air temperature is above 40 degrees F (adjustable). The heat cable shall be entirely self-regulating while energized in freeze protection applications.

I. Provide a thermostat control, which de-energizes the heating cable when the grease waste pipe temperature is above 120 degrees F (adjustable). The heat cable shall be entirely self-regulating while energized

J. Provide all power connection hardware, splices, end seals, etc., to accomplish installation. All hardware shall be by the same manufacturer as the cable.

K. Electric heating cable and accessories shall be UL Listed. Electric heating cable shall conform to all requirements of Division 26 - Electrical Requirements.

L. Electric heating cable shall be Raychem XL-Trace or approved equal, 8 watts per foot.

M. All piping shall be insulated with 1" thick fiberglass insulation.

N. Heating-cable circuit shall be protected by a ground-fault device for equipment protection. This requirement is in accordance with section 427-22 of the NEC-2002.

O. All heating cable components shall be UL Listed, CSA Certified, or FM Approved for use as part of the system to provide pipe freeze protection. Component enclosures shall be rated NEMA 4X to prevent water ingress and corrosion. Installation shall not require the

installing contractor to cut into the heating-cable core to expose the bus wires. Connection systems that require the installing contractor to strip the bus wires or that use crimps or terminal blocks, shall not be acceptable.

2.11 PIPE SUPPORTS AND HANGERS

A. All piping shall be supported by means of hanger rods and pipe hangers from roof or floor structure using supplementary steel and/or lagbolts. Water supply pipe connecting to pumps, equipment, fixtures or fixture supplies shall be made rigid at the connection point.

1. Piping shall be supported from new concrete construction with Anvil International Fig. 282 inserts or drilled expansion anchors.
2. Piping shall be supported from new steel construction with Anvil International Fig. 131 beam clamp, Fig. 61 beam clamp, Fig. 66 welded beam attachment or Fig. 60 washer plate with all-thread rod.
3. Piping and brackets shall be supported from hollow block construction using drilled masonry holes and cadmium plated toggle bolts.
4. Piping shall be supported from wood truss construction with Sioux Chief Pick-Up Talon or equal. Product must be compatible with CPVC.
5. Pipe supports shall not be attached to floor or roof deck.
6. Acceptable manufacturers are: Anvil, Sioux Chief, B-Line and FNW.

B. Unless otherwise noted, hangers and clamps shall be as listed below (all model numbers are B-Line Systems):

1. Insulated water pipe - B3100 or B3109 with B3151 placed over insulation protection saddle.
2. All supports and mounting hardware are to be galvanized, cadmium plated, or factory enamel painted.
3. All supports on insulated piping systems shall be sized to fit outside the insulation and shall be provided with insulation inserts and shields at each hanger or support point.

C. Branch piping to fixtures in chases shall be supported with plastic or copper clamp type supports:

1. B-Line Ruffin series.
2. Holdrite Systems.

D. Maximum spacing between pipe hangers shall be:

1. PVC/CPVC and all plastic pipe:
   a. 1-1/4" and smaller: 3'-0"
   b. 1-1/2" and larger: 4'-0"
2. Pex Piping
   a. Crosslinked Polyethylene PEX Pipe: Install hangers for PEX tubing in strict accordance with manufactures instructions.
   b. Horizontal PEX-a Piping Hangers: Install CTS hangers suitable for PEX-a piping in compliance with the Uponor Commercial Piping Pocket Guide (2017) and local codes, with the following maximum spacing:
   c. For IPC Jurisdictions: 3 inch (75mm) and below: Maximum span, 32 inches (0.81 m).
   d. For UPC Jurisdictions:1 inch (25 mm) and below: Maximum span, 32 inches (0.81 m).
   e. For UPC Jurisdictions: 1-1/4 inch (31 mm) and above: Maximum span, 48 inches(1.2 m).

f. Note: The above maximum hanger spacing requirements may be extended with the use of a continuous support channel such as Uponor PEX-a Pipe Support.

3. Horizontal PEX-a Piping with PEX-a Pipe Channel: Install hangers for PEX-a piping with horizontal support channel in accordance with local jurisdiction and manufacturer's recommendations, with the following maximum spacing:
   a. 1/2 inch (12.7 mm) and above: Maximum span, 8 feet (2.4 m).

4. Vertical PEX-a Piping: Support PEX-a piping with maximum spacing of 5 feet (1.5 m).
5. PEX-a Riser Supports: Install CTS riser clamps at the base of each floor and at the top of every other floor for domestic hot-water systems. Install mid-story guides between each floor. Install CTS riser clamps at the base of each floor and at the top of every fourth floor for domestic cold-water systems. Install mid-story guides.

E. At least one hanger shall occur within 2'-0" from where change in direction takes place. Where pipes extend down or up to other floors, pipe clamps shall be provided on each floor to support vertical risers. Vertical piping drops shall be rigidly anchored to structure at the top and bottom offsets and at eight-foot increments along the vertical drop.

F. Special approved hangers that require less installation space are to be used where required due to ceiling space limitations.

G. All connections to pumps and other vibrating machinery shall be provided with stainless steel braided flexible hose connections. Connections to potable water systems shall meet ANSI/NSF 61 design standards.

H. Expansive Soils. For areas with expansive/thrusting soils, pipe isolation underground piping shall incorporate plumbing void form system. System shall incorporate 1/2" polypropylene wall panels, 3/8" #3 rebar joining system. Piping will be supported by stainless steel clevis or roller type hanger using stainless steel all thread rod washers and nuts. See drawings for detail. Note: Cellular core is specifically not permitted for this application.

1. All installations shall be in accordance with ASTM F2536.
2. Pipe hangers shall be at 4’-0” centers maximum.
3. Pipe hangers shall be clamp on type hanger and shall match pipe size.
4. Hangers shall be made of hot dipped galvanized steel or stainless steel.

2.12 EXPANSION FITTINGS AND LOOPS

A. All vertical DWV piping stacks in buildings shall have expansion fittings to allow for building shrinkage compensation. The fitting shall be equal to IPEX piston style expansion joint HxH 21381-AWBC series. Expansion fitting shall be documented specifically for shrinkage of building materials and thermal expansion/contraction.

1. Wood framed buildings shall have a fitting in the first-floor ceiling space and every other floor thereafter.
2. Concrete buildings shall have a fitting in the first-floor ceiling space and every 8 floors thereafter.
3. All buildings stacks shall utilize riser pipe clamps at each floor.

B. All water piping shall have expansion loops installed in the system for thermal expansion and contraction. Expansion/contraction shall be compensated for using Z-bends, U-bends, expansion joints, and/or flexible connectors. Installation size and location shall be dependent

on piping system material used. Refer to manufacturer installation instructions and expansion detail on drawings.

2.13 WATER HEATERS – ELECTRIC

A. Provide electric storage type water heaters as specified on the Drawings.

B. Water heater shall carry a UL certification for 150 psi working pressure, an ASME temperature and pressure relief valve (T and P) sized for the heater, vacuum relief valve, immersion thermostat, glass lined tank, temperature gauge on outlet, and manual reset high limit control.

C. Provide a metal drain pan at each water heater. Water heaters greater than 10 gallons shall be floor mounted.

D. Provide a combination ball/relief valve on the domestic water supply sized as indicated on the Drawings, Watts series BRV or approved equal.

E. The water heater shall carry a five-year minimum limited warranty for tank leakage.

F. Electric water heaters shall be as manufactured by:

1. A.O. Smith
2. Bradford White
3. Rheem
4. HTP
5. State

2.14 FLASHING

A. Vent pipes passing through roof shall be flashed watertight.

B. The roof connections shall meet the approval of the manufacturer of the roofing materials and shall comply with the roof bond requirements.

C. All vent piping shall be offset above ceilings or in attic space and as shown on the Drawings to penetrate roofs on the least visible sides of building.

2.15 FLOOR, WALL AND CEILING PLATES

A. Furnish and install heavy gauge chromium plated steel wall and ceiling plates on all exposed pipes in finished areas where they pass through walls, ceilings, etc. Plates shall be of type that will remain permanently in position and where pipes are insulated they shall be of size necessary to cover insulated pipe.

2.16 GALVANIC PROTECTION

A. Connections between dissimilar metal water pipe shall be made with dielectric unions or flange waterways so there will be no contact between the metals or with insulating bushings. Dielectric waterways shall have temperature and pressure rating equal to or greater than that specified for the connecting piping. Waterways shall have metal connections on both ends suited to match connecting piping. Dielectric waterways shall be internally lined with an insulator specifically designed to prevent current flow between dissimilar metals. Dielectric flanges shall meet the performance requirements described herein for dielectric waterways. Connecting joints between plastic and metallic pipe shall be made with transition fitting for the specific purpose.

B. Insulate joints between dissimilar metals with suitable isolation gasket and bolts with fiber ferrules and washers and/or suitable armored insulation fittings by Clearflow, Crane, Capital, Mifab, or Epco,

2.17 WATER LEAK PROTECTION

A. The contractor shall install an electronically actuated resettable shutoff valve on the cold water supply of the water heater. The electronically actuated valve shall be a full flow valve that closes upon detection of water at the water detector pad supplied with the valve. Lead Free* valves shall be constructed using Lead Free* materials. Lead Free* Water Detector Shutoff valves shall comply with state codes and standards, where applicable, requiring reduced lead content. A water detector pad shall be installed on the floor beneath the water heater or in a drain pan supplied by the contractor. The water detector pad shall be supplied with an integral cable with connector to connect to the valve control unit. The water detector pad shall be an electronic sensing device. The electronically actuated valve shall act to shut off both the water supply and the power to the water heater simultaneously upon detection of water. A visual and audible indication of actuation shall be initiated and normally open contacts suitable for connection to remote monitored alarm actuation shall close.

B. Shutoff detector and valve shall be Watts LFWDS series system or engineer approved equal.

PART 3 - EXECUTION

3.01 GENERAL REQUIREMENTS

A. All equipment and materials shall be completely installed, adjusted, and fully operational with all accessories and connections.

B. Equipment, piping, ductwork, etc. shall fit into the spaces provided in the building and shall be installed at such times and in such a manner as to avoid damage and as required by the job progress. The Contractor shall coordinate work with other trades and locate work described herein to avoid interferences with structural, electrical and architectural work. Equipment, accessories and similar items requiring normal servicing or maintenance shall be accessible.

C. The Engineer reserves the right to direct the removal of any item which, in his opinion, does not present an orderly and reasonably neat or workmanlike appearance. Such removal and replacement shall be done when directed by the Engineer and without additional cost to the Owner.

D. Mounting heights, unless otherwise noted, are to the finished bottom of the device.

E. All work shall be designed and installed to comply with the requirements for the seismic design category and use group for the area in which the building is constructed.

3.02 EXCAVATION, TRENCHING AND BACKFILLING

A. The Contractor shall perform all excavation to install the work herein specified and as indicated on the Drawings. During excavation, material for backfilling shall be piled back from the banks of the trench to avoid overloading and to prevent slides and cave-ins. All excavated materials not to be used for backfill shall be removed and disposed of by the Contractor. Grading shall be done to prevent surface water from flowing into trenches and others excavation and any water accumulating therein shall be removed by pumping. All excavation shall be made by open cut. No tunneling or boring shall be done except under pavement.

B. The bottom of the trenches shall be graded to provide uniform bearing and support for conduits, cables, or duct bank on undisturbed soil at every point along its entire length. Overdepths shall be backfilled with loose, granular, moist earth, and tamped in 12" layers. Remove unstable soil that is not capable of supporting equipment or installation and replace with specified material for a minimum of 12" below invert of equipment or installation.

C. The trenches shall be backfilled with the excavated materials approved for backfilling, consisting of earth, loam, sandy clay, sand and gravel or soft shale, free from large clods of earth and stones, deposited in 6" layers and tamped until the crown of the pipe is covered by a minimum of 6" of tamped earth. The backfill under and beside the pipe shall be compacted for pipe support. Backfill shall be brought up evenly on both sides of the pipe so that the pipe remains aligned. In instances where the manufacturer's installation instructions for materials are more restrictive than those prescribed by the code, the material shall be installed in accordance with the more restrictive requirement. The backfilling shall be carried on simultaneously on both sides of the trench so that injurious pressures do not occur. The compaction of the filled trench shall be at least equal to 95% of the maximum density as determined by the Standard Proctor Test. Settling the backfill with water will not be permitted. Reopen any trenches not meeting compaction requirements or where settlement occurs, refill, compact, and restore the surface to the grade and compaction indicated, mounded over and smoothed off. A metallic lined underground warning tape shall be provided 12" below finished grade. The tape shall be identified as to the type of line per ANSI standard nomenclature and color.

D. Provide a layer of sand at least 6" deep under all plastic pipe installed in soil. Bell holes shall be excavated to ensure that the sewer pipe rests for its entire length upon a solid trench bottom.

E. Perform excavation and backfilling work in accordance with applicable portions of the earthwork section.

3.03 STORAGE AND PROTECTION OF MATERIALS

A. During construction, all equipment shall be properly protected against damage, defacing and freezing with shipping cartons, plastic sheeting, shipping covers, etc.

B. All open ends of piping and equipment shall be sealed with nipples and caps, plugs, test plugs until final connection to system is made.

C. All equipment and piping shall be protected to prevent entrance of foreign matter and debris by covering exposed openings during construction.

D. Handle and store materials in accordance with manufacturer's and supplier's recommendations and in manner to prevent damage to materials during storage and handling. Replace damaged materials.

E. Equipment and materials shall not be installed until such time as the environmental conditions of the job site are suitable to protect the equipment or materials. Equipment or materials damaged or which are subjected to these elements are unacceptable and shall be removed from the premises and replaced.

3.04 CUTTING AND PATCHING

A. Work shall include all cutting, patching, masonry and carpentry required as part of the equipment installation when not provided by other sections of these specifications.

B. All work shall be performed as specified under architectural specification section for cutting and patching.

3.05 CONCRETE WORK

A. Construct curbs, pads, vaults and similar supports for equipment where required.

B. Provide 3" thick housekeeping pads at floor mounted equipment a minimum of 3" larger than the entire area occupied by equipment. Dowel pads to structural slab.

C. Perform concrete work in accordance with applicable portions of Concrete sections. Minimum compressive strength of concrete shall be same as specified for slabs on grade.

3.06 CLEANING

A. At all times, the premises shall be kept reasonably clean and free of undue amounts of waste, trash and debris by periodic cleaning and removal. After completion, all foreign material, trash and other debris shall be removed from the job site.

B. After all equipment has been installed, but prior to start-up, all equipment, piping, etc. shall be thoroughly cleaned both inside and out.

C. After startup of systems as specified and just prior to Owner review and acceptance, all systems shall be finally cleaned and shall be left ready for use.

3.07 PAINTING

A. Painting, except as otherwise specified, will be done under another section of the specifications, but the Contractor shall leave all surfaces of work free of rust, dirt and grease.

B. The Contractor shall touch-up to match original finish any equipment scratched in shipment or installation. Touch-up painting of plumbing equipment shall be part of the plumbing work.

C. Provide one coat of rust preventive primer on all new structural steel supports and new ferrous surfaces which are not galvanized (this includes piping systems). Rust preventative painting shall be part of the plumbing work.

D. All painting and coating shall match the original and shall conform to the requirements detailed in other sections of these specifications. Do not paint over nameplates on equipment, nonferrous hardware, accessories or trim.

3.08 EQUIPMENT SUPPORT

A. Major equipment supports (framed structural openings, etc.) shall be furnished and installed by others as shown on the Drawings. The plumbing work shall include, the furnishings and installation of all miscellaneous equipment supports, structural members, rods, clamps and hangers required to provide adequate support of all equipment.

B. Unless otherwise shown on the Drawings, all equipment, piping, and accessories shall be installed level, square, and plumb.

C. All equipment, piping, etc. supported by structural joists shall be supported by the top chord only of such joists. Hangers shall not be attached to the bottom chord of any joists.

3.09 PIPE PENETRATIONS

A. Sleeves shall be installed in all masonry or concrete walls, floors, roofs, etc. for pipe penetrations. Sleeves for pipe shall be Schedule 40 black steel. Sleeves shall be sized to provide a minimum of 1/4" clearance between the sleeve and pipe.

B. The 1/4" minimum clearance shall be provided between the sleeve and the insulation on insulated piping systems. A gap of the insulation shall be omitted at each side of a rated wall penetration to allow for the required fire stopping.

C. As far as possible, all pipe penetrations shall be provided for at the time of masonry or concrete construction. Where drilling is required, only core drills shall be used. Star drills shall not be used.

D. All pipes penetrating walls or floors of any construction shall be installed with escutcheon plates on both sides of the penetration securely fastened to the wall or floor. In exposed areas, escutcheon plates shall be chrome plated. All escutcheon plates shall be sized to completely conceal the penetration.

E. Pipe penetrations through exterior walls shall be sealed watertight with expandable link type seals by Thunderline, Linkseal or Engineer approved equal.

F. All pipe and duct penetrations of fire, smoke, or fire and smoke-rated assemblies shall be fire-stopped as required to retain the integrity of the UL rated assembly. Fire barrier products shall be as manufactured by Tremco, Hilti, 3M, Metacaulk, Nelson, or approved equal.

3.10 FLASHING

A. All piping penetrating roofs shall be flashed in an approved manner, shall be watertight, and shall conform to the requirements detailed in other sections of these specifications.

B. Flashing for piping shall have a base not less than 2 square feet, and shall extend up over and into the open end of the pipe. All flashing shall be properly caulked and sealed.

3.11 PIPING SYSTEMS

A. Water Piping - General

1. Pipe used in piping assembly must be clean of dirt and obstructions and shall have ends square and reamed before putting into the fittings.
2. All piping must be true and plumb.
3. All domestic water lines serving flush valve fixtures and washing machines shall be protected from water hammer by shock absorbers. Where shock absorbers are required they shall be as manufactured by Josam Mfg. Company, J. R. Smith, Sioux Chief Ind., Precision Plumbing or Zurn Mfg. Co. and shall conform to the Plumbing and Drainage Institute published requirements.
4. All connections to water heaters, tanks and equipment shall be made with unions or flanges. Insulated piping systems shall be installed to provide space for insulation.
5. Grooved joint shall be installed in accordance with the manufacturer’s written recommendations. Grooved ends shall be clean and free from indentations, projections, or roll marks. The gasket shall be molded and produced by the coupling manufacturer of an elastomer suitable for the intended service. The coupling manufacturer’s factory trained representative shall provide on-site

training for the contractor's field personnel in the use of grooving tools and installation of product. The representative shall periodically visit the job site to ensure best practices in grooved product installation are being followed. (A distributor's representative is not considered qualified to conduct the training.)

6. When installing Aquatherm Green piping for all Potable and Non-Potable systems Contractor shall have received installation training from either the pipe/fitting manufacturer or designated representative before the project starts and shall furnish a copy of the "training documentation" within the project submittal for each installing individual showing current installation training.
7. When installing CPVC for all Potable and Non-Potable systems Contractor shall have received installation training from either the pipe/fitting manufacturer or designated representative before the project starts and shall furnish a copy of the "training documentation" within the project submittal for each installing individual showing current installation training.
8. When installing Pex piping for all Potable and Non-Potable systems Contractor shall have received installation training from either the pipe/fitting manufacturer or designated representative before the project starts and shall furnish a copy of the "training documentation" within the project submittal for each installing individual showing current installation training.
9. When installing heavy duty couplings, install per manufacturer's installation instructions. All couplings shall be installed with a torque wrench and to the manufacturer's torque requirements.

B. Sanitary Waste, Vent, Indirect Waste and Storm Drain Piping - General

1. Pipes shall be plumb and parallel to building walls, beams and columns unless otherwise indicated. All horizontal lines are to be evenly pitched and properly secured with iron or steel hangers, unless noted otherwise. A pitch of 1/8 inch per lineal foot shall be maintained on all soil, and waste lines, wherever possible.
2. All soil and waste pipes shall be extended out full size through the roof or connected to a common vent as shown on the Drawings.
3. Main vent stacks shall run parallel to the soil pipe stacks and shall connect to the vent continuation of the soil stack at least three (3) feet above the rim of the highest plumbing fixtures on the stack. Vent stacks shall also be connected at the base or horizontal offset of the soil stack through a Y and 1/8 bend or an upright Y fittings. Offsets in vent pipe shall be made with 45-degree fittings wherever possible. Horizontal vent lines shall pitch toward the waste line.
4. Threaded joints shall have American National taper screw thread with graphite and oil compound applied to the male threads.
5. Sanitary and vent stacks are to be run straight and plumb and all offsets shall be made at an angle of not less than 45 degrees.

C. Mounting heights, unless otherwise noted, are to the centerline of the equipment and/or device.

3.12 TESTING OF PIPING SYSTEMS

A. General

1. All piping systems shall be subjected, before being insulated or concealed, to testing with water or air as noted and shall hold tight at the pressure head stated for the time interval required without adding air or water. While any system is being tested required head or pressure shall be maintained until all joints are inspected.
2. All tests shall be witnessed by the inspector having jurisdiction and the Owner's Representative, with a minimum 48-hour notice given these authorities.

3. All equipment, material, labor and testing mediums required for testing any of the various systems or any part thereof shall be furnished by the Contractor.
4. All connected equipment, accessories, etc. shall be isolated from piping systems prior to testing.

B. Sanitary Piping Systems

1. Water test shall be applied to these drainage systems either in their entirety or in sections as required, after rough piping has been installed. If the system is tested in sections, each opening shall be tightly closed except the highest opening in the section under test. All sections shall be tested with a minimum of 10 feet of head. In testing successive sections, at least the upper 10 feet of the next section shall be tested so that no joint of piping in the building shall be submitted to a test of less than 10 feet of head. The water shall be kept in the system for at least 30 minutes before inspection starts; the system shall then be made tight at all points.
2. Any points of the drainage systems to be tested with air instead of water shall be made by attaching an air compressor testing apparatus to any suitable opening and after closing all other inlets or outlets, forcing air into the system until there is a minimum gauge pressure of 5 psi. This pressure shall be held without the introduction of additional air for a period of at least 30 minutes.
3. Exterior connections shall be tested as part of the interior systems.

C. Interior Water Piping Systems

1. Upon completion of the entire water supply system or a section of it as required, it shall be tested prior to connection of fixtures and proved tight under a water/air pressure of 150 psi. Pressure shall hold for a period of one hour without introducing additional water/air. Water used for testing shall be from a potable source of supply. Defective joints or piping shall be replaced as required and all piping shall be retested.

D. Exterior Water Piping System

1. All exterior domestic water piping shall be tested to 150 psi for a period of two hours.

E. Defective Work

1. If inspection or tests show defects, such defective work or material shall be replaced and inspection and tests shall be repeated. All repairs to piping shall be made with new material. Caulking of screwed joints or holes is not acceptable.

F. Additional Tests

1. Provide all additional tests such as smoke or pressure tests as required by the regulations or as directed by authorities making the inspection.
2. Provide for any repeated test as directed by the Owner's Representative, to make all systems tight as required.
3. Visual inspections of joints, valves, etc. shall be made as directed by the Engineer.

3.13 DISINFECTION OF WATER SYSTEM – INTERIOR AND EXTERIOR

A. Prior to project completion, all potable water piping systems shall be disinfected per local code requirements.

B. Whenever the authority having jurisdiction does not specify disinfection procedures, the new water piping system shall be thoroughly disinfected with a solution containing not less than 50 parts per million of available chlorine. The chlorinating material shall be either liquid chlorine

or sodium hydrochloride solution and shall be introduced into the system and drawn to all points in the system. The disinfection solution shall be allowed to remain in the system for a period of eight hours, during which period all valves and faucets shall be opened and closed several times. After disinfection, the solution shall be flushed from the system with clear water until the residual chlorine content is not greater than 0.2 parts per million.

C. This work is to be supervised or performed by an approved chemical testing laboratory and results sent to Engineer or his representative for verification.

3.14 FIXTURE CONNECTIONS AND SUPPORTS

A. Wall fixtures shall be hung by means of carrier type fixture supports as manufactured by J.R. Smith, Josam, Mifab, Wade or Zurn.

3.15 SLEEVES

A. Furnish and install pipe sleeves around all piping passing through masonry walls, floors, beams, etc. Sleeves shall be of such diameter as to allow pipe to pass through easily and permit expansion and contraction of pipe. Where pipes are insulated, the sleeves shall be of such diameter as to allow the insulated pipe to pass through easily. The sleeves shall be placed before the pouring of concrete and before construction of walls. Sleeves for vertical risers shall extend a minimum of 1" above the floor slab. Sleeves to outside walls below grade shall be caulked or provided with expansion type mechanical seals as required to make them waterproof.

3.16 INSTALLATION OF UNIONS

A. Unions shall be located as shown on plans and as required by equipment so piping and equipment can be easily dismantled. Unions shall not be installed in any location where they are not readily accessible.

3.17 TRAPS

A. All fixtures, drains, etc. shall be provided with traps, unless specifically shown or specified otherwise. Traps shall be set in an upright position, level and true, and shall be vented as shown and required. All exposed traps shall be provided with cleanout plugs.

3.18 CLEANOUT INSTALLATION

A. Furnish and install cleanouts in soil and waste lines as required by Code and/or job conditions, as shown on the Drawings and as follows: At or near the end of each branch and main drainage line, horizontal lines at intervals as required by code. All cleanouts shall be readily accessible, with plugs easily removable for cleanout lines. Cleanouts at the base of vertical piping shall be held within 2'-0" from finished floor unless otherwise indicated.

3.19 FLASHING INSTALLATION

A. All pipes passing through roofs shall be flashed in an approved manner. Flashing shall be watertight.

B. Roof connections shall meet the approval of the manufacturer of roofing material and shall comply with roof bond requirements.

3.20 EQUIPMENT AND MATERIAL PROTECTION

A. During construction all equipment shall be properly protected against damage, defacing and freezing with shipping cartons, plastic sheeting, shipping covers.

B. All open ends of piping and equipment shall be sealed with nipples and caps, plugs, test plugs until connection to system is made.

3.21 SPACE REQUIREMENTS

A. Piping, apparatus and equipment shall fit into the space provided in the building or within the property and shall be installed at such time and in such manner as to avoid damage to the building structure or property as required by the job progress. Equipment, apparatus and accessories requiring normal servicing or maintenance shall be made easily accessible.

END OF SECTION

SECTION 22 16 05
PROPANE GAS PIPING SYSTEM

PART 1 - GENERAL

1.01 SYSTEM

A. Provide a complete system of propane gas piping from propane supply from tank assembly (by others) to all propane gas burning equipment and appliances.

B. All gas equipment specified herein shall be suitable for use with propane gas system.

1.02 DESIGN STANDARDS

A. The propane gas system shall be designed and installed in accordance with the requirements of the following codes and standards:

1. The South Carolina Fuel Gas Code, 2018 Edition
2. NFPA 54 - National Fuel Gas Code
3. NFPA 58 - Liquefied Petroleum Gas Code, 2017 Edition

PART 2 - PRODUCTS

2.01 PIPE AND FITTINGS

A. Underground Piping

1. Schedule 40 black steel pipe, ASTM A53 with polyethylene jacket, welded joints and standard weight black steel butt weld or socket weld fittings, ASTM A243.
2. Polyethylene pipe, ASTM 2513, with heat fusion joints and fittings, ASTM D2513.
   a. **Tracer.** A yellow insulated copper tracer wire or other approved conductor shall be installed adjacent to underground nonmetallic piping. Access shall be provided to the tracer wire or the tracer wire shall terminate above ground at each end of the nonmetallic piping. The tracer wire size shall not be less than 18 AWG and the insulation type shall be suitable for direct burial.

B. Aboveground Piping

1. Schedule 40 black steel pipe, ASTM A53 with welded joints and standard weight black steel butt weld or socket weld fittings.
2. Schedule 40 black steel pipe, ASTM A53, with 150 pound steel slip-on welding flanges, ASTM A181, for connection to flanged valves and equipment.
3. Schedule 40 black steel pipe, ASTM A53, with screwed joints and 150 pound threaded malleable iron fittings, ASTM A47.
4. Where allowed by Authority Having Jurisdiction, corrugated 304 stainless steel tubing with polyethylene jacket conforming to ASTM-A240 with brass flare type fittings, ASTM B16, 5 psi maximum system pressure.

C. All propane gas piping within the building above gypsum ceilings or within plenum ceilings shall be welded.

2.02 JOINTS

A. Threaded joints shall be made with a mixture of graphite and oil applied to male threads only. After cutting and prior to threading, pipe shall be reamed and shall have burrs removed.

B. Welded joints shall be fusion welded in accordance with the American Standards Code for pressure pipe, ANSI, B31.1, Section 6.

C. Flanged joints shall be faced true, provided with ring type gasket, and made square and tight. Flanges shall have raised or flat faces to mate with adjacent flanges of valves.

2.03 UNIONS

A. Unions in steel piping shall be 150 pound socket welded carbon steel conforming to Federal Specification WW-U-53C.

2.04 VALVES

A. Valves 3" in size and larger shall be semi-steel plug valves with cast iron body, lubricated cast iron plug, flanged ends, and wrench operated for 175 pound WOG. Valve shall be Rockwell Nordstrom Fig. 143 or equal.

B. Valves 2-1/2" in size and smaller shall have bronze body and plug, socket welded ends, and square head for 125 WOG. Valve shall be Crane or Fig. 250 or equal.

C. Full port ball valves 2" in size and smaller shall have brass body with chrome plated brass ball with threaded or socket welded ends, 600 psi WOG, FM approval, AGA approval. Valve shall be Watts series FBV-3C or equal.

D. Lubricated plug valves shall be lubricated at the factory and sealant shall be suitable for propane gas. Provide two valve wrenches for each type of valve specified.

E. Equal valve manufacturers are Rockwell Nordstrom, Crane, Stockham, Powell, Walworth, Milwaukee, or Watts.

F. All valves in the propane system shall carry an FM and AGA approval.

2.05 PIPE SUPPORTS

A. Pipe Sleeves: Provide Schedule 40 pipe sleeve where pipe passes through walls. Sleeves shall be firmly grouted in place and no beams or footings shall be cut or sleeved.

B. Pipe Hangers: All piping shall be supported by means of hanger rods and pipe hangers from roof or floor construction using supplementary steel and/or lag bolts. Piping shall be supported from new concrete construction with drilled expansion anchors. Unless otherwise noted, hangers shall be B-Line Fig. B3100, B3109 or B3198P. Minimum spacing between pipe hangers shall be ten feet (10'-0"). At least one hanger shall occur within two feet (2'-0") from where a change in direction takes place in the line. Where pipes extend down or up to other floors, pipe clamps shall be provided on each floor to support pipe. Equal manufacturers for hangers and clamps are Anvil International, Elcen, Fee and Mason, or approved equal.

C. Piping on roofs shall be supported every ten feet (10'-0"), or two feet (2'-0") from a change in direction, with manufactured adjustable height stainless steel pipe stands with integral pipe roller guides or clevis hanger for securing horizontal piping. Pipe stands shall be secured to the roof per the roofing manufacturer’s installation requirements. Pipe stands

shall be Miro Industries Model 4-RAH, Dura-Blok Rooftop Supports or ERICO CADDY Series or approved equal.

D. Pipe supports for rooftop gas piping may be painted fabricated steel pipe stands with integral pipe guides if approved by the roofing manufacturer.

2.06 EMERGENCY SOLENOID VALVE

A. The main gas supply to kitchen equipment shall be provided with an automatic solenoid valve with manual reset lever. The valve shall be interconnected with the hood fire suppression system to shut down gas supply to all kitchen equipment.

B. Where required by local codes or jurisdictions, main gas supplies to fireplaces, fire pits, BBQ grills, etc. shall be provided with an automatic solenoid valve with manual reset lever. The valve shall be energized to open, closed when de-energized with manual reset. The required voltage shall be coordinated with the electrical contractor. The valve shall carry a UL Listing.

C. The valve shall be energized to open, closed when de-energized with manual reset. The required voltage shall be coordinated with the electrical contractor. The valve shall carry a UL Listing.

D. The emergency shutoff valve is to be provided with manual shutoff valves and unions on each side and located in a surface mount steel cabinet with flush solid metal door. The cabinet is to be located as shown on the drawings with the top of cabinet flush with finished ceiling. The cabinet shall be Potter Roemer 1810 series or approved equal.

E. Valves 3/4"-2-1/2" in size shall be ASCO 8044 series.

F. Furnish and install gas timer valve Fire Magic Model 3090 or approved equal on all fireplaces, fire pits, gas grilles, and other recreational gas fired appliances in addition to main shut off valve.

PART 3 - EXECUTION

3.01 INSTALLATION

A. A valved union shall be provided at each connection to a piece of equipment. Equipment provided with a flanged inlet shall have a flanged connection.

B. All valves installed in horizontal lines shall be installed with the stems horizontal or above.

C. All gas piping shall be graded at the maximum slope available to prevent traps. All horizontal lines shall slope to risers and from the risers to the meter or appliance.

D. Drip legs, 6" long, shall be provided in gas piping at ends of horizontal runs, at the base of risers, and at connections to equipment.

E. Provide pressure regulators at all required connections to equipment; regulators shall be provided at the pressure required by the equipment served. Extend all pressure regulator vents individually to the exterior per local code authority requirements.

F. Branch piping shall be taken off the top or sides of horizontal lines, but not from the bottom.

G. Changes in pipe size shall be made with reducing fittings. No bushings will be allowed.

H. No gas piping shall be placed underground inside the building.

I. Connections to food service equipment shall be provided with an AGA rated flexible connection and quick disconnect coupling. The completed assembly shall allow for removal of the equipment for access to the connection at the rear of the cook line area.

3.02 PAINTING

A. All interior and exterior ferrous metal gas piping, fittings and supports shall be primed and painted with two (2) coats of exterior grade enamel paint unless galvanized, stainless steel, or coated CSST piping is used. The paint color shall be submitted to the Architect for approval.

3.03 TESTING

A. The complete piping system shall be tested with air at 100 psi for two (2) hours.

END OF SECTION

SECTION 22 40 00
PLUMBING FIXTURES

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. All work specified herein shall be accomplished in accordance with the applicable requirements of Section 22 00 00 - Plumbing General.

1.02 WORK INCLUDED

A. Receipt, unloading, handling, proper storage and protection from damage of all materials.

B. Layout and coordination of work with other trades.

C. The work under this section shall include all labor, materials, accessories, services, and equipment necessary to furnish and install the plumbing fixtures, trim and supports, complete as indicated on the Drawings and as specified herein.

PART 2 - PRODUCTS

2.01 GENERAL

A. All fixtures shall be white, unless otherwise indicated.

B. All water closets shall have fully glazed trapways.

C. All exposed trim to be heavy polished chrome plated brass, unless otherwise indicated. Chrome plated escutcheons are to be provided on all exposed fixture and food service equipment supplies and waste lines.

D. Electric water coolers shall be ARI Certified and shall carry a UL Listing. Units shall use refrigerant which is approved for use without ozone depleting properties. All waterway components are to be certified as lead free.

E. All sinks and lavatories for use by the disabled shall have manufactured insulation shields on all supplies and P-traps per ADA requirements unless the vanities are provided with ADA compliant shrouds.

F. All exposed plumbing fixture items such as faucets and flush valves shall be provided with vandalproof trim.

2.02 CLEANOUTS

A. Cleanouts on exposed piping in unfinished areas shall be heavy duty cast iron with countersunk plug. Cleanouts shall be Jay R. Smith Figure 4220 or approved equal.

B. Cleanouts installed behind walls in finished areas shall be cast iron ferrule type for no-hub or service weight pipe with nickel bronze round frame and cover with securing screws. Cleanouts shall be Jay R. Smith Figure 4472T or approved equal.

C. Cleanouts installed in concrete floors shall be cast iron type with gasket seal ABS plug round adjustable ductile iron cover with securing screw and Speedi-Set outlet connection. Cleanouts shall be Jay R. Smith Figure 4231L-M or approved equal.

D. Cleanouts installed in tile floors shall be cast iron type with gasket seal ABS plug for easy removal, adjustable round nickel bronze top recessed for tile with securing screw and Speedi-Set outlet connection. Cleanouts shall be Jay R. Smith Figure 4151L or approved equal.

E. Cleanouts installed in carpeted areas shall be cast iron type with gasket seal ABS plug, nickel bronze round frame and cover with carpet marker. Cleanouts shall be Jay R. Smith 4031-Y or approved equal.

2.03 PLUMBING FIXTURES

A. The following is a list of acceptable manufacturers for the project:

1. Fixtures: American Standard, Kohler, Toto
2. Faucets: American Standard, Chicago Faucets, Kohler, Moen, Speakman, Symmons and Zurn
3. Stainless Steel Sinks: Elkay, Just, Kohler
4. Trim: American Standard, Brasscraft, Kohler, McGuire and Zurn
5. Drains, Carriers and Hydrants: Josam, Mifab, Prier, Jay R. Smith, Wade and Zurn

B. Plumbing fixtures shall be as scheduled on drawings.

PART 3 - EXECUTION

3.01 INSTALLATION

A. All wall hung fixtures shall be supported on concealed chair carriers furnished complete with all necessary bolts, nuts, washers and gaskets unless noted otherwise. The adjustable nipple between the cast iron fitting and the closet bowl shall be threaded cast iron. Secure all floor pieces to floor slab.

B. All exposed piping in connection with fixtures shall be chromium plated. Where supply and waste lines pass through walls, provide chromium plated escutcheons and firmly secure in place.

C. Provide straight or angle supply valves on inlet supplies to all fixtures.

D. Fixtures, trim and methods of piping and installation shall conform to local plumbing code. All fixture types shall be the product of one manufacturer. All fixtures shall be white unless otherwise noted.

E. Bathtub waste and overflow fittings shall be provided with soldered metal connections or PVC solvent welded connections if required by code authorities to eliminate the requirement for access to the fitting.

F. Fixtures shall be cleaned, adjusted and left in proper working order before the project is turned over to the Owner. Flush and clean all faucet aerators prior to turn over. Adjust all faucet lever handles to be parallel to adjacent rear wall in the off position.

G. The Contractor shall furnish and install protective guards as required to protect fixtures against damage by normal operations of other trades. Bathtubs shall be provided with tub liners at all times during construction.

H. Caulk all floor and counter top mounted fixtures and behind all wall-hung plumbing fixtures with white, non-shrinking, silicone caulking eliminating all voids and cracks.

I. Coordinate the mounting height of all fixtures with the Architect prior to installation.

J. The Contractor shall obtain exact information relative to finish grade of the top of the floor drains. All floor drains shall be set flush with finished floors.

K. Cleanouts shall be provided where indicated on drawings and elsewhere as required by code.

L. Where test tees are installed at the base of the stack or on the stack, they may be used as a cleanout.

M. Provide the Owner with three (3) wrenches for removing flush cleanout plugs.

END OF SECTION

SECTION 23 00 00
HVAC GENERAL

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. Refer to Division 1 - General Requirements and any and all Supplementary or Special Requirements, all of which apply to work described in Division 23 - HVAC as if written in full herein.

B. The scope of work described in these Specifications and/or indicated on the Drawings shall include the furnishing of all materials, equipment, appurtenances, accessories, connections, labor, etc. required and/or necessary to completely install, clean, inspect, adjust, test, balance and leave in safe and proper operating condition all HVAC systems. All HVAC work shall be accomplished by workmen skilled in the various trades involved.

C. The Drawings and Specifications are complementary to each other and what is called for by one shall be as binding as if called for by both. If a discrepancy exists between the Drawings and Specifications, the higher implied cost shall be included in the bid, and the Architect shall be notified of the discrepancy in writing.

1.02 CODES AND STANDARDS

A. All HVAC work shall conform to all ordinances and regulations of the City, County and State where the work will take place, including the requirements of all authorities having jurisdiction. The following codes, standards and references shall be observed as a minimum:

1. The 2009 International Energy Conservation Code
2. The 2018 International Mechanical Code
3. State Amendments to the Code
4. National Fire Protection Association (NFPA) Standards and Guidelines
5. Local and State Fire Marshal requirements
6. Local Building and Inspection Department requirements
7. Local adopted codes, standards, ordinances (including noise ordinances), or amendments
8. American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. (ASHRAE)
    a. Standard 90.1-2007 – Energy Standard for Buildings Except Low-Rise Residential Buildings
    b. Standard 90.2-2018 Energy-Efficient Design of Low-Rise Buildings
    c. Standard 62.1-2016 – Ventilation for Acceptable Indoor Air Quality
    d. Standard 62.2-2016 – Ventilation and Acceptable Indoor Air Quality in Residential Buildings
    e. Standard 55-2016 – Thermal Environmental Conditions for Human Occupancy
    f. Other Standards and Guidelines as applicable
9. Sheet Metal and Air Conditioning Contractors' National Association, Inc. (SMACNA) Manuals
10. Air Conditioning, Heating, and Refrigeration Institute (AHRI)
11. Air Conditioning Contractors of America (ACCA)
12. American Society of Mechanical Engineers (ASME)

13. Underwriters Laboratories Inc. (UL)
14. Americans with Disabilities Act (ADA)

B. If Code or other requirements exceed the provisions shown on the Contract Documents, the Engineer shall be notified in writing. Where requirements of the Contract Documents exceed Code requirements, work shall be furnished and installed in accordance with the Contract Documents. Any work done contrary to these requirements shall be removed and replaced at the Contractor's expense.

1.03 NOISE CRITERIA DESIGN GOALS

A. Mechanical equipment, air distribution systems and devices shall be designed to not exceed the following noise criteria (NC) levels:

1. Public Space Areas: NC <35
2. Utility/All Other Areas: NC <40
3. Residential areas: NC <30
4. Open Office areas: NC<40
5. Restaurants: NC<45

1.04 MISCELLANEOUS DEFINITIONS

A. Terms: The following definitions of terms supplement those of the Division 01- General Requirements and are applicable to Division 23 – Heating, Ventilation, and Air Conditioning (HVAC):

1. Contractor: As used herein the term shall mean "the person or entity referred to throughout the Contract Documents as if singular in number. The Contractor shall designate in writing a representative who shall have express authority to bind the Contractor with respect to all matters under this Contract. The term "Contractor" means the Contractor or the Contractor's authorized representative."
2. Furnish: As used herein shall mean "supply and deliver to Project site, unload and inspect for damage."
3. Install: As used herein the term shall mean "to place in position for service, temporarily store, unpack, assemble, erect, apply, place, protect, clean, start up, and make ready for use."
4. Owner: As used herein the term shall mean "the person or entity identified as such and is referred to throughout the Contract Documents as if singular in number. The Owner shall designate in writing a representative who shall have express authority to bind the Owner with respect to all matters requiring the Owner's approval or authorization. The term "Owner" means the Owner or the Owner's authorized representative."
5. Product: As used herein shall include materials, systems, and/or equipment, machinery, components, and fixtures forming the work result. Not materials or equipment used for preparation, fabrication, conveying, or erection and not incorporated into the work result. Products may be new, never before used, or re-used materials or equipment.
6. Provide: As used herein shall mean "furnish and install, complete and ready for the intended use."
7. The Work: As used herein the term shall mean "the construction and services required by the Contract Documents, whether completed or partially completed, and includes all other labor, materials, equipment, and services provided or to be provided by the Contractor to fulfill the Contractor's obligations. The Work may constitute the whole or a part of the Project.

8. Experienced: When used with an entity or individual, “experienced” means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.05 WORK INCLUDED

The HVAC Systems installed and work performed under this Division of the Specifications shall include, but not necessarily be limited to:

A. Airside Systems

1. Equipment: including fans, unitary air conditioners, air handling units, fan-coil units, make-up air units, dedicated outdoor air units, furnaces, split systems, etc.
2. Ductwork and Accessories: including sheet metal, duct-board, kitchen hood and dishwasher exhausts, flexible ductwork, fire and smoke dampers, access doors, etc.
3. Air Terminal Devices: including powered induction units, variable air volume valves, etc.
4. Air Distribution Devices: including louvers, registers, grilles, diffusers, etc.

B. Refrigerant Systems

1. Equipment: including condensing units, etc.
2. Piping, Tubing and Accessories: including pipe, refrigerant tubing, valves, solenoids, thermal expansion valves, strainers, air vents, pipe and equipment drains, condensate drains, expansion devices, etc.

C. Equipment, Ductwork and Piping Supports

1. Equipment Mounts: including roof curbs, concrete housekeeping pads, equipment rails, miscellaneous steel, etc.
2. Hangers and Support Devices: including inserts, hanger rods, strut channel, cross-bracing, anchor bolts, pipe anchors, restraints, etc.
3. Vibration Isolation and seismic restraint: including inertia bases, flexible couplings, expansion devices, snubbers, springs, waffle pads, seismic restraints, etc.

D. Insulation

1. Ductwork Insulation: including exterior duct wrap, internal duct liner, fire wrap, etc.
2. Piping and Equipment Insulation: including preformed, board and wrap.

E. Miscellaneous HVAC Equipment: Unit heaters, wall heaters, roof hoods, heat tracing, etc.

F. Automatic Temperature Controls

1. Decentralized: including all thermostats, control dampers, control valves, programmable controllers, line and low-voltage wiring, smoke detectors, pressure sensors, gas sensors, control logic, etc.

G. Labor and Equipment: including project management, supervision, tradesmen, lifts, fork-trucks, cranes, scaffolding, saws, wrenches, etc.

H. Equipment and Valve Identification

I. Start-up and Commissioning

J. Demonstration and Owner Training

K. Testing, Adjusting and Balancing

1.06 ENGINEER'S DRAWINGS

A. The locations, arrangement and extent of equipment, devices, ductwork, piping, and other appurtenances related to the installation of the HVAC work shown on the Drawings are approximate and define the intent of the design. The Contractor shall not scale Engineer's Drawings, but shall refer to the architectural drawings for exact dimensions of building components. Should a conflict exist between the architectural and engineering drawings regarding dimensions and scale, the Contractor shall notify the Architect of the discrepancy.

B. Materials, equipment or labor not indicated but which can be reasonably inferred to be necessary for a complete installation shall be provided. Drawings and Specifications do not undertake to indicate every item of material, equipment, or labor required to produce a complete and properly operating installation.

1.07 EQUIPMENT, MATERIALS AND BID BASIS

A. Manufacturers' names, model numbers, etc. cited on the Drawings and in the Specifications are for the purpose of describing type, capacity, function and quality of equipment and materials required. All project design and coordination between disciplines has been performed as if the named manufacturer and specific piece of equipment will be provided to the project by the Contractor.

B. Alternate equipment and/or materials other than that named on the Drawings and in the Specifications may be proposed for use, but all equipment and materials shall conform entirely to the specified base items. Proposed alternate equipment shall be substantially equal in size, weight, construction and capacity. Alternate equipment and materials shall be submitted only as full equivalent to the equipment and materials specified, with sufficient supportive documentation and technical literature to demonstrate quality, performance, and workmanship without doubt or question. Requests for prior approval of alternate products shall be made at least ten (10) days prior to the bid date and as required by Division 1 - General Requirements. The Engineer shall consider the use of the alternate equipment based on the supportive documentation made available to him, and shall approve or disapprove any proposed alternates. Major exceptions to these specifications will be considered sufficient cause for rejection of the submittal. The decision of the Engineer shall, in all cases, be final.

1. The ten (10) day prior approval submittal shall include a Compliance Review of the Specifications and Addenda (if any). The Compliance Review shall be paragraph-by-paragraph review of the Specifications with the following information; "C", "D" or "E" marked in the margin of the original Specifications and any subsequent Addenda.
2. "C": Comply with no exceptions.
3. "D": Comply with no deviations. For each and every deviation, provide a numbered footnote with reasons for the proposed deviation and how the intent of the Specification can be satisfied.
4. "E": Exception, does not comply. For each and every exception, provide a numbered footnote with reasons and possible alternatives.

5. Manufacturer shall provide complete paragraph-by-paragraph compliance document detailing unit conformance to the specification. The Engineer will not review the proposal for equipment compliance.

Unless a deviation or exception is specifically noted in the Compliance Review, it is assumed that the bidder is in complete compliance with the plans and specifications. Deviations or exceptions taken in cover letters, subsidiary documents, by omission or by contradiction do not release the bidder from being in complete compliance, unless the exception or deviation has been specifically noted in the Compliance Review. The bidder may submit the latest state-of-the-art components in lieu of specified components at no additional cost, where latest state-of-the-art components perform better than what is specified. All deviations from the specifications must be approved by the Architect/Engineer and the Owner.

C. The Contractor shall coordinate the installation of all HVAC equipment proposed for use in this project with all building trades (architectural, structural, electrical, etc.). Coordination shall be accomplished prior to, and shall be reflected in, the equipment submittals for approval. When the Contractor requests substitution of alternate equipment, it is with the knowledge that he shall be responsible for any and all costs required by the substitution, including necessary engineering and construction revisions in his or any other contract or trade to satisfy the design intent shown on the Plans and described in the Specifications.

D. All materials exposed within HVAC plenums shall have a flame-spread index of not more than 25 and a smoke-developed rating index of not more than 50 unless otherwise allowed by code.

1.08 SUBMITTALS

A. The Contractor shall prepare, submit and obtain Engineer's review of all manufacturers' data on the HVAC equipment and systems prior to ordering, purchasing or installing any equipment or materials. Shop drawings shall be submitted electronically in a portable document format (pdf). An acceptable alternate would be to submit six (6) hard copies of the complete submittal, five of which will be reviewed and returned. Submittals shall be as described in Division 01 - General Requirements. Prior to submitting to the engineer, the contractor shall review and subsequently place his approval stamp on the shop drawings. Submittals shall be transmitted simultaneously in a single .zip file or, in the case of hard copies, three-ring ring binders with the associated specification sections cited and the items submitted clearly identified. Submittals lacking the contractor's approval stamp and partial submittals will be returned without review. Submittals, as a minimum, shall include:

1. All HVAC items scheduled on the Drawings
2. Equipment arrangement, ductwork and piping drawings. Contractor drawings shall be prepared at a minimum scale of 1/8" = 1'-0". A scale of 1/4" = 1'-0" scale is preferred. Drawings shall be indicative of actual equipment purchased and shall show all offsets, transitions, fittings, dampers, valves, hanger locations, etc. Sections are required in spatially tight areas (e.g. kitchens, laundries, central plants, mechanical rooms, etc.) The following will guide the Contractor as to minimum drawing detail required:
   a. Clearly indicate top and bottom of duct and pipe elevations. All elevations shall be coordinated as to not conflict with structural, plumbing, electrical and architectural trades.
   b. Indicate all offsets (both vertical and horizontal).
   c. Indicate graphically all duct and pipe joints and their lengths.
   d. Submit duct and pipe-work fabrication schedule indicating duct size range with minimum duct material gauges, pipe schedule being used, duct and

pipe connection joint types, section lengths, duct reinforcement type and spacing, etc.

e. Indicate graphically all ductwork to be fabricated with internal duct liner.
f. Indicate all insulation for ductwork and piping.
g. Indicate all dampers and valves as shown on design documents and called for in the specifications.
h. Indicate all flexible connectors where required by specifications and notes.

3. Flexible ductwork, duct-board, insulation and linings
4. Ventilation controllers, dampers, louvers, air distribution devices, wall terminations (wall caps), roof terminations (roof caps, hoods, jacks, etc.)
5. Manufacturer's cut sheets of all piping and tubing materials
6. Where split systems are used in a "long line application," submit manufacturer's refrigerant line set routing drawings and engineered calculations supporting installed line lengths and recommended suction and liquid line sizes (deviations in the installed lengths and sizes shall be recorded on the as-built drawings and coordinated with the manufacturer to reconfirm that long line guidelines are being met).
   a. Identify and provide cut sheets of any and all accessories required to make the system complete, functional and reliable.
   b. Any split system with 75 feet of separation between the outdoor unit and the indoor unit requires that the contractor obtain a warranty approval letter from the equipment manufacturer certifying the long line length distances shown on the submitted shop drawings are acceptable.
   c. Refer to the EQUIPMENT INSTALLATION - COMMON REQUIREMENTS paragraph below.
7. Refrigerant type and charge (lbs.) for each item of equipment utilizing refrigerant.
8. AHRI Certificates
9. Valves, thermometers, pressure gauges
10. Thermal expansion/contraction piping system design including complete layout drawings indicating anchor loads, points, and method of structural support.
11. Roof curbs, equipment supports, hanger systems, vibration isolators, seismic restraints
12. Control equipment, systems and diagrams
13. Test and balance reports

B. All submittal approvals required by any code or enforcement authority, insurance underwriter, etc. shall be obtained prior to being submitted to the Engineer.

C. Review of submittals by the Engineer does not relieve the Contractor from responsibility for complying with all requirements of the Contract Documents. Furthermore, it shall be the responsibility of the Contractor to coordinate the requirements (roof penetrations, wall penetrations, floor penetrations, curbs, electrical, etc.) of all approved equipment with the other trades and disciplines.

D. All submittals shall be identified by the equipment mark or tag identification numbers shown on the Contract Drawings. Each individual submittal item shall be marked to show which specification section pertains to the item.

E. The Contractor shall provide a written statement confirming coordination of voltage requirements for all HVAC equipment requiring an electrical connection. Statement shall bear the names and signatures of the HVAC and electrical contractors. A photocopied reproduction of the below statement is acceptable.

VOLTAGE COORDINATION STATEMENT

This statement is to confirm that the voltages of the equipment provided under this specification have been coordinated with the Electrical Drawings, as well as with the Electrical Contractor.

HVAC Contractor: _____
Project Manager Name: _____
Project Manager Signature/Date: _____
Electrical Contractor: _____
Project Manager Name: _____
Project Manager Signature/Date: _____

F. Provide Material Safety Data Sheet (MSDS) or letter from manufacturer certifying the VOC content for each adhesive, sealant, paint and coating.

G. VOC Content: Submit adhesive and sealants product information or MSDS showing VOC Content information for all applicable products specified under this section.

1.09 PERMITS

A. The Contractor shall obtain all permits and inspections required for the installation of the HVAC work and pay all charges incident thereto. He shall deliver copies of all certificates of permit and inspection to the Architect.

1.10 COORDINATION OF TRADES

A. The Contractor shall give full cooperation to other trades, and shall furnish all information necessary to permit the work of all trades to be installed satisfactorily and with the least possible interference or delay.

B. Piping and other HVAC equipment shall not be installed without first coordinating the installation of same with other trades. The Contractor, at his own expense, shall relocate all uncoordinated ductwork, piping and other HVAC equipment installed should they interfere with the proper installation and mounting of electrical, plumbing equipment, ceilings and other architectural or structural finishes.

C. The Contractor shall coordinate the elevations of all ductwork, piping and equipment above ceilings and in exposed areas with the work of all other disciplines prior to installation.

D. In areas where more than one trade is required to use common openings in beams, joists, chases, shafts and sleeves for the passage of conduits, raceways, piping, ductwork and other materials, the Contractor must coordinate the positions of all piping and equipment to be furnished under this section so that all items including the materials and equipment of other trades may be accommodated within the space available.

E. The HVAC Contractor shall confirm that his work does not interfere with the clearances required for finished columns, pilasters, partitions, walls or other architectural or structural elements as shown on the Contract Documents.

F. Work that is installed under this Contract which interferes with the architectural design or building structure shall be removed and relocated as required at no additional cost to the Contract.

G. Coordinate power and fire alarm requirements of all combination fire/smoke dampers and smoke dampers with the electrical contractor.

H. The General Contractor shall coordinate service access paths for roof-mounted equipment requiring routine maintenance. Provide code compliant galvanized steel [aluminum] crossing structure (e.g. stairs with handrails, ladders, etc.) for any obstruction (ductwork, piping, etc.) that exceeds 1'-6" in height x 1'-6" in width. In addition, refer to Part 3 below - EQUIPMENT INSTALLATION - COMMON REQUIREMENTS. Details of such crossings shall be included with piping and ductwork layout and coordination drawings.

I. Coordinate with the roof system used so that a minimum of 8" of the roof curb is above the finished roof for flashing purposes. The top of the curb shall be level and the slope of the roof shall be compensated for by the curb.

1.11 OPERATION AND MAINTENANCE MANUALS

A. The Contractor shall prepare a minimum of two (2) instruction manuals, one of which shall be submitted to the Architect for the Engineer's review. Manuals shall describe installation, operation and maintenance of all HVAC equipment and shall include copies of control schematics, sequences of operation, function and operations of all components, as well as the Contractor's name, address, and telephone number. Manuals shall also contain one copy of all manufacturers' drawings, pamphlets, data, parts lists, and instruction manual for each piece of equipment. Upon approval, one copy shall be delivered to the Owner; one copy shall be kept by the Contractor. The pamphlets and drawings are to be neatly bound in (a) 3-ring binder(s). In addition to the hard copy, provide electronic files (PDF format) of the manuals.

1.12 AS-BUILT DRAWINGS

A. The Contractor shall maintain a record of all changes in the work from that shown in the Contract Documents. The record shall be by red-line mark-up on the most current set of Engineer's Drawings kept in the field office. After all work is completed, the Contractor shall prepare a set of "as-built" reproducible drawings of similar type and quality as the Engineer's Drawings. As an alternate to hard copy drawings, provide electronic files (PDF format) of the as-built conditions. As-built drawings shall accurately depict actual final arrangement of all HVAC items. As-built drawings shall be delivered to the Architect.

1.13 WARRANTY

A. All equipment furnished and installed under this Contract shall be provided with the manufacturer's standard warranty unless otherwise noted.

B. All reciprocating, rotary and scroll air conditioning compressors shall be provided with an extended 5-year parts warranty.

C. The Contractor shall make good all defects in material, equipment, or workmanship disclosed within a period of one (1) year from date of building acceptance by the Owner. The phrase "make good" shall mean to furnish promptly, without charge, all work necessary to remedy the defects to the satisfaction of the Engineer.

PART 2 - PRODUCTS

2.01 GENERAL

A. All equipment, materials, accessories, etc. used shall be new and of current production unless specified otherwise. Equipment not specified in the Engineer's Drawings shall be suitable for the intended use and shall be subject to approval by the Engineer.

B. All equipment, products and materials shall be free of defects and shall be constructed to operate in a safe manner without excessive noise, vibration, leakage, or wear.

C. All equipment shall bear the inspection Label of Underwriters Laboratories Inc.

D. All equipment and material for similar applications or systems shall be provided from the same manufacturer unless noted otherwise.

E. The VOC content of all products in this section shall not exceed the VOC limits established in Section 01 81 13 Sustainable Design Requirements.

F. VOC Content: Submit adhesive and sealants product information or MSDS showing VOC Content information for all applicable products specified under this section. All applicable products in this section must meet low VOC content as specified by LEED Specification Section 01 81 13 Sustainable Design Requirements.

2.02 ELECTRICAL WORK

A. Except as otherwise specified or noted, electrical equipment used for HVAC systems shall be as specified herein.

B. Motor controls, system controls, starters, disconnects, pilot lights, push buttons, etc. shall be furnished by the HVAC Contractor compatible with the apparatus that it operates. Electrical equipment shall be wired for the voltage shown on the Electrical Drawings.

C. The Contractor shall be responsible for coordinating and furnishing equipment of voltage shown on the electrical documents.

D. Electric motors shall be NEMA Premium Efficiency open drip proof type. Motors shall meet NEMA MG1 Table 12-12 of EISA, 2010. Motors shall be selected with a minimum of 15% safety factor greater than the fan brake/horsepower (e.g. 4.75 BHP would require a nominal 7½ HP motor). The motor service factor shall not be used as part of the safety factor. All motors shall have thermal overload protection. Motors shall be capable of operating at ± 10% of the design voltage without voiding the manufacturer's warranty. Motors that drive equipment that will run continuously shall be IEC 60034-1 continuous duty rated.

E. Starters for motors ⅓ HP and smaller shall be manual type, and for ½ HP and larger, shall be magnetic type. Starters shall be minimum size 0, combination type (with disconnect and lockable handle) with molded case circuit breaker. Starters for motors with remote or automatic control shall be magnetic. Relays, interlocks and auxiliary contacts shall be provided as specified and required.

F. Magnetic motor starters shall be across-the-line, full voltage, non-reversing type unless otherwise indicated on the Drawings or specified herein. Starters for motors 75 HP and greater shall be solid state, reduced voltage type.

G. Motor controls shall be either "Hand-Off-Auto" switches or "On-Off" push buttons with one indicating light. "Hand-Off-Auto" switches shall be provided for automatically controlled apparatus.

H. Motor starters that are not an integral part of HVAC equipment shall be installed in conformance with Division 26 - Electrical Requirements.

I. All "loose" disconnects and starters shall be installed by Division 26.

J. Power wiring to disconnects, starters, and equipment shall be provided and installed by Division 26. All equipment requiring electrical power shall be provided with a disconnect switch at each piece of equipment. Coordinate switch type (fused or non-fused) with equipment characteristics, manufacturer's recommendations and the electrical drawings.

K. Provide all system controls and associated control and interlock wiring for complete and operable systems. 120 volt and higher wiring shall be MC cable or in conduit in accordance with local codes and the materials and installation requirements of Division 26 - Electrical.

L. Coordinate power and fire alarm requirements of all combination fire/smoke dampers and smoke dampers with the electrical contractor.

M. All starters and variable frequency drives shall be labeled on the face of the device with a semi-rigid plastic laminate nameplate with 1" high white letters on a black background securely affixed to the equipment. The label shall indicate equipment served (equipment tag used on the Drawings). Labels shall be furnished and installed by the Contractor.

N. All starters for 3-phase equipment shall have overload devices in each phase.

O. Wiring diagrams shall be furnished by the Contractor.

P. Coordinate with the electrical drawings for the required short circuit current rating of the panelboard serving multi-motor and combination-load equipment. The equipment nameplate shall bear a rating of no less than the panelboard rating.

Q. Acceptable manufacturers shall be General Electric, Square D, Eaton, Siemens and Allen Bradley.

2.03 AIR FILTERS

A. All filters shall be U.L. 900 classified.

B. Filters shall be pleated disposable type (MERV 6 minimum) unless specified otherwise.

C. Install one set of new filters in air handling equipment during construction and install a new set prior to test and balance. Fan powered induction units shall have a temporary roll filter media installed at the plenum air inlet during construction. Remove temporary filter media prior to test and balance. Clean and vacuum all inlets prior to test and balance.

D. Temporary roll filter media shall be provided at the inlets to all air handling equipment operated during construction. Remove temporary filter media prior to test and balance. Clean and vacuum all inlets prior to test and balance.

PART 3 - EXECUTION

3.01 GENERAL

A. All equipment and materials shall be completely installed, adjusted, and fully operational with all accessories and connections.

B. Equipment, piping, ductwork, etc. shall fit into the spaces provided in the building and shall be installed at such time and in such a manner as to avoid damage and as required by the job progress. In general, ductwork, piping, equipment, etc. shall be installed tight to structure above. The Contractor shall coordinate work with other trades and locate work described herein to avoid interferences with structural, electrical and architectural work. Shop drawings shall clearly indicate any conflicts with other trades. Equipment,

accessories and similar items requiring normal servicing or maintenance shall be accessible.

C. The Engineer reserves the right to direct the removal of any item which, in his opinion, does not present an orderly and reasonably neat or workmanlike appearance. Such removal and replacement shall be done when directed by the Engineer and without additional cost to the Owner.

D. Listed mounting heights are to the finished bottom of the device unless otherwise noted.

E. All work shall be designed and installed to comply with the requirements for the seismic design category and use group for the area in which the building is constructed.

F. Expansion in piping systems shall be compensated for using u-bends, z-bends or expansion joints as indicated. U-bends (loops) and z-bends shall be complete with pipe guides and anchors. Expansion compensation in piping risers over 100 feet in length shall be made with engineered systems; either spring type isolators and central anchor system (by Mason Industries) or flexible hose expansion loops (Metraloop as manufactured by the Metraflex Company). Refer to specification Section 23 21 13 for additional requirements.

3.02 STORAGE AND PROTECTION OF STORED MATERIALS

A. During construction, all equipment shall be properly protected against damage, defacing and freezing with shipping cartons, plastic sheeting, shipping covers, etc.

B. All open ends of piping and equipment shall be sealed with nipples and caps, plugs, and test plugs until final connection to system is made.

C. All equipment, piping and ductwork shall be protected to prevent entrance of foreign matter and debris by covering exposed openings during construction.

D. Handle and store materials in accordance with manufacturer's and supplier's recommendations and in a manner to prevent damage to materials during storage and handling. Replace damaged materials.

E. Equipment and materials shall not be installed until such time as the environmental conditions of the job site are suitable to protect the equipment or materials. Equipment or materials damaged, or which are subjected to these elements, are unacceptable and shall be removed from the premises and replaced.

3.03 PROTECTION OF HVAC SYSTEMS IN OCCUPIED BUILDINGS

A. Protect equipment and air distribution systems as outlined in SMACNA's IAQ Guidelines for Occupied Buildings Under Construction, latest edition.

3.04 BUILDING DRY-OUT DURING CONSTRUCTION

A. HVAC equipment shall not be used to dehumidify the building interior and dry-out construction materials. The HVAC system does not have the capacity to perform a building dry-out. The HVAC equipment shall not be operated until the building is completely dried-in and construction is substantially complete.

B. Coordinate with the general contractor to provide industrial grade desiccant type dehumidifiers to perform building dry-out. Propane or diesel space heaters are not acceptable as the combustion process adds moisture to the air.

3.05 CUTTING AND PATCHING

A. The work shall include all cutting and patching required as part of the HVAC installation. Refer to Division 1 - General Requirements.

3.06 CONCRETE WORK

A. Construct curbs, pads and similar supports for equipment where required.

B. Provide 4" (min.) thick housekeeping pads for all floor mounted equipment, extending 6" beyond the area occupied by the equipment. Dowel pads to structural slab.

C. Perform concrete work in accordance with applicable portions of Division 3 - Concrete. Minimum compressive strength of concrete shall be same as specified for slabs on grade.

D. Mix and install grout for HVAC equipment base bearing surfaces and anchors. Provide forms as necessary and place grout to completely fill equipment bases.

3.07 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right-of-way for piping to be installed with the required slope.

E. For roof and attic mounted equipment requiring routine maintenance, allow for an unobstructed path from the roof/attic service entry point to the equipment. The path area shall be a minimum of 6'-0" high by 3'-0" wide.

F. Split system outdoor unit equipment has been shown indicating matched systems of the indoor unit with its associated outdoor unit. While the location of the outdoor units are approximate, the importance of unit locations relative to the refrigerant line set penetration through a wall or roof is critical for the project. Prior to ordering equipment, the contractor shall carefully coordinate the line set routing and requirements with the split system manufacturer to insure installation guidelines, especially for long line applications, are being followed. Refrigerant line sets shall be routed to reduce the system total equivalent length and minimize system capacity losses due to elbows, fittings, valves, etc. After the coordinated routing drawings have been approved and certified by the split system manufacturer, they shall be submitted for review along with the equipment and any required accessories. During installation, the contractor is responsible for keeping as-built refrigerant piping installation drawings noting any deviations to the proposed routing. Deviations that may affect proper system operation or performance shall be reviewed by the manufacturer immediately and corrective action implemented as required.

3.08 EQUIPMENT SUPPORTS

A. Major equipment supports (structural steel frames, framed structural slab and wall openings, etc.) shall be furnished and installed by others; however, the HVAC work shall include furnishing and installation of all miscellaneous equipment supports, structural members, rods, clamps and hangers required to provide adequate support of all HVAC equipment.

B. Unless otherwise shown on the Drawings, all HVAC equipment, piping, and accessories shall be installed level, square, and plumb.

C. All equipment, piping, etc. supported by structural bar joists shall be supported only by the top chord of the joists. Hangers shall not be attached to the bottom chord of any joists.

3.09 PIPE AND DUCTWORK PENETRATIONS

A. Sleeves shall be installed in all masonry or concrete walls, floors, roofs, etc. for pipe and ductwork penetrations. Sleeves for pipe shall be schedule 40 black steel pipe. Refer to Section 23 21 13 – Piping and Accessories for additional information. Sleeves for ductwork shall be 20-gauge galvanized steel. Ductwork sleeves shall be sized to provide a minimum of ¼" clearance between the sleeve and duct. For insulated ducts, the clearance shall be between the sleeve and the insulation.

B. As far as possible, all pipe and ductwork penetrations shall be provided for at the time of masonry or concrete construction. Where drilling is required, only core drills shall be used. Star drills shall not be used.

C. All pipes penetrating walls or floors of any construction shall be installed with escutcheon plates on both sides of the penetration securely fastened to the wall or floor. In exposed areas, escutcheon plates shall be chrome plated. All escutcheon plates shall be sized to completely conceal the penetration.

D. Ductwork penetrating walls or floors of any material shall be installed with closure plates on both sides of the penetration.

E. Pipe penetrations through exterior walls shall be sealed weather-tight with a factory fabricated mechanical type rubber seal. Refer to Section 23 21 13 – Piping for additional information.

F. All pipe and duct penetrations of fire, smoke, or fire and smoke-rated assemblies shall be fire-stopped as required to retain the integrity of the UL-rated assembly. Fire barrier products shall be as manufactured by Tremco, Hilti, 3M, Metacaulk, Nelson, STI or approved equal. Refer to Division 7 - Thermal and Moisture Protection.

3.10 FLASHING

A. All piping and ductwork penetrating roofs shall be flashed in an approved manner, shall be watertight, and shall conform to the requirements detailed in Division 7 - Thermal and Moisture Protection.

3.11 EQUIPMENT LABELING

A. All HVAC equipment shall be labeled. This shall include all central plant, air handling or air conditioning equipment, air terminals, and other similar and miscellaneous equipment.

B. Labels for air terminals or other devices shall be located for optimum visibility through access panel or removed ceiling tiles.

C. Equipment labeling shall be one of the following, unless noted or specified otherwise:

1. Permanently attached plastic laminated signs with 1" high lettering
2. Stencil painted identification, 2" high letters, with standard fiberboard stencils and standard black (or other appropriate color) exterior stencil enamel

3.12 VALVE TAGS

A. Each valve in the HVAC system is to be provided with an individually numbered valve tag.

B. Valve tags are to be brass or plastic laminate, 1½" minimum diameter with brass chain and hook for securing to the valve.

C. Valve tags will include a designation to indicate the appropriate system. Numbering shall be consecutive for each service of the hot, chilled, steam, condensate return, or condenser water systems.

D. A printed list or schematic drawing shall be compiled for each system indicating the location and detailed description of the system or equipment served.

E. One (1) copy of each list shall be framed and mounted at the location designated by the Building Engineer. An additional copy of each list is to be included in the Operations and Maintenance Manual.

3.13 CLEANING

A. At all times, the premises shall be kept reasonably clean and free of undue amounts of waste, trash and debris by periodic cleaning and removal. After completion, all foreign material, trash and other debris shall be removed from the job site.

B. After all equipment has been installed, but prior to testing and balancing, all equipment, piping, ductwork, etc. shall be thoroughly cleaned both inside and out.

C. All water piping shall be chemically flushed and cleaned prior to circulating water through equipment.

D. After cleaning, filters shall be installed where required and all systems shall be tested and balanced.

E. After testing and balancing and just prior to Owner review and acceptance, all systems shall be finally cleaned and left ready for use.

3.14 PAINTING

A. Painting will be done under Division 9 - Painting except as otherwise noted, but the HVAC Contractor shall leave all surfaces of work free of rust, dirt and grease.

B. The HVAC Contractor shall touch-up any equipment scratched in shipment or during installation to match the original finish. Touch-up painting of HVAC equipment shall be part of the HVAC work.

C. Any visible ductwork through grilles, registers and diffusers shall be painted flat black.

D. Provide one coat of rust preventive primer on all new structural steel supports and new ferrous surfaces not galvanized, including insulated and non-insulated HVAC piping. Rust preventive painting shall be part of the HVAC work. Rust preventive paint shall be “Rust Destroyer” by Advanced Protective Products, Inc., Fair Lawn, NJ, (800) RUST-007. Product shall have a 5-year warranty when applied directly over rust. Clean and prepare surface per manufacturer’s recommendations.

E. All painting and coating shall match the original finish and shall conform to the requirements detailed in Division 9 - Finishes.

F. Do not paint over equipment nameplates, nonferrous hardware, accessories or trim.

3.15 PRESSURE TESTING

A. Unless otherwise specified herein, all HVAC piping shall be tested as required by Code to 1½ times the rated system pressure or 100 psig, whichever is greater. Care shall be taken to isolate all equipment not suitable for this test pressure by installing pipe caps or blank flanges at the equipment connections. All valves and fittings shall be tested under pressure.

3.16 PERFORMANCE AND DEMONSTRATION TESTS

A. All testing and demonstration of any and all HVAC systems required for acceptance by any authorities having jurisdiction shall be included as part of the HVAC work. This shall include the furnishing of any and all testing equipment, smoke generation devices, and any other required equipment or accessories, and all necessary labor required to perform any required tests or demonstrations. The Contractor shall coordinate and verify all devices, equipment and sequence of testing and/or events with such authorities having jurisdiction. The Contractor shall perform a minimum of two (2) satisfactory preliminary tests or demonstrations prior to any formal tests and/or demonstrations for any code authorities and shall give a minimum of five (5) days advance notice to the Engineer of any and all preliminary tests and/or demonstrations, indicating the date and time of such tests.

B. For testing and demonstration of smoke control systems, the requirements in paragraph 3.14.A apply. In addition, coordinate with the owner/operator for witnessing of formal testing.

3.17 TRAINING

A. Upon completion of the work, the Contractor shall conduct operation and training session(s) for the Owner’s key operating personnel. These sessions shall be of sufficient length and duration to adequately explain the design intent and proper operating and maintenance techniques for all HVAC equipment and systems. After these sessions are completed, the Contractor shall provide a copy of a signed statement by the Owner that his personnel are thoroughly familiar with and capable of operating all HVAC equipment and systems.

END OF SECTION

SECTION 23 07 00
HVAC INSULATION

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. All work specified herein shall be accomplished in accordance with the applicable requirements of Section 23 00 00 - HVAC General.

B. The insulation shall be installed in a neat and workmanlike manner by trained personnel regularly engaged in the installation of insulation and approved by the insulation manufacturer. Insulation, adhesives, coverings and coatings shall be applied in strict accordance with its respective manufacturer's recommendations. Installer has been in business for no less than 5 years and has completed at least 10 installations of similar size projects.

C. The contractor shall verify that test and inspection of the work to be insulated have been completed and approved before the insulation is applied.

D. All insulation must meet applicable codes for Flame Spread and Smoke Developed ratings when tested in accordance with ASTM 84 and UL 723.

1.2 WORK INCLUDED

A. The work done under this section shall include all labor, materials, accessories, services and equipment necessary to furnish and install all insulation, complete, as indicated on the Drawings and as specified herein.

1.3 QUALITY ASSURANCE

A. Materials shall be the standard products of manufacturers regularly engaged in the production of insulation products. Insulation materials shall be products that have been in use in commercial buildings for at least 2 years prior to bid opening.

B. Surface Burning Characteristics:

1. Insulation shall have a composite insulation, jacket, binders, and adhesive Flame-Spread rating of 25 or less and a Smoke-Developed rating of 50 or less and shall be so listed by UL.
2. Insulation and related materials shall have surface burning characteristics determined by test performed on identical products per ASTM E 84, NFPA 255, and UL 723, mounted and installed as per ASTM E 2231.
3. Adhesives, mastics, tapes, and other accessories shall have the same component ratings.
4. Materials shall be labeled indicating compliance with the above requirements.
5. All testing shall be performed by a testing and inspecting agency acceptable to authorities having jurisdiction. Insulation, jacket materials, adhesives, mastics, tapes and cement material containers shall be labeled with appropriate markings of applicable testing and inspecting agency.

1.4 RELATED WORK

A. Where pipes and ducts pass through fire walls, fire partitions, above grade floors, and fire rated chase walls, the penetration shall be protected and sealed with fire-stopping materials as specified in Section 23 00 00 - HVAC General.

B. Adequate provisions shall be made to protect the premises, equipment, and the work of other trades against droppings, adhesives and coatings used in the installation.

C. Where indicated, painting of insulation jackets shall be as specified in Section 09 91 00 - Painting.

D. Refer to Section 23 23 00 Refrigerant Piping, Insulation and Accessories for refrigerant piping insulation.

1.5 SUBMITTALS

A. Submit product information for insulation materials to the Architect in accordance with Division 1 and Section 23 00 00 - HVAC General.

B. Submit shop drawings and data to prove complete compliance with these specifications on products and methods of installation. Include materials used, thickness for each application, flame and smoke ratings, thermal conductivity, permeance, density for each product, and jackets (both factory and field applied). Indicate methods of applications.

PART 2 - PRODUCTS

2.01 GENERAL

A. Provide materials which are the standard products of manufacturers regularly engaged in the manufacture of such products and that essentially duplicate items that have been in satisfactory use for at least 2 years prior to purchase. Insulation shall be CFC and HCFC free.

B. Provide insulation that meets or exceed the requirements of ASHRAE 90.1.

C. Insulation exterior shall be cleanable, grease resistant, non-flaking and non-peeling. Materials shall be compatible and shall not contribute to corrosion, soften, or otherwise attack surfaces to which applied in either wet or dry state.

2.02 PIPE INSULATION

A. Materials as specified in this section shall be manufactured by Armstrong, Johns-Manville, Knauf, Pittsburgh-Corning, CertainTeed, Pabco, Dow Chemical, Owens Corning or approved equal.

B. Insulation thicknesses shall be as shown in the following table:

Minimum Pipe Insulation			Insulation Thickness for Pipe Sizes					
Piping System Types	Fluid Operating Temperature Range		Mean Rating Temp.	Less than 1 in.	1 to less than 1-1/2 in.	1-1/2 to less than 4 in.	4 to less than 8 in.	8 in. and Larger
	°C	°F	°F	In.	In.	In.	In.	In.
Condensate	4.4-15.6	40-60	75	0.5	1.0	1.0	1.0	1.5

C. Unless noted otherwise, the abovementioned piping systems inside the building shall be insulated with a 5 lb/ft^3 (nominal) density sectional fiberglass insulation with a thermal conductivity (k factor) not to exceed 0.23BTU·in/hr·ft^2·°F (0.033 W/m K), when tested in accordance with ASTM C 335 at 75 °F (24 °C). The jacket shall be fire retardant with a suitable vapor barrier. All joints and seams shall be sealed vapor tight. All joints and seams shall be lapped in place to form a continuous vapor barrier covering. All seams shall then be covered with “All Service Jacket” (ASJ) 3" wide tape. The tape shall match the jacket. The tape shall be squeegeed in place to provide complete adhesion of the tape to the jacket and to provide a continuous vapor barrier covering. Exterior water piping shall be heat traced (Refer to Section 23 21 13 - PIPING AND ACCESSORIES).

D. Piping installed outdoors shall be insulated with cellular glass insulation, Pittsburgh-Corning “Foamglas” or approved equal. Insulation thickness required to prevent condensation shall be determined by the manufacturer for worse case ambient conditions.

1. Install with all service jacket and in accordance with manufacturer’s recommendations.
2. Where heat tracing is specified, oversize insulation to allow space for heat tape.

E. Equipment shall be insulated in the same manner as specified for the associated piping. Suitable provisions shall be made for breaking flanges as may be required for maintenance. Hot water pumps do not get insulated unless specifically called for. The following equipment, but not limited to, requires insulation: expansion tanks, air separators, chemical treatment “shot type” feeders, storage tanks, etc.

F. Provide high density preformed pipe insulation inserts at all pipe hangers. Inserts shall be equal to Foamglas by Pittsburgh Corning or calcium silicate. Provide ribbed hanger saddles by Centerline, Buckaroos, Inc. or approved equal.

G. All exposed insulated piping in mechanical rooms below 10'-0" AFF shall be protected by a corrugated aluminum jacket with bands 3'-0" on center.

H. “Circuit setter” type balancing valves shall be insulated with polyisocyanurate or extruded polystyrene block insulation with matching PVC cover. Insulation shall by easily removable for service. Valve insulation shall be as manufactured by Extol or approved equal.

I. Provide insulating tape over all piping specialties to prevent condensation such as drain valves, drain plugs, combination temperature/pressure test plugs, etc.

2.03 BLANKET TYPE INSULATION (DUCTWRAP)

A. Description:

1. Flexible, limited combustible, blanket type insulation composed of mineral or inorganic glass fibers bonded together with a thermosetting resin, meeting ASTM C 553, Type 1 and ASTM C 1290.
2. Vapor retarder jacket: Provide one of the following types of vapor retarder jackets:
   a. Foil-scrim-kraft (FSK), foil reinforced kraft (FRK), or polypropylene-scrim-kraft (PSK) with a 2" (50mm) (min.) stapling and taping flange on one edge.
   b. Conforming to ASTM C 1136 Type II.
3. Surface Temperature Application Limits: Insulation shall be rated for use on surfaces operating at temperatures up to 250°F.

4. Ratings:

Insulation Type:	**Type 1:**	**Type 2:**
Minimum R-Value, out of package*: hr•ft²•°F/Btu (m²•°C/W) at 75°F (24°C) mean temperature	R-7.4 (1.30)	R-10.3 (1.81)
Minimum R-Value, installed: hr•ft²•°F/Btu (m²•°C/W) at 75°F (24°C) mean temperature	R-6.0 (1.06)	R-8.0 (1.46)
Minimum Density: lb/ft³ (kg/m³)	1.0 (16)	0.75 (12)
Thickness: Inches (mm)	2 (51)	3 (76)
Maximum Labeled K-value at 75°F (24°C) mean temperature: Btu.•in/hr.•ft²•°F (W/m.•°C)	0.27 (0.039)	0.29 (0.042)

*Value may vary by manufacturer; minimum installed value must be met

B. Insulate the following with Type 1 blanket insulation:

1. All galvanized steel ductwork containing heated and/or cooled supply air, except:
   a. Exposed ductwork in finished conditioned spaces.
   b. Ductwork indicated to be internally lined or insulated with external insulation.
2. Concealed surfaces of ceiling diffusers exposed to non-return air plenums.
3. Return air ductwork exposed to attics or non-return air plenums.
4. Relief air ductwork and plenums from the exterior to 18” past the relief air damper assembly.
5. Return air, toilet exhaust, and general exhaust ductwork exhausting conditioned air and routed through interior spaces that are ventilated with outside air or exposed to outside air conditions.
6. Concealed outside air ductwork located within indirectly conditioned spaces (e.g. indoor soffits, furr-downs, vertical chases, etc.).
7. Ductwork and plenums located inside of the building (i.e. located within the exterior boundary or skin of the building thermal envelope) when containing or flowing, makeup air, garage ventilation intake or exhaust air ducts and plenums, when not indicated to be insulated with rigid fiberglass insulation. This applies to ducts and plenums whether exposed or concealed within chases when located on the interior side of the exterior skin of heated or cooled space.

C. Insulate the following with Type 2 blanket insulation:

1. Ductwork and plenums located outside of the exterior boundary or skin of the building thermal envelope when containing or flowing heated and/or cooled air when not indicated to be insulated with rigid fiberglass insulation.
2. Supply air ductwork located in unconditioned attic spaces and in indoor spaces that are ventilated with outside air or exposed to outside air conditions.
3. Concealed surfaces of ceiling diffusers exposed to attics.

D. Subject to compliance with requirements, insulation shall be manufactured by: CertainTeed, Johns Manville, Knauf, Owens Corning, or approved equal.

2.04 DUCT LINER

A. Refer to Section 23 31 00 – Ductwork and Accessories for duct liner requirements.

2.05 EXTERIOR SUPPLY AND RETURN AIR DUCTWORK

A. Exterior supply and return air ductwork shall be constructed of galvanized sheet metal lined with 2" thick 3 lb/ft^3 duct liner board (R-8 min.); Johns-Manville Linacoustic R-300. All ductwork seams shall be externally sealed watertight with a 30-year silicone caulk and coated with a rust preventive coating over the entire duct surface.

1. As an alternative to insulated sheet metal, an outdoor duct system as manufactured by Thermaduct, LLC may be used. The system shall incorporate duct and fittings having an installed minimum R-value of 12. The system shall utilize non-fibrous closed cell Kingspan KoolDuct fortified inner liner compliant to UL (C-UL) 181, Standard for Safety Listed, Class 1 system and SMACNA Class 1 leakage, or less. Submit product data and layout drawings during the submittal phase.
2. As an alternative to internal insulation, exterior insulation may be Class B foil faced polyisocyanurate foam insulation with weather resistant white flexible cladding; Alumaguard Lite White by Polyguard. Install in accordance with manufacturer's installation instructions.
3. As an alternative to internal insulation, exterior insulation may be physically crosslinked closed cell polyolefin foam insulation with factory applied heavy duty multilayer composite foil facing with a UV and weather durable coating; Thermobreak No-Clad insulation by Sekisui Voltek. Install in accordance with manufacturer's installation instructions.

2.06 DUCTWORK WITHIN MECHANICAL ROOMS

A. Ducts within mechanical rooms shall be insulated with 1½" thick, 3 lb/ft^3 rigid fiberglass board with an R factor of not less than 6 (K = 0.23 at 75 degrees F mean temperature) with reinforced foil vapor barrier. Insulation shall be secured to ductwork with stick pins and speed washers. All joints and stick pin terminations shall be sealed with 3" wide strips of vapor barrier material and applied to form a continuous vapor seal.

B. Apply 1" x 1" x 30 mils thick white PVC corner angles in accordance with ASTM D 1784, Class 16354-C at all insulation board corners.

2.07 SINGLE WALL BOILER BREECHING AND DIESEL EXHAUST

A. Single wall boiler breeching and diesel exhaust within the building shall be externally insulated with 2" thick calcium silicate block securely held in place with wire or metal bands.

1. As an alternate to field insulated single wall breeching, a factory fabricated insulated double wall pressure stack system may be used. Refer to Section 23 31 00 Ductwork and Accessories for additional information.

2.08 EXTERIOR WEATHER PROTECTION

A. Piping and/or breeching exposed to the weather and designated to be insulated shall be insulated in the same way it is insulated within the building for concealed areas. It shall then be weatherproofed with corrugated aluminum jacketing. It shall have 3/16" corrugations and shall be 0.016" thick with a factory attached moisture barrier continuously laminated across the full width of the jacketing. All pipe fittings, valves and specialties exposed to the weather shall be insulated and weatherproofed with aluminum jacketing. Childers Universe-E11 Jacs of the same metal as the jacketing shall be used. Jacketing shall have a 2" lap at all joints. Longitudinal laps shall be on the underneath side of horizontal runs and slightly offset from one another. The outside of the longitudinal lap

shall also have a 1" hem turned under. All laps shall be made with weatherproof mastic. Wrap the jacketing tightly and smoothly and secure with aluminum or stainless steel bands. Bands shall not be more than 12" on center and a strap shall be placed at the circumferential laps. The lap shall have adequate mastic to make a tight joint. Excess mastic shall be removed from the outside to provide a neat and professional appearance.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Shop drawing submittals shall include a complete package of materials and methods intended for use as described in this section.

B. All work shall be in strict accordance with applicable codes, ordinances and the manufacturer's recommendations.

C. All work shall be performed in a professional workmanlike manner and standard trade practice. It shall be smooth in appearance and suitable for finish painting.

D. All exterior piping shall be installed with a corrugated aluminum jacket with bands 3'-0" on center.

E. Provide insulating tape over all piping specialties to prevent condensation such as drain valves, drain plugs, combination temperature/pressure test plugs, etc.

F. Fiberglass pipe insulation shall be applied to clean (free of rust) dry pipe prior to leak testing. Chilled and condenser water systems shall not be operated until the insulation is completely installed with a vapor barrier in place. Refer to Section 23 21 13 - Piping and Accessories for additional information.

END OF SECTION

SECTION 23 09 00
AUTOMATIC CONTROLS

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. All work specified herein shall be accomplished in accordance with the applicable requirements of Section 23 00 00 - HVAC General.

B. Furnish and install a complete system of automatic controls of the type and characteristics and which will perform the functions described herein and on the Drawings.

C. All equipment, labor, tubing, etc. required to accomplish the control sequences outlined in this section shall be furnished as part of the HVAC work.

D. All other HVAC equipment purchased and installed as described in other sections of these specifications shall be coordinated with the requirements of this section to assure compatibility and function.

E. All electrical control wiring required as part of this work shall be furnished and installed as part of the HVAC work and shall be installed in accordance with Division 26.

F. This section generally describes the desired operating sequence and characteristics of all HVAC systems provided and installed as part of Division 23 of these specifications. The preparation of the detailed control schematics necessary to accomplish the desired systems operation shall be included as part of the HVAC work. Electronic files (e.g. PDFs, etc.) of these control schematics shall be submitted and reviewed by the Engineer as part of the Submittal Phase and prior to the purchase or installation of any control equipment or other equipment that depends on these control schemes for proper operation.

G. Some of the control systems described herein may be pneumatic and will require a source of clean instrument air. The furnishing and installation of this source of clean instrument air shall be part of the mechanical work and shall consist of a duplex tank mounted air compressor and refrigerated air drier of the size, type and characteristics required to provide the quality and amount of air required by all controls. Compressor and accessories shall be located in the Mechanical Room.

H. Mount top of thermostats at 46" AFF unless noted otherwise. Provide clear locking guard assemblies for all public area thermostats. Coordinate thermostat locations with all trades. Coordinate final locations with the general contractor, interior designer and the owner prior to installation. Locate adjacent to light switches where possible. Do not locate thermostats at the center or near center of a wall. Thermostats shall be mounted no closer than 8" from the corner or end of a wall or door. All thermostats shall be ADA compliant.

I. All major control equipment shall be located in a suitable enclosure in the Mechanical Room.

1.02 CODES AND REFERENCES

A. National Fire Protection Association – 90A, 90B, 92

B. ASHRAE Standards

1.03 SUBMITTALS

A. Product Requirements: Provide electronic copies (or PDF) of shop drawings and other submittals on hardware, software, and equipment to be installed or furnished. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated. Begin no work until submittals have been approved for conformity with design intent. When manufacturer's cut sheets apply to a product series rather than a specific product, clearly indicate applicable data by highlighting or by other means. Clearly reference covered specification and drawing on each submittal. General catalogs shall not be accepted as cut sheets to fulfill submittal requirements. Select and show submittal quantities appropriate to scope of work. Submittal approval does not relieve Contractor of responsibility to supply sufficient quantities to complete work. Provide submittals on the following:

1. Wiring diagrams and layouts for each control panel. Show termination numbers.
2. Manufacturer's description and technical data such as performance curves, product specifications, and installation and maintenance instructions for items listed and for relevant items not listed: Control panels, Thermostats, sensors, and Operator interface equipment.
3. Operation and Maintenance (O&M) Manuals

1.04 MANUFACTURERS

A. Acceptable manufacturers/installers for automatic controls: Johnson Controls, Siemens, Automated Logic, Honeywell, American Auto-Matrix, Alerton, Distech Controls, Schneider Electric, Carrier, or Trane.

PART 2 - PRODUCTS

2.01 GENERAL

A. Only those products of particular importance to appearance or function are described in this Products section. Other items required for satisfactory systems operation but not herein described shall be furnished and installed to meet the intent and Operating Sequences herein described.

2.02 PROGRAM CLOCK OVER-RIDES

A. Program clock over-rides shall be manual time switches for flush wall mounting, Mark-Time 90102, 0-3 hours.

B. Units shall be mounted 4'-0" AFF where shown on the Drawings.

C. Over-ride switches shall be provided for each air handling system. Override switches for HVAC units shall be located adjacent to area thermostats. Override switches for other equipment shall be as shown on the Drawings.

2.03 AUTOMATIC CONTROL DAMPERS

A. Dampers shall be of the opposed blade low leakage type with polyurethane blade seals and stainless-steel jamb seals.

B. Leakage shall not exceed 1% of full air flow at 4" WG and below (based on 1,500 FPM approach velocity).

C. Units shall be full size of ductwork with duct mounting flanges as shown on the Drawings.

D. Dampers shall be manufactured by Ruskin, Greenheck or equal with required operators.

2.04 SMOKE CONTROL SYSTEMS

A. All fans, dampers, and other HVAC equipment that is part of a smoke evacuation or smoke management system (including stair and elevator pressurization systems) shall be monitored and controlled by a UL 864 UUKL Listed Firefighter's Smoke Control Panel (FSCP) as manufactured by Delta, Gamewell, Simplex Grinnell, Siemens or approved equal. At a minimum, the FSCP shall include manual control or override of automatic control for mechanical smoke control systems. Panel size and capacity shall be as required by the number of smoke control points. The FSCP shall be located in the Fire Command Center.

1. All fans within the building shall be graphically depicted on the panel face with direction of air flow and relationship to system components shown.
2. Status indictors shall be provided for all smoke control equipment, annunciated by fan and zone and by LED pilot lamp-type indicators as follows:
    a. Fans, dampers and other operating equipment in their normal status – White.
    b. Fans, dampers and other operating equipment in their off or closed status – Red.
    c. Fans, dampers and other operating equipment in their on or open status – Green.
    d. Fans, dampers and other operating equipment in a fault status – Yellow/Amber.
3. The FSCP shall provide control capability over the complete smoke control system equipment within the building as follows:
    a. On-Off-Auto control over each individual piece of operating smoke control equipment that can also be controlled from other sources within the building. This includes stairway pressurization fans; smoke exhaust fans; supply, return and exhaust fans; air handling units, elevator hoistway pressurization fans and other operating equipment used or intended for smoke control purposes.
    b. Open-Auto-Close control over individual dampers relating to smoke control and that they are also controlled from other sources within the building.
    c. On-Off or Open-Close control over smoke control and other critical equipment associated with a fire or smoke emergency and that can be controlled from other sources within the building.

B. Stair and elevator pressurization fans shall be provided with a duct smoke detector in the airstream that shall annunciate a supervisory signal on the FSCP and shall illuminate a lamp adjacent to the fan status indicator. A manual override for each fan shall also be provided. Fans shall not shut off until manually overridden by fire department personnel or until the fire alarm system is reset. The FSCP shall also indicate that air is moving in each pressurization system. Monitoring of air flow shall be accomplished with differential pressure across the fan. The VFD shall not fail to a greater capacity than that associated with the control setpoint for the fan. The duct detector shall be furnished by the Electrical Contractor, mounted by the Mechanical Contractor and wired by the Electrical Contractor.

1. Stair and elevator pressurization shall be controlled by an active compensated pressure control system (one system for each stair/hoistway). The master control unit shall collect all inputs and maintain a user configurable pressure within the stair/elevator by modulating the supply air fan motor speed and independently modulating the roof mounted relief damper in response to pressure readings. Supply air shall be introduced into the stairwell at multiple injection points with a fast response motorized damper at each injection point. Injection point dampers shall be modulated via an injection point monitor and regulator controller receiving input from bi-directional pressure sensor(s).
   a. The controllers shall be UL 864 listed, Standard for Control Units and Accessories for Fire Alarm Systems.
   b. Controller manufacturer: LFSystems Model L864
   c. Standard features:
      1) 7” Color Touchscreen Interface
      2) Adjustable system parameters
      3) Smoke damper control and monitoring
      4) Smoke detector monitoring
      5) Supply air fan control and monitoring
      6) Pressure control damper control
      7) High and Low Pressure Warnings
      8) Three (3) selectable analog 0-10VDC inputs for zone pressure sensors
      9) Dedicated inputs & relay contact outputs for FSCP interface
      10) Dedicated system enable input for Fire Alarm Control Panel (FACP) interface
   d. Communication: Modbus RTU RS485 Serial protocol supported
   e. Required accessories:
      1) Bi-directional pressure sensor to monitor up to two floors; Model LP4 with wall port plate; Model WPP
      2) Outdoor static pressure sensor; Model ZPS
      3) Current sensing relay for pressurization fan; Model CS75
      4) Injection point damper: fast acting (2 second) actuator, opposed blade damper; Model IPD
      5) Injection point regulator controller to control the IPD; Model L850
      6) Opposed blade relief damper with fast acting (2 second) actuator

PART 3 - EXECUTION

3.01 OPERATING SEQUENCE

A. All units and systems shall be controlled as described on the Drawings and as recommended by equipment manufacturers.

END OF SECTION

SECTION 23 23 00
REFRIGERANT PIPING, INSULATION AND ACCESSORIES

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. All work specified herein shall be accomplished in accordance with the applicable requirements of Section 23 00 00 - HVAC General.

B. Refrigerant piping shall meet the requirements of the Safety Standard for Refrigeration Systems (ANSI/ASHRAE Standard 15-Latest Edition) and the Code for Pressure Piping (ANSI/ASME Standard B31.5-Latest Edition: Refrigeration Piping and Heat Transfer Components).

C. Piping, valves, accessories, and insulation installed indoors shall have a flame-spread index of 25 or less, and smoke-developed index of 50 or less.

1.02 WORK INCLUDED

A. The work under this section shall include all labor, materials, accessories, services, and equipment necessary to furnish and install all refrigerant piping, insulating systems, and accessories, complete, as indicated and specified herein.

B. Without limiting the generality thereof, the work in this section shall include the following items:

1. Direct expansion (DX) system piping (cooling only and heat pump)
2. Variable Refrigerant Flow/Variable Refrigerant Volume (VRF/VRV) system piping
3. Insulating the following systems:
   a. Refrigerant suction (low pressure gas) piping
   b. Refrigerant hot gas (discharge or high-pressure gas) piping.
   c. Refrigerant liquid piping for ductless split systems

1.03 RELATED DOCUMENTS

A. Specification sections:

1. 23 81 28 Split System Heat Pumps

1.04 RELATED REFERENCES

A. Designation and Safety Classification of Refrigerants (ANSI/ASHRAE Standard 34-Latest Edition).

1.05 QUALITY ASSURANCE

A. Installer Qualification: Only trained and experienced installers skilled in refrigeration pipe installation and brazing of copper tubing shall be used.

B. Piping, valves, and accessories shall be manufactured in the United States. Submit Certificate of Manufacture with shop drawings.

1.06 SUBMITTALS

A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop based on manufacturer's test data.

B. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes, valve arrangements and locations, wall and floor penetrations, and equipment connection details. Show interface and spatial relationships between piping and equipment.

1. Refrigerant piping indicated on Drawings is schematic only. Size piping and design actual piping layout, including specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.

C. Piping materials including Certificate of Manufacture

D. Insulation products, adhesives, coatings, etc. including Material Safety Data Sheets

E. Field quality-control test reports

F. Operation and maintenance data

1.07 PRODUCT STORAGE AND HANDLING

A. Store piping, insulation, valves, and specialties in a clean and protected area.

B. Piping, tubes, and coils shall be stored with end caps in place to ensure that piping interior and exterior remain clean prior to installation.

PART 2 - PRODUCTS

2.01 REFRIGERANT PIPING

A. Piping shall be:

1. Type “L” hard drawn seamless copper tube conforming to ASTM B88, or
2. Type “ACR” (Air Conditioning and Refrigeration) service copper tubing conforming to ASTM B280.
   a. Straight Lengths: ASTM B 75, UNS C12200, H55 Temper (Light Drawn), ACR Bending Quality; Cleaned, Eddy Current Tested, and Plugged per ASTM B 280.
   b. Coiled: ASTM B 280, UNS C12200, O60 Temper (Soft Annealed), ACR, cleaned and capped. Coils shall be dehydrated, purged with Nitrogen, and tightly capped to insure cleanliness. Piping shall be engineered and constructed to support R-410A to 700 psi @ 250°F.
      1) Acceptable manufacturers:
         a) Streamline/Mueller
         b) Reftekk, Inc.
         c) Linesets, Inc.
         d) ACR Green Proshield by Select Manufacturing, Inc.
         e) JMF Company

B. Joints shall be brazed. Brazing filler metals shall comply with AWS A5.8. Mechanical press type joints are not allowed.

2.02 VALVES, FITTINGS AND SPECIALTIES

A. Fittings shall be wrought copper conforming to ASME/ANSI Standard B16.
B. Valves, filter-driers, and other accessories shall be suitable for refrigerant service.

C. Field Swaged Brazing Cups: MSS-SP-73, ASME B 16.50

D. Field Bends (all angles): ASME B31.5

E. Full Port Refrigeration Service Valves:

1. Body: Forged brass uni-body style with brass cap including key end to remove core
2. Schrader service valve with cap
3. Core: Removable ball-type check valve with stainless-steel spring
4. Seat: Polytetrafluoroethylene
5. End Connections: Socket ends
6. Working Pressure Rating: 700 psig (factory tested)
7. Maximum Operating Temperature 300°F
8. Valves must be specifically rated for R-410A
9. Approved manufacturers: Diamondback, Parker, Mueller/Streamline

2.03 INSULATION

A. Refrigerant piping shall be insulated as follows:

1. Refrigerant Piping Installed Outdoors: shall be insulated with flexible elastomeric tubing insulation with factory applied UV resistant durable protective jacket, Armaflex Shield™ continuous coil pipe insulation as manufactured by Armacell, LLC or alternates listed below, when the product is available in the required pipe size and insulation wall thickness. No field applied protective coating or finish shall be used with this insulation. Longitudinal and butt joints shall be sealed per manufacturer's installation instructions.
   a. Acceptable alternate elastomeric product:
      1) K-Flex USA; K-Flex Titan™
2. Refrigerant Piping Installed Indoors: shall be insulated with flexible elastomeric tubing insulation, AP/Armaflex Black LapSeal™ pipe insulation as manufactured by Armacell, LLC or alternates listed below. All joints and seams shall be sealed weathertight with Armaflex Black LapSeal™ Tape. Black LapSeal™ Tape shall also be used to secure the thermostat cable to the pipe insulation prior to applying the finish coat. The finish coat for this flexible elastomeric insulation when installed outdoors shall be two coats of a water-based latex paint designed for use over all forms of flexible elastomeric insulation. Finish coat shall provide a protective finish suitable to both indoor and outdoor applications, formulated for cold weather flexibility to resist cracking and weather-resistant to ultraviolet (UV) and ozone. Coating shall be Armaflex WB finish or equivalent product compatible with the insulation.
   a. Acceptable alternate product:
      1) Aeroflex, USA, Inc.; Aerocell-SSPT™ with Protape and two coats of field applied Aerocel Aerocoat.
3. Fittings, valves, and specialties shall be insulated with factory formed sectional units of the materials listed above.

4. Insulation that is outdoors and not directly exposed to sunlight (i.e., piping is enclosed in a prefabricated duct system) does not require the UV protective coating.
5. Valves and specialties shall be provided with a factory insulation package fabricated from materials listed above.
6. Insulating systems above are to be considered as a minimum. Air conditioning system manufacturer's recommendations take precedence over the insulation materials listed above. Submit air conditioning manufacturer's installation instructions and insulation product data for review and approval.

B. Insulation thickness shall be as follows:

1. Traditional Cooling Only Split Systems (TXV located at indoor unit) – Insulate suction piping only:
   a. All pipe sizes 1/2" insulation
2. Traditional Heat Pump Split Systems (TXV located at indoor unit) – Insulate suction piping only:
   a. <1-1/2" pipe 1/2" insulation
   b. 1-1/2"<4" pipe 1" insulation

PART 3 - EXECUTION

3.01 GENERAL

A. Refrigerant piping shall be supported as shown on the Drawings and as required at intervals not over 8'-0" O.C. and at all turns and offsets. Hangers and pipe clamps shall be copper plated tubing hangers of adequate size to fit around tubing and insulation as required. Saddles shall be used under insulated tubing to protect insulation. Piping routed more than 6 (six) lineal feet on the roof shall be supported by B-Line "Dura-Blok" rooftop supports or approved equal.

B. Pressure testing of piping systems shall be in accordance with standard industry practice for the refrigerant used.

C. Refrigerant piping shall be clean and free of outside contaminants at all times. Prior to start-up of any equipment or insulation installation, all piping shall be cleaned, tested, dehydrated and charged as recommended by the refrigerant compressor manufacturer.
1. Procedure: Joints and connections in refrigerant piping shall not be installed in partitions or walls or where inaccessible for testing, inspection and rework. Make provisions to prevent contact of dissimilar metals. During construction, cap all tubing to prevent moisture from entering. Keep in dry location.
2. Leak testing and recharging: Upon completion of installation of air conditioning equipment, test all refrigerant piping, components and accessories, including quick-connect refrigerant connectors for evaporator and condensing unit; test with a halide torch; prove tight by Contractor to assure a leak-tight refrigerant system. If leaks are detected at the time of installation or during warranty period, remove entire refrigerant charge from system, correct leaks, and retest system. After system is found to be leak free, evacuation shall be accomplished by use of a reliable gauge and a vacuum pump capable of pulling vacuum of at least one mm Hg absolute. Accomplish system evacuation in strict accordance with equipment manufacturer's printed instruction. System leak testing, evacuation, dehydration and charging with refrigerant shall comply with standard industry practice and local codes and ordinances.

D. Refrigerant piping shall be run continuously, without joints, where possible. All joints in refrigerant piping shall be made accessible. Joints shall not be permitted in concrete slabs or below grade.

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.

F. All piping shall be run true to grade and shall be arranged to make the best possible appearance. Except where otherwise required by conditions of installation, all piping shall be symmetrical and parallel with lines of buildings or structure in which it is installed. All piping shall be run concealed except in mechanical room and where indicated otherwise.

G. All piping and equipment shall be supported and guided. Anchors shall be provided to absorb or transmit thrust and eliminate vibration or pulsation. Hangers or supports shall be provided near each change of direction. Supports shall be so located or shall be of such type as not to unduly restrict the movement of the pipe due to lateral or longitudinal expansion.

3.02 PIPING APPLICATIONS

A. Suction (low pressure gas), Hot Gas (high pressure gas) and Liquid Lines 7/8" OD and Smaller for Conventional Air-Conditioning, Heat Pump, and Heat Recovery Applications: Copper, Type ACR, O60 (soft annealed)-temper tubing and field bent fittings with brazed joints.

B. Suction (low pressure gas), Hot Gas (high pressure gas), and Liquid Lines 2-1/8" OD and smaller for Conventional Air-Conditioning, Heat Pump, and Heat Recovery Applications: Straight Lengths, Copper, Type ACR Type L, H55 (light drawn)-temper tubing and field bent fittings with brazed joints.

3.03 VALVE AND SPECIALTY APPLICATIONS

A. Install service valves as specified or as required to isolate system components.

3.04 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; route and size piping based on manufacturer’s recommended line lengths and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.

B. Install refrigerant piping according to ASHRAE 15 (latest version).

C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas. Concealed locations shall be free of pipe joints.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping adjacent to machines to allow service and maintenance.

G. Install piping free of sags and bends.

H. Field bend changes in direction.

I. Select system components with pressure rating equal to or greater than maximum allowable working pressure.

J. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

K. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Division 08 Section “Access Doors and Frames” if valves or equipment requiring maintenance is concealed behind finished surfaces.

L. Provide jacketed insulation in locations where exposed to mechanical injury.

M. When brazing, remove solenoid-valve coils and sight glasses; also, remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.

N. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

O. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 23 00 00 HVAC General.

P. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 23 00 00 HVAC General.

Q. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 23 00 00 HVAC General.

R. Provide proper compensation for pipe/tube expansion and contraction per equipment manufacturers recommendations.

3.05 PIPE JOINT CONSTRUCTION

A. Brazed Joints: Construct joints according to AWS’s “Brazing Handbook,” Chapter “Pipe and Tube”.
   1. Use Type BcuP-5 (15% Ag, 80% Cu, 5% P), copper-phosphorus alloy pre-formed brazing rings for joining copper swage fittings and copper socket fittings with copper pipe. Do NOT use flux.
   2. Use Type Bag-5 (45% Ag), cadmium-free silver alloy for joining copper with bronze or steel. Use manufacturers recommended flux.

B. Field Swaged Brazing Cups: Fabricate brazing cup on one tubing end for each coupling. Only O60 (soft annealed) and H55 (light drawn) may be swaged. Do NOT swage H58 (drawn general purpose). Use swaging tool designed to provide a minimum of 0.0015" brazing gap and a maximum of 0.005" brazing gap. Brazing cup depth for each tube size shall be as follows:

1/4"	3/8"	1/2"	5/8"	3/4"	7/8"	1-1/8"	1-3/8"	1-5/8"	2-1/8"
0.250"	0.280"	0.310"	0.390"	0.420"	0.460"	0.510"	0.560"	0.600"	0.700"

C. Field Bends: Fabricate field bends with a center-line bend radius greater than or equal to 4 times the nominal OD of the pipe or tube. Tube shall be bent with a tubing bender sized for ACR OD tube sizes and shall not cause cracks or wrinkles in the tube or pipe. Do NOT use a conduit bender for bending ACR copper. The difference between maximum and minimum diameters for pipe bends should not exceed 8% of the nominal outside diameter of the pipe. Only O60 soft annealed-temper and H55 light drawn-temper shall be field bent. Do NOT field bend H58 drawn general purpose-temper copper tube.

D. Brazing and joining procedure:

1. Tube ends shall be cut with a clean sharp tubing cutter.
2. Deburr the I.D. of the cut tube end with a clean deburring tool.
3. Visually inspect the interior of each tube for obstructions and debris before assembly. Protect the joint from contamination before brazing.
4. Method of pre-cleaning: Non-shedding abrasive pads (Scotch Bright) to remove all oxides in the brazing area followed by wiping with a clean lint-free white cloth. Do not groove the surfaces while cleaning.
5. Purge all tubing with oil free nitrogen while brazing and until cool to the touch. Use an oxygen analyzer to verify the absence of oxygen prior to brazing. The oxygen content shall be less than 1% before start of brazing.
6. Use a neutral to slightly reducing flame using oxy/acetylene or oxy/propane.
7. Use the proper torch tip based on tube size as recommended by the torch manufacturer. Use of Turbo-Torch or Rosebud is permitted.
8. Post Brazing Cleaning: Exterior of all completed joints shall be washed with a water-soaked rag or sponge, followed by brushing with a stainless-steel hand wire brush to remove any residue for inspection.

3.06 HANGERS AND SUPPORTS

A. Piping hangers and supports must accommodate expansion and contraction, vibration, dead load of piping and its contents, and seismic-bracing requirements.

B. Install the following pipe attachments or combination thereof:

1. Adjustable steel clevis hangers for individual horizontal runs.
2. Channel strut or angle iron trapeze for multiple horizontal runs
3. Galvanized steel saddle with attachment screw for channel strut applications
4. Rigid high compressive strength foam insulating pipe support at all clamps and support points.
5. Rigid high compressive strength foam pipe support at all riser clamps.
6. Do NOT attach hangers directly to pipe or tube.

C. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:

1. Up to 3/4" OD: Maximum span, 60 inches; minimum rod size, 3/8 inch.
2. Greater than 3/4" thru 1" OD: Maximum span, 72 inches; minimum rod size, 3/8 inch.
3. Greater than 1" thru 2-1/8" OD: Maximum span, 96 inches; minimum rod size, 3/8 inch.

D. Support multi-floor vertical runs every 10 feet and at least at each floor with riser clamps.

3.07 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. Comply with ASME B31.5, Chapter VI.
2. Test as follows or as recommended by the equipment manufacturer's installation instructions:
   a. Line Test Pressure for Refrigerant R-410A:
      1) Suction (low pressure gas) Lines: 550 psig, or per equipment manufacturers recommendation.
      2) Hot-Gas (high pressure gas) and Liquid Lines: 550 psig, or per equipment manufacturers recommendation.
3. Test refrigerant piping and specialties. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
   a. Fill system with 95/5 nitrogen/hydrogen to the required test pressure.
   b. System shall maintain test pressure at the manifold gage throughout duration of test.
   c. Test all joints and fittings with hydrogen leak detector, at test pressure.
   d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

3.08 SYSTEM CHARGING

A. Charge system using the following procedures and per equipment manufacturer's installation instructions.

1. Evacuate (triple evacuation procedure) entire refrigerant system with a vacuum pump to obtain a steady state vacuum of less than 500 micrometers. If vacuum holds for 12 hours, system is ready for charging. Do NOT evacuate the system through a charging manifold. Use only suction rated hoses and core removal tools.
2. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
3. Charge system as recommended by equipment manufacturer.

3.09 OWNER REVIEW OF MAINTENANCE REQUIREMENTS

A. Review manufacturer's maintenance instructions with the owner's representative to make them aware of any reoccurring maintenance requirements such as recoating piping insulation, lubricating service valves, etc.

END OF SECTION

Appendix A

Designer – this is FYI only and not to be included with the spec

Typical Conventional Split System Operating Temperatures:
Low Side (suction) – Low Pressure saturated/superheated vapor – 45°F to 53°F
High Side (discharge) – High Pressure Gas - 180°F
High Side (discharge) – High Pressure saturated liquid - 125°F
High Side (discharge) – High Pressure liquid - 110°F

The peak normal operating temperatures are what dictate insulation thickness in accordance with current state energy codes and/or ASHRAE 90.1.

Peak normal operating temperatures for heat-recovery systems are as follows;

- Carrier – 195°F
- Daikin – 150°F
- LG – 220°F
- Mitsubishi – 190°F
- Samsung – 221°F
- Hitachi – 220°F
- Trane – 190°F

Insulation Material Temperature Ranges

- Armacell Shield – Maximum Service Temp: 220 F
- Armacell Black LapSeal – 3/8" thru 1" wall: 220 F; 1 ½" and 2" wall: 300F
- Aerocell SSPT – Service Temperature, Continuous: 257 F
- K-Flex Titan - Maximum Service Temp: 220 F
- EPDM – Rated to 300 F (EPDM insulation systems utilizing adhesive and tape systems are rated to 257 F)

SECTION 23 31 00
DUCTWORK AND ACCESSORIES

PART 1 - GENERAL

1.01 DESCRIPTION

A. All work in this section shall be subject to the provisions of Section 23 00 00 - HVAC General.

B. Furnish and install all material, labor, accessories, etc. shown on the drawings and as specified herein to completely install all ductwork systems.

C. Ductwork systems shall be classified as follows:
1. Static pressure class +2 in. wg - from constant volume air handling unit, and terminal unit to supply diffusers; all return, outside air and exhaust ductwork.

D. Refer to PART 3 – EXECUTION for duct sealing requirements.

E. Ductwork shall be constructed according to the latest edition of SMACNA ductwork construction standards applicable to the type of ductwork, system pressures described above, and the system material construction.

F. Duct sizes shown on the drawings are nominal inside clear.

1.02 QUALITY ASSURANCE

A. Fire, smoke, combination fire/smoke and radiation dampers shall be installed and maintained in accordance with:
1. Manufacturer’s installation instructions
2. UL installation instructions
3. NFPA Standard 90A (latest edition)
4. SMACNA’s Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems (latest edition)

1.03 SUBMITTALS

A. Product Data:
1. Duct materials:
a. Fiberglass ductboard
b. Flexible duct connectors
c. Flexible ductwork
2. Dampers and accessories
3. Remote damper operators
4. Access doors
5. Flexible duct connectors
6. Duct liner
7. Sealants, mastics, adhesives and coatings

B. For all fire dampers, combination fire and smoke dampers, and smoke dampers, submit UL approved installation instructions for each specific application.

PART 2 - PRODUCTS

2.01 DUCTWORK

A. Ductwork shall be constructed of galvanized steel sheets of the thickness listed in the SMACNA manuals for the pressures referenced above, or of 1" thick (1½" thick if required by the applicable energy code) resin-bonded fiberglass duct board with fire-resistive foil-scrim-kraft (FSK) vapor retarder on the outside surface and a smooth mat finish on the air-side surface. Fabrication and installation shall conform to SMACNA's Fibrous Glass Duct Construction Standards; latest edition. See below for additional requirements.

B. Single-Wall Rectangular Ducts and Fittings:
1. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
2. Transverse Joints: Select joint types and fabricate per SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," "Transverse (Girth) Joints," for static pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
   a. Alternate Product: Subject to compliance with requirements, provide Ductmate Industries, Inc.; 25/35/45 Rectangular Flange System or comparable product by one of the following:
      1) Nexus PDQ; a division of Shilco Holdings, Inc.
      2) Ward Industries, Inc; a division of Hart & Cooley, Inc.
      3) Prior Approved Equal
   b. Slide-on Flanges:
      1) Description: Roll-formed, add on, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.
      2) Material: galvanized steel
      3) Gauge and Shape: For duct constructed using prefabricated systems, refer to the manufacturer's guidelines for sheet gauge, intermediate reinforcement size and spacing, and proper joint reinforcement.
      4) Manufacturers of prefabricated systems must provide duct construction and reinforcement guidelines along with independent testing for leakage, deflection, and seismic performance.
      5) Independent leakage testing must be provided for systems operating at pressures of 10 in. wg (or greater) positive or negative.
      6) Manufacturer's prefabricated systems printed assembly and installation procedures must be adhered to at all times.
      7) Manufacturer's procedures must include fastener and cleat spacing along with details for all system variations including break-away and roofing connections.
      8) All manufactured system components must be clearly embossed with manufacturer's name or markings. Substitution of manufacturer's system components is not permitted.
   c. Formed flanges will be accepted on ductwork 42 inches wide or less and subjected to 2 in. wg static positive pressure or less.
      1) Formed on Flanges: Construct as T-25 A/B flanges, of which construction guidelines are given in Figure 2-1 of the 2005 SMACNA "HVAC Duct Constructions Standards, Metal and Flexible." No other construction standards pertaining to formed on flanges will be accepted.
      2) Formed on flanges must include the use of corners, securely crimped in place, bolts, cleat, and gasket
3. Longitudinal Seams: Select seam types and fabricate per SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," "Longitudinal Seams – Rectangular Ducts," for static-pressure class, applicable sealing requirements, materials

involved, duct support intervals, and other provisions in SMACNA's “HVAC Duct Construction Standards – Metal and Flexible.”

4. Snap-lock longitudinal duct seams are not allowed in public spaces unless secured with sheet metal fastening screws as recommended by SMACNA.
5. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate per SMACNA's “HVAC Duct Construction Standards - Metal and Flexible,” Chapter 4, “Fittings and Other Construction,” for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's “HVAC Duct Construction Standards - Metal and Flexible.”

C. Single-Wall Round and Flat-Oval Ducts and Fittings
1. General Fabrication Requirements: Comply with SMACNA's “HVAC Duct Construction Standards - Metal and Flexible,” Chapter 3, “Round, Oval, and Flexible Duct,” based on indicated static-pressure class unless otherwise indicated.
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) Linx Industries
      2) McGill AirFlow, LLC
      3) SEMCO, LLC
      4) Sheet Metal Connectors, Inc.
      5) Spiral Manufacturing Co., Inc.
      6) Prior Approved Equal
2. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).
3. Transverse Joints: Select joint types and fabricate per SMACNA's “HVAC Duct Construction Standards - Metal and Flexible,” Figure 3-1, “Round Duct Transverse Joints,” for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's “HVAC Duct Construction Standards - Metal and Flexible.”
   a. Transverse Joints in Ducts Larger Than 50 Inches in Diameter: Flanged.
      1) Unexposed Duct 3 inches to 30 inches in diameter: Round duct connects with a one-piece interior slip coupling at least two gages heavier than duct wall, beaded at center and fastened to duct with screws. Seal joint with an approved sealant applied continuously around both ends of coupler prior to assembling and after fastening.
      2) All Exposed Duct and Unexposed Duct 30 inches to 72 inches in diameter: Three-piece, gasket flanged-joint consisting of two internal flanges, with integral mastic sealant, and one external closure ring, for connecting the internal flanges and securing the closed cell neoprene gasketing in place.
         a) Basis-of-Design Product: Subject to compliance with requirements, provide Ductmate Industries, Inc.; Spiralmate or similar comparable product by one of the following:
            (1) Prior Approved Equal
      3) Ducts larger than 72 inches in diameter: Use companion angle flanged joints as defined in Figure 3-1 for the 2005 SMACNA Manual “HVAC Duct Construction Standards, Metal and Flexible” Third Edition. Refer to manual for proper sizing and construction details.

4) Dust Collection Systems and Exposed Duct 3 inches to 14 inches in diameter: Use a one-piece, polyethylene lined gasket connector with integrated bolt for the closure system.
a) Basis-of-Design Product: Subject to compliance with requirements, provide Ductmate Industries, Inc.; Quicksleeve or comparable product by one of the following:
(1) Prior Approved Equal

4. Longitudinal Seams: Select seam types and fabricate per SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
a. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
b. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.
5. Tees and Laterals: Select types and fabricate per SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Double-Wall Round and Flat-Oval Ducts and Fittings
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Linx Industries
b. McGill AirFlow, LLC
c. SEMCO, LLC
d. Sheet Metal Connectors, Inc.
2. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension) of the inner duct.
3. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on static-pressure class unless otherwise indicated.
a. Transverse Joints: Select joint types and fabricate per SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
1) Transverse Joints in Ducts Larger Than 50 inches in Diameter: Flanged.
a) All Exposed Duct and Unexposed Duct 30 inches to 72 inches in diameter: Three-piece, gasket flanged-joint consisting of two internal flanges, with integral mastic sealant, and one external closure ring for connecting the internal flanges and securing the closed cell neoprene gasketing in place.
b) Basis-of-Design Product: Subject to compliance with requirements, provide Ductmate Industries, Inc.; Spiralmate or comparable product by one of the following:
(1) Prior Approved Equal

b. Longitudinal Seams: Select seam types and fabricate per SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
   1) Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
   2) Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.

c. Tees and Laterals: Select types and fabricate per SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

4. Inner Duct: Minimum 0.028-inch (24 gauge) perforated galvanized sheet steel having 3/32-inch diameter perforations, with an overall open area of 23 percent.
5. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard".
   a. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x ºF at 75ºF mean temperature.
   b. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
   c. Coat insulation with antimicrobial coating.
   d. Cover insulation with polyester film complying with UL 181, Class 1.
6. Interstitial Insulation: Flexible elastomeric duct liner complying with ASTM C 534, Type II for sheet materials, and with NFPA 90A or NFPA 90B.
   a. Maximum Thermal Conductivity: 0.25 Btu x in./h x sq. ft. x ºF at 75ºF mean temperature.

E. Rectangular sheet metal duct elbows shall be smooth radius type without turning vanes or square (or mitered) type with turning vanes. Sharp throat elbows (ASHRAE Fitting No. CR3-2) shall not be permitted. Round sheet metal duct elbows shall be smooth radius type without turning vanes, gored type or mitered type with turning vanes.

F. Unless otherwise indicated, elbows shall have a centerline radius of not less than 1½ times the width of the duct. Where space limitations necessitate use of short radius or square elbows, provide turning vanes.

G. Fiberglass duct board shall be UL 181 listed as a Class 1 Rigid Air Duct with a thermal conductivity not to exceed 0.23 at 75°F per ASTM C 518. Thickness shall be as indicated on the drawings or as required by the energy code in effect. Fiberglass duct board shall be Johns Manville Super Duct RC, Knauf Atmosphere Air Duct Board, Owens Corning QuietR Duct Board or Certainteed Ultra*Duct Black Duct Board.
   1. Tapes and mastics used to seal fibrous glass ductwork shall be listed and labeled in accordance with UL 181A and shall be marked "181A-P" for pressure-sensitive tape, "181A-M" for mastic or "181A-H" for heat-sensitive tape.

H. Exhaust ductwork shall be galvanized sheet metal (G 90 minimum) constructed to SMACNA standards and shall not be insulated unless noted otherwise.

I. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

J. Supply and exhaust ductwork serving swimming pool equipment and chemical storage rooms shall be 16-gauge aluminum (alloy 3003 - H14 temper per ASTM B209).

2.02 FLEXIBLE DUCTWORK

A. Flexible ducts shall be listed and labeled as UL Standard 181 Class 1 air duct. Air connectors are not allowed.

B. Flexible ductwork shall comply with the following:
1. NFPA 90A, “Installation of Air Conditioning and Ventilating Systems”
2. NFPA 90B, “Installation of Warm Air Heating and Air Conditioning Systems”
3. SMACNA's “HVAC Duct Construction Standards - Metal and Flexible” for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated.
4. Air Diffusion Council's “ADC Flexible Air Duct Test Code FD 72-R1”.
5. ASTM E 96/E 96M, "Test Methods for Water Vapor Transmission of Materials."

C. Flexible ductwork shall be installed between main supply ducts and diffusers. Length shall be a maximum of 8'-0" long, except in residential applications, where the length shall be as indicated.

D. Flexible ductwork shall be Thermaflex M-KE R-6 (R value = 6.0 minimum or as required by local energy code) flexible air duct or approved equal.

E. Flexible ductwork size shall be the same size as the diffuser neck it serves, unless indicated otherwise.

F. Take-offs for sheet metal ductwork shall be made using a conical spin-in type fitting with manual balancing damper.

G. Take-offs for fiberglass ductboard shall be made using a starting collar fitting with crimp and bead (tab type).

H. Flexible duct connections to ceiling diffusers shall be installed without kinks or sags to provide unrestricted airflow. Provide Flex Flow Elbow supports by Thermaflex.

I. Tapes and mastics used to seal metallic and flexible air ducts shall comply with UL 181B and shall be marked “181B-FX” for pressure-sensitive tape or “181B-M” for mastic.

J. Mechanical fasteners for use with flexible nonmetallic air ducts shall comply with ul 181b and shall be marked “181B-C”.

2.03 FIRE DAMPERS

A. Fire dampers shall be installed at all locations where ductwork or supply or return air openings penetrate any floor, wall or partition with a fire rating.

B. All fire dampers shall be of the “Dynamic” type as classified in UL Standard 555.

C. Fire dampers shall have a rating compatible with the floor, wall or partition, shall be tested to UL Standard 555 and be labeled for the intended installation (horizontal or vertical).

D. Maximum pressure drop: 0.10 in. wg; provide ductwork transitions as required so as not to exceed maximum pressure drop.

E. Fire Resistance Rating: 1½ hours unless noted otherwise indicated on drawings for 3 hours.

F. Closure device: Each fire damper shall be equipped with a factory installed heat responsive device (fusible link) rated to close the damper when temperature at the damper reaches: 165°F.

G. Airflow Closure Rating:
1. Dynamic fire dampers shall be selected for the velocity and pressure rating of the intended installation. Refer to the plans and schedules for airflow rates (CFM) and pressures (in. wg).
2. Dampers shall have a minimum velocity rating of 2000 fpm at a pressure rating of 4 in. wg.
3. Dampers in systems operating above 2000 fpm or 4 in. wg shall be selected for a velocity rating of 4000 fpm at a pressure rating of 6 in. wg or a velocity rating of 6000 fpm at a pressure rating of 8 in. wg as required.

H. Types:
1. Curtain: for use in systems up to 4000 fpm velocity; Style B or C with the blade stack out of the airstream (Style A with the blade stack in the airstream may be used behind registers and grilles or where space conditions do not permit the use of a Style B damper).
   a. Construction:
      1) Frame: Galvanized steel (in gauges required by manufacturer's UL listing).
      2) Blade design: interlocking galvanized steel
      3) Sleeves: Damper shall be supplied as a single assembly with a factory sleeve.
      4) Retaining Angles: Damper shall be supplied with factory retaining angles sized to provide installation overlap in accordance with the manufacturer's UL listing.
      5) Duct Transition Connection: breakaway type
2. Round: for use in systems up to 2000 fpm velocity.
   a. Construction:
      1) Frame: Galvanized steel (in gauges required by manufacturer's UL listing).
      2) Blade design: single galvanized steel blade (in gauge required by manufacturer's UL listing).
      3) Retainer plate(s): supplied with damper.
      4) Sleeves: Length as required per wall thickness.
      5) Duct Transition Connection: breakaway type.
3. Multi-blade:
   a. Up to 2000 fpm velocity: Triple vee-groove type blade.
   b. 2000-4000 fpm velocity: Fabricated double skin airfoil type blade.
   c. Construction:
      1) Frame: Galvanized steel with mitered and interlocking corners (in gauges required by manufacturer's UL listing).
      2) Blade design: 16 ga. galvanized steel strengthened by three longitudinal 1" deep Vee grooves running the entire length of each blade. Each blade shall be symmetrical relative to its axle pivot point, presenting identical performance characteristics with air flowing in either direction through the damper. Provide symmetrical blades of varying size as required to completely fill the damper opening.
      3) Sleeves: Damper shall be supplied as a single assembly with a factory sleeve.

4) Retaining Angles: Damper shall be supplied with factory retaining angles sized to provide installation overlap in accordance with the manufacturer's UL listing.
5) Duct Transition Connection: breakaway type

I. All dampers shall be installed in strict accordance with the manufacturer's UL approved installation details.

J. Where fire dampers are required in a fibrous glass ductboard system, provide sheet metal sleeve per manufacturer's UL installation instructions. Verify gage of sleeve and attachment angle with governing code authorities. Installation shall also conform to SMACNA Figure 5-9 "Fibrous Glass Duct Installation".

2.04 CEILING RADIATION DAMPERS

A. A listed ceiling radiation damper shall be installed at all locations where ductwork or register, diffuser, grille, etc. penetrates the ceiling membrane of a fire-resistance-rated floor/ceiling or roof/ceiling assembly. Ceiling radiation dampers shall have a rating compatible with the floor/ceiling or roof/ceiling assembly and shall be tested to UL Standard 555C.

B. Fire Resistance Rating: 1 hour (minimum).

C. Closure device: Each ceiling radiation damper shall be equipped with a factory installed heat responsive device (fusible link) rated to close the damper when temperature at the damper reaches: 165°F.

D. Construction:
1. Dampers shall be factory-built curtain or butterfly type. They shall conform to the requirements of NFPA Standard 90A and be UL Labeled for the required assembly rating.
2. All dampers shall be installed in strict accordance with the manufacturer's UL approved installation instructions.
3. Provide steel sleeves, mounting angles and steel duct drops of design and length where required to permit mounting within the opening.
4. Provide thermal blanket where required by the manufacturer's UL installation instructions.
5. Where ceiling radiation dampers are shown on the drawings, and if fiberglass ductwork is used, dampers shall be installed with a sheet metal collar or housing or shall be listed for use with fiberglass ductwork.
6. Where fiberglass ductboard plenums are used they shall conform to manufacturer's Fiberglass Ductboard Plenum Installation Instructions.

2.05 COMBINATION FIRE AND SMOKE DAMPERS

A. Fire/smoke dampers shall be installed at all locations where ductwork or supply or return air openings penetrate any floor, wall or partition with a fire and smoke rating, or where otherwise shown on the drawings.

B. Fire/smoke dampers shall be provided with actuators capable of closing the damper on activation of area smoke detectors, the fire alarm system and/or the Firefighter's Smoke Control Panel and shall be normally closed. Actuators shall be compatible with the activating smoke detectors or fire alarm system (coordinate with other trades).

C. Unless otherwise indicated, smoke detectors integral to the combination fire/smoke damper shall be furnished and installed by the fire alarm contractor (coordinate with other trades).

D. All combination fire/smoke dampers shall be of the “Dynamic” type as classified in UL Standards 555 and 555S.

E. Fire/smoke dampers shall have a rating compatible with the floor, wall or partition, shall be tested to UL Standards 555 and 555S and be labeled for the intended installation (horizontal or vertical).

F. Maximum pressure drop: 0.10 in. wg; provide ductwork transitions as required so as not to exceed maximum pressure drop.

G. Fire Resistance Rating: 1½ hours unless noted otherwise on drawings for 3 hours.

H. Leakage Rating: Class 1 (maximum of 8 cfm/ft^2 at 4 in. wg) unless noted otherwise.

I. Elevated Temperature Rating: 350°F (177°C) for 30 minutes.

J. Airflow Closure Rating:
1. Dynamic fire/smoke dampers shall be selected for the velocity and pressure rating of the intended installation. Refer to the plans and schedules for airflow rates (CFM) and pressures (in. wg).
2. Dampers shall have a minimum velocity rating of 2000 fpm at a pressure rating of 4 in. wg.
3. Dampers in systems operating above 2000 fpm or 4 in. wg shall be selected for a velocity rating of 4000 fpm at a pressure rating of 6 in. wg or a velocity rating of 6000 fpm at a pressure rating of 8 in. wg as required.

K. Types:
1. Round: for use in systems up to 3000 fpm velocity.
   a. Construction:
      1) Frame: Galvanized steel (in gauges required by manufacturer’s UL listing).
      2) Blade design: single galvanized steel blade (in gauge required by manufacturer’s UL listing).
      3) Retainer plate(s): supplied with damper.
      4) Sleeves: Length as required per wall thickness.
      5) Duct Transition Connection: breakaway type.
2. Multi-blade:
   a. Up to 2000 fpm velocity: Triple Vee-groove type blade.
   b. 2000-4000 fpm velocity: Fabricated double skin airfoil type blade.
   c. Construction:
      1) Frame: Galvanized steel with mitered and interlocking corners (in gauges required by manufacturer’s UL listing).
      2) Blade design: 16 ga. galvanized steel strengthened by three longitudinal 1" deep Vee grooves running the entire length of each blade. Each blade shall be symmetrical relative to its axle pivot point, presenting identical performance characteristics with air flowing in either direction through the damper. Provide symmetrical blades of varying size as required to completely fill the damper opening.
      3) Blade Stops: Each blade stop (at top and bottom of damper frame) shall occupy no more than ½" of the damper opening area to allow for maximum free area and to minimize pressure loss across the damper.
      4) Seals:
         a) Blade Edge: Blade seals shall be extruded silicone rubber permanently bonded to the appropriate blade edges.
         b) Jamb: Flexible stainless-steel compression type.

5) Linkage: Concealed in jamb.
6) Axles: Minimum ½" diameter plated steel.
7) Bearings: Axle bearings shall be sintered bronze sleeve type rotating in polished extruded holes in the damper frame.
8) Sleeves: Damper shall be supplied as a single assembly with a factory sleeve.
9) Retaining Angles: Damper shall be supplied with factory retaining angles sized to provide installation overlap in accordance with the manufacturer's UL listing.
10) Duct Transition Connection: breakaway type

L. Heat Responsive Device: Electric, controlled closure, quick detect heat-actuated device designed to prevent damage to ductwork and other HVAC system components. The device shall be a reusable/resettable link (RRL) with a temperature setting of 165°F (74°C).

M. No Flow Smoke Detector (if indicated on the drawings): rated for air velocities from 0 to 3000 fpm; UL268A listed, factory mounted internally on the damper sleeve with built-in test switch.

N. Photoelectric [ionization] Type Smoke Detector (if indicated on the drawings): rated for air velocities from 300 [100] to 4000 fpm; UL268A listed, factory mounted internally on the damper sleeve.

O. Damper Motors: Two-position meeting the following:
1. Comply with NEMA designation, temperature rating, service factor, enclosure type, efficiency requirements and the following:
a. Motor Sizes: Minimum size as indicated. If not indicated, large enough so the driven load will not require motor to operate in service factor range above 1.0.
b. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.
c. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
d. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 150 in. x lbf (17 N x m).
e. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40°F (minus 40°C).
f. Nonspring-Return Motors: For dampers larger than 25 sq. ft. (2.3 sq. m), size motor for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 300 in. x lbf (34 N x m).
g. Electrical Connection: 115 V, single phase, 60 Hz.

P. Momentary Test Switch (for use in combination fire and smoke dampers that are not part of a smoke management system): factory mounted and wired assembly for testing and cycling the damper during start-up and maintenance. Power wiring to test switch and actuator shall be per manufacturer's installation instructions.

Q. Accessories for active smoke management systems:
1. Open Closed Indicator (OCI): factory mounted and tested with two switches, one set to close when the damper blades are at their open position, and the other set to close when the damper blades are at their closed position. This will be wired to the Fire Fighter's Smoke Control Station to indicate true damper position.

2. Temperature Limited Override (TLO): factory mounted and tested with two temperature sensing devices (thermostats) with fixed settings (165°F [74°C] and 350°F [177°C]). The primary sensor (with the 165°F [74°C] setting) may be bypassed by an external electrical signal allowing the damper to reopen and remain open until the temperature reaches the setting of the secondary sensor (350°F [177°C]). When the temperature of the secondary sensor is exceeded, the damper closes and remains closed thereafter.
3. Test Switch and Indicator Panel: 5" x 5" control panel with toggle switch, red LED (replaceable) indicator light to indicate closed damper position and a green LED (replaceable) indicator light to indicate open damper position.
4. Power wiring to OCI, TLO, test switch and actuator shall be per manufacturer's installation instructions.

R. Combination Fire and Smoke Dampers shall have a single point wiring per UL requirements (except where two signals are required as with the Temperature Limited Override specified above).

2.06 SMOKE DAMPERS

A. Smoke dampers shall be installed at all locations where ductwork or supply or return air openings penetrate any floor, wall or partition with a smoke rating, or where otherwise shown on the drawings, except where such ductwork or openings are part of an engineered smoke removal system.

B. Smoke dampers shall be provided with actuators capable of closing the damper on activation of area smoke detectors, the fire alarm system and/or the Firefighter's Smoke Control Panel and shall be normally closed. Actuators shall be compatible with the activating smoke detectors or fire alarm system (coordinate with other trades).
1. For stair and elevator hoist-way pressurization fans, provide a Class 1, normally open smoke damper at the fan inlet for use as a control damper; Ruskin Model SD60 or equal.

C. Unless otherwise indicated, smoke detectors integral to the smoke damper shall be furnished and installed by the fire alarm contractor (coordinate with other trades).

D. All smoke dampers shall be tested and certified in accordance with UL Standard 555S.

E. Maximum pressure drop: 0.10 in. wg; provide ductwork transitions as required so as not to exceed maximum pressure drop.

F. Leakage Rating: Class 1 (maximum of 8 cfm/ft^2 at 4 in. wg) unless noted otherwise.

G. Elevated Temperature Rating: 350°F (177°C) for 30 minutes.

H. Airflow Closure Rating:
1. Dynamic smoke dampers shall be selected for the velocity and pressure rating of the intended installation. Refer to the plans and schedules for airflow rates (CFM) and pressures (in. wg).
2. Dampers shall have a minimum velocity rating of 2000 fpm at a pressure rating of 4 in. wg.
3. Dampers in systems operating above 2000 fpm or 4 in. wg shall be selected for a velocity rating of 4000 fpm at a pressure rating of 6 in. wg or a velocity rating of 6000 fpm at a pressure rating of 8 in. wg as required.

I. Types:
1. Round: for use in systems up to 3000 fpm velocity.

a. Construction:
1) Frame: Galvanized steel (in gauges required by manufacturer's UL listing).
2) Blade design: single double skin galvanized steel blade (in gauge required by manufacturer's UL listing).
3) Retainer plate(s): supplied with damper.
4) Sleeves: Length as required per wall thickness.
5) Duct Transition Connection: breakaway type.

2. Multi-blade:
a. Up to 2000 fpm velocity: Triple Vee-groove type blade.
b. 2000-4000 fpm velocity: Fabricated double skin airfoil type blade.
c. Construction:
1) Frame: Galvanized steel with mitered and interlocking corners (in gauges required by manufacturer's UL listing).
2) Blade design: 16 ga. galvanized steel strengthened by three longitudinal 1" deep Vee grooves running the entire length of each blade. Each blade shall be symmetrical relative to its axle pivot point, presenting identical performance characteristics with air flowing in either direction through the damper. Provide symmetrical blades of varying size as required to completely fill the damper opening.
3) Blade Stops: Each blade stop (at top and bottom of damper frame) shall occupy no more than ½" of the damper opening area to allow for maximum free area and to minimize pressure loss across the damper.
4) Seals:
a) Blade Edge: Blade seals shall be extruded silicone rubber permanently bonded to the appropriate blade edges.
b) Jamb: Flexible stainless-steel compression type.
5) Linkage: Concealed in jamb.
6) Axles: Minimum ½" diameter plated steel.
7) Bearings: Axle bearings shall be sintered bronze sleeve type rotating in polished extruded holes in the damper frame.
8) Sleeves: Damper shall be supplied as a single assembly with a factory sleeve.
9) Retaining Angles: Damper shall be supplied with factory retaining angles sized to provide installation overlap in accordance with the manufacturer's UL listing.
10) Duct Transition Connection: breakaway type

J. No Flow Smoke Detector (if indicated on the drawings): rated for air velocities from 0 to 3000 fpm; UL268A listed, factory mounted internally on the damper sleeve with built-in test switch.

K. Photoelectric [ionization] Type Smoke Detector (if indicated on the drawings): rated for air velocities from 300 [100] to 4000 fpm; UL268A listed, factory mounted internally on the damper sleeve.

L. Damper Motors: Two-position meeting the following:
1. Comply with NEMA designation, temperature rating, service factor, enclosure type, efficiency requirements and the following:
a. Motor Sizes: Minimum size as indicated. If not indicated, large enough so the driven load will not require motor to operate in service factor range above 1.0.
b. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.

c. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
d. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 150 in. x lbf (17 N x m).
e. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40°F (minus 40°C).
f. Nonspring-Return Motors: For dampers larger than 25 sq. ft. (2.3 sq. m), size motor for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 300 in. x lbf (34 N x m).
g. Electrical Connection: 115 V, single phase, 60 Hz.

2. Momentary Test Switch (for use in smoke dampers that are not part of a smoke management system): factory mounted and wired assembly for testing and cycling the damper during start-up and maintenance. Power wiring to test switch and actuator shall be per manufacturer's installation instructions.

M. Accessories for active smoke management systems:
1. Open Closed Indicator (OCI): factory mounted and tested with two switches, one set to close when the damper blades are at their open position, and the other set to close when the damper blades are at their closed position. This will be wired to the Fire Fighter's Smoke Control Station to indicate true damper position.
2. Test Switch and Indicator Panel: 5" x 5" control panel with toggle switch, red LED (replaceable) indicator light to indicate closed damper position and a green LED (replaceable) indicator light to indicate open damper position.
3. Power wiring to OCI, test switch and actuator shall be per manufacturer's installation instructions.

N. Smoke Dampers shall have a single point wiring per UL requirements (except where two signals are required as with the Temperature Limited Override specified above).

2.07 CONTROL DAMPERS

A. Automatic control dampers shall be installed as shown on the drawings and shall be controlled as described in the 23 09 00 - Automatic Controls section of these specifications.

B. Unless indicated otherwise, dampers shall be of the opposed blade type constructed of minimum 18-gauge galvanized steel and shall have rigidly constructed blades less than 6" wide and shall have duct mounting flanges.

C. Dampers shall be the low leakage type with replaceable blade and jamb seals. Maximum pressure drop for dampers operating in systems exceeding 2000 fpm shall be 0.10 in. wg.

D. Outside air supply and exhaust openings shall be provided with a Class 1A motorized damper with a maximum leakage rate of 4 cfm/ft^2 (20.3 L/s · m^2) at 1.0 in. wg (249 Pa) when tested in accordance with AMCA 500D.
1. Gravity (non-motorized) dampers having a maximum leakage rate of 20 cfm/ft^2 (101.6 L/s · m^2) at 1.0 in. wg (249 Pa) when tested in accordance with AMCA 500D may be used in any one of the following conditions:
a. In buildings for exhaust and relief dampers.
b. In buildings of less than three stories in height above grade.
c. For ventilation air intakes and exhaust and relief dampers in buildings of any height in Climate Zones 1, 2 and 3.

d. Where the design outdoor air intake or exhaust capacity does not exceed 300 cfm (141 L/s).

Gravity (non-motorized) dampers for ventilation air intakes shall be protected from direct exposure to wind.

2. Dampers smaller than 24 inches (610 mm) in either dimension shall be permitted to have a leakage rate of 40 cfm/ft2 (203.2 L/s · m2) at 1.0 in. wg (249 Pa) when tested in accordance with AMCA 500D.

2.08 REMOTE DAMPER OPERATORS

A. Cable operated type:
1. Manufacturers: Subject to compliance with all requirements: Pottorff, Ventfabrics, Inc., Duro Dyne or Young Regulator Company.
2. Description: Cable system designed for remote manual damper adjustment.
3. Cable: Stainless steel with flexible steel casing.
4. Control: Concealed regulator kit with steel locking rack and pinion gear with hex head adjustment. Damper control is via push-pull lever action.
5. Linear slot diffuser: Young Regulator Model 270-275ML plenum mounted cable controller with 5020CC (round) or 830AC (rectangular) balancing damper.
6. Wall-Box Mounting: Recessed
7. Wall-Box Cover-Plate Material: Steel

B. Electronic type:
1. Manufacturers: Subject to compliance with all requirements: Ventfabrics, Inc., Duro Dyne or Young Regulator Company.
2. Description: System designed for remote electronic damper adjustment.
3. Cable: plenum rated with 5 conductors
4. Control: 12V DC actuator, <0.5 watts
5. Wall mounting kit with recessed wall box and cover plate.
6. Ceiling mounting kit with recessed box and cover plate.
7. Controller: battery powered handheld with LCD damper position indicator (one per project).

C. Install in strict conformance with manufacturer’s installation instructions.

2.09 FLEXIBLE DUCT CONNECTORS

A. Install flexible duct connectors at connections of sheet metal duct to motor driven equipment, in ductwork crossing building expansion joints, or otherwise noted. Install per manufacturer’s instructions, and support sheet metal ductwork so that no weight is supported by the flexible duct connector.

B. Basis-of-Design Product unless noted otherwise below: Subject to compliance with requirements, provide Ductmate Industries, Inc.; PROflex or comparable product by one of the following:
1. Duro Dyne Inc.
2. Ventfabrics, Inc
3. Prior Approved Equal

C. Materials: Flame-retardant or noncombustible fabrics compliant with NFPA 701.

D. Coatings and Adhesives: Comply with UL 181, Class 1 and have a maximum flame spread/smoke developed rating of 25/50.

E. Metal-Edged Connectors: Factory fabricated with a fabric strip 5¾-inches wide attached to two strips of 2¾-inch wide, 0.028-inch thick, galvanized sheet steel. Provide metal compatible with connected ducts.

F. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
1. Minimum Weight: 26 oz./sq. yd.
2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
3. Service Temperature: Minus 40 to plus 200ºF.

G. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
1. Minimum Weight: 24 oz./sq. yd.
2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
3. Service Temperature: Minus 50 to plus 250ºF.

H. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.
1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
2. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
7. Coil Spring: Factory set and field adjustable for a maximum of ¼-inch movement at start and stop.

I. For systems operating at +4 in. wg, provide a molded rubber duct expansion joint. Construction shall consist of an elastomer tube and cover, reinforced with a woven fabric capable of accommodating duct system movement and vibration. Expansion joints shall be Flexicraft Industries, Rubber Duct Expansion Joint Model.

2.10 ACCESS DOORS

A. Hinged, gasketed and latched Access Doors (AD) and/or panels shall be installed at each fire and smoke damper, each duct mounted smoke detector, each valve, at each duct mounted balancing damper or any other mechanical equipment or device that requires accessibility. Doors and panels shall be sized (minimum 18" x 18", duct size allowing), and located to optimize access to dampers, detectors, and other equipment for service and replacement. Access Panels (AP) in walls, ceilings or other surfaces shall be coordinated with architectural finishes and selected by the architect.

B. Access doors shall be designed for five times the pressure of the duct in which it is mounted.

C. Access doors for fire dampers, combination fire/smoke dampers and smoke dampers in medium pressure (+4 in.wg and higher) duct systems shall be the implosion type designed to prevent excessive negative pressure downstream resulting in collapsed ductwork. At the contractor’s option, the access door may be an integral feature of the damper assembly.

D. Access doors for grease exhaust ducts shall be in accordance with NFPA 96 (latest edition). Vertical grease ducts shall have an access door at each floor level in an inconspicuous location.

E. Access doors for fire dampers, combination fire/smoke dampers and smoke dampers shall be permanently identified by a die-cut label with ½” high red block letters on a white

background. Label shall read FIRE DAMPER, COMBINATION FIRE/SMOKE DAMPER or SMOKE DAMPER.

F. Duct-Mounted Access Doors: Fabricate access panels per SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2 (7-2M), "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct".
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Ductmate Industries, Inc.; Access Doors or comparable product by one of the following:
      a. American Warming and Ventilating; a division of Mestek, Inc.
      b. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
      c. Prior Approved Equal
   2. Door:
      a. Double wall, rectangular.
      b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
      c. Vision Panel:
         1) Observation type doors shall be sandwich type provided at all fire and smoke dampers, humidifiers, in-duct smoke detectors, and UVC emitters.
         2) Minimum 12"x12" with 8"x8" viewport, insulated or non-insulated.
         3) For ducts smaller than 12-inches, 10"x6" shall be used with a 4"x 2-5/8" viewport with a single pane of safety glass.
      d. Hinges and Latches: 1"x1" butt or piano hinge with cam latches.
      e. Fabricate doors airtight and suitable for duct pressure class.
   3. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
   4. Number of Hinges and Locks:
      a. Access Doors Less Than 12 inches Square: No hinges and two sash locks.
      b. Access Doors up to 18 inches Square: Continuous hinge and two sash locks.
      c. Access Doors up to 24 by 48 inches: Continuous hinge and two compression latches.
      d. Access Doors Larger Than 24 by 48 inches: Continuous hinge and two compression latches.

G. Pressure Relief Access Door:
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:
      a. American Warming and Ventilating; a division of Mestek, Inc.
      b. Cesco Products; a division of Mestek, Inc.
      c. Elgen Manufacturing
      d. Flexmaster U.S.A., Inc.
      e. Greenheck Fan Corporation
      f. McGill AirFlow LLC
      g. Nailor Industries Inc.
      h. Pottorf
      i. Ventfabrics, Inc.
      j. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
      k. Prior Approved Equal
   2. Door and Frame Material: Galvanized sheet steel.
   3. Door: Single or Double wall with insulation fill, as required, with metal thickness applicable for duct pressure class.
   4. Operation: Open outward for positive-pressure ducts and inward for negative-pressure ducts.
   5. Factory set at 3.0- to 8.0-in. wg.

6. Doors close when pressures are within set-point range.
7. Hinge: Continuous piano
8. Latches: Cam
9. Seal: Neoprene or foam rubber
10. Insulation Fill: 1" thick, fibrous-glass or polystyrene-foam board.

H. Duct Access Panel Assemblies:
1. Basis-of-Design Product: Subject to compliance with requirements, provide Ductmate Industries, Inc.; Ultimate Door or comparable product by one of the following:
a. Flame Gard, Inc.
b. Prior Approved Equal
2. UL 1978 listed by an NRTL
3. Panel and Frame: Minimum thickness steel.
4. Fasteners: Carbon steel. Panel fasteners shall not penetrate duct wall.
5. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000ºF.
6. Minimum Pressure Rating: 10-inch wg, positive or negative.

2.11 DUCT LINER

A. Also refer to Section 23 07 00 - HVAC Insulation.

B. Supply air ductwork a minimum of 15 linear feet downstream and return air ductwork a minimum of 15 linear feet upstream of low-pressure air handling equipment and terminal units shall be internally lined with 1½" thick acoustical duct liner/insulation (minimum R-6 or greater where required by code), Johns Manville Linacoustic RC or approved equal.
1. Duct liner shall be securely fastened to ductwork with stick pins, speed washers and adhesive.
2. Leading edges of liner shall have a sheet metal nosing.
3. Exposed edges and butt joints shall be “buttered” with duct sealer.
4. Duct liner shall be interrupted at all fire, smoke, combination fire/smoke and radiation dampers.
5. Duct liner shall be interrupted not less than 6" upstream and 6" downstream of electric-resistance and fuel-burning heaters in a duct system.

C. Supply air ductwork a minimum of 50 linear feet (or as indicated) downstream of static pressure class +4 in. wg air handling equipment shall be internally lined with 1½" thick acoustical duct liner/insulation, (minimum R-6 or greater where required by code) Johns Manville Linacoustic RC or approved equal. Return air ductwork shall be lined as described in 2.13.B above or as indicated.

D. Return air ductwork, sound boots and transfer ducts shall have 1" thick liner, Johns Manville Linacoustic RC or approved equal.
1. Refer to Section 23 07 00 - HVAC INSULATION for return air ductwork requiring external insulation.

E. Indoor exposed rectangular sheet metal supply and return air ductwork shall be lined with 1" thick duct liner (minimum R-4 or greater where required by code) Johns Manville Linacoustic RC or equal.

F. Indoor exposed round, spiral or flat oval ductwork shall be lined with 1" thick fiberglass duct liner/insulation (minimum R-4 or greater where required by code) Johns Manville Spiracoustic Plus or approved equal.

G. Subject to compliance with requirements, duct liner products shall be manufactured by: CertainTeed, Johns Manville, Knauf, Owens Corning, or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. All ductwork shall be installed in accordance with applicable SMACNA Standards according to the pressure class described in PART 1 - GENERAL.

B. Seal, inspect and test ductwork prior to insulating or concealing. Seal all ductwork and plenums to meet the following SMACNA duct seal class:
   1. Class A: Seal all transverse joint, longitudinal seams, and duct wall penetrations.
      a. Pressure-sensitive tape shall not be used as the primary sealant, unless it has been certified to comply with UL 181A or UL 181B by an independent testing laboratory and the tape is used in accordance with that certification.
      b. All connections shall be sealed, including but not limited to spin-in fittings, taps, other branch connections, access doors, and duct connections to equipment.
      c. Sealing that would void product listings is not required.
      d. Spiral lock seams need not be sealed.
   2. Tapes, sealants and mastics used to seal metallic and flexible air ducts and flexible air connectors shall comply with UL 181B and shall be marked “181B-FX” for pressure-sensitive tape or “181B-M” for mastic/sealant.
   3. Mechanical fasteners for use with flexible nonmetallic air ducts shall comply with UL 181B and shall be marked “181B-C”.

C. Ductwork shall be supported as recommended by SMACNA Standards from structural members. Ductwork shall not be allowed to rest on ceilings, light fixtures or structural members. Ductwork supported from joists shall be supported from the top chord of all joists.

D. All ductwork accessories shall be installed in strict accordance with manufacturer’s recommendations.

E. Ductwork that is designed to operate at static pressures in excess of 3 in. wg and all ductwork located outdoors shall be leak-tested in accordance with SMACNA Standards. Representative sections totaling no less than 25% of the total installed duct area for the designated pressure class shall be tested. All sections shall be selected by the building owner or the designated representative of the building owner. Positive pressure leakage testing is acceptable for negative pressure ductwork. The maximum permitted duct leakage shall be:

$$L_{max} = C_L P^{0.65}$$

where

L_{max} = maximum permitted leakage, cfm per100 ft^2 of duct surface area
C_L = 4, duct leakage class, cfm per100 ft^2 of duct surface area per inch of $water^{0.65}$
P = test pressure, which shall be equal to the design duct pressure class rating, in. of water

All ductwork seams shall be sealed with mastic to provide a system that is within the recommended SMACNA leakage limits. As an alternate, water-based spray-on hardcast products may be used provided they meet or exceed the project requirements.

The ductwork test report shall be submitted in electronic (PDF) format to the Engineer prior to the Contractor’s request for final payment.

F. All ductwork shall be cleaned inside and out prior to system start up and shall be left in a neat and orderly manner.

G. Duct sizes shown on drawings are inside clear dimensions.

H. Unless otherwise approved, ducts shall be true to dimensions indicated, straight and smooth on the inside with neatly finished joints, securely anchored to the building in an approved manner, and installed to be completely free from vibration under all conditions of operation. Exact routing of ductwork will be dependent on location of framing members. Route ductwork to avoid cutting framing members.

I. Brace ducts not more than 60 inches on center.

J. Make slip joints in the direction of air flow.

K. Offset ducts around obstructions where possible. Where duct must encompass obstruction, area of duct shall remain constant.

L. Duct tapers shall not exceed 1:4 ratio and transformations 30 degrees between air flow and diverging or converging air flow.

M. Provide access doors for access to all equipment, dampers and motors concealed by sheet metal.

N. Where applicable, provide seismic bracing and restraints for ductwork per ASCE/SEI 7, latest edition and the latest edition of the SMACNA Seismic Restraint Manual. Also, refer to Section 23 05 48 Noise and Vibration Control.

3.02 BALANCING DAMPERS

A. Install manual volume dampers where indicated on the drawings and where required to properly balance the air distribution system.

B. Provide an opposed blade damper behind the face of each supply register which shall be adjustable through the face of the register with a screwdriver.

C. Provide an opposed blade damper behind the face of return air registers, where indicated, which shall be adjustable through the face of the register with a screwdriver.

D. Provide a butterfly damper in the neck of each ceiling diffuser unless noted otherwise.

END OF SECTION

SECTION 23 34 00
UNITARY EXHAUST AND SUPPLY FANS AND VENTILATORS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Refer to specification section 23 00 00 - HVAC General, all of which applies to work described in this section as if written in full herein. Special attention should be given to Section 2.02 ELECTRICAL WORK for specifics on motor and drive requirements.

B. Furnish and install all unitary exhaust and supply fans and ventilators of the size, type, capacity and characteristics as shown on the equipment schedules and herein described.

C. Base fan-performance ratings on actual project site altitude.

D. Acceptable manufacturers include only those whose products have been in satisfactory use in similar service for not less than five (5) years.

E. Electrical Standards: Provide electrical motors and products which have been listed and labeled by Underwriters Laboratories Inc. and comply with NEMA Standards.

F. Certification, Fan Performance: Fans shall be certified to bear the AMCA label for air and sound performance.

PART 2 - PRODUCTS

2.01 CENTRIFUGAL AND AXIAL FANS AND VENTILATORS

A. All units shall be rigidly constructed of materials suitable for the intended service and shall be installed with all accessories listed on the Drawings.

B. All roof mounted units shall be installed on factory supplied 14-inch high (minimum) insulated roof curbs of the proper type, size and construction for proper mounting. Curbs shall account for all roof slopes and pitches so that the unit is installed level. Units shall be anchored to curbs by a minimum of two lag screws of adequate size on each side. Curbs shall be constructed of galvanized steel, except when the project is located within 5 miles of a sea coast they shall be of aluminum construction.

C. Outdoor fans shall be completely weatherproof for outdoor installation and shall contain internal vibration isolation to assure smooth and quiet performance.

D. Fan wheels and blades shall be constructed of aluminum and shall be statically and dynamically balanced at the factory.

2.02 CEILING-CENTRIFUGAL AND CABINET FANS

A. Units shall be direct-drive type with back-draft damper, acoustically insulated cabinets and speed controller.

PART 3 - EXECUTION

3.01 GENERAL

A. All units shall be installed in accordance with manufacturer's recommendations and as shown on the Drawings.

B. Ceiling-centrifugal and cabinet fans shall be supported from structural members and shall not rest on the ceiling, on lights or on structural members.

C. Units shall be interlocked and controlled as indicated on the Drawings.

D. Ceiling-mounted units shall be installed with ceiling grilles flush with the ceiling.

E. Curb-mounted fans shall be secured to the roof curb with lag screws in each hole in the fan curb cap.

F. Electrical connection to the fan motor shall be made through the roof opening inside the roof curb.

G. Replace fan and motor pulleys as required to achieve design airflow.

END OF SECTION

SECTION 23 37 00

LOUVERS, GRILLES, REGISTERS AND DIFFUSERS

PART 1 - GENERAL

1.01 DESCRIPTION

A. All work in this section shall be subject to the provisions of Section 23 00 00 - HVAC General.

B. Furnish and install all louvers, grilles, registers and diffusers of the size, type, capacity, and characteristics as shown on the equipment schedules and specified herein.

C. Equipment schedules and specifications are intended to establish a minimum level of quality and workmanship for the project. When other than the basis of design equipment is proposed, the Contractor shall be responsible for all costs associated with engineering and construction modifications necessary in his or any other trade that may be required to satisfy the Contract Documents.

D. Refer to the drawings for basis of design manufacturer and acceptable alternates.

PART 2 - PRODUCTS

2.01 LOUVERS

A. Louver components (heads, jambs, sills, blades, etc.) shall be factory assembled by the manufacturer into a complete unit. Louver sizes too large for shipping shall be built-up from factory assembled louver sections to provide the overall sizes required.

B. Louver design shall incorporate structural supports required to withstand a wind load of 20 lbs./square foot.

C. All louver performance data submitted for approval shall bear the AMCA Certified Ratings Seal for Air Performance and Water Penetration.

D. All louvers shall have a factory applied finish coating as scheduled with the color selection made by the Architect at the time of shop drawing approval. Color charts shall be submitted with louver shop drawings.

E. Screens:

1. General: Provide a screen at each exterior louver.
2. Frames: Same kind and form of metal as indicated for louver to which screens are attached.
3. Screening material:
   a. Bird Screen: Aluminum, ¼" by ¼" square mesh wire; 0.047" thick

2.02 GRILLES, REGISTERS AND DIFFUSERS

A. Units shall be of the type, size, and construction as scheduled or indicated.
B. Unless otherwise noted or indicated, all air devices shall be supplied with a factory finish of manufacturer's standard white.

C. Grilles, registers and diffusers shall be ordered with borders compatible with the ceiling system type in which they are installed. Refer to architectural drawings for type of ceiling and/or suspension system.

D. Aluminum air devices shall be used for all areas subject to excessive moisture or humidity (e.g. showers, pools, bathrooms, etc.).

PART 3 - EXECUTION

3.01 LOUVERS

A. Louvers shall be installed in accordance with the manufacturer's recommendations.

B. The louver installation shall be made weatherproof by caulking and sealing at the frame and flanges in accordance with the manufacturer's recommendations.

C. Combination louver/dampers shall be installed with the required actuators and linkage mechanisms and shall be field adjusted for full opening/closure stroke. Louvers shall be interlocked as scheduled or indicated.

3.02 GRILLES, REGISTERS AND DIFFUSERS

A. All air devices located in ceiling tiles shall be centered or shall be on quarter points of 2 ft. x 2 ft. tiles.

B. Where a line of sight allows the ductwork, wall, or ceiling structure to be seen behind any units, such ductwork, wall or ceiling structure shall be painted with nonflammable flat black paint to minimize visibility.

C. All air devices not installed on T-bar ceiling grids shall be securely fastened to adjacent structures.

D. Where air distribution devices are installed in inaccessible ceilings, provide the spin-in fitting without a volume damper. Provide an opposed blade damper in the neck of the air distribution device with access to the damper control through or at the face of the device.

END OF SECTION

SECTION 23 81 14
PACKAGED TERMINAL HEAT PUMP (PTHP)

PART 1 - GENERAL

1.01 DESCRIPTION

A. All work specified herein shall be accomplished in accordance with the applicable requirements of Section 23 00 00 - HVAC General.

B. Furnish and install the equipment as specified below. The manufacturer shall have available factory trained service technicians and an inventory of replacement parts within a 100-mile radius of the job site.

C. Furnish units as manufactured by Friedrich, Trane, Carrier, Amana, Islandaire, or General Electric.

PART 2 - PRODUCTS

2.01 EQUIPMENT

A. Factory assembled single piece, heating and cooling unit. Contained within the unit enclosure shall be compressor, coils, fans and fan motor, electric heating coil, controls, all wiring, and a full refrigerant charge. Units shall be UL Listed.

B. Unit cabinet shall be galvanized steel, bonderized and coated with a baked enamel finish. Wall sleeve shall be of polymeric material.

C. Fans and Motor

1. Evaporator fan shall be a single-inlet squirrel cage blower with a corrosion resistant finish, discharging air upwards. Fan shall be dynamically balanced.
2. Condenser fan shall be a propeller type with corrosion resistant finish, discharging air out the rear of the unit, and shall be dynamically balanced.
3. Motor shall be totally enclosed, permanently lubricated and multiple speed.

D. Compressor

1. The compressor shall be fully hermetic with internal and external vibration isolation.
2. Compressor shall have a 5-year warranty.

E. Coils

1. The coils shall have aluminum plate fins mechanically bonded to seamless copper tubes with all joints brazed.

F. Refrigerant Components

1. All piping, reversing valve, compressor and expansion devices shall be included.

G. Controls and Safeties

1. Controls shall consist of an OFF/FAN/HEAT/COOL selector switch, adjustable thermostat with upper and lower limits, VENT OPEN/CLOSE and FAN CYCLE switches.
2. Safeties for compressor shall consist of automatic reset overtemperature and overcurrent protection; for fan motor shall consist of inherent, automatic reset overtemperature protection.
3. Condensate drain kit for draining to the exterior or piping riser.

H. Operating Characteristics

1. Unit shall be capable of starting and running at 115 degrees F ambient outdoor temperature per maximum load criteria of AHRI Standard 210. Compressor with standard controls shall be capable of operation down to 25 degrees F ambient outdoor temperature.

I. Filter

1. Filter shall be one-piece cleanable type that filters return air.

J. Heating System (Heat Pump)

1. Include an auxiliary electric resistance heating coil (if scheduled) to operate whenever the compressor alone cannot satisfy the heating load.

K. Special Features

1. Corrosion protection provides for extra paint on control box partition and exterior coil.
2. Extruded aluminum architectural condenser grille.
3. Indoor trim strip.
4. Sub-base with power receptacle.
5. Other accessories as scheduled.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Packaged Terminal Heat Pump units shall be installed and wired in accordance with the manufacturer’s recommendations.

END OF SECTION

SECTION 23 81 28
SPLIT SYSTEM HEAT PUMPS

PART 1 - GENERAL

1.01 DESCRIPTION

A. All work specified herein shall be accomplished in accordance with the applicable requirements of Section 23 00 00 - HVAC General.

B. Furnish and install a direct expansion air-to-air heat pump unit of the size and capacity shown on the equipment schedule. The unit shall be completely factory assembled and tested, and shall include compressor, indoor and outdoor coils, stand-by electric strip heating coils, fan motors as required, pre-wired controls, interconnecting refrigerant tubing, wiring, and circuit breakers. Condensing unit shall be factory matched with evaporator coils and air handling unit; units shall be rated in accordance with AHRI and UL Listed.

C. Equipment schedules and specifications are intended to establish a minimum level of quality and workmanship for the project. When other than the basis of design equipment is proposed, the Contractor shall be responsible for all costs associated with engineering and construction modifications necessary in his or any other trade that may be required to satisfy the Contract Documents.

D. Refer to the drawings for basis of design manufacturer and acceptable alternates.

1.02 RELATED DOCUMENTS

A. For piping, valves, accessories and piping insulation refer to Section 23 23 00 – Refrigerant Piping.

PART 2 - PRODUCTS

2.01 GENERAL

A. Each unit shall be a complete and factory package consisting of compressor, condenser coil, stand-by electric heating coil, condenser fans and motors, refrigeration and temperature controls, Unit shall have a certified AHRI rating.

2.02 AIR HANDLER

A. The cabinet shall be complete and constructed of minimum 20-gauge galvanized steel zinc coated and shall be painted with a baked-on powder coating finish. Interior surface of the cabinet shall be lined with a flexible acoustical and thermal insulation and shall be fire proof. Thickness of insulation shall be 1-1/2". Access to fan motor, filters, coils, controls and power supply shall be through the front panel of the unit.

B. The nonferrous direct expansion cooling coil shall be factory mounted and charged with refrigerant. Provide reversing valve, expansion valve, solenoid valve and complete refrigeration circuit. Provide insulated drain pan with exterior primary and secondary drain connection.

C. The air handling unit shall accept a 1" thick high velocity air filter, mounted internally and located upstream of the cooling coil.

D. The blower section shall have an adjustable V-belt or direct drive fan motor with a forward-curved centrifugal type blower mounted on vibration isolators. The fan motor shall have thermal overloads and be permanently lubricated. Direct drive fan motors shall have at least three (3) speeds.

E. An electric resistance heater shall supplement the heat pump operation.

F. The unit shall be supplied with a single point power connection.

2.03 OUTDOOR UNIT

A. The cabinet shall be constructed of galvanized steel with a baked-on enamel finish. Provide with removable access panel at one side of unit to access the compressor, coil, controls, and power supply. Drain holes shall be provided at the base of the unit. Provide fan and coil guards.

B. The compressor shall be the hermetic scroll or rotary type, furnished with complete refrigeration circuit(s) including nonferrous condenser coil, receiver, charging valve, refrigerant holding charge, external service valves, compressor anti-cycle protection, internal temperature and current-sensing overloads, crankcase heater, filter drier, evaporator freeze stat, liquid line solenoid valve, and vibration isolation. Controls shall include over and under voltage protection, high pressure cutout with auto-reset, motor starters and contactors. Compressor shall have a five-year warranty.

C. The fan motor shall be permanently lubricated with built-in thermal overload protection.

D. Install unit level as indicated on the Drawings.

E. The unit shall be supplied with a single point power connection.

2.04 CONTROLS

A. Unless noted otherwise, provide a seven-day programmable thermostat with manual changeover.

B. The thermostat shall prevent the auxiliary electric heat from being energized whenever the heating load can be met by the heat pump.

PART 3 - EXECUTION

3.01 GENERAL

A. Units shall be installed as shown on the Drawings and in strict accordance with manufacturer’s recommendations.

B. Units shall be installed level.

C. Units shall be installed to allow adequate service to all components.

END OF SECTION

SECTION 23 82 39.19
ELECTRIC WALL HEATERS

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. All work specified herein shall be accomplished in accordance with the applicable requirements of Section 23 00 00 - HVAC General.

1.02 WORK INCLUDED

A. Receipt, unloading, handling, proper storage and protection from damage of all materials.

B. Layout and coordination of work with other trades.

C. The work under this section shall include all labor, materials, accessories, services, and equipment necessary to furnish and install wall heaters complete as indicated on the Drawings and as specified herein.

PART 2 - PRODUCTS

2.01 WALL HEATERS

A. Unit shall be completely factory assembled, wired, tested and shipped as a single assembly; capacity shall be as indicated on the Drawings.

B. Unit heaters shall be constructed in accordance with provisions of the National Electrical Code and shall be UL or ETL tested and listed to UL Standard 2021 – UL Standard for Safety Fixed and Location-Dedicated Electric Room Heaters.

C. Front grille shall be 16-gauge steel or aluminum finished in baked enamel or anodized with downflow discharge louvers.

D. Element shall consist of helically coiled nickel chromium alloy resistance wire enclosed in corrosion resistant sheaths.

E. Controls shall include fan delay switch, built-in thermostat, automatic reset thermal overload switch and a non-fused disconnect power switch.

F. Unit shall be designed to either recess into the wall or for surface mounting as scheduled, and shall include all mounting accessories.

G. Unit shall be Raywall, QMark, Markel, Berko, Indeeco or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. All units shall be installed in strict accordance with the manufacturer’s recommendations.

END OF SECTION

SECTION 26 00 00
ELECTRICAL GENERAL

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. General Conditions: Refer to the General Conditions, the Supplementary General Conditions and the Special Conditions, all provisions of which apply to work under this section as if written in full herein.

B. The scope of work to be done under this section of the specifications shall include the furnishing of labor, material, equipment and tools required for the complete installation of systems for power, lighting, signals and all other work indicated on the drawings or as specified herein. A 100% operational building and electrical distribution system up to a connection point for Owner furnished equipment will be provided.

C. The drawings and specifications are complementary to each other and what is called for by one shall be as binding as if called for by both.

1.02 STANDARDS

A. All work shall conform to all ordinances and regulations of the City, County, State and/or other authorities having jurisdiction in accordance with the requirements of the following codes, standards and design guides:

1. The 2017 edition of the National Electrical Code (NFPA 70) with local Amendments
2. The 2020 edition of the International Building Code with local Amendments
3. The 2020 edition of the Life Safety Code (NFPA 101)
4. The 2020 edition of the Florida Fire Prevention Code
5. ASHRAE 90.1-2016
6. Regulations of the local utility company with respect to metering and service entrance
7. Local city and county ordinances governing electrical work

1.03 PERMITS

A. The Contractor shall obtain all permits and inspections required for the installation of this work and pay all charges incident thereto. He shall deliver to the Architect all certificates of said inspection.

1.04 WORK INCLUDED

The electrical systems installed and work performed under this division of the specifications shall include, but not necessarily be limited to, those listed below. All materials and appliances, obviously a part of the electrical systems and necessary to its proper operation, but not specifically mentioned or shown on the drawings, shall be furnished and installed without additional charge.

A. Power Distribution System

B. All lighting systems (indoor and outdoor, normal, emergency and exit) including all fixtures, lamps, plaster and/or tile frames, standards, switches, outlets, wiring, dimmers, contactors, time clocks, photocells, batteries, raceways and other components and fittings required for complete lighting systems

C. Wiring, including power circuit connections for HVAC, plumbing and other mechanical equipment

D. Grounding Systems

E. Temporary service lighting and power system

F. Low voltage system raceways and equipment mounting boards as indicated on the drawings

G. Underground raceway excavation, backfill, and compaction

H. Fire Alarm System

I. Concrete work for duct banks, manholes, covering, lighting standard bases and equipment bases (where not assigned to General Contractor)

J. Electrical Equipment Identification

K. Supporting Devices for Electrical Components

L. Work as required by electric and telecommunication utilities, as well as the coordination of additional work (i.e. work performed by the utility) with that of other trades.

1.05 DRAWINGS

A. Drawings are generally diagrammatic and show the arrangement and location of fixtures, equipment and conduit. The Contractor shall carefully investigate the structural and finish conditions affecting his work and arrange his work accordingly. Should conditions on the job make it necessary to rearrange conduit or equipment, the Contractor shall so advise the Engineer and secure approval before proceeding with such work.

B. Where exact locations are required by equipment for stubbing-up and terminating conduit concealed in floor slabs, the Contractor shall request shop drawings, equipment location drawings, foundation drawings, and any other data required by him to locate the concealed conduit before the floor slab is poured.

C. Materials, equipment or labor not indicated but which can be reasonably inferred to be necessary for a complete installation shall be provided. Drawings and specifications do not undertake to indicate every item of material, equipment, or labor required to produce a complete and properly operating installation.

D. Locate pull boxes, panelboards, control pushbuttons, terminal cabinets, safety switches and such other apparatus as may require periodic maintenance, operation, or inspection, so that they are easily accessible. If such items are shown on the plans in locations which are found to be inaccessible, the Engineer must be advised of the situation before work is advanced to the point where extra costs will be involved.

E. All additional circuit connections to panelboards must be preapproved by the Engineer.

F. The location, arrangement and extent of equipment, devices, conduit, and other appurtenances related to the installation of electrical work shown on drawings are approximate. The Contractor shall not scale drawings, but shall refer to the architectural drawings for exact dimensions of building components. Should a conflict exist between

the architectural and engineering drawings regarding dimensions and scale, the Contractor shall notify the Architect of the discrepancy.

G. Verify the ceiling type, ceiling suspension systems, and clearance above hung ceilings prior to ordering lighting fixtures. Notify the Engineer of any discrepancies.

H. Review all architectural drawings for door swings, cabinets, counters and built-in equipment.

1.06 OPERATION AND MAINTENANCE MANUALS

A. The Contractor shall prepare a minimum of two (2) instruction manuals, one of which shall be submitted to the Architect for the Engineer's review, describing installation, operation and maintenance of all Electrical equipment. Manuals shall include copies of control schematics, sequences of operation, indicate the function and operations of all components, as well as the Contractor's name, address, and telephone number. Manuals shall also contain one copy of all manufacturer's drawings, pamphlets, data, parts lists, and instruction manual for each piece of equipment. Upon approval, one copy shall be delivered to the Owner; one copy shall be kept by the Contractor. The pamphlets and drawings are to be neatly bound in a 3-ring binder(s).

1.07 AS-BUILT DRAWINGS

A. The Contractor shall maintain a record of all changes in the work from that shown in the Contract Documents. After all work is completed, the Contractor shall prepare a set of "as-built" reproducible drawings of similar type and quality as the Contract Drawings that reflect all changes and that accurately show actual final construction, and deliver these drawings to the Architect.

1.08 EQUIPMENT, MATERIALS AND BID BASIS

A. Manufacturers' names, model numbers, etc. as specified on the drawings and herein are for the purpose of describing type, capacity, function and quality of equipment and materials required.

B. Unless "approved equal" is specifically stated, bids shall be based on equipment names in specifications or on drawings as "base" products.

C. "Equal product" and "approved equal" items listed shall conform to specified base items and shall be substantially equal in size, weight, construction and capacities. The "equal" equipment and materials shall be submitted as full equivalent to the equipment and materials specified, with sufficient supportive documentation and technical literature to demonstrate quality, performance, and workmanship without doubt or question. Submittals for "equal" products shall be made at least ten (10) days prior to bid (refer to the General Conditions of these specifications). The Engineer shall consider the use of the "equal" equipment based on the supportive documentation available to him, and shall approve or disapprove any proposed alternates. The decision of the Engineer shall, in all cases, be final.

D. The Contractor shall coordinate the installation of all electrical equipment proposed for use in this project with all building trades (architectural, structural, mechanical, etc.). Coordination shall be accomplished prior to, and shall be reflected in, the submittal of shop drawings for approval. When substitution of equipment is made, the Contractor shall be responsible for the costs of any item and engineering and construction revisions necessary

in his or any other contract or trade that may be required to satisfy the plans and specifications.

E. If substitutions are made in lieu of equipment specified, the manufacturer's literature shall be submitted to the Engineer for approval. In the case of lighting fixtures, full IES photometric test reports for the fixture, lamp(s), and lenses shall be submitted for approval.

1.09 SUBMITTALS

A. The Contractor shall prepare, submit, and obtain Engineer's review of manufacturers' submittals on the following equipment and systems prior to ordering, purchasing, or installation of any equipment or materials. All required submittals shall be transmitted electronically (e.g. pdfs, etc.) with the associated specification section and the item submitted clearly identified. Partial submittals will be returned without review.

1. Submit a listing of all the materials indicated below, with the type of material, manufacturer and catalog or model number for each (where applicable):
   Package #1
   Conductors
   Conduit
   Multiconductor Cables
   Wiring Devices and Plates
   Disconnect Switches
2. Submit complete shop drawings of the following when supplied by the electrical contractor:
   Package #2
   Fuses and/or Circuit Breakers
   Modular Meter Centers
   Surge Protective Devices
   Panelboards and Cabinets
   Package #3
   Lighting Fixtures
   Occupancy Sensors
   Lighting Control Panels
   Time Switches
   Photocells
   Lighting Contactors
   Package #4
   Fire Alarm System
3. Submit test reports as required in section 3.07 - Electrical Testing.

B. All shop drawing approvals required by any code or enforcement authority, insurance underwriter, etc. shall be obtained prior to being submitted to the Engineer.

C. Review of shop drawings by the Engineer does not relieve the Contractor from responsibility for complying with all requirements of the Contract Documents. Furthermore, it shall be the responsibility of the Contractor to coordinate the requirements (roof penetrations, wall penetrations, floor penetrations, curbs, electrical, etc.) of all approved equipment with the other trades and disciplines at no additional cost.

D. All shop drawings shall be identified by the equipment mark or tag identification numbers shown on the Contract Drawings. Each individual submittal item shall be marked to show which specification section pertains to the item.

1.10 COORDINATION OF TRADES

A. The Contractor shall give full cooperation to other trades, and shall furnish all information necessary to permit the work of all trades to be installed satisfactorily and with least possible interference or delay.

B. Work shall not be performed without first coordinating the installation of same with other trades. The Contractor, at his own expense, shall relocate all uncoordinated equipment installed should they interfere with the proper installation and mounting of mechanical equipment, ceilings and other architectural or structural finishes.

C. The Contractor shall coordinate the elevations of all equipment above ceilings and in exposed areas with the work of all other disciplines prior to installation.

D. In areas where more than one trade is required to use common openings in beams, joists, chases, shafts and sleeves for the passage of conduits, raceways, piping, ductwork and other materials, the Contractor must coordinate the positions of all piping and equipment to be furnished under this section so that all items including the materials and equipment of other trades may be accommodated within the space available.

E. The Contractor shall confirm that work installed under this section does not interfere with the clearances required for finished columns, pilasters, partitions, walls or other architectural or structural elements as shown on the Contract Documents.

F. Work that is installed under this Contract which interferes with the architectural design or building structure shall be removed and relocated as required at no additional cost to the Contract.

1.11 WARRANTY

A. All equipment furnished and installed under this Contract shall be provided with the manufacturer’s standard warranty unless otherwise noted.

B. The Contractor shall make good all defects in material, equipment, or workmanship disclosed within a period of one (1) year from date of building acceptance by the Owner. The phrase “make good” shall mean to furnish promptly, without charge, all work necessary to remedy the defects to the satisfaction of the Engineer.

1.12 TEMPORARY LIGHT AND POWER

A. The Contractor shall provide a temporary service of the amperage and voltage required by the Project Manager.

B. Sufficient wiring, outlets and lamps shall be installed to ensure proper lighting in accordance with OSHA, state and municipal codes. Refer to Division 1 specifications for requirements.

1.13 EQUIPMENT REQUIRING ELECTRICAL SERVICE

A. Review all specification sections and drawings including mechanical, plumbing and other equipment drawings and other divisions of the specifications for equipment requiring electrical service. Provide service to and make connections to all such equipment requiring electrical service.

B. Prior to installing material such as electrical equipment, devices, feeders, or branch circuits serving equipment of all other trades, the Contractor shall coordinate with the electrical requirements of the equipment to be installed.

1.14 MECHANICAL SYSTEMS COORDINATION

A. All control wiring for mechanical systems shall be installed under Division 23.

B. Motor controllers (starters) shall be furnished under Division 23 and installed under Division 26, unless specified otherwise.

C. Power wiring to all motors and motor controllers and between motors and controllers shall be provided in Division 26.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS

A. All equipment, materials, accessories, etc. used shall be new and of current production unless specified otherwise. Equipment not specified in the Contract Documents shall be suitable for the intended use and shall be subject to approval by the Engineer.

B. All equipment, products and materials shall be free of defects and shall be constructed to operate in a safe manner without excessive noise, vibration, leakage, or wear.

C. All equipment shall bear the inspection label of Underwriters Laboratories Inc.

D. All equipment and material for similar applications or systems shall be provided from the same manufacturer unless noted otherwise.

E. The published standards and requirements of the National Electrical Manufacturers Association, the American National Standard Institute, the Institute of Electrical and Electronic Engineers, and the American Society of Testing Materials, are made a part of these specifications and shall apply wherever applicable.

2.02 IDENTIFICATION

A. Equipment or devices specified in the individual sections to be identified shall be identified by machine cut stencil unless the equipment is identified by the manufacturer. Identification of flush mounted cabinets and panelboards shall be on the inside of the device. Surface mounted equipment shall be identified on the outside cover. Equipment operating on 208Y/120 volt system shall be identified with black labels with white inner core.

B. All switchboards and panelboards supplied by a feeder shall be stencil-labeled to indicate the equipment where the power supply originates.

PART 3 - EXECUTION

3.01 GENERAL REQUIREMENTS

A. Mounting heights, unless otherwise noted, are to be center line of the equipment and/or device except the mounting height of suspended light fixtures which is to the bottom of fixture.

B. All work shall be designed and installed to comply with the requirements for the seismic design category and use group for the area in which the building is constructed.

3.02 EXCAVATION, TRENCHING & BACKFILLING

A. Contractor shall call underground utilities locator company before digging.

B. Barricades shall be provided around open holes and trenches. Temporary bridges shall be provided over trenches cut through major sidewalk routes. Major sidewalk routes shall not be closed to pedestrian traffic.

C. Barriers shall be provided to protect landscaping adjacent to the excavation area.

D. When rocks, concrete or other debris are encountered during excavation, remove completely.

E. Where sidewalk sections must be removed for installation of underground ducts, remove the sidewalk sections completely from joint to joint.

F. Where asphalt must be removed for installation of underground ducts, saw cut the asphalt in two, straight, parallel lines.

G. Backfill excavations in 6-inch layers and mechanically compact to 98 percent compaction.

H. Excavated materials may be used as backfill only if the backfill is sand or clean dirt that is free of rocks and debris over 3/4" in diameter.

I. In landscaped areas, backfill and mechanically compact to a depth of 6 inches below grade.

J. Backfill the last 6 inches with clean topsoil. Reseed lawn areas.

K. Restore concrete sidewalks and asphalt.

L. The Contractor shall perform all excavation to install the work herein specified and as indicated on drawings. During excavation, material for backfilling shall be piled back from the banks of the trench to avoid overloading and to prevent slides and cave-ins. All excavated materials not to be used for backfill shall be removed and disposed of by the Contractor. Grading shall be done to prevent surface water from flowing into trenches and other excavation and any water accumulating therein shall be removed by pumping. All excavation shall be made by open cut. No tunneling shall be done except under pavement.

M. The bottom of the trenches shall be graded to provide uniform bearing and support for conduits, cables, or duct bank on undisturbed soil at every point along its entire length. Overdepths shall be backfilled with loose, granular, moist earth, and tamped. Remove unstable soil that is not capable of supporting equipment or installation and replace with specified material for a minimum of 12" below invert of equipment or installation.

N. The trenches shall be backfilled with the excavated materials approved for backfilling, consisting of earth, loam, sandy clay, sand and gravel or soft shale, free from large clods of earth and stones, deposited in 6" layers and tamped until the crown of the pipe is covered by a minimum of 6" of tamped earth. The backfill under and beside the pipe shall be compacted for pipe support. Backfill shall be brought up evenly on both sides of the pipe so that the pipe remains aligned. In instances where the manufacturer’s installation instructions for materials are more restrictive than those prescribed by the code, the

material shall be installed in accordance with the more restrictive requirement. The backfilling shall be carried on simultaneously on both sides of the trench so that injurious pressures do not occur. The compaction of the filled trench shall be at least equal to 98% of the maximum density as determined by the Standard Proctor Test. Settling the backfill with water will not be permitted. Reopen any trenches not meeting compaction requirements or where settlement occurs, refill, compact, and restore the surface to the grade and compaction indicated, mounded over and smoothed off. A metallic lined underground warning tape shall be provided 12" below finished grade. The tape shall be red for electrical lines and orange for telephone and shall be identified as to the type of line.

O. Perform excavation and backfilling work in accordance with applicable portions of the earthwork section.

3.03 STORAGE AND PROTECTION OF MATERIALS

A. Refer to the general requirements section of the specifications, Division 1, for storage, protection, and handling requirements.

B. Inspect materials upon arrival at project and verify conformance to Contract Documents. Prevent unloading of unsatisfactory material.

C. Store packaged materials in original undamaged condition with manufacturer’s labels and seals intact.

D. Containers which are broken, opened, watermarked, or otherwise damaged materials are unacceptable and shall be removed from premises.

E. Equipment and materials shall not be installed until such time as the environmental conditions of the job site are suitable to protect the equipment or materials. Equipment or materials damaged or which are subjected to these elements are unacceptable and shall be removed from the premises and replaced.

3.04 CONCRETE WORK

A. Construct curbs, pads, vaults and similar supports for electrical equipment where required.

B. Provide 4" thickness housekeeping pads at floor mounted equipment, covering entire area occupied by equipment. Dowel pads to structural slab.

C. Perform concrete work in accordance with applicable portions of Concrete sections. Minimum compressive strength of concrete shall be same as specified for slabs on grade.

3.05 PAINTING

A. Except as otherwise specified, painting shall be accomplished under Painting Section. Surfaces shall be left clean of debris and free from oil and other substances which would prevent paint bond.

B. Touch up finishes of factory painted apparatus where finish is marred during installation.

C. Where galvanizing is broken during fabrication or installation, recoat exposed areas with cold galvanizing compound.

D. Do not paint over nameplates on equipment, nonferrous hardware, accessories or trim.

3.06 WORKMANSHIP

A. Install systems, materials and equipment level and plumb, parallel and perpendicular to other building systems and components.

3.07 ELECTRICAL TESTING

A. Furnish all labor, materials, instruments, supplies, and services and bear all costs for the accomplishment of the tests herein specified or requested at job site. Correct all defects appearing under test, and repeat the tests until no defects are disclosed, leave the equipment clean and ready for use.

B. All grounds, crosses, shorts, etc., must be eliminated from the wiring. Test all lighting fixtures, together with switches and controls; test the operation of all motors, controllers, and other electrical equipment devices.

C. All feeders shall be Meggar tested. A copy of all test reports shall be given to the Engineer.

D. The Contractor shall perform any tests other than herein specified which may be required by the Engineer or the authority having jurisdiction.

E. Perform the following tests after installation but before energizing the equipment. The following tests and procedures apply to all equipment and material that is to be tested under this Contract.

1. Transformers
   a. Visually inspect all components for damage, check bushings and insulators for cracks; transformer casing for evidence of leakage; pressure, temperature and liquid level gauges for proper indications.
2. Ground Resistance
   a. Visually inspect for specified ground connections.
   b. Perform ground resistance test at all connections to switchboards and panelboards.
   c. Use three point or fall of potential method.
   d. Verify single point connection (at the counterpoise) between the grounded and grounding systems.
   e. Additional ground rod is required if resistance is greater than 25 ohms.
3. Panelboards
   a. Visually inspect all components for damage.
   b. Check operation of circuit breakers/fusible switches.
4. Ground Fault Systems
   a. Visually inspect for damage and improper connections.
5. Transfer and Other Relay Schemes
   a. Investigate intended function and verify correct operation.

F. The Engineer shall be notified immediately of any unfavorable test results or indication of faulty equipment. No piece of equipment shall be energized until the test data is evaluated and the equipment is proven acceptable.

G. If the test and inspection data submitted should indicate deficiencies in the operation of the electrical apparatus or in the manufacturer thereof, the Contractor shall promptly implement the necessary adjustments, corrections, modifications and/or replacements necessary to meet the specified requirements.

3.08 COMMISSIONING

A. The following systems shall be commissioned in accordance with the requirements of the 2016 ASHRAE 90.1:
   1. Occupant Sensor controls
   2. Time Switch controls
   3. Daylight responsive controls

B. Programming of sensors, controls, switches, schedules, VFD operation and other systems shall be set by the installing contractor.

C. The following shall be provided to the building owner or owner representative within 90 days after the date of system acceptance.
   1. Submittals, Shop drawings
   2. Installation instructions, operations and maintenance instructions for each piece of equipment and system installed.
   3. Maintenance schedule
   4. Names and address of at least one service agency.
   5. Lighting controls system maintenance and calibration information, including wiring diagrams, schematics, and control sequence descriptions. Desired or field determined set-points shall be permanently recorded on control drawings at control devices or for digital control systems, in programming comments.
   6. A complete narrative of how each system is intended to operate, including suggested setpoints.

3.09 TRAINING

A. Upon completion of the work, the Contractor shall conduct operation and training session(s) for the Owner's key personnel. These sessions shall be of sufficient length and duration to adequately explain the design intent and proper operating and maintenance techniques for all equipment and systems. After these sessions are completed, the Contractor shall provide a copy of a signed statement by the Owner that his personnel are thoroughly familiar with and capable of operating all equipment and systems.

END OF SECTION

SECTION 26 05 19
CONDUCTORS

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. All work specified herein shall be accomplished in accordance with the applicable requirements of Section 26 00 00 - Electrical General.

1.02 WORK INCLUDED

A. The work under this section shall include all labor, materials, accessories, services and equipment necessary to furnish and install conductors, complete, as indicated on the Drawings and as specified herein. Provide a complete system of wiring with all feeders and branch circuits as shown on the Drawings. The wiring system shall be complete to each and every outlet and apparatus shown on the Drawings which requires electrical connections.

B. This section includes wires, cables, and connectors for power, lighting, signal, control and related systems rated 600 volts or less.

1.03 COLOR CODING

A. Color coding shall be as follows:

120/208 Volt System
Phase A –Black
Phase B – Red
Phase C – Blue
Neutral – White
Ground – Green

(Verify color-coding with local code Authority and use local code requirements if and only if the above color code is not acceptable to local authority.)

B. All wire shall be color coded throughout its entire length. Colored phase tape is not allowed.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturers: Wire shall be Southwire, General Cable, Encore or approved equal.

2.02 CONDUCTORS

A. Conductor Material: Unless noted otherwise, conductors shall be copper, 99% conductivity except where specifically noted otherwise on Drawings.

B. All wire and cable for feeders and branch circuits shall have copper conductors and shall be 600 volts, 90 degrees C, NEC type conductors with THHN/THWN-2/XHHW-2 insulation.

C. Wire No. 8 AWG and larger shall have stranded conductors. Wire No. 10 AWG and smaller shall be solid conductor type.

D. No conductor shall be smaller than No. 12 AWG unless otherwise specified or noted. For wiring within dwelling units, No. 14 AWG is allowed for 15-amp circuits, unless prohibited by the authority having jurisdiction.

E. Branch circuit wiring which supplies more than one fluorescent fixture through the wiring of other fixtures shall be high temperature wire approved for such use.

F. Pulling lubricant is neither required nor allowed for Southwire/SIMpull™ or Encore SuperSlick conductors.

G. Nonmetallic-Sheathed Cable

1. NM cable shall be permitted in one-, two- and multi-family dwellings for building construction types III, IV and V, and where permitted by the local authority.
2. NM cable shall be permitted in other structures of types III, IV, and V construction provided that it is concealed within walls, floors, and/or ceilings that provide a thermal barrier of material that has at least a 15-minute finish rating as identified in listings of fire-rated assemblies.
3. NM cable shall not be installed in areas such as attic spaces within a clubhouse building which do not meet the thermal barrier criteria listed above or in portions of a building defined as assemblies per NEC article 518 with an occupant load of 100 or more people.

2.03 ALUMINUM CONDUCTORS

A. Where substituted for copper conductors, aluminum conductors shall match or exceed copper ampacity.

B. Aluminum conductors shall be compact, AA-8000 series.

C. Aluminum conductors shall not be used for branch circuits, and shall not be installed to any vibrating equipment (e.g. mechanical equipment, transformers, elevators, fire pumps). Minimum rating of feeder size shall be 100 amps.

D. Mechanical screw-type connectors shall comply with the following:

1. Connectors shall be dual rated (AL7CU or AL9CU) and listed by UL for use with aluminum and copper conductors and sized to accept aluminum conductors of the ampacity specified.
2. Using a suitable stripping tool, to avoid damage to the conductors, remove insulation from the required length of the conductor.
3. Wire brush the conductor and apply a listed joint compound.
4. Terminations: Terminations shall be performed using the manufacturers recommended tools, hardware, and procedures. Bolted terminations shall be bolted to torque levels in accordance with equipment manufacturers published data utilizing a torque wrench that has been calibrated and is appropriate for the application. In the absence of connector or equipment manufacturer's recommended torque values, use those specified in UL 486A and UL 486B.
5. Wipe off any excess joint compound.

E. For connection to aluminum bus, the following hardware shall be used:

1. Bolts: Anodized alloy 2024-T4 and conforming to ANSI B18.2.1 and to ASTM B211 or B221 chemical and mechanical property limits.
2. Nuts: Aluminum alloy 6061-T6 or 6262-T9 and conforming to ANSI B18.2.2.
3. Washers: Flat aluminum alloy 2024-T4, Type A plain, standard wide series conforming to ANSI B27.2.
4. Terminations: Terminations shall be performed using the manufacturers recommended tools, hardware, and procedures. Bolted terminations shall be bolted to torque levels in accordance with equipment manufacturers published data utilizing a torque wrench that has been calibrated and is appropriate for the application. In the absence of connector or equipment manufacturer's recommended torque values, use those specified in UL 486A and UL 486B.

F. For connection to copper bus, the following hardware shall be used:

1. Bolts: Plated or galvanized medium carbon steel; heat treated, quenched and tempered equal to ASTM A-325 or SAE grade 5.
2. Nuts: Heavy semi-finished hexagon, conforming to ANSI B18.2.2, threads to be unified coarse series (UNC), class 2B.
3. Washers: Should be steel, Type A plain standard wide series conforming to ANSI B27.2.
4. Belleville conical spring washers: shall be of hardened steel, cadmium plated or silicone bronze.
5. Terminations: Terminations shall be performed using the manufacturers recommended tools, hardware, and procedures. Bolted terminations shall be bolted to torque levels in accordance with equipment manufacturers published data utilizing a torque wrench that has been calibrated and is appropriate for the application. In the absence of connector or equipment manufacturer's recommended torque values, use those specified in UL 486A and UL 486B.

G. Aluminum conductors shall not be used where expressly forbidden by the local electrical inspections department or plan review board of jurisdiction. The electrical contractor shall verify this requirement prior to bid.

H. Aluminum conductors shall not be connected to equipment which is not UL Listed for aluminum.

I. Service entrance cable, Type SE (THHN/THWN-2/XHHW-2), Style SER, 600 volt, aluminum alloy shall be permitted as unit panel feeder in multifamily dwellings.

2.04 METAL CLAD "MC" CABLE

A. Where allowed by the authority having jurisdiction, the use of metal clad cable is permitted as described below and shall meet all the requirements of the following codes and standards:

1. Underwriters Laboratories Inc. 44, 83, 1479, 1569, 1581, 2556
2. National Fire Protection Association NFPA 70, Article 330
3. All local codes and municipal ordinances.

B. The conductors of the metal clad cable shall comply with Articles 1.03 and 2.02 of this same section.

C. Unless noted otherwise on drawings, MC cable shall be limited to branch circuits concealed in walls, above ceilings and within electrical rooms. For MC cable circuits powered from a surface-mounted panelboard, cable homeruns shall be installed to a metal wireway above the panelboard, and conductors (without armor) shall be routed within metal conduit(s) from wireway to panelboard. Ampacity adjustment factors are not necessary for conduit lengths of 24" or less.

D. MC cable shall not be allowed for wiring to mechanical equipment, except for within the dwelling units.

E. Unless noted otherwise, the metal clad cable shall be **MC** with either a galvanized steel jacket or aluminum interlocked armor, a UL 1569 binder tape, with either a green insulated grounding conductor or MCI-A type cable with interlocked armor that is listed and identified for grounding, and rated for a maximum of 600 volts.

F. Where indicated, the metal clad cable shall be a **Jacketed Metal Clad and Parking Deck Cable** with a black or gray PVC covering, using solid copper conductors, a Mylar assembly covering tape, rated at 90 degrees centigrade, with a green insulated grounding conductor and rated for a maximum of 600 volts.

G. Refer to National Electrical Code Article 330 for uses not permitted.

H. Cables installed in other than vertical runs through bored or punched holes in wood or metal framing members, or through notches in wooden framing members and protected by a steel plate at least 1/16 inches thick, shall be considered supported and secured where such support does not exceed six (6) feet intervals.

I. Cables containing four or fewer conductors sized not larger than No. 10 AWG shall be secured within 12 inches of every box, cabinet, fitting or other cable termination.

J. Metal clad cable (Type MC), where installed in wet and damp locations, shall be rated for the condition of use and by written authorization from the project Engineer.

2.05 ACCESSORIES

A. Wire Joints: T & B “Sta-Kon,” Scotchlok Type “R,” Ideal No. 452 or 453, or Buchanan “B-Cap.”

B. Cable Connectors: Solderless Type O.Z. “circular clamp type” or T & B “lock-tite” appropriate for the particular application involved.

PART 3 - EXECUTION

3.01 PREPARATION

A. Lubricant: No grease, oil or lubricant other than powdered soapstone or approved pulling compound shall be used to facilitate the pulling of wires. Lubricant shall not be used for conductors with SIMpull™ insulation.

3.02 INSTALLATION

A. Complete electrical systems shall be provided as shown on the Drawings and/or as specified herein.

B. Wires shall be pulled without excessive strain to prevent damage to conductor or insulation. Provide pull boxes as required to facilitate pulling of wire.

C. Prior to energizing, all service and feeder cables shall be tested with megohm meter to determine insulation resistance levels. Test report shall be submitted to the Engineer.

D. Each raceway indicated by symbol on Drawings shall contain three (3) No. 12 AWG wires unless otherwise noted, scheduled or indicated. Hatch marks on raceway symbols indicate the number of conductors in a raceway when the number exceeds three (3).

E. At each fixture or device outlet, a loop or end of wire not less than 6" long shall be left for connection to fixture or device.

F. Splices, taps and connections shall be made up as follows:

1. Wire sizes No. 10 AWG and smaller with wire nuts.
2. Wire and cable of sizes No. 8 AWG and larger, with insulated mechanical or crimped connectors.

G. Perform conductor tests as described in Section 26 00 00 - Electrical General.

END OF SECTION

SECTION 26 05 26
GROUNDING

PART 1 - GENERAL

1.01 DESCRIPTION

A. The work required under this section of the Specifications consists of furnishing, installation and connections of the building grounding system. Exterior branch circuit wiring and feeder conductors extended beyond the building are included. The building electrical system shall be single-phase, 3-wire grounded delta system supplemented with equipment grounding system. Equipment grounding system shall be established with equipment grounding conductors; the use of metallic raceways for equipment grounding is not acceptable.

1.02 REGULATORY REQUIREMENTS

A. Install a complete grounding system in accordance with the National Electrical Code.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Provide all materials under this section of the specifications.

B. All materials shall be new, UL Listed, and bear a UL Label.

C. Refer to Section 26 05 19 - Conductors for conductor specification.

2.02 GROUNDING CONDUCTORS

A. Grounding electrode conductor shall be bare or green insulated copper conductor sized as indicated on the Drawings.

B. Equipment grounding conductors shall be green insulated conductors sized as indicated on the Drawings. Where size is not indicated on the Drawings, conductor size shall be determined from the National Electrical Code table on sizes of equipment grounding conductors.

C. Bonding jumpers shall be flexible copper bonding jumpers sized in accordance with the National Electrical Code tables for grounding electrode conductors.

2.03 PANELBOARDS, TRANSFORMERS, AND DISCONNECT SWITCHES

A. Provide each low voltage distribution and branch circuit panelboard with a copper equipment grounding bar brazed or riveted to the associated enclosures or cabinet and an insulated neutral bar.

B. Provide a conductor termination grounding lug bonded to the enclosure of each equipment item.

2.04 DEVICES

A. Each receptacle and switch device shall be furnished with a grounding screw connected to the metallic device frame.

2.05 GROUND RODS

A. Ground rods shall be 3/4" x 10'-0" copper clad steel.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Ground all non-current carrying parts of the electrical system including raceways, equipment frames and enclosures, outlet boxes, junction boxes, and other conductive material in close proximity with electrical circuits.

B. Service entrance and separately derived electrical systems, grounding electrode system

1. The grounded conductor(s) of the electrical service serving the premises wiring system shall be connected to the neutral bus bar in the service equipment which shall be grounded to the cold water system, the ground rod system, and other grounding electrodes specified herein or indicated on the Drawings. Grounding electrode conductors shall be installed rigid, nonmetallic conduit to point of ground connection, unless subject to physical damage in which case it shall be installed in galvanized rigid steel.
2. Make connection to main water line entering the building. Make connections ahead of any valve or fittings whose removal may interrupt ground continuity.
3. Bond together the following systems to form the grounding electrode system. All system connections shall be made to the electrodes as close as possible to the service entrance equipment and each connected at the service entrance equipment neutral bus. Do not connect electrode systems together except at neutral bus.
   a. Cold water piping system
   b. Ground rod system
   c. Rebar in concrete footing
4. Ground the neutral of all dry type transformers to either building steel or a common grounding electrode conductor connected to a service ground. Transformers shall be bonded to the nearest available point on the interior water piping system. In reinforced concrete structures building steel shall be considered to be reinforcing steel of vertical columns.
5. Grounding electrode connections to structural steel, reinforcing bars, ground rods, or where indicated on the Drawings shall be with chemical exothermic weld connection devices recommended for the particular connection type. Connections to piping shall be with UL Listed mechanical ground clamps.
6. Where there is more than one service to a building or interconnected buildings, services shall be connected by means of a grounding electrode conductor.
7. Bonding shall be in accordance with the National Electrical Code.
8. Install ground rods where indicated on the Drawings with the top of the ground rods 12 inches below finished grade.

C. Equipment Grounding Conductor

1. Grounding conductors for branch circuits are not shown on the Drawings; however, grounding conductors shall be provided in all branch circuit raceways and cables.
2. Grounding conductors for feeders are typically indicated on the Drawings and the raceway is sized to accommodate grounding conductor shown. Where grounding conductor size is not indicated on the Drawings, conductor shall be in

accordance with the equipment grounding conductor table of the National Electrical Code.

D. Other Grounding Requirements

1. Each telephone backboard shall be provided with a No. 6 grounding conductor. When backboard is located in vicinity of electrical service equipment, the “point of grounding” of this conductor shall be the main cold water service with connections made ahead of any valves or joints. Remote backboards shall use building steel as “point of ground.” Terminate conductor by stapling to backboard.
2. At each building expansion joint flexible copper bonding jumpers shall be attached to building structure by chemical weld process. Install bonding jumpers in concealed locations that will not subject connections or jumpers to physical abuse. Install 100' on centers across expansion joints.

3.02 TESTING

A. Upon completion of the ground rod installation, the Contractor shall test the installation in accordance with the “Electrical Testing” section of Section 26 00 00 - Electrical General. Grounding resistance reading shall be taken before connection is made to the building cold water piping system. Ground resistance readings shall not be taken within 48 hours of rainfall.

END OF SECTION

SECTION 26 05 30
FIRESTOPPING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. Applicable requirements of Division 26 shall be considered a part of this section and shall have the same force as if printed herein full.

B. This document describes the products and execution requirements relating to Firestopping for Electrical Systems.

C. Product specifications, general design considerations, and installation guidelines are provided in this document. Typical firestopping installation details will be provided on Drawings as an attachment to this document. If the bid documents are in conflict, the Drawings shall take precedence. The successful Contractor shall meet or exceed all requirements described in this document.

1.02 WORK INCLUDED

A. The work included under this Specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the Specification or not.

B. The work shall include, but not be limited to the following:

1. Furnish and install all Firestopping Materials.

PART 2 - PRODUCTS

2.01 APPROVED PRODUCTS

A. Approved Firestopping manufacturer(s)

1. FlameStopper Thru-Wall Fitting - Wiremold Company (Firestop Devices)
2. Tremco Inc. (Firestop Cast in Place Sleeves, Caulks, QuickComm Sleeves, QuickComm Units, Pillows, Putty Pads, Outlet Box Inserts, Silicone, Composite Sheets, Collars, Devices)
3. STI Firestop Products (Firestop Devices, Putties, Caulks, Sealants, etc.)
4. Hilti (Putties, Caulks, Sealants, etc.)

2.02 TYPES OF PRODUCTS

A. Firestop Products

1. Intumescent Firestop Sealants and Caulks
2. Acrylic Firestop Sealant and Caulks
3. Silicone Firestop Sealants and Caulks
4. Cast in Place Devices
5. Firestop Putty, Putty Pads
6. Outlet Box Inserts

7. QuickComm Sleeves
8. TREMstop Straps
9. Firestop Collars
10. Wrap Strips
11. Firestop Mortar
12. Firestop Pillows
13. Accessories: Forming/Damming Materials: Mineral Wool, Backer Rod or other type as per manufacturer recommendation.

B. Firestop Devices

1. Thru-Wall Fitting (FlameStopper by Wiremold)
   a. The firestop device box shall be constructed of 16-gauge G90 steel.
   b. The firestop device intumescent block shall be constructed of a graphite base material with expansion starting at 375 degrees F and an unrestrained expansion between 6 to 12 times. The intumescent block shall be held securely by the box in order to prevent tampering and damage during installation.
   c. The firestop device shall have doors which can be adjusted to prevent materials from penetrating the device if the device is empty or completely full. The doors shall be constructed of 16-gauge G90 steel with No. 10-32 screws use to adjust opening size.
   d. The firestop device shall be available for 2" and 4" trade size EMT conduit.
   e. The firestop device shall be available in safety yellow powder coat, custom colors and an unpainted galvanized finish.
2. Fire Rated Cable Pathway (STI EZ-PATH)
   a. Fire rated cable pathway device modules shall be comprised of steel raceway with intumescent foam pads allowing 0 - 100% cable fill.
3. Tremco (QuickComm Unit) 24" x 12" or 34" x 18"
   a. Fire rated steel frame with an intumescent channel. UL Tested for large openings with 100% visual cable fill. UL Tested for Concrete Floors, Block Walls, Dry Walls and Hollow Core Floors.
4. Tremco (QuickComm Sleeve)
   a. Fire rated steel sleeve with an intumescent inner sleeve. UL Tested for Concrete Floors, Block Walls, Dry Walls, Hollow Core and Fluted Decks.

2.03 UL CLASSIFICATION

A. Thru-Wall Fitting: The firestop device for use in through-penetration firestop systems shall have been examined and tested by Underwriters Laboratories Inc. to UL1479 (ASTM E 814 & ASTM E 84).

B. Threaded, Smooth and Split-Sleeve Firestop Devices: Firestopping sealants and devices shall be used together as a firestop system. All firestop systems shall bear a UL Classification system number.

C. QuickComm Sleeve: Firestop Sleeve for use in through penetration firestop systems. Shall be tested by Underwriters Laboratories Inc. or a recognized Testing Laboratory for through penetration fire stopping applications.

D. QuickComm Unit: Intumescent Firestopping Unit for use in large openings for firestopping for cables, Fiber optic, Power Control, Telecommunications

1. Threaded Firestop System

a. Block Wall - W-J-3049
b. Dry Wall - W-L-3138

2. Threaded Firestop System (Vertical)
   a. Slab - F-A-3010
3. Smooth Firestop System
   a. Block Wall - W-J-3048
   b. Dry Wall - W-L-3137
4. Split-Sleeve Firestop System
   a. Block Wall - W-J-3047
   b. Dry Wall - W-L-3136
5. Tremco QuickComm Sleeve
   a. Block Wall- C-AJ-0123, C-AJ-2580, C-AJ-3270
   b. Dry Wall- WL-0025, WL-2418, WL-3318
   c. Concrete Floor- C-AJ-0123, C-AJ-2580, C-AJ-3270
   d. Fluted Deck- C-AJ-0123
   e. Hollow Core- C-AJ-0123, C-AJ-2580, C-AJ-3318
6. Tremco QuickComm Unit
   a. Dry Wall- WL-3319, WL-4070
   b. Concrete Floor- F-A-3035, F-A-4006

2.04 FIRESTOPPING SYSTEMS

A. Thru-Wall Fitting Firestop System

1. The device shall be classified for use in one-, two-, three-, and four-hour rated gypsum, concrete and block walls and provide an L rating of less than 5 cfm. The device shall also be tested by Underwriters Laboratories Inc. to UL2043 and determined to be suitable for use in air handling spaces.

B. Threaded, Smooth and Split-Sleeve Firestop Systems

1. Shall conform to both Flame (F) and Temperature (T) ratings as required by local building codes and as tested by nationally accepted test agencies per ASTM E814 and ASTM E 84 (UL 1479) fire tests in a configuration that is representative of field conditions.
2. The F rating must be a minimum of one (1) hour but not less than the fire resistance rating of the assembly being penetrated. T rating when required by code authority shall be based on measurement of the temperature rise on penetrating item(s). The fire test shall be conducted with a minimum positive pressure differential of 0.01 inches of water column.

C. Firestopping materials and systems must be capable of closing or filling through-openings created by the burning or melting of combustible pipes, cable jacketing, or pipe insulation materials.

D. Firestopping material shall be asbestos and lead free and shall not incorporate nor require the use of hazardous solvents.

E. Firestopping sealants must be flexible, allowing for normal pipe movement.

F. Firestopping materials shall not shrink upon drying as evidenced by cracking or pulling back from contact surfaces.

G. Firestopping materials shall be moisture resistant, and may not dissolve in water after curing.

H. Firestopping material shall be installed inside the cavity of the wall as shown by the annular space requirements in the UL Tested System.

PART 3 - EXECUTION

3.01 CONDITIONS REQUIRING FIRESTOPPING

A. General

1. Provide firestopping for conditions specified whether or not firestopping is indicated, and if indicated, whether such material is designed as insulation, safing, or otherwise.

B. Through-Penetrations

1. Firestopping shall be installed in all open penetrations and in the annular space in all penetrations in any bearing or non-bearing fire-rated barrier.

C. Membrane-Penetrations

1. Where required by code, all membrane-penetrations in rated walls shall be protected with firestopping products that meet ASTM E 814 and ASTM E 84 Test requirements.

D. Smoke-Stopping

1. As required by the other sections, smoke-stops shall be provided for through-penetrations, membrane-penetrations, and construction gaps with a material approved for the ASTM E 136 Standards.

3.02 EXAMINATION

A. Examine the areas and conditions where firestops are to be installed and notify the Architect of conditions detrimental to the proper and timely completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected.

B. Verify that environmental conditions are safe and suitable for installation of firestop products.

C. Verify that all pipes, conduit, cable, and other items that penetrate fire-rated construction have been permanently installed prior to installation of firestops.

3.03 INSTALLATION

A. General

1. Through Penetration firestop submittals showing each UL Rated Assembly shall be located in the general Contractor’s trailer for Inspection purposes.
2. Installation of firestops shall be performed by an applicator/installer qualified and trained by the manufacturer. Written documentation stating training done on the specific project shall be supplied to the General Contractor for inspection purposes. Installation shall be performed in strict accordance with manufacturer’s detailed installation procedures.

3. Apply firestops in accordance with UL Tested Systems, fire resistance requirements, acceptable sample installations, and manufacturer's recommendations.
4. Unless specified and approved, all insulation used in conjunction with through-penetrants shall remain intact and undamaged and may not be removed.
5. Seal holes and penetrations to ensure an effective smoke seal. In areas of high traffic, protect firestopping materials from damage. If the opening is large, install firestopping materials capable of supporting the weight of a human.
   a. Insulation types specified in other sections shall not be installed in lieu of firestopping material specified herein.
   b. All combustible penetrants (e.g. non-metallic pipes or insulated metallic pipes) shall be firestopped using products and systems tested in a configuration representative of the field condition.

B. Dam Construction

1. When required to properly contain firestopping materials within openings, damming or packing materials may be utilized. Combustible damming material must be removed after appropriate curing. Noncombustible damming materials may be left as a permanent component of the firestop system.

3.04 FIELD QUALITY CONTROL

A. Preconstruction meeting shall take place to address firestopping systems to be installed.

B. Prepare and install firestopping systems in accordance with UL Tested System and manufacturer's printed instructions and recommendations.

C. Follow safety procedures recommended in the Material Safety Data Sheets.

D. Finish surfaces of firestopping that are to remain exposed in the completed work to a uniform and level condition.

E. All areas of work must be accessible until inspection by the applicable Code Authorities.

F. Correct unacceptable firestops and provide additional inspection to verify compliance with this Specification.

3.05 CLEANING

A. Remove spilled and excess materials adjacent to firestopping without damaging adjacent surfaces.

B. Leave finished work in a neat and clean condition with no evidence of spillovers or damage to adjacent surfaces.

END OF SECTION

SECTION 26 05 31
SEISMIC RESTRAINT OF ELECTRICAL SYSTEMS COMPONENTS

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. This document describes the design, products and execution requirements relating to seismic restraint of required electrical system components.

B. Applicable Codes:
1. Florida Building Code 2020 and ASCE 7-10
2. NFPA 70 – National Fire Protection Association (National Electrical Code)

1.02 WORK INCLUDED

A. The work included under this Specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation.

B. To comply with Design Category C requirements, the work shall include, but not be limited to, the following:

1. For electrical system components with importance factor (*Ip*) of 1.5, and associated with emergency and legally required standby power systems, design, furnish and install all seismic restraint supports and devices. Components (where applicable) include electrical equipment, conduits, busways, cable trays, generators, and emergency/egress lighting fixtures.

1.03 SUBMITTALS

A. Provide Seismic Design Force calculations per ASCE 7 by a registered professional engineer licensed to practice in the state where the project is located. Submit pre-approved restraint selections and installation details from Manufacturers Seismic Restraints catalog (SRS-02).

B. Shop drawings of seismic restraint designs shall be submitted, indicating location of all seismic supports, devices, etc. required for electrical system components, including the following:

1. All vertical support and seismic brace locations
2. All anchorage connections to structure (brand, type, quantity and size)
3. Applicable installation details

1.04 QUALITY ASSURANCE

A. Prior to the commencement of work, the contractor responsible for the construction of the “designated seismic system” shall submit to the authority having jurisdiction and owner a written “statement of responsibility” per IBC Chapter 17, acknowledging special requirements contained in the statement of special inspection (issued by project structural engineer).

B. Contractor shall provide a certificate of completion from the manufacturer’s representative upon completion of work.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. International Seismic Application Technology

B. Amber/Booth

C. Mason Industries

D. B-Line

E. Approved alternates

2.02 PRODUCT SUITABILITY

A. All products (cables, clamps, vibration isolators, hangers, etc.) shall be listed and tested, and shall be appropriate for its intended use.

B. All steel products installed outdoors shall be galvanized.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Seismic Restraint of Piping:

1. All seismic restraint systems shall be installed in strict accordance with the manufacturer's seismic restraint guidelines manual and all certified submittal data, including verification of proper torques.
2. Transverse piping restraints shall be at 40-foot maximum spacing for all pipe sizes, except where lesser spacing is required to limit anchorage loads.
3. Longitudinal restraints shall be at 80-foot maximum spacing for all pipe sizes, except where lesser spacing is required to limit anchorage loads.
4. Transverse restraint for one pipe section may also act as a longitudinal restraint for a pipe section of the same size connected perpendicular to it if the restraint is installed within 24-inches of the elbow or tee or combined stresses are within allowable limits at longer distances.
5. Hold down clamps must be used to attach pipe to all trapeze members before applying restraints.
6. Branch lines may not be used to restrain main lines.
7. Provide reinforced clevis bolts when required.
8. Piping crossing building seismic or expansion joints, passing from building to building, or supported from different portions of the building, shall be installed to allow differential support displacements without damaging the pipe, equipment connections, or support connections. Pipe offsets, loops, anchors, and guides shall be installed as required to provide specified motion capability and limit motion of adjacent piping.
9. Do not brace a system to two independent structures such as ceiling and wall.
10. Provide appropriately sized openings in walls, floors, and ceilings for anticipated seismic movement. Provide fire seal systems in fire-rated walls.

B. Seismic Restraint of Electrical Services

1. All seismic restraint systems shall be installed in strict accordance with the manufacturer's seismic restraint guidelines manual and all certified submittal data, including verification of proper torques.
2. Installation of seismic restraints shall not cause any change in position of equipment or piping, resulting in stresses or misalignment.
3. No rigid connections between equipment and the building structure shall be made that degrade the noise and vibration-isolation system specified.
4. Do not install any equipment, piping, duct, or conduit that makes rigid connections with the building unless isolation is not specified.
5. Prior to installation, bring to the architect's/engineer's attention any discrepancies between the specifications and the field conditions, or changes required due to specific equipment selection.
6. Bracing may occur from flanges of structural beams, upper truss cords of bar joists, cast-in-place inserts, or wedge-type concrete anchors. Consult structural engineer of record.
7. Overstressing of the building structure shall not occur from overhead support of equipment. Bracing attached to structural members may present additional stresses. The contractor shall submit loads to the structural engineer of record for approval in this event.
8. Brace support rods when necessary to accept compressive loads. Welding of compressive braces to the vertical support rods is not acceptable.
9. Provide reinforced clevis bolts where required.
10. Seismic restraints shall be mechanically attached to the system. Looping restraints around the system is not acceptable.
11. Do not brace a system to two independent structures such as a ceiling and wall.
12. Provide appropriately sized openings in walls, floors, and ceilings for anticipated seismic movement. Provide fire seal systems in fire-rated walls.

END OF SECTION

SECTION 26 05 33
CONDUIT AND RACEWAYS

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. This section covers the complete interior and exterior conduit system.

B. All work specified herein shall be accomplished in accordance with the applicable requirements of Section 26 00 00 - Electrical General.

1.02 STANDARDS

A. Industry Standards

1. Underwriters Laboratories Inc. (UL) Publications
   - No. 1: Standard for Flexible Metal Conduit
   - No. 6: Standard for Rigid Metal Conduit
   - No. 467: Standard for Grounding and Bonding Equipment
   - No. 651: Standard for Schedule 40 and 80 Rigid PVC Conduit
   - No. 797: Electrical Metallic Tubing - Steel
   - No. 1242: Standard for Electrical Intermediate Metal Conduit - Steel
2. American National Standards Institute (ANSI)
   - C-80.1: Rigid Galvanized Conduit
   - C-80.3: Electrical Metallic Tubing

1.03 WORK INCLUDED

A. The work under this section shall include all labor, materials, accessories, services and equipment necessary to furnish and install conduits and raceways, complete, as indicated on the Drawings and as specified herein.

B. Other manufacturers of equal quality and performance may be submitted to the Engineer for review. When substitution of equipment is made, the Contractor shall be responsible for the costs of any item and engineering and construction revisions necessary in his or any other contract or trade that may be required to satisfy plans and specifications.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Approved Manufacturers

1. Metallic Conduit Fittings
   a. Thomas and Betts
   b. Appleton
   c. RACO
   d. Crouse Hinds
   e. Steel City
2. Support Channel
   a. Unistrut
   b. Kindorf
3. Non-metallic Conduit Fittings
   a. Carlon

b. Georgia Pipe Company

4. Rigid, IMC or Flexible Conduit
   a. Allied
   b. Republic
   c. Triangle
   d. Wheatland
   e. Youngstown
   f. Southwire
5. Flexible Conduit (PVC Conduit)
   a. Anaconda “Sealtite”
   b. Robroy
   c. Southwire
6. Electrical Metallic Tubing
   a. Steeltubes
   b. National
   c. Wheatland
   d. Allied
   e. Triangle
   f. Youngstown
7. Plastic PVC
   a. Carlon
   b. Georgia Pipe Company
8. Pull Box Manufacturer(s)
   a. Hoffman
   b. OZ Gedney
   c. Or Approved Equal
9. Approved Marker Tape Manufacturer(s)
   a. William Frick & Associates
   b. Or Approved Equal
10. Approved Maintenance Hole/Handhole Manufacturer(s)
   a. Old Castle
   b. Pencell (Handholes Only)
   c. Quazite (Handholes Only)
   d. Or Approved Equal
11. Approved Conduit Plug/Cap Manufacturer(s)
   a. Jack Moon
   b. Or Approved Equal

2.02 CONDUIT FITTINGS

A. Electrical metallic tubing (EMT) couplings and connectors shall be steel. Malleable iron, pressure cast or die cast fittings are not permitted.

B. Fittings and couplings shall be set-screw type and/or compression type per 3.01 13. Steel set screw type for 2.5" conduit and larger shall have 2 screws for connectors and 4 screws for couplings. All connectors shall be insulated throat type.

C. Rigid steel and IMC couplings and connectors shall be standard threaded couplings, locknuts, bushings and elbows. All materials shall be steel. Erickson-type couplings may be used to complete a conduit run.

2.03 NON-METALLIC CONDUIT AND FITTINGS

A. Non-metallic conduit shall be heavy wall, Schedule 40 PVC. Electrical non-metallic tubing (ENT) shall be allowed within dwelling units.

B. Couplings and connectors for non-metallic conduit shall be of the same material and be the product of the same manufacturer of the conduit furnished.

C. PVC conduit for concrete encasement shall be Type EB, UL Labeled for 90 degrees C cables. Fittings shall be Type EB, solvent type, and from the same manufacturer as the conduit.

D. Concrete shall have a minimum strength of 2,500 psi at 28 days.

2.04 CONDUIT SUPPORT

A. Individual conduit hangers shall be galvanized spring steel specifically designed for the purpose and sized appropriately for the conduit type and diameter. Support individual conduits 1-1/2" and smaller with 1/4" threaded steel rods and use 3/8" rods for 2" and larger.

B. Conduit support channels shall be 14-gauge galvanized (or equivalent treatment) channel sized for the amount of conduit to be supported. Channel suspension shall be 3/8" threaded steel rods. Conduit straps shall be spring steel type compatible with channel.

C. Conduit straps shall be single-hole cast metal type or two-hole galvanized metal type. Conduit clamps shall be spring steel type for use with exposed structural steel.

2.05 RIGID METALLIC CONDUIT, INTERMEDIATE METALLIC CONDUIT, AND ELECTRICAL METALLIC TUBING

A. Rigid metallic conduit and intermediate metallic conduit shall be steel and standard thread.

B. Electrical metallic tubing (EMT) shall be steel.

2.06 RIGID METALLIC, INTERMEDIATE METALLIC, AND FLEXIBLE CONDUIT AND FITTINGS

A. Rigid metallic conduit and intermediate metallic conduit shall be steel and standard thread.

B. Flexible conduit shall be steel or aluminum type classified for system grounding.

C. Connectors for flexible conduit shall be insulated throat type rated as suitable for system ground continuity.

D. Flexible conduit used for other than connections to lighting fixtures shall not be less than 1/2" trade size. 3/8" flexible conduit may be used for connection to lighting fixtures when sized according to the National Electrical Code.

E. Flexible conduit used in damp or wet locations shall be liquid tight.

2.07 PULL BOXES

A. Pull boxes shall be constructed of galvanized steel with flat, removable covers fastened with plated steel screws.

B. Pull boxes shall be equipped with keyhole screw slots in the cover to permit removal of the cover without extracting the screws.

C. Pull boxes shall have provisions for grounding.

2.08 MAINTENANCE HOLES/HANDHOLES

A. Maintenance Holes

1. Maintenance holes shall be pre-cast or cast-in-place concrete with a strength of 3,500 psi at 28 days, and steel reinforced.
2. Maintenance holes shall include a cast iron frame with cover, a hot dipped galvanized steel ladder, and hot dipped galvanized pulling eyes embedded in the concrete opposite each duct entrance and in the floor beneath the cover.
3. Maintenance holes shall be equipped with grounding busbar.
4. Maintenance holes shall be equipped with racking for cable storage.
5. Ground splices and connections at maintenance holes shall be exothermic welds, copper or bronze compression ground fittings, or bolted compression ring lugs.
6. The cover for electrical maintenance holes shall have the lettering, “POWER” or “ELECTRIC.”
7. The cover for low voltage maintenance holes shall have the lettering, “COMMUNICATIONS.”

B. Handholes

1. Handholes shall be non-conductive and shall not require grounding for safety. Handholes shall be unaffected by freeze/thaw and resistant to sunlight and chemicals. Handholes shall be pre-cast polymer concrete, heavy duty rated and bottomless.
2. Handholes shall be equipped with racking for cable storage.
3. Electrical handholes shall have the word “POWER” or “ELECTRIC” molded in the cover by the manufacturer. The cover shall be attached with penta-head stainless steel bolts.
4. Low voltage handholes shall have the word “COMMUNICATIONS” molded in the cover by the manufacturer. The cover shall be attached with penta-head stainless steel bolts.
5. Handholes shall be able to withstand 10,000 lbs minimum.
6. See Drawings for handhole dimensions and locations.

2.09 CONDUIT PLUGS/CAPS

A. Conduit Plugs/Caps

1. Conduit plugs shall provide a watertight seal at exposed ends of conduits.
2. Conduit plugs shall be conduit size specific.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General

1. Minimum size for electrical conduits shall be 1/2" trade size.
2. Minimum size for low voltage conduits shall be 3/4" trade size.
3. Conceal all conduits, except in unfinished spaces such as equipment rooms or as indicated by symbol on the drawings.
4. Leave all empty conduits with a 200 pound test nylon cord pull line.
5. Flattened, dented, or deformed conduits are not permitted and shall be removed and replaced.

6. Fasten conduit support device to structure with wood screws on wood, toggle bolts on hollow masonry, anchors as specified on solid masonry or concrete, and machine bolts, clamps, or spring steel clips, on steel.
7. Protect conduits against dirt, plaster, and foreign debris with conduit caps or plugs, which shall remain in place until all masonry is complete. Protect conduit stub-ups during construction from damage; any damaged conduits shall not be used and are to be replaced.
8. All feeder conduits shall be cleared of any dirt, foreign debris, etc.
9. Install conduit with wiring, including homeruns as indicated on the drawings. Any change resulting in a savings in labor or materials is to be made only in accordance with a Contract change. Deviations shall be made only where necessary to avoid interferences and when approved by Engineer by written authorization.
10. Conduits which penetrate roof membranes shall be installed in accordance with manufacturer's recommendations and architectural specifications.
11. Seal all conduits entering building from below grade, all conduits entering refrigerated spaces i.e. freezers and coolers, and all conduits entering exterior mounted electrical equipment with insulating electrical putty to prevent entrance of moisture.
12. Separate raceway systems are to be installed for power systems and for control, signal and communications systems. Do not install control, signal or communications cables in the same raceways as branch circuit or feeders cables, unless indicated otherwise on the drawings.
13. Conduit fittings shall be set screw type for dry, indoor environments. Conduit fittings shall be gland and ring compression type for all conduit exposed to outdoor environments or wet locations.
14. Conduit shall be run parallel or at right angles to walls, ceilings, and structural members.
15. Support conduits at intervals not exceeding ten feet and within three feet of each outlet, junction box, fitting, panelboard, enclosure or cabinet. Support conduits from structural steel members with spring steel type or beam conduit clamps and to non-metallic structural members with one-hole conduit straps. For exposed conduits and where conduits must be suspended below structure, single conduit runs shall be supported from structure by hanger rod and conduit clamp assembly, and multiple conduits shall be supported by trapeze type support suspended from structure. Do not attach conduits to ceiling suspension system channels or suspension wires.
16. Attach feeder conduits larger than one inch trade diameter to or from structure on intervals not exceeding twelve feet with conduit beam clamps, one-hole conduit straps or trapeze type support.
17. Where conduits must pass through structural members obtain approval of Architect.
18. Install all conduits or sleeves penetrating or routed within rated fire walls or fire floors to maintain fire rating of wall or floor. Conduit shall not be installed in rated floors or walls if it compromises or violates the fire rating of floor or wall. Refer to architectural documents.
19. Provide expansion and deflection coupling where conduit passes over a building expansion joint.
20. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.
21. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot water pipes. Install horizontal raceway runs above water and steam piping.
22. Telephone and signal system raceways: 2" trade size and smaller: In addition to above requirements, install raceways in maximum lengths of 150 feet and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements.

23. Conduit shall be installed for feeders on the supply side of any panelboard(s) supplying branch circuits for pools, spas or hot tubs.

B. Uses Permitted

1. Conduits installed within concrete floor slabs shall be galvanized rigid steel (GRS), intermediate metal conduit (IMC), Schedule 40, heavy wall PVC, or electrical non-metallic tubing (ENT).
2. Conduit run exterior exposed: Galvanized rigid steel (GRS) or intermediate metal conduit (IMC).
3. Conduits in direct contact with earth shall be Schedule 40, heavy wall PVC. Elbows for underground conduits greater than 200' in length shall be galvanized rigid steel (GRS), or electrical metallic tubing (EMT) if elbows are concrete encased. Service entrance conduits installed exposed, or concealed in walls or above ceilings, shall be galvanized rigid steel (GRS) or intermediate metal conduit (IMC). Unless indicated otherwise, service entrance conduits shall be installed “outside” of the building as defined by the NEC. Provide concrete encasement where required or as indicated on drawings.
4. All other conduit, unless specified herein, not permitted in accordance with the NEC, or otherwise indicated on the drawings, shall be electrical metallic tubing (EMT). PVC conduit is not allowed in exposed or concealed areas, but only within concrete or below grade. Feeder or branch circuit conduits that emerge from a floor slab in an exposed location shall be galvanized rigid steel (GRS), electrical metallic tubing (EMT) or intermediate metal conduit (IMC). Where conduits emerge from a floor slab in a concealed location (a wall cavity or above ceiling), PVC elbows are permitted, provided that a conduit adaptor for steel conduit is installed at the nearest point at the slab.
5. Use flexible conduit for connections to motors, electrical duct heaters, unit heaters, kitchen equipment, laundry equipment, flush mounted lighting fixtures, and any vibrating equipment.
    a. Flexible conduit used for connection of motors, dry type transformers, electric duct heaters, unit heaters, and bus duct tap devices shall not exceed 36 inches in length.
    b. Flexible conduit from outlet box to flush mounted lighting fixture shall not exceed 6 feet in length.
    c. Maintain ground continuity through flexible conduit with green equipment grounding conductor; do not use flexible conduit for ground continuity.
    d. Flexible conduit installed within plenum spaces shall be limited to lengths not exceeding 4 feet.
    e. Liquid tight flexible conduit shall be used to connect equipment in exterior, damp or wet locations.

C. Below Grade Raceway Installations

1. Install top of conduits 2 inches minimum below bottom of building slabs.

D. Raceway Installations within Concrete

1. Conduit shall be run following the most direct route between points.
2. Conduit shall not be installed in concrete where the outside diameter is larger than 1/3 of the slab thickness.
3. Conduits shall not be installed within shear walls unless specifically indicated on the drawings. Conduit shall not be run directly below and parallel with load bearing walls.

4. Protect all conduits entering and leaving concrete floor slabs from physical damage during construction.
5. Provide expansion fittings in all conduits that pass through building expansion joints.

3.02 PULL BOXES

A. Pull boxes shall be secured, independent of the conduit entries into the box. Pull boxes shall be secured to the building structure. In ceiling applications, pull boxes shall not be supported with ceiling wires.

B. Conduits entering pull boxes shall connect to pull boxes using die-cast zinc connectors.

C. Pull boxes shall be free from burrs, dirt and debris.

3.03 MAINTENANCE HOLES/HANDHOLES

A. Maintenance holes/handholes shall be installed on a base of pea gravel at least 12 inches deep.

B. Tops of maintenance holes/handholes shall be level with the existing grade.

C. Ducts should enter as perpendicular to the wall surface as possible.

D. Maintenance holes shall be grounded with four 3/4 inch diameter by 8 foot long ground rods, one driven inside of the maintenance hole at each corner. Connect the ground rods and any duct bank ground conductors together with a No. 4/0 AWG bare, stranded copper ground wire loop. A No. 2 AWG bare stranded copper pigtail from the ground wire loop shall be used to ground the maintenance hole cover frame, ladder support bracket, any metallic concrete inserts and metallic cable racks, and the shields of any cables that are spliced in the maintenance hole.

3.04 CONDUIT PLUGS/CAPS

A. Protect conduits against dirt, plaster, and foreign debris with conduit plugs. Plugs shall remain in place until ready for use.

B. Simplex, triplex or quadplex duct plugs shall be installed in conduits to house and seal cables.

3.05 ADDITIONAL REQUIREMENTS FOR INTERIOR LOW VOLTAGE CONDUITS

A. Conduit runs shall not have more than two (2) 90-degree bends between pull points.

B. Communications conduit system shall contain no condulets (also known as an LB).

C. Rigid metal conduit (RMC) or intermediate metal conduit (IMC) shall be used for entrance conduits that exceed 50 feet into the building.

D. Horizontal Conduits

1. Support horizontal conduits at intervals not exceeding ten feet and within three feet of each outlet, junction box, backboard, enclosure or cabinet. Support conduits from structural steel members with spring steel type or beam conduit clamps and to non-metallic structural members with one-hole conduit straps. For exposed conduits and where conduits must be suspended below structure, single conduit

runs shall be supported from structure by hanger rod and conduit clamp assembly, and multiple conduits shall be supported by trapeze type support suspended from structure. Do not attach conduits to ceiling suspension system channels or suspension wires.

2. For runs that total more than 100 feet in length, insert pull boxes so that no segment between boxes exceeds the 100 feet limit.
3. Each horizontal home-run conduit can serve from one (1) to three (3) outlet boxes. For one (1) outlet box, a 3/4" conduit shall be used, minimum. For two (2) outlet boxes, a 1" conduit shall be used, minimum. For three (3) outlet boxes, a 1-1/4" conduit shall be used, minimum.

3.06 REQUIREMENTS FOR OUTSIDE PLANT LOW VOLTAGE CONDUITS

A. Duct Banks

1. Duct banks shall be sloped downward toward maintenance holes/handholes and away from buildings a minimum of 6 inches per 100 feet. Duct banks shall not route water from maintenance holes/handholes into buildings. Duct banks shall not contain traps between maintenance holes/handholes where water may accumulate.
2. Where power and communications duct banks run in parallel, they shall be separated by a minimum of 12 inches.
3. Where duct banks enter maintenance holes or buildings, they shall be constructed as integral to the wall.
4. Duct bank shall extend to the inside surfaces of the walls, and the duct bank reinforcing shall be integrated with the wall reinforcing.
5. Bell ends shall be provided on ducts where the ducts enter maintenance holes or buildings.
6. Direct buried ducts and fittings shall have bend radii greater than the minimum bend radii of the cables enclosed, and shall not be smaller than the radii of standard manufactured elbows.
7. Direct buried ducts shall be installed parallel to or at right angles to building lines and site features, and as close to curbs and sidewalks as possible to avoid interferences with future landscaping.
8. Where direct buried PVC ducts cannot be buried deep enough to meet the NEC minimum cover requirements, rigid steel conduits shall be installed instead, or a concrete cover shall be poured over the ducts.
9. An orange detectable marker tape (for communications) shall be buried in the backfill approximately 12 inches above duct banks or direct buried cables for the entire length of the duct run.
10. A flexible mandrel and a stiff bristled brush shall be pulled through the ducts to clean them prior to cable pulling.
11. Ducts shall be identified in the maintenance holes and at both ends.

B. Additional OSP Conduit Requirements

1. Install a #14 AWG tracer wire in one conduit for the entire length of each duct run.
2. Below Grade Conduit Installations
   a. Install top of conduits 24 inches minimum below finished grade or as indicated on Drawings.
   b. Install top of conduits 6 inches minimum below bottom of building slabs.
3. For runs that total more than 400 feet in length, insert handholes/maintenance holes so that no segment exceeds the 400 feet limit.

END OF SECTION

SECTION 26 05 34
OUTLET BOXES AND JUNCTION BOXES

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. All work specified herein shall be accomplished in accordance with the applicable requirements of Section 26 00 00 - Electrical General.

1.02 WORK INCLUDED

A. The work under this section shall include all labor, materials, accessories, services and equipment necessary to furnish and install outlet and junction boxes, complete, as indicated on the Drawings and as specified herein.

B. Equipment schedules and specifications are based on the one manufacturer listed in the schedule. Other manufacturers of equal quality and performance may be submitted to the Engineer for review. When substitution of equipment is made the Contractor shall be responsible for the costs of any item and engineered and construction revisions necessary in his or any other contract or trade that may be required to satisfy plans and specifications.

1.03 QUALITY ASSURANCE

A. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

B. Cast-Metal Outlet and Device Boxes: NEMA FB 1, Type FD, with gasketed cover.

C. Nonmetallic Outlet and Device Boxes: NEMA OS 2.

D. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

E. Cast-Metal Pull and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.

F. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous hinge cover and flush latch.

1. Metal Enclosures: Steel, finished inside and out with manufacturer’s standard enamel.
2. Nonmetallic Enclosures: Plastic, finished inside with radio-frequency-resistant paint.

G. Cabinets: NEMA 250, Type 1, galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer’s standard enamel. Hinged door in front cover with flush latch and concealed hinge. Key latch to match panelboards. Include metal barriers to separate wiring of different systems and voltage and include accessory feet where required for freestanding equipment.

1.04 JOB CONDITIONS

A. Protection: Anchor boxes securely to formwork. Provide necessary protection to prevent entry of concrete.

B. Sequencing, Scheduling: Locations of outlets shown on the Drawings are relative and approximate. Exact locations shall be determined on the job and the outlets accurately set according to the architectural drawings, dimensions, casework kneespace, building conditions, furniture positions and Architect's direction. The right is reserved to change the exact location (10'-0" or less) of any switch, ceiling outlet or other outlet in any room before it is permanently installed without increase in Contract cost.

C. All outlet boxes and junction boxes shall be accessible. Any boxes in non-accessible areas (furred ceilings) shall be set flush with barrier surface at a location approved by the Architect.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturers: Thomas & Betts/Steel City, Pass & Seymour or equal.

2.02 OUTLET BOXES

A. Standard Outlet Boxes: Boxes and covers shall be thermo plastic or phenolic and rated according to the space it occupies, of such form and dimensions as to be adapted to its specific use and location, kind of fixtures to be used and number, size and arrangement of conduits connecting thereto and particularly sized to accommodate the number and size of wires to be contained therein.

B. Ceiling outlet boxes shall be 1-1/2" or 3-3/8" deep, 4" octagonal (or 4" square when required due to number of wires). Plaster rings or device covers need not be provided on ceiling boxes. Provide extension rings on ceiling boxes to accommodate number of conductors in box.

C. Wall outlet boxes for toggle switches and convenience outlets shall be 1-1/2" or 2-1/8" deep, 4" or 4-11/16" square. Provide with single-device covers (or two-device covers where needed). Covers shall be raised type to compensate for thickness of plaster or gypsum board wall finish.

D. Outlet boxes for telecommunication purposes (telephone, data, etc.) shall be 4" x 4" square, 2-1/8" deep. Provide with single device covers (or two-device covers where needed). Covers shall be raised type to compensate for thickness of plaster or gypsum board wall finish.

E. Junction boxes shall be as specified for ceiling and wall outlet boxes. Provide flat covers on ceiling outlets to match ceiling finish. Provide blank device type coverplates on wall outlets, of same materials as specified for device coverplates in same room or area.

F. Outlet boxes where exposed rigid conduit is used shall be cast ferrous alloy, galvanized or cast aluminum.

G. Covers: Where outlet boxes are to be capped, blank coverplates shall be used.

H. Barriers: Provide barriers between devices operating at different voltages or on separate systems such as normal, critical, or life safety.

2.03 FLOOR BOXES

A. Product Description

1. Floor boxes for receptacles and telephone/data outlets shall be round. Boxes shall include a non-metallic concrete cover to prohibit concrete or debris from entering the box during installation.
2. Floor boxes for use in slab on grade installations shall be non-metallic PVC and be suitable for use in slab on grade conditions.
3. Floor boxes for use in above grade installations shall be metallic and suitable for use in concrete slabs above grade.
4. Provide number of compartments as indicated on drawings.
5. Coverplates and flanges shall be brass.
6. Floor box device covers shall meet UL 514C requirements for scrubwater test standards.

B. Manufacturer

1.	Hubbell	RF400 Series (Non-Metallic) B252 Series (Metallic)
2.	Wiremold	862 Series (Non-Metallic) 885 Series (Metallic)
3.	Thomas & Betts	68P Series (Non-Metallic)

C. For poke-thru devices, refer to 2.04 D of Section 26 27 26 - Wiring Devices.

2.04 PULL AND JUNCTION BOXES

A. Pull and Junction boxes are not completely indicated. They shall be sized and installed where required in accordance with the NEC.

B. Pull and Junction boxes shall be the suitable NEMA type number to match the environmental conditions.

C. Locations of concealed pull and junction boxes shall be indicated on the record as built drawings for Owner’s record.

2.05 CABINETS, FITTINGS, BOXES: GENERAL

A. Cabinets shall be in accordance with UL 50, “Electrical Cabinets and Boxes” and NEMA 250, Type 1. Electrical cabinets, boxes and fittings shall be as required for types, sizes, and NEMA enclosure classes. Where not indicated, provide units of types, sizes, and classes appropriate for the use and location. Provide all items complete with covers and accessories required for the intended use. Provide gaskets for units in damp or wet locations.

B. Construction shall be sheet steel, NEMA 1 class except as otherwise indicated. Cabinets shall consist of a box and a front consisting of a 1-piece frame and a hinged door. Arrange door to close against a rabbet placed all around the inside edge of the frame, with a uniformly close fit between door and frame. Provide concealed fasteners, not over 24" apart, to hold fronts to cabinet boxes and provide for adjustment. Provide flush or concealed door hinges not over 24" apart and not over 6" from top and bottom of door. For flush cabinets, make the front approximately 3/4" larger than the box all around. For surface mounted cabinets make from same height and width as box. Furnish metal barriers to separate wiring of different systems and voltage, and furnish accessory feet where required for freestanding equipment.

C. Fasteners for general use shall be corrosion resistant screws and hardware including cadmium and zinc plated items.

D. Fasteners for damp and wet locations shall be stainless steel screws and hardware.

E. Exterior finish shall be gray baked enamel for items exposed in finished locations except as otherwise indicated.

F. Painted interior finish, where indicated, shall be white baked enamel.

G. Fittings for boxes, cabinets, and enclosures shall be in accordance with UL 5148 and shall be zinc plated steel for conduit hubs, bushings and box connectors.

2.06 UNDERGROUND PULL/JUNCTION BOXES

A. Unless noted otherwise, underground enclosures shall be fiberglass, open-bottom and sloped-wall. Covers shall be polymer concrete. Boxes shall be installed in areas expected to experience only light incidental, non-deliberate vehicular traffic (including that from mowers).

B. Enclosures shall meet the load requirements and three-point test procedures specified in the industry standard ANSI SCTE 77 2007. Enclosures shall meet the Tier 8 cover load test (for light traffic) of 12,000 lbs. over a 10" x 10" plate.

C. Manufacturer’s guidelines shall be followed for installation, including 6" gravel bed beneath box for stability and drainage. Concrete collar shall be poured around enclosure to protect the ring and top from impact due to soil erosion.

D. Manufacturer

1. Highline Products
2. OZ-Gedney

PART 3 - EXECUTION

3.01 INSPECTION

A. The location of all wall outlets, including light fixtures, receptacles, switches, etc., shall be checked to see that the outlet will clear any wall fixture, shelving, work tables, sinks, baseboard and fin type convectors, bulletin boards, etc., that will be installed.

B. Exact locations of outlet boxes shall be coordinated with other trades so that outlet will not be covered by ductwork, piping, etc.

C. The approximate locations of outlets are indicated on the Drawings. The exact locations shall be determined at the building. The right is reserved to change, without additional cost, the exact location of any outlet, a maximum of 10' before it is permanently installed.

3.02 PREPARATION

A. Architectural Placement: Outlets occurring in architectural features shall be accurately centered in same. Space wall switch outlets equidistant from door trims on the strike side of doors as actually installed so that coverplate clears trim. Orientation of outlet boxes (horizontal or vertical) shall be as indicated on architectural elevations.

B. Install all outlet boxes in finished areas flush with wall or ceiling finish. Maintain 1/4" or less space between outlet box front and finish wall surface.

C. All switches at same level shall be installed on one horizontal line as shown on the Drawings.

D. Wall mounted controls, including temperature controls, in a room shall be grouped at the same location and at same mounting heights.

3.03 INSTALLATION

A. At all concealed outlets for electric lights, switches, wall receptacles, etc., standard outlet boxes and plaster rings shall be provided.

B. Outlet boxes shall be firmly anchored in place and shall be provided with approved fixture studs where required. Outlet boxes shall not depend on the coverplate to hold it secure to the wall.

C. Boxes on opposite sides of walls or partitions: Where drawings show back-to-back wiring devices, the devices on opposite sides of the wall shall be offset a minimum of 6". Through-the-wall type boxes shall not be used. Where boxes will be located on opposite sides of walls or partitions located 24" or closer to each other, moldable putty pads shall be installed to completely cover the exterior surfaces of the box within the stud cavity with a ball of putty material used to plug the end of each conduit at its connection to the box.

D. All holes cut through new or existing smoke or fire partitions shall be sealed. Sealant shall be 3M Brand Fire Barrier System or approved equal. Seals shall be installed in accordance with manufacturer’s recommendations.

E. All flush boxes in rated walls that are larger than 16 square inches in area shall be backed as follows: 1-hour wall - 1 layer of 5/8" gypsum board; 2-hour rated wall - 2 layers of 5/8" gypsum board. Gypsum shall be fire code and attached to outside surfaces of box(es).

F. Cast aluminum, threaded hub type boxes with gasketed weatherproof covers shall be used for wet locations where box is surface mounted.

G. Location of floor boxes indicated is approximate. The Contractor shall refer to the final furniture layout or request field instructions for the exact location. Consult the Architect prior to installation.

END OF SECTION

SECTION 26 05 35
LOW VOLTAGE BACKBOARDS & ENCLOSURES

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. Applicable requirements of Section 26 00 00 - Electrical General shall be considered a part of this section and shall have the same force as if printed herein full.

B. This document describes the products and execution requirements relating to backboards.

C. Product specifications, general design considerations, and installation guidelines are provided in this document. The successful vendor shall meet or exceed all requirements described in this document and/or on the Drawings.

1.02 WORK INCLUDED

A. The work included under this specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the Specification or not.

B. The work shall include, but not be limited to, the following:

1. Furnish and install all backboards.
2. Furnish and install all structured media enclosures.

PART 2 - PRODUCTS

2.01 APPROVED PRODUCTS

A. Approved Equipment Backboard Manufacturer(s)

1. Hoover – ¾" Pyro-Guard
2. Standard ¾" Plywood (treated with fire-retardant paint)

B. Approved Structured Media Enclosure Manufacturer(s)

1. Leviton
2. Uniprise
3. Hubbell

2.02 STRUCTURED MEDIA ENCLOSURE

A. The structured media enclosure shall be a one-piece (excluding cover) box, made of 18-gauge, white, powder-coated steel. It shall flush-mount with four wood screws (provided) on standard 16" center wall studs prior to dry wall. The structured media enclosure shall have minimum dimensions of 14.38"h x 14.38"w x 3.60"d with 16.10"h x 16.10"cover.

B. The structured media enclosure shall meet all applicable standards: be UL Listed, comply with all ANSI/TIA/EIA 568-B.2 and ANSI/TIA/EIA 570-A requirements and meet FCC part 68.

PART 3 - EXECUTION

3.01 BACKBOARDS

A. Backboards shall be 3/4" void free plywood. Size of backboard shall be 4' x 8' unless noted differently on Drawings. Backboards shall be painted with two (2) coats of gray fire-retardant paint.

3.02 RESIDENTIAL STRUCTURED MEDIA ENCLOSURE

A. Residential Structured Media Enclosures shall be installed as per the requirements specified by the manufacturer’s installation guidelines and best industry practice.

B. Residential Structured Media Enclosures shall be installed in accordance with the recommendations made in the ANSI/TIA/EIA-570-A standard.

C. Residential Structured Media Enclosures shall be bonded and grounded in accordance with the recommendations made in the J-STD-607-A standard.

END OF SECTION

SECTION 26 09 23
OCCUPANCY SENSORS

PART 1 - GENERAL

1.01 WORK INCLUDED

A. The Contractor's work shall include all labor, materials, tools, appliances, control hardware, sensor, wire, junction boxes and equipment necessary for and incidental to the delivery, installation and furnishing of a completely operational occupancy sensor lighting control system, as described herein.

B. The Contractor/supplier shall examine all general specification provisions and drawings for related electrical work required as work under Division 26.

C. The Contractor shall coordinate all work described in this section with all other applicable plans and specifications, including but not limited to wiring, conduit, fixtures, HVAC systems and building management systems.

1.02 EQUIPMENT QUALIFICATION

A. Products supplied shall be from a single manufacturer that has been continuously involved in the manufacturing of occupancy sensors for a minimum of five (5) years. Mixing of manufacturers shall not be allowed.

B. All components shall be UL Listed, offer a 5-year warranty and meet all state and local applicable code requirements.

C. Products shall be manufactured by an ISO 9002 certified manufacturing facility and shall have a defect rate of less than 1/3 of 1%.

D. Wall switch products must be capable of withstanding the effects of inrush current. Submittals shall clearly indicate the method used.

1.03 SYSTEM DESCRIPTION

A. The objective of this section is to ensure the proper installation of the occupancy sensor based lighting control system so that lighting is turned off automatically after reasonable time delay when a room or area is vacated by the last person to occupy said room or area.

B. The occupancy sensor based lighting control shall accommodate all conditions of space utilization and all irregular work hours and habits.

C. The Contractor shall warrant all equipment furnished in accordance to this specification to be undamaged, free of defects in materials and workmanship, and in conformance with the specifications. The supplier's obligation shall include repair or replacement, and testing without charge to the Owner, all or any parts of equipment which are found to be damaged, defective or non-conforming and returned to the supplier. The warranty shall commence upon the Owner's acceptance of the project. Warranty on labor shall be for a minimum period of one (1) year.

1.04 SUBMITTALS

A. Manufacturer shall substantiate conformance to this specification by supplying the necessary documents, performance data and wiring diagrams. Any deviations to this specification must be clearly stated by letter and submitted.

B. Submit a lighting plan clearly marked by manufacturer showing proper product, location and orientation of each sensor.

C. Submit any interconnection diagrams per major subsystem showing proper wiring.

D. Submit standard catalog literature which includes performance specifications indicating compliance to the specification.

E. Catalog sheets must clearly state any load restrictions when used with electronic ballasts.

1.05 SYSTEM OPERATION

A. It shall be the Contractor's responsibility to make all proper adjustments to assure Owner's satisfaction with the occupancy system.

1.06 ACCEPTABLE MANUFACTURERS

A. The Watt Stopper, or Pre-Approved Equal: For pre-approval, provide all the information listed under section 1.04 A and 1.04 D a minimum of ten (10) working days prior to initial bid date.

B. The listing of any manufacturer as "acceptable" does not imply automatic approval. It is the sole responsibility of the electrical contractor to ensure that any price quotations received and submittals made are for sensors which meet or exceed the specifications included herein.

PART 2 - PRODUCTS

2.01 GENERAL

A. All products shall be Watt Stopper product numbers.

1. Ceiling sensors: CI-300, CI-305, CI-355, CX-100, CX-105, DT-200, DT-205, DT-300, DT-305, DT-355, UT-300, UT-305, UT-355, WPIR, WT-605, WT-600, WT-1105, WT-1100, WT-2205, WT-2200, WT-2250, WT-2255

2. Wall switch sensors: DSW-100, DSW-200, DSW-301, DSW-302, DW-100-24, DW-311, PW-100, PW-100-24, PW-200, PW-301, PW-302, PW-311, UW-100, UW-100-24, UW-200

3. Power and Auxiliary Packs: BZ-50, BZ-150, BZ-200, BZ-250, C120E-P, C277E-P, S120/27-P

4. HID Control: DM-105

5. Outdoor sensors: EW-200, EW-205-24

6. Low Temperature: CB-100

7. Digital Time Switches: TS-400, TS-400-24

8. Automatic Control Switch: AS-100

B. Wall switch sensors shall be capable of detection of occupancy at desktop level up to 300 square feet, and gross motion up to 1000 square feet.

C. Wall switch sensors shall accommodate loads from 0 to 800 watts at 120 volts; 0 to 1,200 watts at 277 volts and shall have 180 degrees coverage capability.

D. Wall switch products shall utilize Zero Crossing Circuitry, which increases relay life, protects from the effects of inrush current, and increases sensor's longevity.

E. Wall switch sensors shall have no leakage current to load, in manual or in Auto/Off mode for safety purposes and shall have voltage drop protection.

F. Where specified, wall switch sensors shall provide a field selectable option to convert sensor operation from automatic-ON to manual-ON.

G. Where specified, vandal resistant wall switch sensors shall utilize a hard lens with a minimum 1.0 mm thickness. Products utilizing a soft lens will not be considered.

H. Passive infrared sensors shall utilize Pulse Count Processing and Digital Signature Analysis to respond only to those signals caused by human motion.

I. Passive infrared sensors shall utilize mixed signal ASIC which provides high immunity to false triggering from RFI (hand-held radios) and EMI (electrical noise on the line), superior performance, and greater reliability.

J. Passive infrared sensors shall have a multiple segmented Fresnel lens, in a multiple-tier configuration, with grooves-in to eliminate dust and residue build-up.

K. Where specified, passive infrared and dual technology sensors shall offer daylighting footcandle adjustment control and be able to accommodate dual level lighting.

L. Dual technology sensors shall be corner mounted to avoid detection outside the controlled area when doors are left open.

M. Dual technology sensors shall consist of passive infrared and ultrasonic technologies for occupancy detection. Products that react to noise or ambient sound shall not be considered.

N. Ultrasonic sensors shall utilize Advanced Signal Processing to adjust the detection threshold dynamically to compensate for constantly changing levels of activity and air flow throughout controlled space.

O. Ultrasonic operating frequency shall be crystal controlled at 25 kHz within + 0.005% tolerance, 32 kHz within + 0.002% tolerance, or 40 kHz + 0.002% tolerance to assure reliable performance and eliminate sensor crosstalk. Sensors using multiple frequencies are not acceptable.

P. All sensors shall be capable of operating normally with electronic ballasts, PL lamp systems and rated motor loads.

Q. Coverage of sensors shall remain constant after sensitivity control has been set. No automatic reduction shall occur in coverage due to the cycling of air conditioner or heating fans.

R. All sensors shall have readily accessible, user adjustable settings for time delay and sensitivity. Setting shall be located on the sensor (not the control unit) and shall be recessed to limit tampering.

S. In the event of failure, a bypass manual override shall be provided on each sensor. When bypass is utilized, lighting shall remain on constantly or control shall divert to a wall switch until sensor is replaced. This control shall be recessed to prevent tampering.

T. All sensors shall provide an LED as a visual means of indication at all times to verify that motion is being detected during both testing and normal operation.

U. Where specified, sensor shall have an internal additional isolated relay with Normally Open, Normally Closed and Common outputs for use with HVAC control, Data Logging and other control options. Sensors utilizing separate components or specially modified units to achieve this function are not acceptable.

V. All sensors shall have UL rated, 94V-0 plastic enclosures.

W. Outdoor motion sensors shall have UL 773A ratings. EWF outdoor sensors shall additionally have UL 1571 ratings.

X. EW-100 outdoor sensors shall cover up to 35 feet, with a field of view of 180 degrees. EW-200 outdoor sensors shall cover up to 52.5 feet, with a field of view of 270 degrees. EN-100 outdoor sensors shall cover up to 35 feet, with a field of view of 90 degrees. EN-200 outdoor sensors shall cover up to 100 feet, with a long range lens view.

Y. EWF outdoor sensors shall include polycarbonate lamp holders that accept PAR 20 or 38 lamps up to 150W per lamp.

Z. Outdoor sensors shall have an operating temperature range of -40 degrees F to +130 degrees F.

AA. To ensure complete protection from weather elements and exposure, outdoor sensors shall be manufactured with precision double-shot tooling and contain internal silicon gaskets.

2.02 CIRCUIT CONTROL HARDWARE – CU

A. Control Units: For ease of mounting, installation and future service, control unit(s) shall be able to externally mount through a 1/2" knock-out on a standard electrical enclosure and be an integrated, self-contained unit consisting internally of an isolated load switching control relay and a transformer to provide low-voltage power. Control unit shall provide power to minimum of two (2) sensors.

B. Relay Contacts shall have rating of:

13A - 120 VAC Tungsten
20A - 120 VAC Ballast
20A - 277 VAC Ballast

C. Control wiring between sensors and controls units shall be Class II, 18-24 AWG, stranded UL Classified, PVC insulated or TEFLON jacketed cable suitable for use in plenums, where applicable.

D. Minimum acceptable wire gauge from the circuit control hardware relays shall be #14 AWG.

PART 3 - EXECUTION

3.01 INSTALLATION

A. It shall be the Contractor's responsibility to locate and aim sensory in the correct location required for complete and proper volumetric coverage within the range of coverage(s) of controlled areas per the manufacturer's recommendations. Rooms shall have 90 to 100% coverage to completely cover the controlled area to accommodate all occupancy habits of single or multiple occupants at any location within the room(s). The locations and quantities of sensors shown on the drawings are diagrammatic and indicate only the rooms which are to be provided with sensors. The Contractor shall provide additional sensors if required to properly and completely cover the respective room.

B. It is the Contractor's responsibility to arrange a pre-installation meeting with the manufacturer's factory authorized representative, at the Owner's facility, to verify placement of sensors and installation criteria.

C. Proper judgment must be exercised in executing the installation so as to ensure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference of structural components. The Contractor shall also provide, at the Owner's facility, the training necessary to familiarize the Owner's personnel with the operation, use, adjustment, and problem solving diagnosis of the occupancy sensing devices and systems.

3.02 FACTORY COMMISSIONING

A. The electrical contractor shall provide both the manufacturer and the Electrical Engineer with ten (10) working days written notice of the scheduled commissioning date. Upon completion of the system fine tuning the factory authorized technician shall provide training to the Owner's personnel in the adjustment and maintenance of the sensors.

END OF SECTION

SECTION 26 09 43
DISTRIBUTED DIGITAL LIGHTING CONTROL SYSTEM

PART 1 GENERAL

1.01 INTRODUCTION

A. The work covered in this section is subject to all of the requirements in the General Conditions of the Specifications. The Contractor shall coordinate all of the work in this section with all of the trades covered in other sections of the specification to provide a complete and operable system.

1.02 DESIGN / PERFORMANCE REQUIREMENTS

A. Digital Lighting Management System shall accommodate the square-footage coverage requirements for each area controlled, utilizing room controllers, digital occupancy sensors, switches, daylighting sensors and accessories that suit the required lighting and electrical system parameters.

B. System shall conform to requirements of NFPA 70.

C. System shall comply with FCC emission standards specified in part 15, sub-part J for commercial and residential application.

D. System shall be listed under UL sections 916 and/or 508.

1.03 SUBMITTALS

A. Product Data: Manufacturer's data sheets on each product to be used, including:

1. Catalog sheets and specifications.
2. Ratings, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.
3. Storage and handling requirements and recommendations.
4. Installation instructions.

B. Shop Drawings: Wiring diagrams a for the various components of the System specified including:

1. Composite wiring and/or schematic diagram of each control circuit as proposed to be installed.
2. Show location of all devices, including at minimum sensors, load controllers, and switches/dimmers for each area on reflected ceiling plans.
3. Provide room/area details including products and sequence of operation for each room or area. Illustrate typical acceptable room/area connection topologies.
4. Network riser diagram including floor and building level details. Include network cable specification. Illustrate points of connection to integrated systems. Coordinate integration with mechanical and/or other trades.

C. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

1.04 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in the manufacture of lighting control equipment and ancillary equipment, of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. System Components: Demonstrate that individual components have undergone quality control and testing prior to shipping.

C. System Support: Factory applications engineers shall be available for telephone support.

D. NEC Compliance: Comply with NEC as applicable to electrical wiring work.

E. NEMA Compliance: Comply with applicable portions of NEMA standards pertaining to types of electrical equipment and enclosures.

F. UL Approvals: Remote panels are to be UL Listed under UL 916 Energy Management Equipment.

G. FCC Emissions: All assemblies are to be in compliance with FCC emissions Standards specified in Part 15 Subpart J for Class A application.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store products in a clean, dry space in original manufacturer's packaging in accordance with manufacturer's written instructions until ready for installation

1.06 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

B. Do not install equipment until following conditions can be maintained in spaces to receive equipment:

1. Ambient temperature: 32 to 104 degrees F (0 to 40 degrees C).
2. Relative humidity: Maximum 90 percent, non-condensing.

1.07 WARRANTY

A. Products Warranty: Manufacturer shall provide a 5 year limited warranty on products within this installation, except where otherwise noted, and consisting of a one for one device replacement.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturers: WattStopper, nLight, Lutron, or Pre-Approved Equal

B. Requests for substitutions must be submitted a minimum of ten (10) working days prior to the initial bid date.

2.02 DISTRIBUTED DIGITAL LIGHTING CONTROL SYSTEM

A. Equipment Required: Lighting Control and Automation system as defined under this section covers the following equipment.

1. Digital Lighting Management (DLM) local network: Free topology, plug-in wiring system (Cat 5e) for power and data to room devices.
2. Digital Room Controllers: Self-configuring, digitally addressable one, two or three relay plenum-rated controllers for on/off control. Selected models include 0-10 volt or line voltage forward phase control dimming outputs and integral current monitoring capabilities.
3. Digital Occupancy Sensors: Self-configuring, digitally addressable, calibrated occupancy sensors with LCD display and two-way active infrared (IR) communications.
4. Digital Switches: Self-configuring, digitally addressable pushbutton on/off, dimming, and scene switches with two-way active infrared (IR) communications.
5. Digital Daylighting Sensors: Single-zone closed loop, multi-zone open loop and single-zone dual-loop daylighting sensors with two-way active infrared (IR) communications for daylight harvesting using switching, bi-level, tri-level or dimming control.
6. Digital Lighting Management Relay Panel and Zone Controller: Provides up to 8, 24, or 48 mechanically latching relays. Relays include a manual override and a single push-on connector for easy installation or removal from the panel. Panel accepts program changes from handheld configuration tool for date and time, location, holidays, event scheduling, button binding and group programming. Provides BACnet MS/TP-compliant digital networked communication between other lighting controls and/or building automation system (BAS). Zero relay Zone Controller primarily supports Digital Fixture Controller applications.
7. Emergency Lighting Control Unit (ELCU): Allows a standard lighting control device to control emergency lighting in conjunction with normal lighting in any area within a building

B. Local Network LMRJ-Series: DLM local network is a free topology lighting control physical connection and communication protocol designed to control a small area of a building.

1. Digital room devices connect to the local network using pre-terminated Cat 5e cables with RJ-45 connectors, which provide both data and power to room devices. Systems that utilize RJ-45 patch cords but do not provide serial communication data from individual end devices are not acceptable.
2. If manufacturer's pre-terminated Cat5e cables are not used for the installation each cable must be individually tested and observed by authorized service representative following installation.

2.03 DIGITAL LOAD CONTROLLERS (ROOM, PLUG LOAD AND FIXTURE CONTROLLERS)

A. Digital Load Controllers: Digital controllers for lighting zones, fixtures and/or plug loads automatically bind room loads to the connected control devices in the space without commissioning or the use of any tools. Provide controllers to match the room lighting and plug load control requirements. Controllers are simple to install, and do not have dip switches/potentiometers, or require special configuration for standard Plug n' Go applications. Control units include the following features

1. Automatic room configuration to the most energy-efficient sequence of operation based upon the devices in the room.
2. Simple replacement using the default automatic configuration capabilities, a room controller may be replaced with an off-the-shelf device.
3. Multiple room controllers connected together in a local network must automatically arbitrate with each other, without requiring any configuration or setup, so that

individual load numbers are assigned starting with load 1 to a maximum of 64, assigned based on each controller's device ID's from highest to lowest.

4. Device Status LEDs to indicate:
   a. Data transmission
   b. Device has power
   c. Status for each load
   d. Configuration status
5. Quick installation features including:
   a. Standard junction box mounting
   b. Quick low voltage connections using standard RJ-45 patch cable
6. Based on individual configuration, each load shall be capable of the following behavior on power up following the loss of normal power:
   a. Turn on to 100 percent
   b. Turn off
   c. Turn on to last level
7. Each load be configurable to operate in the following sequences based on occupancy:
   a. Auto-on/Auto-off (Follow on and off)
   b. Manual-on/Auto-off (Follow off only)
8. Polarity of each load output shall be reversible, via digital configuration, so that on is off and off is on.
9. BACnet object information shall be available for the following objects:
   a. Load status
   b. Schedule state, normal or after-hours
   c. Demand Response enable and disable
   d. Room occupancy status
   e. Total room lighting and plug loads watts
10. UL 2043 plenum rated
11. Manual override and LED indication for each load
12. Zero cross circuitry for each load
13. All digital parameter data programmed into an individual room controller or plug load controller shall be retained in non-volatile FLASH memory within the controller itself. Memory shall have an expected life of no less than 10 years.
14. Dimming Room Controllers shall share the following features:
    a. Each load shall have an independently configurable preset on level for Normal Hours and After Hours events to allow different dimmed levels to be established at the start of both Normal Hours and After Hours events.
    b. Fade rates for dimming loads shall be specific to bound switch buttons, and the load shall maintain a default value for any bound buttons that do not specify a unique value.
    c. The following dimming attributes may be changed or selected using a wireless configuration tool:
       1) Establish preset level for each load from 0-100 percent
       2) Set high and low trim for each load
       3) Initiate lamp burn in for each load of either 0, 12 or 100 hours
    d. Override button for each load provides the following functions:
       1) Press and release for on/off control
       2) Press and hold for dimming control
    e. Each dimming output channel shall have an independently configurable minimum and maximum calibration trim level to set the dimming range to match the true dynamic range of the connected ballast or driver. LED level indicators on bound dimming switches shall utilize this new maximum and minimum trim.
    f. Each dimming output channel shall have an independently configurable minimum and maximum trim level to set the dynamic range of the output within the new 0-100 percent dimming range defined by the minimum and maximum calibration trim.

g. Calibration and trim levels must be set per output channel. Devices that set calibration or trim levels per controller (as opposed to per load) are not acceptable.
h. All configuration shall be digital. Devices that set calibration or trim levels per output channel via trim pots or dip-switches are not acceptable.

B. On/Off Room Controllers shall include:

1. Dual voltage (120/277 VAC, 60 Hz) capable rated for 20A total load
2. One or two relay configuration
3. Simple 150 mA switching power supply (Only 4 100 series devices on a Cat 5e local network)
4. Three RJ-45 DLM local network ports with integral strain relief and dust cover
5. WattStopper product numbers: LMRC-101, LMRC-102

C. On/Off/0-10V Dimming KO Mount Room Controllers shall include:

1. Dual voltage (120/277 VAC, 60 Hz) capable rated for 10A total load
2. Optional real time current and voltage monitoring (with - M Monitoring option).
3. One or two relays configurations
4. Smart 150 mA switching power supply
5. Two RJ-45 DLM local network ports. Provide molded strain relief ring
6. One dimming output per relay
   a. 0-10V Dimming - Where indicated, one 0-10 volt analog output per relay for control of compatible ballasts and LED drivers. The 0-10 volt output shall automatically open upon loss of power to the Room Controller to assure full light output from the controlled lighting
7. Units capable of providing both Class 1 or Class 2 wiring for the 0-10V output
8. WattStopper product numbers: LMRC-111, LMRC-111-M, LMRC-112, or LMRC-112-M.

D. On/Off/0-10V Dimming Enhanced Room Controllers shall include:

1. Dual voltage (120/277 VAC, 60 Hz) capable or 347 VAC, 60 Hz. 120/277 volt models rated for 20A total load; 347 volt models rated for 15A total load
2. Built in real time current monitoring
3. One, two or three relays configurations
4. Smart 250 mA switching power supply
5. Four RJ-45 DLM local network ports. Provide integral strain relief
6. One dimming output per relay
   a. 0-10V Dimming - Where indicated, one 0-10 volt analog output per relay for control of compatible ballasts and LED drivers. The 0-10 volt output shall automatically open upon loss of power to the Room Controller to assure full light output from the controlled lighting (LMRC-110 series and 210 series).
7. WattStopper product numbers: LMRC-211, LRMC-212, LRMC-213.

E. On/Off/ Forward Phase Dimming Room Controllers shall include:
1. Dual voltage (120/277 VAC, 60 Hz) rated for 20A total load, with forward phase dimmed loads derating to 16A for some load types
2. Built in real time current monitoring
3. One or two relays configurations
4. Smart 250 mA switching power supply
5. Four RJ-45 DLM local network ports. Provide integral strain relief

6. One dimming output per relay
    a. Line Voltage, Forward Phase Dimming - Where indicated, one forward phase control line voltage dimming output per relay for control of compatible two-wire or three-wire ballasts, LED drivers, MLV, forward phase compatible ELV, neon/cold cathode and incandescent loads. (LMRC-220 series)
7. WattStopper product numbers: LMRC-221, LMRC-222

2.04 DIGITAL WALL OR CEILING MOUNTED OCCUPANCY SENSOR

A. Digital Occupancy Sensors shall provide graphic LCD display for digital calibration and electronic documentation. Features include the following:

1. Digital calibration and pushbutton configuration for the following variables:
    a. Sensitivity, 0-100 percent in 10 percent increments
    b. Time delay, 1-30 minutes in 1 minute increments
    c. Test mode, Five second time delay
    d. Detection technology, PIR, Ultrasonic or Dual Technology activation and/or re-activation.
    e. Walk-through mode
2. Load parameters including Auto/Manual-ON, blink warning, and daylight enable/disable when photosensors are included in the DLM local network.
3. Programmable control functionality including:
    a. Each sensor may be programmed to control specific loads within a local network.
    b. Sensor shall be capable of activating one of 16 user-definable lighting scenes.
    c. Adjustable retrigger time period for manual-on loads. Load will retrigger (turn on) automatically within a configurable period of time (default 10 seconds) after turning off.
    d. On dual technology sensors, independently configurable trigger modes are available for both Normal (NH) and After Hours (AH) time periods. The retrigger mode can be programmed to use the following technologies:
    e. Ultrasonic and Passive Infrared
    f. Ultrasonic or Passive Infrared
    g. Ultrasonic only
    h. Passive Infrared only
    i. Independently configurable sensitivity settings for passive infrared and ultrasonic technologies (on dual technology sensors) for both Normal (NH) and After Hour (AH) time periods.
4. One or two RJ-45 port(s) for connection to DLM local network.
5. Two-way infrared (IR) transceiver to allow remote programming through handheld commissioning tool and control by remote personal controls.
6. Device Status LEDs, which may be disabled for selected applications, including:
    a. PIR detection
    b. Ultrasonic detection
    c. Configuration mode
    d. Load binding
7. Assignment of occupancy sensor to a specific load within the room without wiring or special tools.
8. Manual override of controlled loads.
9. All digital parameter data programmed into an individual occupancy sensor shall be retained in non-volatile FLASH memory within the sensor itself. Memory shall have an expected life of no less than 10 years.

B. BACnet object information shall be available for the following objects:

1. Detection state
2. Occupancy sensor time delay
3. Occupancy sensor sensitivity, PIR and Ultrasonic

C. Units shall not have any dip switches or potentiometers for field settings

D. Multiple occupancy sensors may be installed in a room by simply connecting them to the free topology DLM local network. No additional configuration will be required.

E. WattStopper product numbers: LMPX, LMDX, LMPC, LMUC, LMDC

2.05 DIGITAL WALL SWITCH OCCUPANCY SENSORS

A. Digital Occupancy Sensors shall provide scrolling LCD display for digital calibration and electronic documentation. Features include the following:

1. Digital calibration and pushbutton configuration for the following variables:
   a. Sensitivity: 0-100 percent in 10 percent increments
   b. Time delay: 1-30 minutes in 1 minute increments
   c. Test mode: Five second time delay
   d. Detection technology: PIR, Dual Technology activation and/or re-activation.
   e. Walk-through mode
   f. Load parameters including Auto/Manual-ON, blink warning, and daylight enable/disable when photosensors are included in the DLM local network.
2. Programmable control functionality including:
   a. Each sensor may be programmed to control specific loads within a local network.
   b. Sensor shall be capable of activating one of 16 user-definable lighting scenes.
   c. Adjustable retrigger time period for manual-on loads. Load will retrigger (turn on) automatically during the configurable period of time (default 10 seconds) after turning off.
   d. On dual technology sensors, independently configurable trigger modes are available for both Normal (NH) and After Hours (AH) time periods. The retrigger mode can be programmed to use the following technologies:
      1) Ultrasonic and Passive Infrared
      2) Ultrasonic or Passive Infrared
      3) Ultrasonic only
      4) Passive Infrared only
3. Independently configurable sensitivity settings for passive infrared and ultrasonic technologies (on dual technology sensors) for both Normal (NH) and After Hour (AH) time periods.
4. Two RJ-45 ports for connection to DLM local network.
5. Two-way infrared (IR) transceiver to allow remote programming through handheld configuration tool and control by remote personal controls.
6. Device Status LEDs including
   a. PIR detection
   b. Ultrasonic detection
   c. Configuration mode
   d. Load binding
7. Assignment of any occupancy sensor to a specific load within the room without wiring or special tools.
8. Assignment of local buttons to specific loads within the room without wiring or special tools
9. Manual override of controlled loads

10. All digital parameter data programmed into an individual wall switch sensor shall be retained in non-volatile FLASH memory within the wall switch sensor itself. Memory shall have an expected life of no less than 10 years.

B. BACnet object information shall be available for the following objects:
   1. Detection state
   2. Occupancy sensor time delay
   3. Occupancy sensor sensitivity, PIR and Ultrasonic
   4. Button state
   5. Switch lock control
   6. Switch lock status

C. Units shall not have any dip switches or potentiometers for field settings.

D. Multiple occupancy sensors may be installed in a room by simply connecting them to the free topology DLM local network. No additional configuration will be required.

E. Two-button wall switch occupancy sensors, when connected to a single relay dimming room or fixture controller, shall operate in the following sequence as a factory default:
   1. Left button
      a. Press and release - Turn load on
      b. Press and hold - Raise dimming load
   2. Right button
      a. Press and release - Turn load off
      b. Press and hold - Lower dimming load

F. Low voltage momentary pushbuttons shall include the following features:
   1. Load/Scene Status LED on each switch button with the following characteristics:
      a. Bi-level LED
      b. Dim locator level indicates power to switch
      c. Bright status level indicates that load or scene is active
   2. The following button attributes may be changed or selected using a wireless configuration tool:
      a. Load and Scene button function may be reconfigured for individual buttons (from Load to Scene, and vice versa).
      b. Individual button function may be configured to Toggle, On only or Off only.
      c. Individual scenes may be locked to prevent unauthorized change.
      d. Fade Up and Fade Down times for individual scenes may be adjusted from 0 seconds to 18 hours.
      e. Ramp rate may be adjusted for each dimmer switch.
      f. Switch buttons may be bound to any load on any load controller or relay panel and are not load type dependent; each button may be bound to multiple loads.
      g. WattStopper part numbers: LMPW, LMDW. Available in white, light almond, ivory, grey, red and black; compatible with wall plates with decorator opening.

2.06 DIGITAL WALL SWITCHES

A. Low voltage momentary pushbutton switches in 1, 2, 3, 4, 5 and 8 button configuration. Wall switches shall include the following features:

   1. Two-way infrared (IR) transceiver for use with personal and configuration remote controls.
   2. Removable buttons for field replacement with engraved buttons and/or alternate color buttons. Button replacement may be completed without removing the switch from the wall.

3. Configuration LED on each switch that blinks to indicate data transmission.
4. Load/Scene Status LED on each switch button with the following characteristics:
   a. Bi-level LED
   b. Dim locator level indicates power to switch
   c. Bright status level indicates that load or scene is active
   d. Dimming switches shall include seven bi-level LEDs to indicate load levels using 14 steps.
5. Programmable control functionality including:
   a. Button priority may be configured to any BACnet priority level, from 1-16, corresponding to networked operation allowing local actions to utilize life safety priority
   b. Scene patterns may be saved to any button other than dimming rockers. Once set, buttons may be digitally locked to prevent overwriting of the preset levels.
6. All digital parameter data programmed into an individual wall switch shall be retained in non-volatile FLASH memory within the wall switch itself. Memory shall have an expected life of no less than 10 years.

B. BACnet object information shall be available for the following objects:

1. Button state
2. Switch lock control
3. Switch lock status

C. Two RJ-45 ports for connection to DLM local network.

D. Multiple digital wall switches may be installed in a room by simply connecting them to the free topology DLM local network. No additional configuration shall be required to achieve multi-way switching.

E. Load and Scene button function may be reconfigured for individual buttons from Load to Scene, and vice versa.

1. Individual button function may be configured to Toggle, On only or Off only.
2. Individual scenes may be locked to prevent unauthorized change.
3. Fade Up and Fade Down times for individual scenes may be adjusted from 0 seconds to 18 hours.
4. Ramp rate may be adjusted for each dimmer switch.
5. Switch buttons may be bound to any load on any load controller or relay panel and are not load type dependent; each button may be bound to multiple loads.
6. WattStopper product numbers: LMSW-101, LMSW-102, LMSW-103, LMSW-104, LMSW-105, LMSW-108, LMDM-101. Available in white, light almond, ivory, grey, red and black; compatible with wall plates with decorator opening.

2.07 DIGITAL DAYLIGHTING SENSORS

A. Digital daylighting sensors shall work with load controllers and relay panels to provide automatic switching, bi-level, or tri-level or dimming daylight harvesting capabilities for any load type connected to the controller or panel. Daylighting sensors shall be interchangeable without the need for rewiring.
   1. Closed loop sensors measure the ambient light in the space and control a single lighting zone.
   2. Open loop sensors measure incoming daylight in the space, and are capable of controlling up to three lighting zones.
   3. Dual loop sensors measure both ambient and incoming daylight in the space to insure

that proper light levels are maintained as changes to reflective materials are made in a single zone

B. Digital daylighting sensors shall include the following features:

1. Sensor's internal photodiode shall only measure lightwaves within the visible spectrum. The photodiode's spectral response curve shall closely match the entire photopic curve. Photodiode shall not measure energy in either the ultraviolet or infrared spectrums. Photocell shall have a sensitivity of less than 5 percent for any wavelengths less than 400 nanometers or greater than 700 nanometers.
2. Sensor light level range shall be from 1-6,553 foot-candles (fc).
3. Capability of ON/OFF, bi-level or tri-level switching, or dimming, for each controlled zone, depending on the selection of load controller(s) and load binding to controller(s).
4. For switching daylight harvesting, the photosensor shall provide a field-selectable deadband, or a separation, between the "ON Setpoint" and the "OFF Setpoint" that will prevent the lights from cycling excessively after they turn off.
5. For dimming daylight harvesting, the photosensor shall provide the option, when the daylight contribution is sufficient, of turning lights off or dimming lights to a field-selectable minimum level.
6. Photosensors shall have a digital, independently configurable fade rate for both increasing and decreasing light level in units of percent per second.
7. Photosensors shall provide adjustable cut-off time. Cut-off time is defined by the number of selected minutes the load is at the minimum output before the load turns off. Selectable range between 0-240 minutes including option to never cut-off.
8. Optional wall switch override shall allow occupants to reduce lighting level to increase energy savings or, if permitted by system administrator, raise lighting levels for a selectable period of time or cycle of occupancy.
9. Integral infrared (IR) transceiver for configuration and/or commissioning with a handheld configuration tool, to transmit detected light level to wireless configuration tool, and for communication with personal remote controls.
10. Configuration LED status light on device that blinks to indicate data transmission.
11. Status LED indicates test mode, override mode and load binding.
12. Recessed switch on device to turn controlled load(s) ON and OFF.
13. BACnet object information shall be available for the following daylighting sensor objects, based on the specific photocell's settings:
    a. Light level
    b. Day and night setpoints
    c. Off time delay
    d. On and off setpoints
    e. Up to three zone setpoints
    f. Operating mode - on/off, bi-level, tri-level or dimming
14. One RJ-45 port for connection to DLM local network.
15. A choice of accessories to accommodate multiple mounting methods and building materials. Photosensors may be mounted on a ceiling tile, skylight light well, suspended lighting fixture or backbox. Standard tube photosensors accommodate mounting materials from 0-0.62 inch thick (LMLS-400, LMLS-500). Extended tube photosensors accommodate mounting materials from 0.62 to 1.25 inches thick (LMLS-400-L, LMLS-500-L). Mounting brackets are compatible with J boxes (LMLS-MB1) and wall mounting (LMLS-MB2). LMLS-600 photosensor to be mounted on included bracket below skylight well.
16. Any load or group of loads in the room can be assigned to a daylighting zone
17. Each load within a daylighting zone can be individually enabled or disabled for discrete control (load independence).
18. All digital parameter data programmed into a photosensor shall be retained in non-

volatile FLASH memory within the photosensor itself. Memory shall have an expected life of no less than 10 years.

C. Closed loop digital photosensors shall include the following additional features:

1. An internal photodiode that measures light in a 100-degree angle, cutting off the unwanted light from bright sources outside of this cone.
2. Automatic self-calibration, initiated from the photosensor, a wireless configuration tool or a PC with appropriate software.
3. Automatically establishes application-specific setpoints following self-calibration. For switching operation, an adequate deadband between the ON and OFF setpoints shall prevent the lights from cycling; for dimming operation a sliding setpoint control algorithm with separate Day and Night setpoints shall prevent abrupt ramping of loads.
4. WattStopper Product Number: LMLS-400, LMLS-400-L.

D. Open loop digital photosensors shall include the following additional features:

1. An internal photodiode that measures light in a 60-degree angle (cutting off the unwanted light from the interior of the room).
2. Automatically establishes application-specific setpoints following manual calibration using a wireless configuration tool or a PC with appropriate software. For switching operation, an adequate deadband between the ON and OFF setpoints for each zone shall prevent the lights from cycling; for dimming operation, a proportional control algorithm shall maintain the design lighting level in each zone.
3. Each of the three discrete daylight zones can include any non-overlapping group of loads in the room.
4. WattStopper Product Number: LMLS-500, LMLS-500-L.

2.08 EMERGENCY LIGHTING CONTROL DEVICES

A. Emergency Lighting Control Unit - A UL 924 listed device that monitors a switched circuit providing normal lighting to an area. The unit provides normal ON/OFF control of emergency lighting along with the normal lighting. Upon normal power failure the emergency lighting circuit will close, forcing the emergency lighting ON until normal power is restored. Features include:
1. 120/277 volts, 50/60 Hz, 20 amp ballast rating
2. Push to test button
3. Auxiliary contact for remote test or fire alarm system interface

B. WattStopper Product Numbers: ELCU-100, ELCU-200.

PART 3 EXECUTION

3.01 PREPARATION

A. Do not begin installation until measurements have been verified and work areas have been properly prepared.

B. If preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 INSTALLATION

A. Install system in accordance with the approved system shop drawings and manufacturer's

instructions.

B. Install all room/area devices using manufacturer's factory-tested Cat 5e cable with pre-terminated RJ-45 connectors.

1. If pre-terminated cable is not used for room/area wiring, each field-terminated cable shall be tested following installation and testing results submitted to the Manufacturer's Representative for approval prior to proceeding with the Work.
2. If fixtures have internal DLM Control Modules, ensure that they are also connected with Cat 5e cable.
3. Install all room to room network devices using manufacturer-supplied LM-MSTP network wire or wireless devices. Network wire substitution is not permitted and may result in loss of product warranty.
4. Low voltage wiring topology must comply with manufacturer's specifications.
5. Route network wiring as indicated on the Drawings as closely as possible. Document final wiring location, routing and topology on as built drawings.

C. All line voltage connections shall be tagged to indicate circuit and switched legs.

D. Test all devices to ensure proper communication.

E. Calibrate all sensor time delays and sensitivity to guarantee proper detection of occupants and energy savings. Adjust time delay so that controlled area remains lighted while occupied.

F. Provide written or computer-generated documentation on the configuration of the system including room by room description including:

1. Sensor parameters, time delays, sensitivities, and daylighting setpoints.
2. Sequence of operation, (e.g. manual ON, Auto OFF. etc.)
3. Load Parameters (e.g. blink warning, etc.)

G. Post start-up tuning - Adjust sensor time delays and sensitivities to meet the Owner's requirements 30 days from beneficial occupancy. Provide a detailed report to the Architect / Owner of post start-up activity.

H. Tighten all panel Class I conductors from both circuit breaker and to loads to torque ratings as marked on enclosure UL label.

I. All Class II cabling shall enter enclosures from within low-voltage wiring areas and shall remain within those areas. No Class I conductors shall enter a low-voltage area.

J. Run separate neutrals for any phase dimmed branch load circuit. Different types of dimming loads shall have separate neutral.

K. Verify all non-panel-based lighting loads to be free from short circuits prior to connection to room controllers.

3.03 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing. Notify Architect and Manufacturer in writing a minimum of 3 weeks prior to system start-up and testing.

B. Tests and Inspections: Manufacturer's service representative shall perform the following inspections and prepare reports.

1. Verify Class I and II wiring connections are terminated properly by validating system performance.
2. Set IP addresses and other network settings of system front end hardware per facilities IT instructions.
3. Verify / complete task programming for all switches, dimmers, time clocks, and sensors.
4. Verify that the control of each space complies with the Sequence of Operation.
5. Correct any system issues and retest.

C. Provide a report in table format with drawings or using a software file that can be opened in the manufacturer's system software including each room or space that has lighting control installed. Indicate the following:

1. Date of test or inspection.
2. Loads per space, or Fixture Address identification.
3. Quantity and Type of each device installed
4. Reports providing each device's settings.

3.04 PRODUCT SUPPORT AND SERVICE

A. Factory telephone support shall be available at no cost to the Owner following acceptance. Factory assistance shall consist of assistance in solving application issues pertaining to the control equipment.

END OF SECTION

SECTION 26 24 16
PANELBOARDS

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. All work specified herein shall be accomplished in accordance with the applicable requirements of Section 26 00 00 - Electrical General.

B. Provide the panelboards indicated on the Drawings complete with overcurrent protection devices and spaces.

C. This section includes panelboards and distribution panelboards and associated auxiliary equipment rated 600 V or less as shown on the drawings.

D. Refer to panel schedule and one-line power diagram on drawings for specific requirements of each panel.

1.02 WORK INCLUDED

A. The work under this section shall include all labor, materials, accessories, services and equipment necessary to furnish and install panelboards, complete, as indicated on the Drawings and as specified herein.

B. Equipment schedules and specifications are based on the one manufacturer listed in the schedule. Other manufacturers of equal quality and performance may be submitted to the Engineer for review. When substitution of equipment is made, the Contractor shall be responsible for the costs of any item and engineering and construction revisions necessary in his or any other contract or trade that may be required to satisfy plans and specifications.

1.03 QUALITY ASSURANCE

A. Panels shall be factory assembled.

B. Coordination: Coordinate installation with architectural and structural features, equipment installed under other sections of the Specifications and electrical equipment to ensure panel access and so that clearance minimums are provided.

C. Components and installation shall be in accordance with NFPA 70, “National Electrical Code,” NEMA PBI, “Panelboards” and UL67 and UL50.

D. Panelboards and load centers shall be listed and identified for use with 75 degrees C rated conductors.

1.04 SUBMITTALS

A. Refer to Section 26 00 00 - Electrical General for submittal requirements.

B. Manufacturers Product Data:

1. Submit material Specifications and installation data for products specified under Part 2 - Products to include:
   a. Overcurrent protection devices

b. Panelboards

C. Shop Drawings: Submit shop drawings to indicate information not fully described by the product data to indicate compliance with the Contract Drawings.

1. Include electrical characteristics and ratings for each panelboard with dimensions, mounting, bus material, voltage, ampere rating, mains, poles and wire connection, and any accessories. Indicate method of ground bus attachment to enclosure.
2. Include bussing diagram indicating each bussing overcurrent protection device position.
3. Provide a schedule indicating overcurrent protection device type, trip and size, poles, frame type, interrupting capacity.

1.05 ARC FLASH LABELING

A. Arc flash labels shall be factory provided and installed in accordance with NFPA 70.

B. A permanent label shall be factory applied to service equipment rated 1200 amps or more. The label shall meet the requirements of NFPA 70 and contain the following information:
1. Nominal system voltage
2. Available fault current at the service overcurrent protective devices
3. The clearing time of service overcurrent protective devices based on the available fault current at the service equipment
4. The date the label was applied

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Panelboard manufacturer shall be:

1. Siemens
2. Square D
3. ABB-GE
4. Cutler-Hammer

2.02 GENERAL REQUIREMENTS

A. All panels and overcurrent protection devices shall be UL Listed and bear a UL Label. Where panel serves as service entrance equipment, panel shall bear a UL Label indicating suitability as service entrance equipment.

B. Panels shall be of the dead front safety type.

C. Provide panels complete with factory assembled circuit breakers or fuses connected to the bus bars in the positions shown on the panel schedules.

D. Provide all panelboards fully rated to the A.I.C. ratings noted on the schedules, but not less than 10,000 amperes for 120/208 volt panelboards and not less than 14,000 amperes for 277/480 volt panelboards. All devices in a panelboard shall be rated for the A.I.C. ratings shown for the panelboard.

2.03 BUSSING AND INTERIORS

A. All bus bars shall be aluminum. Main lugs and main overcurrent protection devices shall be UL approved for copper or aluminum conductors and shall be of a size range for the conductors indicated on the drawings. Each panel shall contain a full size grounding bus. All panelboards shall contain a full size insulated neutral bus unless otherwise indicated on the drawings.

B. The neutral and ground bus shall have a sufficient number of lugs to singularly terminate each individual conductor requiring a connection.

C. Where designated on panel schedule as “space,” include all necessary bussing, device support and connections. Provide blank cover for each space.

D. Where specified or indicated on the drawings, provide sub-feed lugs adjacent to the mains or feed-through lugs opposite end of mains and increase box heights to provide additional cable bending and termination space. Lugs to be the same size and capacity as mains and rated for aluminum or copper conductor terminations.

2.04 ENCLOSURES

A. Panelboard width shall not be less than twenty inches unless indicated on the drawings (32" minimum for distribution panelboards).

B. Provide concealed captive clamping devices, concealed hinges and chrome lock for all flush mounted panels. Key all panels throughout project alike.

C. Where two section panels are required, both sections shall have fully rated bus, separate cabinets connected by conduit nipples. Interconnect sections with copper conductors with ampacity equal to rating of main bus. Route phase and neutral conductors together between panels. Provide separate trims for each section.

D. Panelboard trims for surface mounted panelboards shall be continuously hinged on one side so that when opened, wiring gutters are completely exposed.

E. Provide a label for each branch circuit, feeder, and main circuit breaker in distribution panels, permanently attached per the requirements of Section 26 00 00 - Electrical General, 2.02A.

F. Cabinets, flush or surface mounted as indicated. NEMA PB-1, Type 1 enclosure, except where the following enclosure requirements are indicated:

1. NEMA 250, Type 3R - Raintight.
2. NEMA 250, Type 3S - Raintight and dust tight.
3. NEMA 250, Type 4X - Corrosion-resistant stainless steel enclosure, watertight, dust tight, and resistant to oil and coolant seepage. This type shall be used in kitchen areas.
4. NEMA 250, Type 12 - Dust tight, drip proof, and resistant to oil and coolant seepage.

G. Enclosure shall be fabricated with galvanized steel. Trims shall have electrostatic applied ANSI gray enamel finish and adjustable indicating trim clamps for securing trim to the enclosure. Screwed-on trims shall not be acceptable. Trim shall have an angle support along the bottom serving as a support between trim and enclosure for safe installation and removal of trim.

H. Exterior Panels: Panelboards mounted outside of building shall be in NEMA type 3R enclosures. Panelboards shall have in addition to the standard specified items the following:

1. Piano hinge
2. Seams continuously welded
3. Rolled lip around door and cabinet
4. No knockouts or holes
5. Neoprene gaskets on inside of door
6. Stainless steel hardware
7. Drip hood at top above door

2.05 CIRCUIT BREAKERS

A. Interrupting rating of all circuit breakers in panelboards shall have UL rating of not less than the RMS symmetrical amps indicated on the Drawings at system voltage. Series rated devices are acceptable with the following exceptions: devices used in distribution serving emergency, standby and multiple elevator loads (selective coordination).

B. Circuit breakers shall be provided with trip rating and poles as indicated on the drawings or specified herein.

C. Multi-pole breakers shall be common trip and common reset; tie handle connection between single pole breakers is not acceptable.

D. Branch circuit breakers in lighting and appliance panels shall be quick-make, quick-break, thermal magnetic type bolted to the bus. Circuit breakers in distribution type panelboards shall be bolted to the bus.

E. Provide the following special devices and accessories when indicated on the drawings or specified herein.

1. Ground fault interrupting circuit breakers (GFI) where indicated on the drawings.
2. Provide handle lock-on device (to prevent manually turning off device without removal) for all overcurrent devices where indicated on panelboard schedules, and for those protecting circuits serving fire alarm equipment, and for those dedicated for powering emergency battery-powered unit equipment.
3. Provide UL Listed “SWD” switching duty circuit breakers on the devices indicated on the drawings.
4. Provide shunt trip device for electrically tripping circuit breakers indicated on the drawings.
5. Overcurrent protective devices for fire alarm circuits shall have handles that are factory-marked in the color red.

2.06 LOAD CENTERS

A. Individual apartment unit panels shall be “Load Center” type of amperage indicated on drawings.

B. Branch breakers shall be plug-in type.

C. Arc-fault circuit breakers shall protect 15- and 20-amp branch circuits in dwelling units serving lighting, receptacles and smoke detectors except for those located in bathrooms, garages and outdoors.

D. Load center trims shall be factory-painted white.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Provide from each flush mounted panelboard four (4) 3/4" empty conduits stubbed out above ceiling line and capped (not applicable to living unit load centers).

B. Install panelboards in accordance with NEMA PB1.1, “General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less” and manufacturer’s written installation instructions.

C. Mount panelboards with top circuit breaker not more than 6'-6" above finished floor.

D. Only one conductor installed under terminal of individual circuit breakers. Form and train conductors in panel enclosure neatly parallel and at right angles to sides of box. Un-insulated conductor shall not extend beyond one-eighth inch from terminal lug.

E. Do not splice conductors in panels. Where required, install junction box adjacent to panel and splice or tap conductors in box.

F. Mounting and Support

1. Mounting
   a. Enclosure shall be secured to structure by a minimum of four (4) fastening devices. Panelboards 600 amp and larger shall be secured by a minimum of eight (8) devices. A 1.5 inch minimum diameter round washer shall be used between head of screw or bolt and enclosure.
   b. Enclosures shall be mounted where indicated on the drawings or specified herein. Support from the structure with fastening device specified.
   c. Attach enclosure directly to masonry, concrete, or wood surfaces.
   d. Mounted enclosure on metal channel (strut), which is connected to structure with fastening device specified, for installation on steel structure or sheet rock walls.

G. Maintain conductor phase color code requirements described in the conductors and cables section of the specifications.

H. A typewritten branch circuit directory (based on as-built conditions) shall be provided for each panelboard and load center, permanently mounted on inside of door in a transparent, protective cover. Room number(s) or room name(s) shall be included in the circuit description in coordination with the final naming/numbering scheme for the project (e.g. “Office Receptacles” shall read “Office Receptacles – Rm. 202, 203”).

I. Any circuit breaker provided with arc energy reducing maintenance switch shall be labeled “BREAKER IS PROVIDED WITH ARC ENERGY REDUCING MAINTENANCE SWITCH”. Labeling shall be per the requirements of Section 26 00 00 – Electrical General 2.02A.

J. Install panelboard ground fault circuit interrupter devices in accordance with installation guidelines of NEMA 289, “Application Guide for Ground Fault Circuit Interrupters.”

K. Tighten electrical connectors and terminals, including grounding connections, in accordance with manufacturer’s published torque-tightening values. Where manufacturer’s torque values are not indicated, use those specified in UL 486A and UL 486B.

L. Mounting of all panelboards and all hardware used for mounting shall be in accordance with the seismic criteria per the applicable building code.

M. Fusible coordination panelboards shall be shipped without branch circuit fuses installed. Branch circuit fuses shall be shipped separately with the chassis. Where main fuses are specified 100A or greater, equipment shall be shipped with main fuses installed.

END OF SECTION

SECTION 26 27 13
MODULAR METERING EQUIPMENT

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Utility Company Furnished Metering Equipment: Install all current transformers, kWh and associated metering equipment furnished by the electric service utility per utility company standards.

B. Contractor Furnished Metering Equipment: Furnish and install the modular metering equipment and service equipment per the Contract Documents, National Electrical Code, and the utility company standards.

1.02 REFERENCES

A. ANSI C12.1, American National Standard Code for Electricity Metering.

B. Unless noted otherwise, the equipment shall be UL Listed as suitable for use as service entrance equipment.

C. Utility company metering standards. The Contractor shall coordinate supply voltage and phase, and output voltage and phase with the electrical utility company and the Contract Documents.

1.03 EQUIPMENT DESCRIPTION

A. The wall mounted metering system shall be outdoor NEMA 3R, and installed with clearances per NEC Article 110.

B. The metering equipment shall be surface mounted.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Store the equipment and materials in an indoor location with controlled temperature and humidity, as recommended by the manufacturer.

1.05 WARRANTY

A. The manufacturer shall provide a 3-year (minimum) limited warranty for repair and replacement of the equipment.

PART 2 - PRODUCTS

2.01 MANUFACTURER

A. Contractor-furnished metering equipment shall be Cutler-Hammer, General Electric Company, Siemens Energy and Automation, Square D, or approved equal.

B. The Metering Equipment shall be furnished by the same supplier as the electrical distribution equipment. The equipment supplier shall be responsible for coordinating the installation and calibration of the metering equipment with the electrical distribution equipment.

2.02 MATERIALS

A. The metering equipment shall have an AIC rating as shown on the drawings. Unless noted otherwise, series rated equipment is acceptable.

B. The housing shall be formed and welded code gauge steel. All components shall be factory assembled. Sockets shall be rated for continuous duty.

C. Blank covers shall be provided for all unused sockets. If the metering equipment is to be energized prior to installation of all meters, provide insulated and sealed blanks for each unused socket.

D. For each assembly, the mains service disconnect shall be an integral circuit breaker.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that the connections to the metering equipment are complete, correct, and ready to accept the installation of the conductors.

B. Verify field voltages, CT ratios, measurements, etc. are as shown on the Drawings.

3.02 LOCATION

A. Location of the metering equipment shall meet NEC Article 110.

3.03 INSTALLATION

A. Provide pairs of ultraviolet resistant, weatherproof, machine printed adhesive labels to identify each meter socket with the corresponding tenant panel. Lettering shall be black on white or silver background. Size shall be as approved by the building inspector and Architect.

B. Any circuit breaker rated 1200A or more shall be provided with arc energy reducing maintenance switch. Breaker shall be labeled “BREAKER IS PROVIDED WITH ARC ENERGY REDUCING MAINTENANCE SWITCH”. Labeling shall be per the requirements of Section 26 00 00 – Electrical General 2.02A.

C. Install the equipment and all associated sensors, devices, conductors, etc. per the manufacturer’s instructions. Specific attention shall be paid to the manufacturer’s instruction on application of voltages.

D. Install required safety labels. Provide a voltage/phase label at each service disconnecting means.

E. Where used as service equipment, provide service ground connection, as shown on the electric riser diagram.

3.04 FIELD QUALITY CONTROL

A. Inspect the installed wiring systems for completeness, tightness or terminations, grounding, and physical damage.

B. Check tightness of all accessible mechanical and electrical connections. If and where noted, use calibrated electrical meters, and torque wrench(es). Minimum acceptable values shall be as specified in the equipment manufacturer's instructions.

3.05 ADJUSTING

A. Adjust all controls, settings, OCPDs, access doors, operating handles for free mechanical and/or electrical operation as described in the equipment manufacturer's instructions.

3.06 CLEANING

A. All metering equipment and associated raceway systems shall be cleaned prior to the pulling of conductors. Clean the exposed portions of all conductors within panelboards, junction boxes, and other equipment to remove pulling lubricant, construction debris, dirt, and shipping materials.

END OF SECTION

SECTION 26 27 26
WIRING DEVICES

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. All work specified herein shall be accomplished in accordance with the applicable requirements of Section 26 00 00 - Electrical General.

1.02 WORK INCLUDED

A. The work under this section shall include all labor, materials, accessories, services and equipment necessary to furnish and install wiring devices, complete, as indicated on the Drawings and as specified herein.

B. Equipment schedules and specifications are based on the one manufacturer listed in the schedule. Other manufacturers of equal quality and performance may be submitted to the Engineer for review. The following manufacturers are allowed:

1. Hubbell
2. Pass & Seymour
3. Cooper
4. Leviton
5. Thomas & Betts/Steel City
6. Walker/Wiremold

When substitution of equipment is made, the Contractor shall be responsible for the costs of any item and engineering and construction revisions necessary in his or any other contract or trade that may be required to satisfy plans and specifications.

C. This section includes receptacles, connectors, switches, dimmers, timeclocks and coverplates.

1.03 QUALITY ASSURANCE

A. Wiring devices shall comply with applicable sections of NEMA Standard WD-1, NFPA 70, Article 100.

B. All special purpose receptacles shall be NEMA standard configuration.

C. Comparative devices by acceptable manufacturers are equal.

PART 2 – PRODUCTS

2.01 WIRING DEVICE DESCRIPTION AND MANUFACTURER – COMMON AREAS

A. Single & Duplex Receptacles (20 Amp)

1. Single or duplex type receptacle as indicated. 125V/20/A/2P/3W/G rating - NEMA - 5-20R type.
2. Face color shall be white – confirm with architect prior to purchase.
3. Manufacturer

a. Hubbell 5362

B. GFCI Duplex Receptacles

1. Duplex, feed-thru type ground fault current interrupter receptacle with test/reset buttons. 125V/20A/2P/3W/G rating - NEMA 5-20R type conforming to UL #498, UL #943 Class A and NEMA #WD1-4.02.
2. Manufacturer
   a. Hubbell GF20 Series

C. Isolated Ground Single & Duplex Receptacles

1. Single or duplex type receptacles as indicated. 125V/20A/2P/3W/IG rating - NEMA 5-20R type ground internally isolated from receptacle frame and ground pigtail or terminal screw.
2. Manufacturer
   a. Hubbell IG5352

D. Clock/Flat Screen Receptacles

1. Single type receptacle with a recessed outlet clock hanger type mounting coverplate. 125V/15A/2P/3W/G - NEMA 5-15R type.
2. Manufacturer
   a. Hubbell RR151CH Series

E. Maintained Contact Switches

1. Provide toggle operated switches SPST, DPST, 3-way or 4-way operation as indicated. 277V/20A rating, quiet type, maintained contact, and a green hexagonal ground screw or ground pigtail, and side wired.
2. Manufacturer
   a. Hubbell 1221 Series (Color to match receptacles).

F. Momentary Contact Switches

1. Provide toggle or key operated switches as indicated with single circuit, 3-position center-off operation. 277V/20A rating, quiet type, momentary contact, spring loaded switch, and green hexagonal ground screw or ground pigtail, back and side wired.
2. Manufacturer
   a. Hubbell HBL 155* (Color to match receptacle).

G. Maintained Contact Slider Type Switch (For Multi-Ganging with Dimmers)

1. Slide-operated switch (to match dimmer), single pole, 3-way or 4-way operation as indicated, 120/277V, 20A rating.
2. Manufacturer
   a. Leviton Monet Series
   b. Lutron Nova T Series

H. Slider Type Wall Box Dimmers

1. Slide operated AC solid state type dimmer with positive ON/OFF switching, integral surge protection, voltage stabilized output, RFI filtered and maximum lighting level adjustment. 120V/60Hz, unless noted otherwise, with lettering and/or nameplate as indicated. Dimmers shall have lowest profile available (wattage permitting).
2. Manufacturer

	Load Type				
	Incandescent/ Halogen	Dimmable CFL/LED (screw base)	Magnetic low voltage	Electronic low voltage	0-10V Fluorescent/ LED
Lutron Nova T Series	NT-600-XX	NTCL-253P-XX	NTLV-600-XX	NTELV-600-XX	NTSTV-DV-XX
Leviton SureSlide Series	6673-10X	6672-1LX	6611-PX	6615-P0X	
Leviton Renoir Series					AWSMG-7DW

I. Illuminated Toggle Switches

1. Single pole, 3-way or 4-way, as indicated, conforming to UL #20, NEMA #WDI-3.02 and F.S. #W-S-896E. 277V/20A rating, quiet type, maintained contact, and a green hexagonal ground screw or ground pigtail, back and side wired. Red colored toggle to glow when switch is on.
2. Manufacturer
   a. Hubbell HBL 1221PL

J. Weather-Resistant Receptacles

1. All 15- and 20-amp receptacles installed in damp or wet locations shall be listed weather-resistant type.

K. Tamper-Resistant Receptacles

1. All 15- and 20-ampere, 125- and 250-volt nonlocking-type receptacles in the areas indicated below shall be listed tamper-resistant receptacles.
   a. Common areas of multifamily dwellings.
   b. Child care facilities
   c. Preschools and elementary education facilities
   d. Business offices, corridors, waiting rooms and the like in clinics, medical and dental offices and outpatient facilities
   e. Subset of assembly occupancies including places of waiting transportation, gymnasiums, skating rinks, and auditoriums

L. Controlled Duplex Receptacles (20 Amp)

1. Duplex type receptacle, 125V/20/A/2P/3W/G controlled by an automatic control device (or by an automatic energy management system) shall be permanently marked with the universal “power” symbol to differentiate them from non-controlled receptacles.
2. Face color shall be white – Confirm with architect prior to purchase.
3. Manufacturer
   a. Hubbell BR20C1 – Split Wired

b. Hubbell BR20C2 – Both Outlets Controlled

2.02 WIRING DEVICE DESCRIPTION AND MANUFACTURER – DWELLING UNITS

A. Duplex Receptacles (15 Amp)

1. 125V/15A/2P/3W/G rating - NEMA 5-15 R type, duplex receptacle with green hexagonal ground screw, mounting frame with plaster ears, back and side wired.
2. Face color shall be white – Confirm with architect prior to purchase.
3. Manufacturer
   a. Leviton T5820-* Series
   b. Hubbell

B. GFCI Duplex Receptacles

1. Duplex, feed-thru type ground fault current interrupter receptacle with test/reset buttons. 125V/20A/2P/3W/G rating - NEMA 5-20R type conforming to UL #498, UL #943 Class A and NEMA #WD1-4.02.
2. Manufacturer
   a. Leviton T7899 or approved equal
   b. Hubbell

C. Clock/Flat Screen Receptacles

1. Single type receptacle with a recessed outlet clock hanger type mounting coverplate. 125V/15A/2P/3W/G - NEMA 5-15R type.
2. Manufacturer
   a. Leviton 5320-* Series
   b. Hubbell RR151CH Series

D. Maintained Contact Switches

1. Provide toggle operated switches SPST, DPST, 3-way or 4-way operation as indicated. 120V/15A rating, quiet type, maintained contact, and a green hexagonal ground screw or ground pigtail, back and side wired.
2. Manufacturer
   a. Leviton 1451-2 (Color to match receptacles)
   b. Hubbell RS115 Series

E. Maintained Contact Slider Type Switch (For Multi-Ganging with Dimmers)

1. Slide-operated switch (to match dimmer), single pole, 3-way or 4-way operation as indicated, 120/277V, 20A rating.
2. Manufacturer
   a. Leviton Monet Series
   b. Lutron Nova T Series

F. Slider Type Wall Box Dimmers

1. Slide operated AC incandescent solid state type dimmer with positive ON/OFF switching, integral surge protection, voltage stabilized output, RFI filtered and maximum lighting level adjustment. 120V/60Hz, unless noted otherwise, with

lettering and/or nameplate as indicated. Dimmers shall have lowest profile available (wattage permitting).

2. Manufacturer

	Load Type				
	Incandescent/ halogen	Dimmable CFL/LED (screw base)	Magnetic low voltage	Electronic low voltage	0-10V Fluorescent/ LED
Lutron Nova T Series	NT-600-XX	NTCL-253P-XX	NTLV-600-XX	NTELV-600-XX	NTSTV-DV-XX
Leviton SureSlide Series	6673-10X	6672-1LX	6611-PX	6615-P0X	
Leviton Renoir Series					AWSMG-7DW

G. Illuminated Toggle Switches

1. Single pole, 3-way or 4-way, as indicated, conforming to UL #20, NEMA #WDI-3.02 and F.S. #W-S-896E. 120V/20A rating, quiet type, maintained contact, and a green hexagonal ground screw or ground pigtail, back and side wired. Lighted toggle to glow when switch is off.
2. Manufacturer
   a. Leviton 1461-LHC

H. Tamper-Resistant Receptacles

1. All 125-volt, 15- and 20-amp receptacles in a dwelling unit shall be listed tamper-resistant receptacles.

I. Weather-Resistant Receptacles

1. All 15- and 20-amp receptacles installed in damp or wet locations shall be listed weather-resistant type.

J. Tamper-Resistant Receptacle with USB Chargers

1. Device shall include two 15-amp tamper-resistant receptacles and two 5-volt DC USB 2.0 and 3.0 compatible charging ports.
2. Where shown on drawings as ground-fault protected, device shall be wired from load-side of a GFCI receptacle.
3. Manufacturer
   a. Pass & Seymour TM826USB*CC6

2.03 COVERPLATE DESCRIPTION AND MANUFACTURER – COVERPLATES

A. Flush Mounted Interior Receptacle/Switch Coverplates

1. Single or multi-gang to match device type. Medium size (4-7/8" min.), standard depth, smooth finish with thermoplastic material.
2. Color to match device color.
3. Coverplates in mechanical/electrical equipment rooms and high abuse areas shall be stainless steel, non-magnetic.
4. Coverplates flush mounted in exposed masonry construction shall be jumbo type.

5. Manufacturer
   a. Hubbell NPJ Series (thermoplastic)
   b. Hubbell SS Series (stainless steel)

B. Weatherproof Device Coverplates

1. Provide weatherproof “in use” cast aluminum lockable covers. Plastic covers are allowed on dwelling balconies.
   a. Hubbell WP Series
   b. Thomas & Betts Russell Stoll Series

C. Multi-Outlet Raceway

1. Product Description
   a. Two-piece rectangular surface raceway of length as prescribed. Stainless steel type 304 housing complete with all bends, fittings, couplings, caps and mounting hardware.
   b. Single 15A/125V grounding outlets UL Labeled and full length ground wire.
   c. Outlets 18" on centers starting no less than 9" from end.
   d. Maximum of six outlets per circuit. Where two or more circuits are utilized the outlets shall be on alternate circuits.
2. Manufacturers
   a. Walker/Wiremold
   b. Hubbell

2.04 MISCELLANEOUS ITEMS

A. Time Switches

1. Electronic Astronomical Schedule Type
   a. 365 day scheduling, solid state, skip-a-day feature, daylight saving changeover, leap year adjusted with capacitor backup, DPDT-120V/20A rated contacts, light sensor input.
   b. Acceptable Manufacturer
      1) Tork DZS Series (channels as required)

B. Photoelectric Control Switches

1. Product Description
   a. Raintight photoelectric self-contained control for switching.
   b. Die-cast housing with adjustable sensor.
2. Manufacturers
   a. AMF/Paragon
   b. Tork 2100 Series

C. Lighting Contactor

1. Product Description
   a. Multi-pole contactor for switching branch circuit tungsten and ballast lighting and resistant heating loads.
   b. Number of poles as indicated (paralleling multiple contactors is acceptable), poles rated for 20 amperes @ 600V continuous duty.

c. Mechanically held contactor with coil clearing contacts, operating coil voltage to match circuit characteristics.
d. Housed in panelboard (if indicated).

D. Poke-thru Floor Devices

1. Product Description
   a. Refer to drawings for specific features.
   b. Device shall meet UL 514A requirements for scrubwater test standards.
2. Manufacturer
   a. Hubbell
   b. Walker/Wiremold
   c. Thomas & Betts/Steel City

E. Single/Multiple Station Smoke Alarms: Each sleeping room shall be provided with a smoke alarm. Alarms shall be 120V (with battery back-up) with built-in evacuation horn, power-on indicator and auxiliary contact. Where more than one is installed in a dwelling unit, activation of one detector shall trigger all alarms in that unit. Alarms shall have integral alarm silencing feature.

F. Single/Multiple Station Combination Smoke/Carbon Monoxide Alarms: Each area outside of a sleeping room shall be provided with a combination smoke/carbon monoxide alarm. Alarms shall be 120V (with battery back-up) with built-in evacuation horn, power-on indicator and auxiliary contact. Where more than one is installed in a dwelling unit, activation of one detector shall trigger all alarms in that unit. Alarms shall have integral alarm silencing feature.

PART 3 - EXECUTION

3.01 INSTALLATION

A. All dimmer circuits shall have dedicated neutrals.

B. Install decorative plates on switch, receptacle, and blank outlets when indicated.

C. Install devices and wall plates flush and level.

D. Coordinate the exact location of wiring devices with other trades and architectural features. Do not locate devices on two different architectural finishes such as half on wall tile and half on painted surface, unless noted otherwise.

E. Provide plaster rings in areas requiring them due to construction.

F. Where more than one device is indicated, arrange in gangs covered with one coverplate per manufacturer’s instructions.

G. Where dimmer(s) and switch(es) are shown adjacent to one another, switch(es) shall be a maintained contact switch matching dimmer style, so that a common, multi-gang faceplate can be used.

H. Provide 6" long ground wire from grounding lug to all switches and receptacles to a screw type bonding device on the conduit or outlet box.

END OF SECTION

SECTION 26 28 16
DISCONNECT SWITCHES

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. All work specified herein shall be accomplished in accordance with the applicable requirements of Section 26 00 00 - Electrical General.

1.02 WORK INCLUDED

A. The work under this section shall include all labor, materials, accessories, services and equipment necessary to furnish and install disconnect switches, up to 1200 amps, complete, as indicated on the Drawings and as specified herein.

B. Equipment schedules and specifications are based on the one manufacturer listed in the schedule. Other manufacturers of equal quality and performance may be submitted to the Engineer for review. When substitution of equipment is made, the Contractor shall be responsible for the costs of any item and engineering and construction revisions necessary in his or any other contract or trade that may be required to satisfy plans and specifications.

C. This section includes fuses.

D. This section includes individually mounted enclosed switches used for the following:

1. Service disconnecting means.
2. Feeder and branch-circuit protection.
3. Motor and equipment disconnecting means.

1.03 SUBMITTALS

A. Product Data: For each type of switch and fuse accessory, and component indicated, include dimensions and manufacturer’s technical data on features, performance, electrical characteristics, ratings, and finishes.

1.04 QUALITY ASSURANCE

A. 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.

B. Comply with NEMA AB 1, NEMA KS 1 and UL 98.

C. Comply with NFPA 70.

D. Comply with NEMA FU 1.

E. Source Limitations: Provide fuses from a single manufacturer.

1.05 COORDINATION

A. Coordinate layout and installation of switches and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturer of fusible and non-fusible switches shall be Cutler-Hammer, General Electric, Siemens or Square D Company.

B. Manufacturer of fuses shall be Bussman, Gould Shawmutt or Littelfuse.

2.02 ENCLOSED SWITCHES

A. All disconnect switches shall be heavy duty type with lockable handles (general duty allowed for equipment serving dwelling units).

B. Enclosed, non-fusible switch: NEMA KS 1.

C. Enclosed, fusible switch, 800A and smaller: NEMA KS 1 with clips to accommodate specified fuses and interlocked with cover in closed position.

D. Furnish and install all safety type disconnecting switches indicated on the drawings, specified or required by the National and/or State Electrical Code. Switches shall be externally operable. If the size is not shown on the drawings, the subcontractor shall size the disconnect switch in accordance with name plate data of the equipment they serve.

E. Coordinate with other trades that may provide unit mounted disconnect switches prior to submission of bids.

F. Safety type disconnecting switches shall be heavy duty, 600 volt industrial type with quick-make, quick-break mechanism and interlocking cover which normally cannot be opened when the switch is in the “ON” position. Switches shall be single throw. Fusible switches shall be equipped with fuse clips to receive Bussman fuses. Switches shall have provision for padlocking in the open and closed positions. The operating handle shall be visible in either the on or off position.

G. All fused disconnect switches mounted above 6'-6" shall be hook stick operable.

H. Non-fused “pull-out” disconnects shall be allowed only for HVAC equipment serving dwelling units.

2.03 INTERIOR

A. Switch blades shall be operated by rotating shaft directly connected to the operating handle mechanism. Switch blades shall be clearly visible in the open position. All switches shall have clear shields over the incoming line lugs. Line shields shall be attached in such a way that switch blade covers or arc shields need not be removed for line installation. Line and load lugs shall be front removable and suitable for copper or aluminum, 60/75 degree wire through 200A sizes, 75 degrees C wire for 400-800A sizes.

B. Current limiting type RK1 dual element time delay fuses shall be furnished and installed as necessary; rating shall be shown on drawing.

2.04 ENCLOSURES

A. All switches shall have NEMA type 1 general purpose enclosures unless indicated otherwise on the drawings. NEMA 3R covers shall be side hinged rather than top hinged. NEMA 1 and 3R switches through 200A sizes shall tangential knockouts for conduit line up against walls. NEMA 12 enclosures through 200A sizes shall be UL Listed for conversion to NEMA 3R usage by opening a factory provided drain hole. All types of enclosures shall have metal nameplates affixed to the cover to show the switch type and rating and clearly indicate “ON” and “OFF” direction of handle movement. Provide hubs on all NEMA 4, 4X, or 3R type disconnects.

B. Provide manufacturer’s standard factory applied finish unless otherwise indicated.

C. Provide phenolic engraved nameplate for disconnect switches.

2.05 CONTROL POLE

A. Where required a direct action interlock or control pole shall be affixed to the switch base in such a manner as to operate positively and only with the opening and closing of the switch power poles.

2.06 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, nonrenewable cartridge fuse; class and current rating indicated; voltage rating consistent with circuit voltage.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

B. Examine elements and surfaces to receive enclosed switches for compliance with installation tolerances and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Locate disconnect switches to provide working clearance and full accessibility as required by the National Electrical Code.

B. Mounting and Support

1. Mounting
   a. Enclosure shall be secured to structure by a minimum of four (4) fastening devices. A 1.5-inch minimum diameter round washer shall be used between head of screw or bolt and enclosure.
   b. Enclosure shall be mounted where indicated on the drawings or specified herein. Support from the structure with fastening device specified. Mount with operating handle at 60" AFF, unless other height is indicated.
   c. Attach enclosure directly to masonry, concrete, or wood surfaces.
   d. Mounted enclosure on metal channel (strut), which is connected to structure with fastening device.

e. Where enclosure is not indicated on a wall or structure, construct a metal channel (strut) free standing frame secured to floor, pad, or other appropriate building structure.

C. Do not splice conductors in enclosure. Where required install junction box or wireway adjacent to enclosure and splice or tap conductors in box. Refer to number of conductors in a conduit limitation defined in the conductors and cables section of the Specifications and do not exceed.

3.03 CONNECTIONS

A. Install equipment grounding connections for switches with ground continuity to main electrical ground bus.

B. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.04 CLEANING

A. On completion of installation, inspect interior and exterior of enclosures. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

B. Touch up paint all scratched or marred surfaces with factory furnished touch up paint of the same color as the factory applied paint.

END OF SECTION

SECTION 26 51 00
LIGHTING

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section specifies the lighting system requirements.

B. All fixtures shall be current source, provided with lamps ready to use.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Refer to another division for the ceiling systems.

B. Lighting system shall be coordinated with the ceilings.

1.03 SUBSTITUTIONS/VALUE ENGINEERING/PRICING

A. Substitution/value engineering requests shall be accompanied by complete manufacturer's data with model numbers, cut sheets with options indicated, and a full photometric report. For exterior lighting, a computer generated point-by-point calculation shall be provided.

B. All substitution requests shall be submitted in completion to Engineer at least 10 days prior to bid date.

C. Pricing for lighting fixtures shall be separate from pricing for lighting controls (occupancy sensors, relay controls, dimming).

PART 2 - PRODUCTS

2.01 BALLASTS

A. All fluorescent lamp ballasts shall be low-loss, high power factor Class "P," with "A" sound rating and shall bear UL and CBM certifications. Ballast case temperature shall not exceed 90 degrees C.

B. All fluorescent fixtures shall be equipped with program-start ballasts. Multi-lamp ballasts shall be parallel-wired.

C. Fluorescent fixtures located in an outdoor environment shall be equipped with a minimum 0°F cold temperature ballast.

D. Linear and compact fluorescent lamp ballasts shall be electronic by Advance, General Electric, Osram Sylvania, or Universal.

E. All HID lighting fixtures shall have a high power factor, regulated output ballast provided by the fixture manufacturer, pre-wired with a glass tube fuse holder and fuse on each primary hot lead.

F. Electronic driver for LED fixtures shall include the following:

1. Rated for a minimum 50,000 hours of life

2. Class A sound rating
3. Total Harmonic Distortion: 15% or less

2.02 LAMPS

A. Fluorescent lamps shall be energy saving type, 3,500 degrees K, CRI 75, of size and wattage as scheduled on the Drawings, unless noted otherwise on Light Fixture Schedule. They shall be General Electric or equal as manufactured by Sylvania or Philips unless indicated otherwise on Drawings. Lamps shall have a rated life of 20,000 hours minimum at three (3) hours per start.

B. Incandescent lamps shall be of type, size and voltage as scheduled on the Drawings. Lamps shall be of the extended service type with a rated life of 2,500 hours. Reflector lamps (R and PAR) shall have a rated life of 2,000 hours for the standard type and 4,000 hours for the “Quartz” or “Krypton” types. Quartz lamps shall be clear with a rated life of 2,000 hours.

2.03 LIGHTING FIXTURES

A. Letter designations beside outlet symbols on Drawings correspond to letter designations in Lighting Fixture Schedule.

B. Recessed incandescent fixtures, where used in an insulated ceiling, shall be equipped with thermal protection and shall bear the UL Label indicating the suitability for such use.

C. Lens material for recessed fluorescent fixtures shall be 100% virgin acrylic, 0.125" thick in a square prism pattern similar to KSH-K-12 or as scheduled in Lighting Fixture Schedule.

D. Site lighting poles shall meet or exceed the local wind loading requirements of authority having jurisdiction.

E. Concrete pole bases shall be required for site lighting poles.

F. Recessed lighting fixtures installed in the building thermal envelope (e.g. attic) shall be IC rated and labeled with enclosures that are sealed and gasketed to limit air leakage between conditioned and non-conditioned spaces.

G. Recessed lighting fixtures that penetrate the membrane of a rated ceiling/floor assembly shall be either listed and labeled, or installed within an enclosure, so that the ceiling rating is maintained. Rated enclosures shall be by Fire Rated Product Specialties (FRPS) or approved equal.

H. All linear fluorescent lighting fixtures (with double-ended lamps) shall have a factory-installed, concealed disconnecting means for each ballast.

2.04 LED LUMINAIRES

A. UL or ETL Listed and labeled

B. Minimum 80CRI

C. 5 Year warranty minimum

D. Tested to LM-79, LM-80 and TM-21 standards

E. Lumen Maintenance: 70% lumen output for 50k hours

F. Power Factor: 0.9

PART 3 - EXECUTION

3.01 LIGHTING FIXTURES

A. Provide lighting fixtures at all locations indicated by distinctive symbols or notes on the Drawings.

B. Lighting fixtures shall be secured to ceiling grid with clips or screws and two #12 steel wires mounted to opposite corners of light fixture secured to structure.

C. Locations of lighting fixtures on the electrical drawings are approximate. Refer to Architectural reflected ceiling plan for actual locations of fixtures and mounting heights.

D. Lighting fixtures installed in plaster and stucco ceiling shall have plaster frame and shall be of the flanged type.

E. Fixtures recessed in concealed-spline tile and in gypsum board ceilings shall be flanged.

F. Surface or recessed fixtures in or on plastered ceilings shall be supported from pieces of support channel spanning across the main supporting channels and shall not depend on the metal lath for support.

G. Each recessed lighting fixture shall have a trim to match the type of ceiling (exposed grid, metal panel, etc.) in which it is being installed, except where noted otherwise on the plans.

H. Each lighting fixture recessed in a concrete wall shall have a junction box or wiring compartment provided inside the fixture housing. Provide conduit access into the fixture concealed.

END OF SECTION

SECTION 27 00 00
COMMUNICATIONS

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. Applicable requirements of Division 01 General Requirements shall be considered a part of this section and shall have the same force as if printed herein full.

1.02 QUALITY ASSURANCE

A. Specifications, Standards and Codes: All work shall be in accordance with the following:

1. The 2017 edition of the National Electrical Code (NFPA 70), with South Carolina Amendments
2. The latest adopted edition of the Life Safety Code (NFPA 101)
3. The 2018 edition of the International Building Code (IBC), with South Carolina Amendments
4. The 2018 edition of the International Fire Code (OFC), with local Amendments
5. The latest adopted edition of the National Fire Alarm and Signaling Code (NFPA 72), Chapter 24
6. The latest adopted edition of the Standard for the Installation, maintenance, and Use of Emergency Services Communications Systems (NFPA 1221)
7. Building Industry Consulting Service International (BICSI)
8. Telecommunications Distribution Methods Manual (TDMM)
9. American National Standards Institute (ANSI)
10. The National Electrical Safety Code (NESC)
11. The National Electrical Safety Code (ANSI C-2)
12. National Electrical Manufacturers Association (NEMA)
13. Telecommunications Industries Association (TIA)
14. Electronic Industries Association (EIA)
15. Institute of Electrical & Electronics Engineers (IEEE)
16. Underwriters Laboratories (UL)
17. American Standards Association (ASA)
18. Federal Communications Commission (FCC)
19. Occupational Safety and Health Administration (OSHA)
20. American Society of Testing Material (ASTM)
21. Americans with Disabilities Act (ADA)
22. Local city and county ordinances governing electrical work
23. In the event of conflicts, the more stringent provisions shall apply.

1.03 SCOPE

A. The work to be performed under this section of the Specifications shall include all labor, material, equipment and tools required for the complete installation of the work indicated on the Drawings and as specified herein.

B. All materials, that are a part of the Communications Infrastructure and necessary to its proper operation, but not specifically mentioned and shown on the Drawings, shall be furnished and installed without additional charge.

C. The Drawings and Specifications are complementary to each other and what is called for by one shall be as binding as if called for by both. If a discrepancy exists between the Drawing and Specifications, the higher cost shall be included, and the engineer shall be notified of the discrepancy.

1.04 WORK INCLUDED

The Communications Infrastructure installed and work performed under this Division of the Specifications shall include but not necessarily be limited to the following:

A. Firestopping

B. Grounding and Bonding

C. Communications Pathways, Underground Ducts and Raceways

D. Identification and Labeling

E. Commissioning

F. Communications Entrance Protection

G. Communications Cabinets, Racks and Enclosures

H. Communications Termination Blocks and Patch Panels

I. Cable Management and Ladder Racks

J. Communications Rack Mounted Power Protection and Power Strips

K. Structured Media Enclosures

L. Voice/Data Cabling Infrastructure

M. CATV Cabling Infrastructure

N. Copper, Fiber Optic, and Coaxial Horizontal Cabling

O. Communications Faceplates and Connectors

P. Communications Patch Cords and Station Cords

Q. Wireless Access Points

R. Audio-Visual Systems

S. Underground Raceway Excavation, Backfill and Compaction

T. Concrete Work for Duct Banks, Maintenance Holes, Handholes, Vaults and Restoration

1.05 DEFINITIONS

A. Terms: The following definitions of terms supplement those of the General Requirements and are applicable to Division 27 - Communications:

1. Provide: As used herein shall mean “furnish, install and test (if applicable) complete.”
2. Infrastructure: As used herein shall mean cable, conduit, raceway, cable tray or j-hooks with all required boxes, fittings, connectors, and accessories; completely installed.
3. Work: As used herein shall be understood to mean the materials completely installed, including the labor required.

1.06 DRAWINGS

A. Drawings are generally diagrammatic and show the arrangement and location of pathways, outlets, support structures and equipment. The Contractor shall coordinate the structural and finish conditions affecting his work and arrange his work accordingly. Should conditions on the job make it necessary to make adjustments to pathways or materials, the Contractor shall so advise the Engineer and secure approval before proceeding with such work.

Where exact locations are required by equipment for stubbing-up and terminating conduit concealed in floor slabs, the Contractor shall provide shop drawings, equipment location drawings, foundation drawings, and any other data required to locate the concealed conduit before the floor slab is poured.

B. Materials, equipment or labor not indicated but which can be reasonably inferred to be necessary for a complete installation shall be provided. Drawings and Specifications do not undertake to indicate every item of material, equipment, or labor required to produce a complete and properly operating installation.

C. The right is reserved to make reasonable changes in locations of equipment indicated on Drawings prior to rough-in without increase in contract cost.

D. The Contractor shall not reduce the size or number of conduit runs indicated on the Drawings without the written approval of the Engineer.

E. Any work installed contrary to Contract Drawings shall be subject to change as directed by the Engineer, and no extra compensation will be allowed for making these changes.

F. The location of equipment, support structures, outlets, and similar devices shown on the Drawings are approximate only. Do not scale Drawings. Obtain layout dimensions for equipment from Architectural plans unless otherwise noted.

G. Schematic diagrams shown on the Drawings indicate the required functions only. The technology of a particular manufacturer may be used to accomplish the functions indicated without exact adherence to the schematic Drawings shown. Additional labor and materials required for such deviations shall be furnished at the Contractor’s expense.

H. Verify the ceiling type, ceiling suspension systems, and clearance above hung ceilings prior to ordering cabling and associated hardware. Notify the Engineer of any discrepancies.

I. Review all architectural drawings for modular furniture.

J. Portions of these Drawings and Specifications are abbreviated and may include incomplete sentences. Omissions of words or phrases such as “the Contractor shall,” “shall be,” “as

indicated on the Drawings," "in accordance with," "a," "the" and "all are intended" shall be supplied by inference.

1.07 SUBMITTALS

A. Provide submittals for the following systems:

1. Firestopping
2. Grounding and Bonding
3. Communications Pathways, Underground Ducts and Raceways
4. Identification and Labeling
5. Commissioning
6. Communications Entrance Protection
7. Communications Cabinets, Racks and Enclosures
8. Communications Termination Blocks and Patch Panels
9. Cable Management and Ladder Racks
10. Communications Rack Mounted Power Protection and Power Strips
11. Structured Media Enclosures
12. Voice/Data Cabling Infrastructure
13. CATV Cabling Infrastructure
14. Copper, Fiber Optic, and Coaxial Horizontal Cabling
15. Communications Faceplates and Connectors
16. Communications Patch Cords and Station Cords
17. Wireless Access Points
18. Audio-Visual Systems
19. Underground Raceway Excavation, Backfill and Compaction
20. Concrete Work for Duct Banks, Maintenance Holes, Handholes, Vaults and Restoration

B. Submit for approval, details of all materials, equipment and systems to be furnished. Work shall not proceed without the Owner and/or the Project Manager's approval of the submitted items.

1. Submittals for individual systems and equipment assemblies that consist of more than one item or component shall be made for the system or assembly as a whole. Partial submittals will not be considered, reviewed or stored, and such submittals will not be returned except at the request and expense of the Contractor.
2. Contractor shall generate shop drawings. Modify reviewed and accepted shop drawings to include revisions based upon completion of work. Submit shop drawings with record drawings on hard copy.
3. Shop drawings shall include equipment racks, patch panels, termination blocks, connection details, rack mounting details and any other details not included in the construction drawings.

C. Any materials and equipment listed that are not in accordance with Specification requirements may be rejected.

D. The approval of material, equipment, systems and shop drawings is a general approval subject to the Drawings, Specifications and verification of all measurements at the job. Approval does not relieve the Contractor from the responsibility of shop drawing errors. The Contractor shall carefully check and correct all shop drawings prior to submission for approval.

E. Materials List: Submit a complete materials list indicating all equipment to be provided as part of this section.

F. Samples: Submit selection and verification samples of finishes, colors, and textures as requested.

G. Complete details of equipment mounting configuration.

H. Manufacturing assembly and testing procedures and forms.

I. Installation testing and check out procedures and forms to be used by the Contractor and Architect and/or Consultant.

J. The conduit plans, equipment plans, riser diagrams, block diagrams and details are to be submitted in the latest version of MicroStation or AutoCAD, and shall be submitted on a minimum of 'D' size drawings. Documents submitted in any other manner including marked up sets of the bid documents shall receive immediate rejection and will not be reviewed. A complete, electronic set of as-built documents will be issued at the completion of the project.

K. Submittals issued in a manner inconsistent with the requirements of these specifications shall receive immediate rejection and will not be reviewed. Submittals issued containing materials, products and/or equipment that is not listed or approved by addendum shall receive immediate rejection and will not be reviewed.

1.08 QUALITY ASSURANCE

A. Equipment and materials required for installation under these Specifications shall be the current model and new (less than one [1] year from the date of manufacture), unused and without blemish or defect.

B. Equipment shall bear labels attesting to Underwriters Laboratories, where subject to label service. Manufacturers of equipment and materials pertinent to these items shall have been engaged in the manufacture of said equipment a minimum of three (3) years and, if so directed by the Owner, be able to furnish proof of their ability by submitting affidavits and descriptive data about their product including size and magnitude comparable to requirements specified herein.

1.09 CONTRACTOR QUALIFICATIONS

A. The Contractor shall have total responsibility for the coordination and installation of the work shown and described in the Drawings and Specifications. The Contractor shall be a company specializing in the design, fabrication and installation of integrated communications systems.

B. Communications Systems specified shall be installed under the direction of a qualified Contractor. Qualification requirements shall include submittal by the Contractor to the Architect of the following:

1. List of previous projects of this scope, size and nature; including names and sizes of projects, description of work, time of completion and names of contact persons for reference.
2. Shall certify that they are manufacturer-authorized for work to be performed.

C. Contractor must employ at least one (1) full-time Registered Communications Distribution Designer (RCDD).

1.10 COORDINATION WITH OTHER TRADES

A. The Contractor shall coordinate Communications work with that of other sections as required ensuring that the entire communications work will be carried out in an orderly, complete and coordinated fashion.

1.11 SITE INVESTIGATION

A. Prior to submitting bids of the project, visit the site of the work to become aware of existing conditions that may affect the cost of the project. Where work under this project requires extension, relocation, reconnections or modifications to existing equipment or systems, the existing equipment or systems, shall be restored to their original condition before the completion of this project.

1.12 PERMITS

A. Obtain all permits and inspections for the installation of this work and pay all charges incident thereto. Deliver to the Owner all certificates of said inspection issued by authorities having jurisdiction.

1.13 RENOVATIONS AND ADDITIONS

A. All work that would adversely affect the normal operation of the other portions of the Owner's property shall be done at a time other than normal working hours. Normal working hours shall be considered 8 a.m. to 5 p.m. Monday through Friday.

B. Prior to submitting bids on the project, visit the site of the work to become aware of existing conditions that may affect the cost of the project.

C. Where work under this project requires extension, relocation, reconnections or modifications to existing equipment or systems, the existing equipment or systems shall be restored to their original and operating condition. Remove all equipment indicated to be demolished, including outlets, devices, raceways and support structures.

D. Care shall be exercised in the removal and storage of equipment indicated to be relocated or removed and reused. Prior to placing back into service, equipment shall be cleaned and marred or chipped paint surfaces touched-up.

E. Provide all coring, cutting and patching to existing walls, floors, etc., required for the removal of existing work or the installation of new work.

1.14 OPERATION & MAINTENANCE MANUALS

A. The Contractor shall furnish two (2) hard copies and one electronic copy of operational and maintenance manuals for all systems furnished. The manuals shall include component lists, instructions for care, operation instructions, instructions for ordering replacement equipment and personnel to contact for warranty work.

1.15 APPROVALS

A. Deviations from this specification must be documented in writing to the Architect and Engineer at least twenty-one (21) business days prior to the bid date.

B. Complete catalogue data, product specifications and technical information on alternative equipment must be provided including all associated cost savings or additions, including but not limited to equipment, equipment installation, power wiring and materials, programming, documentation and project management.

1.16 DELIVERY & HANDLING

A. General: Comply with Division 1 Product Requirements Section.

B. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

C. Storage and Protection: Store materials and equipment in an area protected from harmful weather conditions and at temperature conditions recommended by manufacturer. After initial installation, protect equipment from exposure to dust, dirt, paint and other contaminants.

1.17 PROJECT CONDITIONS

A. Field Measurements: Verify actual measurements/openings by field measurements before fabrication; show recorded measurements on shop drawings.

B. Scheduling: Coordinate taking field measurements, fabrication schedule and deliveries with construction progress schedule to avoid construction delays.

1.18 WARRANTY

A. Warranty: All equipment and labor provided under this section is warranted for two (2) years from Substantial Completion or System Commissioning, whichever occurs first.

B. During the warranty period, the Contractor shall perform quarterly preventative maintenance inspections on all installed equipment.

C. Nothing in the above warranty shall apply to material which has been misused or abused as follows: neglect by the owner, defects or damage caused by work or failure of work by others, ordinary wear or normal equipment adjustment.

D. Additionally, any unauthorized modifications, repairs or tampering shall constitute termination of the warranty.

1.19 TRAINING

A. The Contractor shall provide four (4) hours of on-site training for operational purposes and forty (40) hours of training for maintenance purposes at the turnover of the project.

PART 2 PRODUCTS

2.01 SUBSTITUTIONS

A. Where equipment is identified by manufacturer and catalog number, it shall be as the base of requirements for quality and performance. Where manufacturers for equipment are identified by name, the Contractor may submit for approval, similar equipment of other manufacturers as substitution. The Engineer's decision as to whether the submitted equipment is acceptable shall be final and binding.

B. All changes necessary to accommodate the substituted equipment shall be made at the Contractor's expense, and shall be as approved by the Engineer. Detailed drawings indicating the required changes shall be submitted for approval at the time the substitution is requested.

C. If substitutions are made in lieu of device specified; form, dimension, design and profile shall be submitted to the Engineer for approval.

D. Submit request for approval of substitute materials in writing to the Architect at least ten (10) days prior to bid opening.

2.02 MATERIALS

A. All materials used in this work shall be new and shall bear the inspection label of Underwriters' Laboratories Inc. or certification by other recognized laboratory.

B. The published standards and requirements of the Telecommunications Industries Association (TIA), National Electrical Manufacturers Association (NEMA), the American National Standard Institute (ANSI), the Institute of Electrical and Electronic Engineers (IEEE), and the American Society of Testing Materials (ASTM), are made a part of these Specifications and shall apply wherever applicable.

C. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, for which replacement parts are available.

D. When more than one unit of the same class of equipment or material is required, such units shall be the products of a single manufacturer or partner manufacturers that offer a certified solution.

E. Components of an assembled unit need not be products of the same manufacturer, but must offer a certified end-to-end solution.

F. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.

G. Components shall be compatible with each other and with the total assembly for the intended service.

PART 3 EXECUTION

3.01 EXAMINATION OF CONDITIONS

A. Prior to the start of work, the Contractor shall carefully inspect the installed work of other trades and verify that such work is complete to the point where installation may properly commence. Start of work indicates acceptance of conditions.

B. Install equipment in accordance with applicable codes and regulations, and the referenced standards.

C. In the event of a discrepancy, immediately notify the Project Manager.

D. Do not proceed with installation until unsatisfactory conditions and discrepancies have been fully resolved.

3.02 PROTECTION OF SYSTEMS AND EQUIPMENT

A. Protect materials and equipment from damage during storage at the site and throughout the construction period. Equipment and materials shall be protected during shipment and storage against physical damage, dirt, theft, moisture, extreme temperature and rain.

B. Damage from rain, dirt, sun and ground water shall be prevented by storing the equipment on elevated supports and covering the sides with securely fastened protective rigid or flexible waterproof coverings.

C. During installation, equipment shall be protected against entry of foreign matter on the inside and be vacuum cleaned both inside and outside before testing, operating or painting.

D. As determined by the Project Manager, damaged equipment shall be fully repaired or shall be removed and replaced with new equipment to fully comply with requirements of the Contract Documents.

E. Damaged paint on equipment and materials shall be repainted with painting equipment and finished with the same quality of paint and workmanship as used by the manufacturer.

3.03 ACCESS TO EQUIPMENT

A. Equipment shall be installed in location and manner that will allow access for maintenance and inspection.

B. Working spaces shall be not less than specified in the National Electrical Code (NEC/NFPA 70) for voltages specified.

C. Where the Project Manager determines that the Contractor has installed equipment not accessible for operation and maintenance, equipment shall be removed and reinstalled as directed by the Project Manager, at no additional cost to the Owner. “Accessible” is defined as being capable of being reached without the use of ladders or without climbing or crawling under or over obstacles such as motors, pumps, belt guards, transformers, piping and duct work.

3.04 CLEANING

A. During construction, and prior to Owner acceptance of the building, remove from the premises and dispose of packing material and debris caused by communications work.

B. Remove dust and debris from interiors and exteriors of components. Clean accessible current carrying elements prior to being energized.

C. General: Upon completion of the work, remove excess dust & debris, materials, equipment, apparatus, tools and similar items. Leave the premises clean, neat and orderly.

3.05 COMPLETION

A. Results Expected: Systems shall be complete and operational and controls shall be set and calibrated. Testing, start-up and cleaning work shall be complete.

B. Maintenance Materials: Special tools for proper operation and maintenance of the equipment provided under this Specification shall be delivered to the Owner.

3.06 TESTING AND VERIFICATION

A. See specific Division 27 sections for testing parameters of sub-systems.

B. The Contractor shall verify that requirements of this Specification are met. Verification shall be through a combination of analyses, inspections, demonstrations and tests, as described below.

C. Verification by inspection includes examination of items and comparison of pertinent characteristics against the qualitative or quantitative standard set forth in the Specifications. Inspection may require moving or partially disassembling the item to accomplish the verification, included as part of the work at no additional cost to the Owner.

D. The Contractor shall verify by demonstrations and/or tests that the requirements of this Specification have been met. The Contractor shall demonstrate that the communications systems, components and subsystems meet Specification requirements in the “as-installed” operating environment during the “System Operation Test.” The Contractor shall measure and record temperature, humidity and other environmental parameters.

E. The Contractor shall schedule and coordinate the final acceptance tests. The Contractor shall provide necessary instruments, labor and materials required for tests. Provide equipment manufacturer’s technical representative and qualified technicians.

F. The Contractor shall satisfy all items detailed in the final acceptance check-off list (punch list). The list shall be a complete representation of specified installation requirements. At the time of final acceptance punch list items shall be corrected until the system is found to be acceptable to the Owner and the Project Manager.

END OF SECTION

SECTION 27 05 10
FIRESTOPPING FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. Applicable requirements of Division 27 - Communications shall be considered a part of this section and shall have the same force as if printed herein full.

B. This document describes the products and execution requirements relating to Firestopping for Communications Systems.

C. Product specifications, general design considerations, and installation guidelines are provided in this document. The successful vendor shall meet or exceed all requirements described in this document and on the drawings.

1.02 SUBMITTALS

A. Provide product data from manufacturer’s specifications.

1.03 WORK INCLUDED

A. The work included under this Specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the Specification or not.

B. The work shall include, but not be limited to the following:

1. Furnish and install all firestopping materials.

PART 2 PRODUCTS

2.01 APPROVED PRODUCTS

A. Approved Firestopping Manufacturer(s)

1. Flamestopper Thru-Wall Fitting - Wiremold Company (Firestop Devices)
2. Unique Firestop Products (Firestop Devices)
3. STI Firestop Products (Firestop Devices, Putties, Caulks, Sealants, etc.)
4. Hilti (Putties, Caulks, Sealants, etc.)

2.02 TYPES OF PRODUCTS

A. Sealants

1. Intumescent Firestop Sealants and Caulks
2. Latex Firestop Sealant

3. Acrylic Water-Based Sealant
4. Silicone Firestop Sealants and Caulks
5. Firestop Putty
6. Firestop Collars
7. Wrap Strips
8. 2-Part Silicone Firestop Foam
9. Firestop Mortar
10. Firestop Pillows
11. Elastomeric Spray
12. Accessories:
13. Forming/Damming Materials: Mineral fiberboard or other type as per manufacturer recommendation

B. Firestop Devices

1. Thru-Wall Fitting (Flamestopper by Wiremold)

    a. The firestop device box shall be constructed of 16 gage G90 steel.
    b. The firestop device intumescent block shall be constructed of a graphite base material with expansion starting at 375°F and an unrestrained expansion between 6 to 12 times. The intumescent block shall be held securely by the box in order to prevent tampering and damage during installation.
    c. The firestop device shall have doors which can be adjusted to prevent materials from penetrating the device if the device is empty or completely full. The doors shall be constructed of 16 gage G90 steel with No. 10-32 screws use to adjust opening size.
    d. The firestop device shall be available for 2" and 4" trade size EMT conduit.
    e. The firestop device shall be available in safety yellow powder coat, custom colors and an unpainted galvanized finish.

2. Threaded Firestop Device (Unique Firestop Products)

    a. Threaded steel sleeve device incorporating flat washers secured by threaded device shall be installed around cables. The device shall be available in 1, 2 and 4-inch sizes. Maximum diameter of the wall penetration for 1, 2 and 4-inch sizes shall be 1-1/4, 2-7/16 and 4-1/2 inches respectively.

3. Smooth Firestop Device (Unique Firestop Products)

    a. Smooth steel sleeve device incorporating flat washers secured by sliding compression couplers. The device shall be available in 1, 2 and 4-inch sizes. Maximum diameter of the wall penetration for 1, 2 and 4-inch sizes shall be 1-1/4, 2-7/16 and 4-1/2 inches respectively.

4. Split-Sleeve Firestop Device (Unique Firestop Products)

    a. Threaded steel sleeve halves incorporating split couplings and slotted washers to fit the specific diameter of the opening. The device shall be available in 1, 2 and 4-inch sizes. Maximum diameter of the wall penetration for 1, 2 and 4-inch sizes shall be 1-1/4, 2-7/16 and 4-1/2 inches respectively.

5. Fire Rated Cable Pathway (STI EZ-PATH)

    a. Fire rated cable pathway device modules shall be comprised of steel raceway with intumescent foam pads allowing 0-100 percent cable fill.

2.03 UL CLASSIFICATION

A. Thru-Wall Fitting - The firestop device for use in through-penetration firestop systems shall have been examined and tested by Underwriters Laboratories Inc. to UL1479 (ASTM E 814) and bear the U.S. and Canadian UL Classification Mark.

B. Threaded, Smooth and Split-Sleeve Firestop Devices - Firestopping sealants and devices shall be used together as a firestop system. All firestop systems shall bear a UL Classification system number. UL Classification system numbers are as follows:

1. Threaded Firestop System

   a. Block Wall - W-J-3049
   b. Dry Wall - W-L-3138

2. Threaded Firestop System (Vertical)

   a. Slab - F-A-3010

3. Smooth Firestop System

   a. Block Wall - W-J-3048
   b. Dry Wall - W-L-3137

4. Split-Sleeve Firestop System

   a. Block Wall - W-J-3047
   b. Dry Wall - W-L-3136

2.04 FIRESTOPPING SYSTEMS

A. Thru-Wall Fitting Firestop System:

1. The device shall be classified for use in one-, two-, three, and four-hour rated gypsum, concrete and block walls and provide a maximum L rating of six cfm. The devices shall also been tested by Underwriters Laboratories Inc. to UL2043 and determined to be suitable for use in air handling spaces.

B. Threaded, Smooth and Split-Sleeve Firestop Systems:

1. Shall conform to both Flame (F) and Temperature (T) ratings as required by local building codes and as tested by nationally accepted test agencies per ASTM E814 or UL 1479 fire tests in a configuration that is representative of field conditions.
2. The F rating must be a minimum of one (1) hour but not less than the fire resistance rating of the assembly being penetrated. T rating when required by code authority shall be based on measurement of the temperature rise on penetrating item(s). The fire test shall be conducted with a minimum positive pressure differential of 0.01 inches of water column.
3. For joints, must be tested to UL 2079 with movement capabilities equal to those of the anticipated conditions.

C. Firestopping materials and systems must be capable of closing or filling through-openings created by 1) the burning or melting of combustible pipes, cable jacketing, or pipe insulation materials, or 2) deflection of sheet metal due to thermal expansion (electrical & mechanical duct work).

D. Firestopping material shall be asbestos and lead free and shall not incorporate nor require the use of hazardous solvents.

E. Firestopping sealants must be flexible, allowing for normal pipe movement.

F. Firestopping materials shall not shrink upon drying as evidenced by cracking or pulling back from contact surfaces.

G. Firestopping materials shall be moisture resistant, and may not dissolve in water after curing.

PART 3 EXECUTION

3.01 CONDITIONS REQUIRING FIRESTOPPING

A. General

1. Provide firestopping for conditions specified whether or not firestopping is indicated, and if indicated, whether such material is designed as insulation, safing, or otherwise.

B. Through-Penetrations

1. Firestopping shall be installed in all open penetrations and in the annular space in all penetrations in any bearing or non-bearing fire-rated barrier.

C. Membrane-Penetrations

1. Where required by code, all membrane-penetrations in rated walls shall be protected with firestopping products that meet the requirements of third party time/temperature testing.

D. Construction Joints/Gaps

1. Firestopping shall be provided between the edges of floor slabs and exterior walls, between the tops of walls and the underside of floors, in the control joint in masonry walls and floors and in expansion joints.

E. Smoke-Stopping

1. As required by the other sections, smoke-stops shall be provided for through-penetrations, membrane-penetrations, and construction gaps with a material approved and tested for such application.

3.02 EXAMINATION

A. Examine the areas and conditions where firestops are to be installed and notify the Architect of conditions detrimental to the proper and timely completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected.

B. Verify that environmental conditions are safe and suitable for installation of firestop products.

C. Verify that all pipes, conduit, cable, and other items that penetrate fire-rated construction have been permanently installed prior to installation of firestops.

3.03 INSTALLATION

A. General

1. Installation of firestops shall be performed by an applicator/installer qualified and trained by the manufacturer. Installation shall be performed in strict accordance with manufacturer's detailed installation procedures.
2. Apply firestops in accordance with fire test reports, fire resistance requirements, acceptable sample installations, and manufacturer's recommendations.
3. Unless specified and approved, all insulation used in conjunction with through-penetrants shall remain intact and undamaged and may not be removed.
4. Seal holes and penetrations to ensure an effective smoke seal.
5. In areas of high traffic, protect firestopping materials from damage. If the opening is large, install firestopping materials capable of supporting the weight of a human.
6. Insulation types specified in other sections shall not be installed in lieu of firestopping material specified herein.
7. All combustible penetrants (e.g. non-metallic pipes or insulated metallic pipes) shall be firestopped using products and systems tested in a configuration representative of the field condition.

B. Dam Construction

1. When required to properly contain firestopping materials within openings, damming or packing materials may be utilized. Combustible damming material must be removed after appropriate curing. Noncombustible damming materials may be left as a permanent component of the firestop system.

3.04 FIELD QUALITY CONTROL

A. Prepare and install firestopping systems in accordance with manufacturer's printed instructions and recommendations.

B. Follow safety procedures recommended in the Material Safety Data Sheets.

C. Finish surfaces of firestopping that are to remain exposed in the completed work to a uniform and level condition.

D. All areas of work must be accessible until inspection by the applicable Code Authorities.

E. Correct unacceptable firestops and provide additional inspection to verify compliance with this Specification.

3.05 CLEANING

A. Remove spilled and excess materials adjacent to firestopping without damaging adjacent surfaces.

B. Leave finished work in a neat and clean condition with no evidence of spill-overs or damage to adjacent surfaces.

3.06 IDENTIFICATION

A. Refer to Section 27 05 53 - Identification for Communications Systems for labeling details.

END OF SECTION

SECTION 27 05 26
GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. Applicable requirements of Division 27 - Communications shall be considered a part of this section and shall have the same force as if printed herein full.

B. This document describes the products and execution requirements relating to Grounding and Bonding for Communications Systems.

C. Product specifications, general design considerations, and installation guidelines are provided in this document. The successful vendor shall meet or exceed all requirements described in this document and on the drawings.

1.02 SUBMITTALS

A. Provide product data from manufacturer’s specifications.

1.03 WORK INCLUDED

A. The work included under this Specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the Specification or not.

B. The work shall include, but not be limited to the following:

1. Furnish and install all grounding conductors.
2. Furnish and install all grounding lugs and hardware.
3. Furnish and install all grounding busbars.

PART 2 PRODUCTS

2.01 APPROVED PRODUCTS

A. Equipment Grounding Conductor Manufacturer(s)

1. Southwire
2. Or Approved Equal

B. Grounding Lug Manufacturer(s)

1. Burndy
2. Thomas & Betts
3. Or Approved Equal

C. Grounding Busbar Manufacturer(s)

1. Chatsworth Products, Inc.
2. Middle Atlantic
3. B-Line
4. Or Approved Equal

2.02 GROUNDING CONDUCTORS

A. Grounding Conductor

1. Construction shall be Type THHN copper conductors, insulated with heat and moisture resistant PVC over which a UL Listed jacket is applied.
2. Jacket color shall be green or black. Black jacketed cable shall be identified at each termination point with a wrap of green tape.

2.03 GROUNDING LUGS

A. Grounding Lugs and Hardware

1. Grounding lugs shall be 2-hole and installed with a crimper that when properly executed the die of the crimper impresses the die # on the lug base. All lugs shall be sleeved with clear heat-shrink to allow for inspection of the crimp. Silicon bronze or stainless steel bolts and washers shall be used to install lugs to equipment. Exothermic welding is also allowed.

2.04 GROUNDING BUSBARS

A. Grounding Busbar

1. The grounding busbar shall be made of 1/4" thick solid copper.
2. The grounding busbar shall be installed with minimum clearance, 1" offsets and 1-1/2" insulators.
3. The grounding busbar shall accommodate 2-hole compression lugs.
4. The grounding busbar shall meet or exceed ANSI/TIA-607-B requirements.

PART 3 EXECUTION

3.01 GROUNDING

A. The facility shall be equipped with a Communications Bonding Backbone (TBB). This backbone shall be used to ground all communications cable shields, equipment, racks, cabinets, raceways, and other associated hardware that has the potential to act as a current carrying conductor. The TBB shall be installed independent of the building's electrical and building ground and shall be designed in accordance with the recommendations contained in the ANSI/TIA-607-B Telecommunications Bonding and Ground Standard.

B. The main entrance facility/equipment room in each building shall be equipped with a telecommunications main grounding busbar (TMGB). Each telecommunications room (TR) shall be provided with a telecommunications ground busbar (TGB). The TMGB shall be connected to the building electrical entrance grounding facility.

C. All racks, metallic backboards, cable sheaths, metallic strength members, splice cases, cable trays, etc. entering or residing in the MC/IC/TC shall be grounded to the respective TGB or TMGB using a minimum #6 AWG stranded copper bonding conductor and compression lugs.

D. All wires used for communications grounding purposes shall be identified with a green insulation. Non-insulated wires shall be identified at each termination point with a wrap or green tape. All cables and busbars shall be identified and labeled in accordance with the ANSI/TIA-606-A.

E. See Section 27 05 43 - Underground Ducts and Raceways for Communications Systems for underground duct and raceway systems ground requirements.

3.02 IDENTIFICATION

A. Refer to Section 27 05 53 - Identification for Communications Systems for labeling details.

END OF SECTION

SECTION 27 05 28
PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. Applicable requirements of Division 27 - Communications shall be considered a part of this section and shall have the same force as if printed herein full.

B. This document describes the products and execution requirements relating to Pathways for Communications Systems.

C. Product specifications, general design considerations, and installation guidelines are provided in this document. The successful vendor shall meet or exceed all requirements described in this document and on the drawings.

1.02 SUBMITTALS

A. Provide product data from manufacturer's specifications.

1.03 WORK INCLUDED

A. The work included under this specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the Specification or not.

B. The work shall include, but not be limited to the following:

1. Furnish and install complete conduit system.
2. Furnish and install all communications outlet boxes.
3. Furnish and install all pull boxes.
4. Furnish and install all cable hangers.
5. Furnish and install all tie wraps/Velcro straps.

PART 2 PRODUCTS

2.01 APPROVED PRODUCTS

A. Rigid/Intermediate Conduit Manufacturer(s)

1. Allied
2. Triangle
3. Wheatland
4. Youngstown

B. Non-Metallic (PVC) Manufacturer(s)

1. Carlon

2. Georgia Pipe Company
3. Or Approved Equal

C. Electrical Metallic Tubing (EMT) Manufacturer(s)

1. Allied
2. Triangle
3. Wheatland
4. Youngstown

D. Electrical Non-Metallic Tubing (ENT) Manufacturer(s)

1. Carlon
2. Or Approved Equal

E. EMT Fittings Manufacturer(s)

1. Thomas & Betts
2. Steel City
3. Or Approved Equal

F. ENT Fittings Manufacturer(s)

1. Carlon
2. Or Approved Equal

G. Innerduct/Inner-Conduit Channel Manufacturer(s)

1. Carlon
2. Endot Industries
3. MaxCell
4. Petroflex
5. Eastern

H. Metallic Communications Outlet Box Manufacturer(s)

1. Steel City
2. Raco
3. Or Approved Equal

I. Non-Metallic Communications Outlet Box Manufacturer(s)

1. Thomas & Betts
2. Carlon
3. Or Approved Equal

J. Pull Box Manufacturer(s)

1. Hoffman
2. OZ Gedney
3. Quazite
4. Or Approved Equal

K. Approved Cable Hanger Manufacturer(s)

1. MonoSystems – The Hook Series
2. Erico Products – Caddy Series

3. B-Line
4. Or Approved Equal

L. Approved Tie Wrap/Velcro Strap Manufacturer(s)

1. Thomas & Betts
2. Panduit
3. Or Approved Equal

2.02 CONDUIT

A. Rigid and Intermediate Conduit

1. Rigid conduit, intermediate conduit, couplings, locknuts, bushings, elbows and connectors shall be standard thread. All materials shall be steel. Set screw or non-threaded fittings are not permitted.

B. Non-Metallic (PVC) Conduit

1. Non-metallic conduit shall be heavy wall, Schedule 40 PVC.
2. Couplings and connectors for non-metallic conduit shall be of the same material and be the product of the same manufacturer of the conduit furnished.

C. Electrical Metallic Tubing (EMT)

1. Electrical metallic tubing (EMT), couplings and connectors shall be steel. Malleable iron, pressure-cast or die-cast fittings are not permitted.
2. Fittings for 2" EMT and smaller shall be steel set screw type, except where otherwise noted. Fittings for 2.5" and larger shall be steel set screw type with two (2) screws for connectors and four (4) screws for couplings. All connectors shall be insulated throat type.

D. Electrical Non-Metallic Tubing (ENT)

1. ENT shall be a pliable, non-metallic raceway manufactured of the same PVC material used for rigid non-metallic conduit.
2. Fittings and outlet boxes shall be designed for use with ENT and listed by Underwriters Laboratories.

E. Conduit Support

1. Individual conduit hangers shall be galvanized spring steel specifically designed for the purpose and sized appropriately for the conduit type and diameter. Support individual conduits 1-1/2 inch and smaller with 1/4 inch threaded steel rods and use 3/8 inch rods for 2 inch and larger.
2. Conduit support channels shall be 14 gauge galvanized (or equivalent treatment) channel sized for the amount of conduit to be supported. Channel suspension shall be 3/8" threaded steel rods. Attach suspension rods to structure with swivel type connectors. Conduit straps shall be spring steel type compatible with channel.
3. Conduit straps shall be single hole cast metal type or two hole galvanized metal type. Conduit clamps shall be spring steel type for use with exposed structural steel.

F. Innerduct/Inner-Conduit Channel

1. Innerduct shall be corrugated plastic equipped with pull-string or mule tape.

2. Inner-conduit channel (MaxCell) shall be 3-channel with each channel equipped with mule tape.
3. See Drawings for innerduct/inner-conduit channel (MaxCell) details.

2.03 METALLIC COMMUNICATIONS OUTLET BOXES

A. Metallic outlet boxes and device covers shall be galvanized steel not less than 1/16" thick.

B. The dimensions of the metallic outlet box shall be 4" x 4" square with a minimum depth of 2-1/8".

C. Metallic outlet boxes shall be equipped with single device covers (or two-device covers where needed). Where installed in plaster, gypsum board, etc., covers shall be raised to compensate for the thickness of the wall finish.

D. Where metallic outlet boxes are to be empty for future use, blank coverplates shall be used.

2.04 NON-METALLIC COMMUNICATIONS OUTLET BOXES

A. The non-metallic outlet box shall be thermoplastic and be rated according to the space it occupies.

B. The dimensions of the non-metallic outlet box shall be approximately 4" x 4" square with a minimum depth of 2-1/8".

C. Non-metallic outlet boxes shall be equipped with single device covers. Covers shall be raised to compensate for the thickness of the wall finish.

D. Where non-metallic outlet boxes are to be empty for future use, blank faceplates shall be used.

2.05 PULL BOXES

A. Pull boxes shall be constructed of galvanized steel with flat, removable covers fastened with plated steel screws.

B. Pull boxes shall be equipped with keyhole screw slots in the cover to permit removal of the cover without extracting the screws.

C. Pull boxes shall have provisions for grounding.

2.06 CABLE HANGERS

A. J-Hooks

1. J-hooks shall provide a bearing surface of sufficient width to comply with required bend radii of high-performance cables. J-hook shall be cULus Listed.
2. J-hooks shall have flared edges to prevent damage while installing cables.
3. J-hooks sized 1-5/16" and larger shall have a cable retainer strap to provide containment of cables within the hanger. The cable retainer strap shall be removable and reusable and be suitable for use in air handling spaces.

B. Adjustable Non-Continuous Cable Support Sling

1. Constructed from steel and woven laminate; sling length can be adjusted to hold up to 425 4-pair balanced twisted pair cables; rated for indoor use in non-corrosive environments. Rated to support Category 5 and higher cable, or optical fiber cable. Cable support sling shall be cULus Listed.
2. Adjustable non-continuous cable support sling shall have a static load limit of 100 lbs.
3. Adjustable non-continuous cable support sling shall be suitable for use in air handling spaces.

2.07 TIE WRAPS AND VELCRO STRAPS

A. Tie Wraps and Velcro Straps

1. Cables shall be fastened to support structures with tie wraps/Velcro straps.
2. Tie wraps/Velcro straps installed in air handling spaces must be plenum rated.

a. Non-plenum Tie Wrap color shall be black.
b. Plenum Tie Wrap color shall be red.
c. Non-plenum Velcro strap color shall be black.
d. Plenum Velcro strap color shall be red.

PART 3 EXECUTION

3.01 PENETRATIONS

A. Holes through concrete and masonry in new and existing structures shall be cut with a diamond core drill or concrete saw upon approval of the structural engineer of record for the base of building. Pneumatic hammer, impact electric, hand or manual hammer type drills shall not be allowed, except where permitted by the Project Manager as required by limited working space. X-ray all floor penetrations accordingly.

B. Holes shall be located so as not to affect structural sections such as ribs or beams.

C. Holes shall be laid out in advance. The Project Manager shall be advised prior to drilling through structural sections, for determination of proper layout.

D. Structural Penetrations: Where conduits, wireways and other raceways pass through fire partitions, fire walls or walls and floors provide a code compliant effective barrier against the spread of fire, smoke and gases.

E. All penetrations where conduit is not used shall be sleeved.

F. No gaps or rough edges shall be allowed between wall and conduit/sleeve.

3.02 CONDUIT SYSTEM

A. Conceal all conduits, except in unfinished spaces such as equipment rooms or as indicated by symbol on the Drawings.

B. Leave all empty conduits with a 200 pound test nylon cord pull line.

C. Flattened, dented, or deformed conduits are not permitted and shall be removed and replaced.

D. Fasten conduit support device to structure with wood screws on wood, toggle bolts on hollow masonry, anchors as specified on solid masonry or concrete, and machine bolts, clamps, or spring steel clips, on steel.

E. Install conduit with wiring, including homeruns as indicated on the Drawings. Any change resulting in a savings in labor or materials is to be made only in accordance with a contract change. Deviations shall be made only where necessary to avoid interferences and when approved by Engineer by written authorization.

F. Conduit shall be run parallel or at right angles to existing walls, ceilings, and structural members.

G. Attach backbone conduits larger than one-inch trade diameter to or from structure on intervals not exceeding twelve feet with conduit beam clamps, one-hole conduit straps or trapeze type support.

H. Where conduits must pass through structural members obtain approval of Architect.

I. Install all conduits or sleeves penetrating or routed within rated firewalls or fire floors to maintain fire rating of wall or floor. Conduit shall not be installed in rated floors or walls if it compromises or violates the fire rating of floor or wall. Refer to architectural documents.

J. Provide expansion and deflection coupling where conduit passes over a building expansion joint.

K. Service entrance conduits and feeder conduits in direct contact with earth shall be schedule 40, heavy wall PVC. All service entrance conduit elbows shall be galvanized rigid steel. Service entrance conduits installed exposed or concealed in walls or above ceilings shall be galvanized rigid steel (G.R.S.) or intermediate metal conduit (IMC). Service entrance conduits shall be installed “outside” of the building as defined by the N.E.C. Provide concrete encasement where required or as indicated on Drawings.

L. All other conduit, unless specified herein, shall be electrical metallic tubing (EMT) or electrical non-metallic tubing (ENT). PVC conduit is not allowed in exposed or concealed areas, but only within concrete.

M. Conduit Installations Within Slab/Floor

1. Conduit shall be run following the most direct route between points.
2. Conduit shall not be installed in concrete where the outside diameter is larger than 1/3 of the slab thickness.
3. Conduits shall not be installed within shear walls unless specifically indicated on the Drawings. Conduit shall not be run directly below and parallel with load bearing walls.
4. Protect each metallic conduit installed in concrete slab or conduits 1-1/2 inch and smaller passing through a concrete slab against corrosion where conduit enters and leaves concrete by wrapping conduit with vinyl all-weather electrical tape.
5. Protect all conduits entering and leaving concrete floor slabs from physical damage during construction.
6. Provide expansion fittings in all conduits where length or run exceeds 200 feet or where conduits pass through building expansion joints.
7. Install all conduits penetrating or routed within rated fire floors to maintain the fire rating of the floor. Conduit shall not be installed in rated floors or walls if it compromises or violates the fire rating of floor or wall. Refer to architectural documents.
8. Conduits installed within concrete floor slabs which are in direct contact with grade or which penetrate the building roof shall be galvanized rigid steel (G.R.S.), intermediate metal conduit (I.M.C.) or Schedule 40, heavy wall PVC.

N. Communications cables shall not occupy conduits with power cables.

O. Metallic conduits shall be grounded in accordance with ANSI/TIA-607-B.

P. Conduit runs shall not have more than two (2) 90-degree bends between pull points.

Q. Communications conduit system shall contain no condulets (also known as an LB).

R. Rigid metal conduit (RMC) or intermediate metal conduit (IMC) shall be used for entrance conduits that exceed 50 feet into the building.

S. Horizontal Conduits

1. Support horizontal conduits at intervals not exceeding ten feet and within three feet of each outlet, junction box, backboard, enclosure or cabinet. Support conduits from structural steel members with spring steel type or beam conduit clamps and to non-metallic structural members with one-hole conduit straps. For exposed conduits and where conduits must be suspended below structure, single conduit runs shall be supported from structure by hanger rod and conduit clamp assembly, and multiple conduits shall be supported by trapeze type support suspended from structure. Do not attach conduits to ceiling suspension system channels or suspension wires.
2. For runs that total more than 100 feet in length, insert pull boxes so that no segment between boxes exceeds the 100 feet limit.
3. Each horizontal home-run conduit can serve from one (1) to three (3) outlet boxes. For one (1) outlet box, a 3/4" conduit shall be used, minimum. For two (2) outlet boxes, a 1" conduit shall be used, minimum. For three (3) outlet boxes, a 1-1/4" conduit shall be used, minimum.

3.03 COMMUNICATIONS OUTLET BOXES

A. Exact locations of the outlet boxes shall be coordinated with the electrical contractor and other trades.

B. The approximate locations of the outlets are indicated on the Drawings. The exact locations shall be determined at the building. The right is reserved to change, without additional cost, the exact location of any outlet, a maximum of 10' before it is permanently installed.

C. Orientation of outlet boxes (horizontal or vertical) shall be as indicated on the architectural elevations.

D. Install all outlet boxes in finished areas flush with the wall. Maintain 1/4" or less space between outlet box front and finished wall surface.

E. Outlet boxes shall be firmly anchored in place and shall not depend on the coverplate to hold it secure to the wall.

F. Outlet boxes installed back-to-back in fire-rated walls shall be separated horizontally by a minimum of 24".

3.04 PULL BOXES

A. Pull boxes shall be secured, independent of the conduit entries into the box. Pull boxes shall be secured to the building structure. In ceiling applications, pull boxes shall not be supported with ceiling wires.

B. Conduits entering pull boxes shall connect to pull boxes using die-cast zinc connectors.

C. Pull boxes shall be free from burrs, dirt and debris.

D. Pull boxes shall be installed in accordance with ANSI/TIA-569-B.

E. Pull boxes shall be grounded in accordance with ANSI/TIA-607-B.

3.05 CABLE HANGERS

A. Installation and configuration shall conform to the requirements of ANSI/TIA-568-C.0, ANSI/TIA-568-C.1 & ANSI/TIA-569-B, NFPA 70 (National Electrical Code), applicable local codes, and to the manufacturer's installation instructions.

B. Install cables using techniques, practices, and methods that are consistent with Category 5e or higher requirements and that supports Category 5e or higher performance of completed and linked signal paths, end to end.

C. Install cables without damaging conductors, shield, or jacket.

D. Do not bend cables, in handling or in installing, to smaller radii than minimums recommended by manufacturer.

E. Pull cables without exceeding cable manufacturer's recommended pulling tensions. Use pulling means that will not damage media.

F. Do not exceed load ratings specified by manufacturer.

G. Adjustable non-continuous support sling shall have a static load limit of 100 lbs.

H. To avoid electromagnetic interference (EMI), pathways shall provide minimum clearances of four feet from motors or transformers, one foot from conduit and cables used for electrical power distribution, and five inches from fluorescent lighting. Pathways shall cross perpendicular to fluorescent lighting and electrical power cables or conduits.

3.06 TIE WRAPS AND VELCRO STRAPS

A. Tie wraps/Velcro straps shall be installed around cables at intervals of 12" minimum.

B. Tie wraps shall secure cables to cable trays using an "X" pattern.

C. Do not over-cinch cables.

3.07 IDENTIFICATION

A. Refer to Section 27 05 53 - Identification for Communications Systems for labeling details.

END OF SECTION

SECTION 27 05 43
UNDERGROUND DUCTS AND RACEWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. Applicable requirements of Division 27 - Communications shall be considered a part of this section and shall have the same force as if printed herein full.

B. This document describes the products and execution requirements relating to Underground Ducts and Raceways for Communications Systems.

C. Product specifications, general design considerations, and installation guidelines are provided in this document. The successful vendor shall meet or exceed all requirements described in this document and on the drawings.

1.02 SUBMITTALS

A. Provide product data from manufacturer’s specifications.

1.03 WORK INCLUDED

A. The work included under this specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the Specification or not.

B. The work shall include, but not be limited to the following:

1. Furnish and install complete conduit system.
2. Furnish and install all maintenance holes/handholes.
3. Furnish and install all conduit plugs/caps.

PART 2 PRODUCTS

2.01 APPROVED PRODUCTS

A. Rigid/Intermediate Conduit Manufacturer(s)

1. Allied
2. Triangle
3. Wheatland
4. Youngstown

B. PVC/HDPE Conduit Manufacturer(s)

1. Carlon
2. Georgia Pipe Company

3. FiberTel
4. Or Approved Equal

C. Innerduct/Inner-Conduit Channel Manufacturer(s)

1. Carlon
2. Endot Industries
3. MaxCell
4. Petroflex

D. Marker Tape Manufacturer(s)

1. William Frick & Associates
2. Or Approved Equal

E. Approved Maintenance Hole/Handhole Manufacturer(s)

1. Quazite
2. Old Castle
3. Pencell
4. Or Approved Equal

F. Approved Conduit Plug/Cap Manufacturer(s)

1. Jack Moon
2. Or Approved Equal

2.02 CONDUIT SYSTEM

A. PVC conduit for concrete encasement shall be Type DB, UL Labeled for 90 degrees C cables. Fittings shall be Type DB, solvent type, and from the same manufacturer as the conduit.

B. Concrete shall have a minimum strength of 2,500 psi at 28 days.

C. PVC conduit for direct burial shall be Schedule 40, UL Labeled for 90 degrees C cables. Fittings shall be Schedule 40, solvent type, and from the same manufacturer as the conduit.

D. Rigid and Intermediate Conduit

1. Rigid conduit, intermediate conduit, couplings, locknuts, bushings, elbows and connectors shall be standard thread. All materials shall be steel. Set screw or non-threaded fittings are not permitted.
2. Galvanized rigid steel conduit shall be hot dipped galvanized inside and outside, in 10 foot lengths and threaded on both ends. Fittings and bushings shall be threaded, cast or malleable iron, and hot dipped galvanized inside and outside.

E. Non-Metallic Conduit

1. Non-metallic conduit shall be heavy wall, Schedule 40 PVC/HDPE.
2. Couplings and connectors for non-metallic conduit shall be of the same material and be the product of the same manufacturer of the conduit furnished.

F. Conduit Support

1. Conduit straps shall be single-hole cast metal type or two hole galvanized metal type. Conduit clamps shall be spring steel type for use with exposed structural steel.

G. Innerduct/Inner-Conduit Channel

1. Innerduct shall be non-corrugated PVC equipped with mule tape.
2. Inner-conduit channel (MaxCell) shall be 3-channel with each channel equipped with mule tape.
3. See Drawings for innerduct/inner-conduit channel (MaxCell) details.

H. Marker Tape

1. Marker tape shall be detectable, orange for communications, and labeled to indicate the type of circuit buried below.

2.03 MAINTENANCE HOLES/HANDHOLES

A. Maintenance Holes

1. Maintenance holes shall be pre-cast or cast in place concrete with a strength of 3,500 psi at 28 days, and steel reinforced.
2. Maintenance holes shall include a cast iron frame with cover, a hot dipped galvanized steel ladder, and hot dipped galvanized pulling eyes embedded in the concrete opposite each duct entrance and in the floor beneath the cover.
3. Maintenance holes shall be equipped with grounding busbar.
4. Maintenance holes shall be equipped with racking for cable storage.
5. Ground splices and connections at maintenance holes shall be exothermic welds, copper or bronze compression ground fittings, or bolted compression ring lugs.
6. The cover for maintenance holes shall have the lettering, “COMMUNICATIONS.”

B. Handholes

1. Handholes shall be non-conductive and shall not require grounding for safety. Handholes shall be unaffected by freeze/thaw and resistant to sunlight and chemicals. Handholes shall be pre-cast polymer concrete, heavy duty rated and bottomless.
2. Handholes shall be equipped with racking for cable storage.
3. Handholes shall have the word “COMMUNICATIONS” molded in the cover by the manufacturer. The cover shall be attached with penta-head stainless steel bolts.
4. Handholes shall be able to withstand 10,000 lbs minimum.
5. See Drawings for handhole dimensions and locations.

2.04 CONDUIT PLUGS/CAPS

A. Conduit Plugs/Caps

1. Conduit plugs shall provide a watertight seal at expose ends of conduits.
2. Conduit plugs shall be conduit size specific.
3. Triplex and Quadplex duct plugs shall provide a watertight seal between the conduit and innerduct(s).
4. Simplex duct plugs shall provide a watertight seal between the innerduct and the cable that occupies it.
5. TDUX inflatable bladders shall be used to seal conduits equipped with MaxCell.

PART 3 EXECUTION

3.01 CONDUIT SYSTEM

A. Excavation and Backfill

1. Contractor shall call underground utilities locator company before digging.
2. Barricades shall be provided around open holes and trenches. Temporary bridges shall be provided over trenches cut through major sidewalk routes. Major sidewalk routes shall not be closed to pedestrian traffic.
3. Barriers shall be provided to protect landscaping adjacent to the excavation area.
4. When rocks, concrete or other debris are encountered during excavation, remove completely.
5. Where sidewalk sections must be removed for installation of underground ducts, remove the sidewalk sections completely from joint to joint.
6. Where asphalt must be removed for installation of underground ducts, saw cut the asphalt in two, straight, parallel lines.
7. Backfill excavations in 6-inch layers and mechanically compact to 98 percent compaction.
8. Excavated materials may be used as backfill only if the backfill is sand or clean dirt that is free of rocks and debris over 3/4" in diameter.
9. In landscaped areas, backfill and mechanically compact to a depth of 6 inches below grade.
10. Backfill the last 6 inches with clean topsoil. Reseed lawn areas.
11. Restore concrete sidewalks and asphalt.
12. The Contractor shall perform all excavation to install the electrical work herein specified and as indicated on Drawings. During excavation, material for backfilling shall be piled back from the banks of the trench to avoid overloading and to prevent slides and cave-ins. All excavated materials not to be used for backfill shall be removed and disposed of by the Contractor. Grading shall be done to prevent surface water from flowing into trenches and others excavation and any water accumulating therein shall be removed by pumping. All excavation shall be made by open cut.
13. The bottom of the trenches shall be graded to provide uniform bearing and support for conduits, cables, or duct bank on undisturbed soil at every point along its entire length. Overdepths shall be backfilled with loose, granular, moist earth, tamped. Remove unstable soil that is not capable of supporting equipment or installation and replace with specified material for a minimum of 12" below invert of equipment or installation.
14. The trenches shall be backfilled with the excavated materials approved for backfilling, consisting of earth, loam, sandy clay, sand and gravel or soft shale, free from large clods of earth and stones, deposited in 6" layers and rammed until the installation has a cover of not less than the adjacent ground but not greater than 2" above existing ground. The backfilling shall be carried on simultaneously on both sides of the trench so that injurious pressures do not occur. The compaction of the filled trench shall be at least equal to 95% of the maximum density as determined by the Standard Proctor Test. Settling the backfill with water will not be permitted. Reopen any trenches not meeting compaction requirements or where settlement occurs, refill, compact, and restore the surface to the grade and compaction indicated, mounded over and smoothed off.

B. Duct Banks

1. Duct banks shall be sloped downward toward maintenance holes/handholes and away from buildings a minimum of 6 inches per 100 feet. Duct banks shall not route water from maintenance holes handholes into buildings. Duct banks shall not contain traps between maintenance holes/handholes where water may accumulate.
2. Directional changes in duct banks shall be made with 20' minimum radius bends. Duct banks and direct buried ducts shall be supported on undisturbed soil or on piers extending down to undisturbed soil.

3. Where power and communications duct banks run in parallel, they shall be separated by a minimum of 12 inches.
4. Prior to concrete encasement, ducts, reinforcing steel and ground wires shall be secured with nonmetallic straps or cable ties to nonmetallic duct spacers at intervals not exceeding 8 feet. Duct spacers shall be sized for the ducts being held, and shall provide the minimum spacing between ducts required for concrete flow and by the NEC. Duct spacers shall be anchored to the ground using nonmetallic bands and stakes.
5. Duct banks shall have a minimum of 3 inches of concrete cover on all sides.
6. Where duct banks enter maintenance holes or buildings, they shall be constructed as integral to the wall.
7. Duct bank shall extend to the inside surfaces of the walls, and the duct bank reinforcing shall be integrated with the wall reinforcing.
8. Bell ends shall be provided on ducts where the ducts enter maintenance holes or buildings.
9. Direct buried ducts and fittings shall have bend radii greater than the minimum bend radii of the cables enclosed, and shall not be smaller than the radii of standard manufactured elbows.
10. Direct buried ducts shall be installed parallel to or at right angles to building lines and site features, and as close to curbs and sidewalks as possible to avoid interferences with future landscaping.
11. Where direct buried PVC ducts cannot be buried deep enough to meet the NEC minimum cover requirements, rigid steel conduits shall be installed instead, or a concrete cover shall be poured over the ducts.
12. An orange detectable marker tape (for communications) shall be buried in the backfill approximately 12 inches above duct banks or direct buried cables for the entire length of the duct run.
13. A flexible mandrel and a stiff bristled brush shall be pulled through the ducts to clean them prior to cable pulling.
14. Ducts shall be identified in the maintenance holes and at both ends.

C. Additional OSP Conduit Requirements

1. Leave all empty conduits with a 200-pound test nylon cord pull line.
2. Install a #14 AWG tracer wire in one conduit for the entire length of each duct run.
3. Flattened, dented, or deformed conduits are not permitted and shall be removed and replaced.
4. Install conduit, including homeruns as indicated on the Drawings. Any change resulting in a savings in labor or materials is to be made only in accordance with a contract change. Deviations shall be made only where necessary to avoid interferences and when approved by Engineer by written authorization.
5. Where conduits must pass through structural members obtain approval of Architect.
6. Install all conduits or sleeves penetrating or routed within rated firewalls or fire floors to maintain fire rating of wall or floor. Conduit shall not be installed in rated floors or walls if it compromises or violates the fire rating of floor or wall. Refer to architectural documents.
7. Provide expansion and deflection coupling where conduit passes over a building expansion joint.
8. Service entrance conduits and feeder conduits in direct contact with earth shall be schedule 40, heavy wall PVC/HDPE. All service entrance conduit elbows shall be galvanized rigid steel. Service entrance conduits installed exposed or concealed in walls or above ceilings shall be galvanized rigid steel (GRS) or intermediate metal conduit (IMC). Service entrance conduits shall be installed “outside” of the building as defined by the N.E.C. Provide concrete encasement where required or as indicated on Drawings.
9. Seal all conduits entering building to prevent entrance of moisture.
10. Conduit fittings shall be gland and ring compression type for all conduit exposed to outdoor environments.
11. Below Grade Conduit Installations

a. Install top of conduits 24 inches minimum below finished grade and as indicated on Drawings.
b. Install top of conduits 6 inches minimum below bottom of building slabs.
c. Where transition is made from below grade PVC installation to a metallic conduit system above grade or slab.

12. Communications cables shall not occupy conduits with power cables.
13. All metallic conduits shall be grounded in accordance with J-STD-607-A.
14. For runs that total more than 400 feet in length, insert handholes/maintenance holes so that no segment exceeds the 400 feet limit.
15. Conduit runs shall not have more than two (2) 90-degree bends between pull points.
16. Communication conduit system shall contain no condulets (also known as an LB).

3.02 MAINTENANCE HOLES/HANDHOLES

A. Maintenance holes/handholes shall be installed on a base of pea gravel at least 12 inches deep.

B. Tops of maintenance holes/handholes shall be level with the existing grade.

C. Ducts should enter as perpendicular to the wall surface as possible.

D. Maintenance holes shall be grounded with four 3/4 inch diameter by 8 foot long ground rods, one driven inside of the maintenance hole at each corner. Connect the ground rods and any duct bank ground conductors together with a No. 4/0 AWG bare, stranded copper ground wire loop. A No. 2 AWG bare stranded copper pigtail from the ground wire loop shall be used to ground the maintenance hole cover frame, ladder support bracket, any metallic concrete inserts and metallic cable racks, and the shields of any cables that are spliced in the maintenance hole.

3.03 CONDUIT PLUGS/CAPS

A. Protect conduits against dirt, plaster, and foreign debris with conduit plugs. Plugs shall remain in place until ready for use.

B. Simplex, triplex or quadplex duct plugs shall be installed in conduits to house and seal cables.

C. TDUX inflatable bladders shall be used to seal conduits equipped with MaxCell.

3.04 IDENTIFICATION

A. Refer to Section 27 05 53 - Identification for Communications Systems for labeling details.

END OF SECTION

SECTION 27 05 53
IDENTIFICATION FOR COMMUNICATIONS SYSTEMS

PART 1 -GENERAL

1.01 GENERAL REQUIREMENTS

A. Applicable requirements of Division 27 - Communications shall be considered a part of this section and shall have the same force as if printed herein full.

B. This document describes the equipment and execution requirements relating to Identification for Communications Systems.

C. Equipment specifications, general considerations, and guidelines are provided in this document. The successful vendor shall meet or exceed all requirements described in this document and on the drawings.

1.02 WORK INCLUDED

A. The work included under this Specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete installation. The Contractor will provide and install all of the required material whether specifically addressed in the Specification or not.

B. The work shall include, but not be limited to the following:

1. Perform all labeling.

PART 2 LABELING

2.01 LABELING REQUIREMENTS

A. Labeling shall be done in accordance with the recommendations made in the ANSI/TIA-606-A document, manufacturer's recommendations and best industry practices.

B. All spaces, pathways, outlets, cables, termination hardware, grounding system and equipment shall be labeled with machine-generated labels.

C. All labels shall be clear with black text.

D. All cables shall be labeled with machine generated, wrap around labels.

E. A total of three (3) labels per horizontal cable are required at the following intervals: 6" from outlet; 18" from outlet; 12" from termination block/patch panel.

F. Labeling scheme shall be alphanumeric.

PART 3 NOT USED

END OF SECTION

SECTION 27 08 00
COMMISSIONING OF COMMUNICATIONS

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. Applicable requirements of Division 27 - Communications shall be considered a part of this section and shall have the same force as if printed herein full.

B. This document describes the equipment and execution requirements relating to Commissioning of Communications.

C. Equipment specifications, general considerations, and guidelines are provided in this document. The successful vendor shall meet or exceed all requirements described in this document and on the drawings.

1.02 WORK INCLUDED

A. The work included under this specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete installation. The Contractor will provide and install all of the required material whether specifically addressed in the Specification or not.

B. The work shall include, but not be limited to the following:

1. Perform all copper cabling testing.
2. Perform all optical fiber cabling testing.
3. Perform all coaxial cabling testing.
4. Provide all documentation, as-builts, training and warranty.

PART 2 TESTING

2.01 TESTING REQUIREMENTS

A. General

1. All cables and termination hardware shall be 100% tested for defects in installation and to verify cabling system performance under installed conditions according to the requirements of ANSI/TIA-568-C.0 and/or ANSI/TIA-568-C.1. All conductors/strands of each installed cable shall be verified prior to system acceptance. Any defect in the cabling system installation including but not limited to cable, connectors, feed through couplers, patch panels, and connector blocks shall be repaired or replaced in order to ensure 100% useable conductors/strands in all cables installed.

B. Copper Testing

1. All twisted-pair copper cable links shall be tested for continuity, pair reversals, shorts, opens and performance as indicated below. Additional testing is required to verify Category 6 performance. Horizontal balanced twisted pair cabling shall be tested using a level III test unit for Category 6 performance compliance.

2. Continuity - Each pair of each installed cable shall be tested using a test unit that shows opens, shorts, polarity and pair-reversals, crossed pairs and split pairs. The test shall be recorded as pass/fail as indicated by the test unit and referenced to the appropriate cable identification number and circuit or pair number. Any faults in the wiring shall be corrected and the cable re-tested prior to final acceptance.
3. Length - Each installed cable link shall be tested for installed length using a TDR type device. The cables shall be tested from patch panel to patch panel, block to block, patch panel to outlet or block to outlet as appropriate. The cable length shall conform to the maximum distances set forth in the ANSI/TIA-568-C.2 Standard. Cable lengths shall be recorded, referencing the cable identification number and circuit or pair number. For multi-pair cables, the shortest pair length shall be recorded as the length for the cable.

C. Fiber Testing

1. All fiber testing shall be performed on all fibers in the completed end-to-end system. There shall be no splices unless clearly defined in the RFP and/or Drawings. These tests also include continuity checking of each fiber.
2. Multimode

    a. Test the optical fiber cable bi-directionally with an OTDR and uni-directionally with a power meter/light source. Fiber must be tested at both 850nm and 1300nm. Maximum attenuation dB/Km @ 850nm/1300nm shall be 3.5/1.5. Maximum attenuation per connector pair shall be .75 dB. Attenuation testing shall be performed with a stable launch condition using a one-meter or two-meter jumper, wrapped around a mandrel sized according to fiber type, to attach the light source to the cable plant. Fiber jumper shall be wrapped around mandrel no less than five (5) times. The jumper-mandrel assembly shall remain connected to the light source after calibration and the power meter moved to the far end using a new jumper to take measurements. Test set-up and performance shall be conducted in accordance with ANSI/TIA-568-C.3, and to the manufacturer's application guides.

3. Singlemode

    a. Test the optical fiber cable bi-directionally with an OTDR and uni-directionally with a power meter/light source. Fiber must be tested at both 1310nm and 1550nm. Maximum attenuation dB/Km @ 1310nm/1550nm shall be 0.5/0.5 for outside plant and 1.0/1.0 for inside plant. Maximum attenuation per connector pair shall be .75 dB. Attenuation testing shall be performed with a stable launch condition using one-meter or two-meter jumpers to attach the test equipment to the cable plant. The light source shall be left in place after calibration and the power meter moved to the far end to take measurements. Test set-up and performance shall be conducted in accordance with ANSI/TIA-568-C.3, and to the manufacturer's application guides.

4. Approved optical fiber test equipment manufacturers are as follows:

    a. Power Meters & Light Sources
    Optical Wavelength Laboratories (OWL)
    Noyes
    Photonix
    Fluke
    Agilent
    b. Optical Time Domain Reflectometers (OTDR)
    GN Nettest
    Agilent
    Fluke
    Anritsu
    Tektronix

D. Coaxial Testing

1. Sweep testing of each reel of coaxial cable shall be performed over the 5 MHz through 1 GHz range by the cable manufacturer for transmission and structural return loss and be so certified in writing by the cable manufacturer.
2. Verification testing with a verification field test instrument will determine shorts, continuity, termination location and length of cable.
3. Approved* testers are as follows:

    a. Fluke – CableIQ Series
    b. Test-Um – Validator Series
    *A level IIe, III or IV certification tester may be used in lieu of approved tester.

4. Signal strength measurement shall be performed with a field strength meter.
5. Signal level at each outlet will be +5 dBmv, + 3 dB.
6. Approved signal strength meters are as follows:

    a. Acterna – Stealth Series
    b. Acterna – MicroStealth Series
    c. Acterna – CLI Series
    d. Sadelco – DisplayMax Series
    e. Sadelco – DisplayMax Jr. Series
    f. Promax – Prolink Series

E. Test Results

1. Test documentation shall be provided on disk as part of the as-built package. The disk shall be clearly marked on the outside front cover with the words “Project Test Documentation,” the project name, and the date of completion (month and year). The results shall include a record of test frequencies, cable type, conductor pair (or strand) and cable (or outlet) I.D., measurement direction, reference setup, and crew member name(s). The test equipment name, manufacturer, model number, serial number, software version and last calibration date will also be provided at the end of the document. Unless the manufacturer specifies a more frequent calibration cycle, an annual calibration cycle is anticipated on all test equipment used for this installation. The test document shall detail the test method used and the specific settings of the equipment during the test as well as the software version being used in the field test equipment.
2. The field test equipment shall meet the requirements of ANSI/TIA-568-C.2 and/or ANSI/TIA-568-C.3.
3. Printouts generated for each cable by the wire (or fiber) test instrument shall be submitted as part of the documentation package. Alternately, the Contractor may furnish this information in electronic form (CD). These CDs shall contain the electronic equivalent of the test results as defined by the Specification and be of a format readable from Microsoft Word.
4. When repairs and re-tests are performed, the problem found and corrective action taken shall be noted, and both the failed and passed test data shall be documented.

PART 3 DOCUMENTATION, AS-BUILTS, TRAINING AND RECORDS

3.01 DOCUMENTATION & AS-BUILTS

A. As-Built record documentation for communications work shall include:

1. Cable routing and identification
2. System function diagrams
3. Manufacturers' description literature for equipment

4. Connection and programming schedules as appropriate
5. Equipment material list including quantities
6. Spare parts list with quantities
7. Details not on original Contract Documents
8. Test results
9. Warranties
10. Release of liens

B. The Contractor shall provide and maintain at the site a set of prints on which shall be accurately shown the actual installation of all work under this section, indicating any variation from contract drawings, including changes in pathways, sizes, locations and dimensions. All changes shall be clearly and completely indicated as the work progresses.

C. Progress prints shall be available for inspection by the Owner or any of his representatives and may be used to determine the progress of communications infrastructure work.

D. At the completion of the work, prepare a new set of as-built drawings, of the work as actually noted on the marked-up prints, including the dimensioned location of all pathways.

E. Furnish as-built drawings and documentation to the Project Manager. As-built drawings shall be generated in AutoCAD 2006 or later. Submit as-built drawings electronically on CD and hard copy.

3.02 OPERATIONS AND MAINTENANCE MANUAL

A. After completion of the work, the Contractor shall furnish and deliver to the Engineer three (3) copies of a complete Operations & Maintenance Manual. A system wiring diagram shall be furnished for each separate system.

B. The manual shall be subdivided into separate sections with tab dividers to identify subsystems of the integrated system. Reference appropriate Specification sections.

C. Provide the following additional information for each electronic system. Information shall be edited for this project where applicable.

1. Operations manuals for components and for systems as a whole
2. Maintenance manuals for components and for system as a whole
3. Point-to-point diagrams, cabling diagrams, construction details and cabling labeling details
4. List of spare parts, materials and suppliers of components. Provide name, address and telephone number for each supplier.
5. Emergency instructions for operational and maintenance requirements
6. Delivery time frame for replacement of component parts from suppliers
7. Recommended inspection schedule and procedures for components and for system as a whole
8. List of spare parts, materials and suppliers of components. Provide name, address and telephone number for each supplier.
9. Complete “reviewed” shop drawings and product data for components and system as a whole
10. Troubleshooting procedures for each system and for each major system component

3.03 TRAINING

A. The Contractor shall be responsible for training of facility personnel. Training shall take place after occupancy and before acceptance and shall include programs for on-site operations and maintenance of technology and communications systems. Training shall be for not more than

ten (10) people, shall be held at the Owner's site and shall be of sufficient duration and depth to ensure that the trained personnel can operate the installed systems and can perform usual and customary maintenance actions.

3.04 WARRANTY

A. General

1. All equipment is to be new and warranted free of faulty workmanship and damage.
2. Replacement of defective equipment and materials and repair of faulty workmanship within 24 hours of notification, except emergency conditions (system failures), which must be placed back in service within eight (8) hours of notification, all at no cost to the Owner.
3. The minimum warranty provisions specified shall not diminish the terms of individual equipment manufacturer's warranties.

B. Voice & Data Structured Cabling

1. Manufacturer(s) shall provide a minimum 15-year warranty for components used in the installed Voice & Data Structured Cabling System. Defective and/or improperly installed products shall be replaced and/or correctly installed at no cost to the Owner.

C. Coaxial Cabling Infrastructure

1. Manufacturer(s) shall provide a minimum 1-year warranty for components used in the installed Coaxial Cabling Infrastructure. Defective and/or improperly installed products shall be replaced and/or correctly installed at no cost to the Owner.

D. Pathway & Support Infrastructure

1. Manufacturer(s) shall provide a minimum 1-year warranty for components used in the installed Pathway & Support Infrastructure. Defective and/or improperly installed products shall be replaced and/or correctly installed at no cost to the Owner.

END OF SECTION

SECTION 27 11 13
COMMUNICATIONS ENTRANCE PROTECTION

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. Applicable requirements of Division 27 - Communications shall be considered a part of this section and shall have the same force as if printed herein full.

B. This document describes the products and execution requirements relating to Communications Entrance Protection.

C. Product specifications, general design considerations, and installation guidelines are provided in this document. The successful vendor shall meet or exceed all requirements described in this document and on the drawings.

1.02 SUBMITTALS

A. Provide product data from manufacturer’s specifications.

1.03 WORK INCLUDED

A. The work included under this specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the Specification or not.

B. The work shall include, but not be limited to the following:

1. Furnish and install all building entrance protector terminals.
2. Furnish and install all bonding shield connectors.

PART 2 - PRODUCTS

2.01 APPROVED PRODUCTS

A. Approved Building Entrance Protector Terminal Manufacturers

1. Circa
2. Marconi
3. Porta Systems

B. Approved Bonding Shield Connector Manufacturers

1. 3M
2. Or Approved Equal

2.02 BUILDING ENTRANCE PROTECTOR TERMINALS

A. Indoor Building Entrance Protector Terminal

1. The indoor building entrance protector terminal shall be equipped with 110-connector inputs and outputs and shall accommodate industry standard 5-pin protection modules.
2. The indoor building entrance protector terminal shall protect up to 100-pairs and shall be equipped with an internal fuse link.
3. The indoor building entrance protector terminal shall be wall or frame mountable, and able to be stacked for future expansion.
4. The indoor building entrance protector terminal shall be equipped with external ground connectors that accept 6-14 AWG ground wire.

B. Solid State Surge Protection Modules

1. The solid-state surge protector module shall be 5-pin and shall provide transient and power fault protection for standard telephone line applications.
2. The solid-state surge protector module shall be designed to provide a balanced configuration to protect against line-to-line metallic surges.
3. The solid-state surge protector module shall feature an external failsafe mechanism, which permanently grounds module under sustained high current conditions.
4. The solid-state surge protector module shall feature nanosecond response time and safe mode operation in adverse situations.
5. The solid-state surge protector module shall be UL & cUL Listed.

2.03 BONDING SHIELD CONNECTOR

A. Shield Connector

1. The purpose of the bonding shield connector is to make a stable, low resistant electrical connection between the shield of a communications cable and a ground conductor.
2. The bonding shield connector shall be tin-plated tempered brass.

PART 3 EXECUTION

3.01 BUILDING ENTRANCE PROTECTOR TERMINALS

A. All copper circuits shall be provided with protection between each building with an entrance cable protector panel. All building-to-building circuits shall be routed through this protector. The protector shall be connected with a #6 AWG copper bonding conductor between the protector ground lug and the telecommunications room (TR) busbar.

B. Building entrance protector shall be installed in accordance with the recommendations contained in the ANSI/TIA-607-B Telecommunications Bonding and Ground Standard.

C. Building entrance protector panels shall be installed as per the requirements specified by the manufacturer's installation guidelines.

3.02 BONDING SHIELD CONNECTOR

A. Bonding shield connector shall be installed in accordance with the recommendations contained in the ANSI/TIA-607-B Standard.

B. Bonding shield connector shall be installed as per the requirements specified by the manufacturer's installation guidelines.

3.03 IDENTIFICATION

A. Refer to Section 27 05 53 - Identification for Communications Systems for labeling details.

END OF SECTION

SECTION 27 11 16
COMMUNICATIONS CABINETS, RACKS AND ENCLOSURES

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. Applicable requirements of Division 27 - Communications shall be considered a part of this section and shall have the same force as if printed herein full.

B. This document describes the products and execution requirements relating to Communications Cabinets, Racks and Enclosures.

C. Product specifications, general design considerations, and installation guidelines are provided in this document. The successful vendor shall meet or exceed all requirements described in this document and on the drawings.

1.02 SUBMITTALS

A. Provide product data from manufacturer’s specifications.

1.03 WORK INCLUDED

A. The work included under this specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all the required material whether specifically addressed in the Specification or not.

PART 2 PRODUCTS

2.01 APPROVED PRODUCTS

A. Approved Equipment Rack/Cabinet Manufacturer(s)

1. Middle Atlantic
2. Chatsworth Products, Inc.
3. Eaton
4. Or Approved Equal

2.02 EQUIPMENT RACKS/CABINETS

A. Equipment Racks

1. The equipment rack shall be constructed of high strength, lightweight aluminum.
2. The vertical rails of the equipment rack shall be equipped with the EIA hole pattern.
3. 2-Post Rack shall be: 45U H x 19" W x 18” D, floor mounted.
4. 4-Post Rack shall be: 45U H x 19” W x 29” D, floor mounted.

5. Wall Mount Rack shall be: 21U H x 19" W x 18” D.
6. Rack color shall be black

B. Equipment Cabinets

1. The frame of the equipment cabinet shall be constructed of high strength steel.
2. Front and rear doors of the equipment cabinet shall be lockable.
3. The vertical rails of the equipment cabinet shall be equipped with the EIA hole pattern.
4. 42U Cabinet shall be: 80” H x 23.6" W x 31.5" D, floor mounted.
5. 45U Cabinet shall be: 85” H x 23.6" W x 39.4" D, floor mounted.
6. 19U Wall Mount Cabinet shall be: 36” H x 24" W x 18" D.
7. Cabinet color shall be black.

2.03 BACKBOARDS

A. Backboards shall be 3/4" void free plywood. Size of backboard shall be 4' x 8' unless noted differently on Drawings. Backboards shall be painted with two (2) coats of gray fire-retardant paint

PART 3 EXECUTION

3.02 EQUIPMENT RACKS/CABINETS

A. Equipment racks shall be securely attached to the concrete floor using minimum 3/8" hardware or as required by local codes.

B. Equipment cabinets shall be installed as per the requirements specified by the manufacturer's installation guidelines.

C. Equipment racks/cabinets shall be placed with a minimum of 40-inch clearance from the walls from the front and rear of the rack or as indicated on Drawings.

D. All equipment racks/cabinets shall be grounded to the telecommunications ground bus bar.

E. Mounting screws not used for installing patch panels and other hardware shall be bagged and left with the rack upon completion of the installation.

F. Contractor shall provide one (1) 25-count bag of rack screws per rack for the Owner. These screws are in addition to what will be used by the contractor to mount the equipment that they are contracted to install.

3.03 BACKBOARDS

A. Install backboards level and secure with hardware that is sufficient to support the load of the backboard and the equipment that will mounted on it. Also, make provisions for future equipment when calculating load weight.

3.04 IDENTIFICATION

A. Refer to Section 27 05 53 - Identification for Communications Systems for labeling details.

END OF SECTION

SECTION 27 11 19
COMMUNICATIONS TERMINATION BLOCKS AND PATCH PANELS

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. Applicable requirements of Division 27 - Communications shall be considered a part of this section and shall have the same force as if printed herein full.

B. This document describes the products and execution requirements relating to Communications Termination Blocks and Patch Panels.

C. Product specifications, general design considerations, and installation guidelines are provided in this document. The successful vendor shall meet or exceed all requirements described in this document and on the drawings.

1.02 SUBMITTALS

A. Provide product data from manufacturer's specifications.

1.03 WORK INCLUDED

A. The work included under this specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the Specification or not.

B. The work shall include, but not be limited to the following:

1. Furnish and install all patch panels.
2. Furnish and install all optical fiber panels/enclosures.
3. Furnish and install all termination blocks.
4. Furnish and install all PoE (Power-over-Ethernet) switches.

PART 2 PRODUCTS

2.01 APPROVED PRODUCTS

A. Approved Patch Panel Manufacturer(s)

1. Leviton
2. Panduit
3. Middle Atlantic

B. Approved Optical Fiber Enclosure Manufacturer(s)

1. Leviton
2. Panduit

3. Middle Atlantic

C. Approved Termination Block Manufacturer(s)

1. Leviton
2. Panduit
3. Middle Atlantic

D. Approved PoE Switch Manufacturer(s)

1. Cisco
2. Allied Telesis
3. HP – ProCurve Series

2.02 PATCH PANELS

A. Category 6/6A Patch Panel

1. The Category 6/6A patch panel shall be compatible with 19" equipment racks, cabinets or wall mount brackets.
2. The Category 6/6A patch panel shall be equipped with 8-position modular ports and shall allow for termination using both T568A and T568B wiring schemes.
3. The Category 6/6A patch panel shall be equipped with front labeling space to facilitate port identification.
4. The connector module shall meet or exceed the Category 6/6A performance criteria per ANSI/TIA-568-C.2.

2.03 OPTICAL FIBER PANELS/ENCLOSURES

A. Rack Mount Optical Fiber Panel/Enclosure

1. The rack mount optical fiber panel/enclosure shall be equipped with either a swing out mechanism or a sliding drawer to access fibers.
2. The rack mount optical fiber panel/enclosure shall be capable of terminating tight-buffered or loose tube optical fiber cable.
3. The rack mount optical fiber panel/enclosure shall provide for bend radius control throughout the panel as well as storage space for slack cabling.
4. The panel/enclosure shall meet or exceed the performance criteria per ANSI/TIA-568-C.3.
5. The rack mount optical fiber panel/enclosure shall be equipped with optical fiber adapter panels.

    a. The optical fiber adapter panels shall accommodate either multimode or singlemode terminated optical fiber.
    b. The optical fiber adapter panels shall be compatible with LC connectors.
    c. OM3 laser optimized adaptors shall be aqua in color and equipped with zirconia ceramic sleeves.
    d. Singlemode adaptors shall be blue or green in color and equipped with zirconia ceramic sleeves.

B. Wall Mount Optical Fiber Panel/Enclosure

1. The wall mount optical fiber panel/enclosure shall have a hinged door for access, with locking available for security.

2. The wall mount optical fiber panel/enclosure shall be capable of terminating tight-buffered or loose tube optical fiber cables and all popular connector types.
3. The wall mount optical fiber panel/enclosure shall provide for bend radius control throughout the panel as well as storage space for slack cabling.
4. The panel/enclosure shall meet or exceed the performance criteria per ANSI/TIA-568-C.3.
5. The wall mount optical fiber panel/enclosure shall be equipped with optical fiber adapter panels.

    a. The optical fiber adapter panels shall accommodate either multimode or singlemode terminated optical fiber.
    b. The optical fiber adapter panels shall be compatible with LC connectors.
    c. OM3 laser optimized adaptors shall be aqua in color and equipped with zirconia ceramic sleeves.
    d. Singlemode adaptors shall be blue or green in color and equipped with zirconia ceramic sleeves.

2.04 TERMINATION BLOCKS

A. 110 Type Wiring Blocks/Cross-Connect Kits

1. The 110-type wiring blocks shall be available in 100- and/or 300-pair configurations.
2. The 110-type wiring block shall be Category 6/6A.
3. The cross-connect kits shall include all the components required to complete a wall-mounted 110 cross-connect installation and be available in both 100- and/or 300-pair configuration. (Includes 110-blocks, connecting blocks and designation strips).
4. The termination block shall meet or exceed the performance criteria per ANSI/TIA-568-C.2.
5. Backbone blocks shall use 5-pair connecting blocks on each 25-pair row.
6. Horizontal blocks shall use 4-pair connecting blocks on each 25-pair row.

B. 66-Blocks

1. The 66-type wiring block shall be a 50-pair configuration.
2. The 66-type wiring block shall have a split clip system using bridge clips to connect incoming pairs to outgoing pairs.
3. The 66 block’s labeling system shall use designation strips or covers to accommodate labels.

2.05 POE SWITCHES

A. Category 6/6A PoE Switch

a. IEEE 802.3af Power over Ethernet compliant
b. 2.68Mbps throughput
c. 3.6Gbps switching capacity
d. Broadcast storm control capability
e. 20MB RAM minimum
f. Auto MDI/MDI-X capability
g. 95W minimum PoE budget
h. 19” rack-mountable
i. UL listed
j. RoHS compliant
k. Telnet remote login capability
l. Non-blocking architecture

m. SNMP v1 and v2 compatibility
n. Wirespeed performance
o. Rapid Spanning-Tree capability
p. WPA-PSK (AES) IEEE 802.1X RADIUS capability
q. VLAN tagging
r. Port mirroring
s. Link aggregation – LACP capability
t. SNTP capability
u. GVRP capability

PART 3 EXECUTION

3.01 PATCH PANELS AND POE SWITCHES

A. Cables shall be dressed and terminated in accordance with the recommendations made in ANSI/TIA-568-C.0 and/or ANSI/TIA-568-C.1, manufacturer's recommendations and best industry practice.

B. Pair untwist at the termination shall not exceed 13 mm (0.5 inch).

C. Bend radius of the cable in the termination area shall not exceed 4 times the outside diameter of the cable.

D. Cables shall be neatly bundled and dressed to their respective patch panel or PoE switch. Each patch panel or PoE switch shall be fed by an individual bundle separated and dressed back to the point of cable entrance into the rack or frame.

E. Each cable shall be clearly labeled on the cable jacket behind the patch panel or PoE switch at a location that can be viewed without removing the bundle support ties. Cables labeled within the bundle, where the label is obscured from view shall not be acceptable.

3.02 OPTICAL FIBER PANELS/ENCLOSURES

A. Cables shall be dressed and terminated in accordance with the recommendations made in ANSI/TIA-568-C.0 and/or ANSI/TIA-568-C.1, manufacturer's recommendations and best industry practices.

B. Each cable shall be individually attached to the respective splice enclosure by mechanical means. The cables strength member shall be securely attached the cable strain relief bracket in the enclosure.

C. Bend radius of the optic fiber cable in the panel/enclosure shall not exceed 10 times the outside diameter of the cable.

D. Each fiber bundle shall be stripped upon entering the splice tray and the individual fibers routed in the splice tray.

E. Each cable shall be clearly labeled at the entrance to the splice enclosure. Cables labeled within the bundle shall not be acceptable.

F. A maximum of 12 strands of fiber shall be spliced in each tray.

G. All spare strands shall be installed into spare splice trays.

H. Fiber slack shall be neatly coiled within the fiber splice tray or enclosure. No slack loops shall be allowed external to the fiber panel.

3.03 TERMINATION BLOCKS

A. Cables shall be dressed and terminated in accordance with the recommendations made in ANSI/TIA-568-C.0 and/or ANSI/TIA-568-C.1, manufacturer's recommendations and best industry practice.

B. Pair untwist at the termination shall not exceed 13 mm (0.5 inch).

C. Bend radius of the cable in the termination area shall not exceed 4 times the outside diameter of the cable.

D. Cables shall be neatly bundled and dressed to their respective termination block. Each termination block shall be fed by an individual bundle separated and dressed back to the point of cable entrance into the rack or frame.

E. Each cable shall be clearly labeled on the cable jacket within 12" of the termination block at a location that can be viewed without removing the bundle support ties. Cables labeled within the bundle, where the label is obscured from view shall not be acceptable.

F. Wall mounted termination block fields shall be mounted on communications backboard.

G. Wall mounted termination block fields shall be installed as per the requirements specified by the manufacturer's installation guidelines.

3.04 IDENTIFICATION

A. Refer to Section 27 05 53 - Identification for Communications Systems for labeling details.

END OF SECTION

SECTION 27 11 23
COMMUNICATIONS CABLE MANAGEMENT AND LADDER RACK

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. Applicable requirements of Division 27 - Communications shall be considered a part of this section and shall have the same force as if printed herein full.

B. This document describes the products and execution requirements relating to Communications Cable Management and Ladder Rack.

C. Product specifications, general design considerations, and installation guidelines are provided in this document. The successful vendor shall meet or exceed all requirements described in this document and on the drawings.

1.02 SUBMITTALS

A. Provide product data from manufacturer's specifications.

1.03 WORK INCLUDED

A. The work included under this specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the Specification or not.

B. The work shall include, but not be limited to the following:

1. Furnish and install all horizontal cable management.
2. Furnish and install all vertical cable management.
3. Furnish and install ladder rack system.
4. Furnish and install all tie wraps/Velcro straps.
5. Furnish and install all C-rings/D-rings.

PART 2 PRODUCTS

2.01 APPROVED PRODUCTS

A. Approved Horizontal Cable Management Manufacturer(s)

1. Chatsworth Products, Inc.
2. Middle Atlantic
3. Panduit
4. Or Approved Equal

B. Approved Vertical Cable Management Manufacturer(s)

1. Chatsworth Products, Inc.
2. Middle Atlantic
3. Panduit
4. Or Approved Equal

C. Approved Ladder Rack System Manufacturer(s)

1. Chatsworth Products, Inc.
2. Middle Atlantic
3. Hoffman
4. Or Approved Equal

D. Approved Tie Wrap/Velcro Strap Manufacturer(s)

1. Middle Atlantic
2. Panduit
3. Thomas & Betts
4. Or Approved Equal

E. Approved C-Ring/D-ring Manufacturer(s)

1. Chatsworth Products, Inc.
2. Middle Atlantic
3. Panduit
4. Or Approved Equal

2.02 CABLE MANAGEMENT - HORIZONTAL

A. Horizontal Cable Management

1. The horizontal wire manager shall be compatible with 19-inch equipment racks, cabinets or wall mount brackets.
2. The horizontal cable manager shall provide support for patch cords at the front of the panel.
3. The horizontal cable manager shall be 2 rack-units in height.

2.03 CABLE MANAGEMENT - VERTICAL

A. Vertical Cable Management

1. The vertical cable manger shall be double-sided.
2. The vertical cable manager shall provide support for patch cords at the front of the rack and wire management at the rear of the rack.
3. The vertical cable manager shall be a minimum width of 6".
4. Vertical cable manager color shall be black.

2.04 LADDER RACKS

A. Ladder Rack System

1. See Drawings for ladder rack system details.
2. The ladder rack system shall be securely mounted with hardware designed for use in ladder rack systems.

3. End caps shall be installed on the exposed ends of the ladder racks, channel supports and bolts. Protective covers shall be installed on threaded rods that come in contact with cabling plant.
4. Ladder Rack System color shall be black.

2.05 TIE WRAPS AND VELCRO STRAPS

A. Tie Wraps and Velcro Straps

1. Backbone cables shall be fastened to support structures with tie wraps/ Velcro straps.
2. Horizontal cables shall be fastened to support structures with Velcro straps.

a. Tie Wrap color shall be black.
b. Velcro Strap color shall be black.

2.06 C-RINGS/D-RINGS

A. C-Rings/D-rings

1. C-rings/D-rings shall be used on backboards to support cables, patch cords and cross-connect wire.
2. C-rings/D-rings shall be made of high-strength, fire-retardant material with rounded edges to prevent damage to cable and wire insulation.

PART 3 EXECUTION

3.01 CABLE MANAGEMENT - HORIZONTAL

A. Horizontal cable managers shall be installed below patch panels in a 1:1 ratio (one horizontal cable manager per patch panel) and as indicated on Drawings.

3.02 CABLE MANAGEMENT - VERTICAL

A. Vertical cable managers shall be installed on both sides of a single equipment rack. Where two (2) or more racks are positioned in a row, vertical cable managers shall be installed between each rack and each end of the row.

3.03 LADDER RACKS

A. Ladder rack system shall be installed straight, level and perpendicular to walls and ceiling slabs.

B. Ladder racks shall be supported at 5' intervals maximum.

C. Provide all hardware, accessories, fasteners, anchors, threaded rods and support channels required to provide a complete ladder rack system.

D. See Drawings for ladder rack system details.

3.04 TIE WRAPS AND VELCRO STRAPS

A. Tie wraps/Velcro straps shall be installed around cables at intervals of 12" minimum.

B. Tie wraps shall secure cables to ladder racks using an “X” pattern.

C. Do not over-cinch cables.

3.05 C-RINGS/D-RINGS

A. C-ring/D-rings shall be installed on 3/4" backboard, straight and level.

3.06 IDENTIFICATION

A. Refer to Section 27 05 53 - Identification for Communications Systems for labeling details.

END OF SECTION

SECTION 27 11 26
COMMUNICATIONS RACK MOUNTED POWER PROTECTION AND POWER STRIPS

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. Applicable requirements of Division 27 - Communications shall be considered a part of this section and shall have the same force as if printed herein full.

B. This document describes the products and execution requirements relating to Communications Rack Mounted Power Protection and Power Strips.

C. Product Specifications, general design considerations, and installation guidelines are provided in this document. The successful vendor shall meet or exceed all requirements described in this document and on the drawings.

1.02 SUBMITTALS

A. Provide product data from manufacturer's specifications.

1.03 WORK INCLUDED

A. The work included under this specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the Specification or not.

B. The work shall include, but not be limited to the following:

1. Furnish and install all power distribution units.
2. Furnish and install all rack mounted UPS.

PART 2 - PRODUCTS

2.01 APPROVED PRODUCTS

A. Approved Power Distribution Unit Manufacturer(s)

1. Leviton
2. Middle Geist
3. Geist
4. Or Approved Equal

B. Approved Rack Mounted UPS Manufacturer(s)

1. APC
2. Middle Atlantic
3. Tripp Lite
4. Or Approved Equal

2.02 POWER DISTRIBUTION UNITS

A. Power Distribution Unit

1. The power distribution unit shall be equipped with a minimum of twelve (12) 3-prong, 120 VAC outlets, 7' cord and an on/off switch.
2. The power distribution unit shall be equipped with surge protection with a 20 Amp current limit.
3. The power distribution unit shall be equipped with a bracket that enables it to be mounted on a 19" rack, cabinet or wall mount bracket without modification.

2.03 RACK MOUNTED UPS

A. 1500VA Rack Mounted UPS (IDF Rooms)

1. The rack mounted UPS shall have an output power capacity of 1,440VA/980W. Input/output voltage shall be 120V. Power cord length shall be eight (8) feet, minimum.
2. The rack mounted UPS shall be equipped with six (6) NEMA 5-15R output connections.
3. The rack mounted UPS shall have a surge energy rating of 459 joules and have a typical backup time of 7.4 minutes at full load.
4. The rack mounted UPS shall be 2 rack-units in height and able to mount to a 19" rack or cabinet without modification.

B. 3000VA Rack Mounted UPS (MDF Room or A/V Rooms)

1. The rack mounted UPS shall have an output power capacity of 3,000VA/2,100W. Input/output voltage shall be 208V. Output voltage shall be 120V/208V. Power cord length shall be ten (10 feet, minimum.
2. The rack mounted UPS shall be equipped with twelve (12) NEMA 5-20R, two (2) NEMA L6-20R and one (1) NEMA L6-30R output connections.
3. The rack mounted UPS shall have a surge energy rating of 480 joules and have a typical backup time of 14.1 minutes at full load.
4. The rack mounted UPS shall be 5 rack-units in height and able to mount to a 19" rack or cabinet without modification.

PART 3 - EXECUTION

3.01 POWER DISTRIBUTION UNITS

A. Power distribution units shall be installed as per the requirements specified by the manufacturer’s installation guidelines.

B. See Drawings for installation location on rack(s)/cabinet(s).

3.02 RACK MOUNTED UPS

A. Rack mounted UPS shall be installed as per the requirements specified by the manufacturer’s installation guidelines.

B. See Drawings for installation location on rack(s)/cabinet(s).

3.03 IDENTIFICATION

A. Refer to Section 27 05 53 - Identification for Communications Systems for labeling details.

END OF SECTION

SECTION 27 11 90
STRUCTURED MEDIA ENCLOSURES

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. Applicable requirements of Division 27 - Communications shall be considered a part of this section and shall have the same force as if printed herein full.

B. This document describes the products and execution requirements relating to Structured Media Enclosure Requirements.

C. Product specifications, general design considerations, and installation guidelines are provided in this document. The successful vendor shall meet or exceed all requirements described in this document and on the drawings.

1.02 SUBMITTALS

A. Provide product data from manufacturer’s specifications.

1.03 WORK INCLUDED

A. The work included under this specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the Specification or not.

B. The work shall include, but not be limited to the following:

1. Furnish and install all structured media enclosures.
2. Furnish and install all voice and data modules.
3. Furnish and install all bridged voice modules.
4. Furnish and install all video splitters.

PART 2 - PRODUCTS

2.01 APPROVED PRODUCTS

A. Approved Structured Media Enclosure Manufacturer(s)

1. Leviton
2. Panduit
3. Suttle – SOHO Series
4. Primex – Verge Series
5. Or Approved Equal

B. Approved Voice and Data Module Manufacturer(s)

1. Leviton

2. Panduit
3. Suttle – SOHO Series
4. Primex
5. Or Approved Equal

C. Approved Bridged Voice Module Manufacturer(s)

1. Leviton
2. Panduit
3. Suttle – SOHO Series
4. Primex
5. Or Approved Equal

D. Approved Video Splitter Manufacturer(s)

1. Leviton
2. Panduit
3. Suttle – SOHO Series
4. Primex
5. Or Approved Equal

2.02 STRUCTURED MEDIA ENCLOSURE

A. The structured media enclosure shall be a one-piece (excluding cover) box made of white, RF-transparent plastic. It shall flush-mount with four wood screws (provided) on standard 16" center wall studs prior to dry wall.

B. The structured media enclosure shall have a minimum dimension of 30"h x 14"w x 3.5"d with 32"h x 16" cover.

C. The structured media enclosure shall meet all applicable standards: be UL Listed, comply with all ANSI/TIA-570-B requirements and meet FCC part 68.

2.03 VOICE AND DATA MODULE

A. The data module shall be Power Sum rated with a Power Sum NEXT performance equal to or better than the ANSI/TIA-568-C.2, Category 6 pair-to-pair NEXT performance specifications.

B. The data module shall be a printed circuit board module with no less than six (6) 8-position modular ports.

2.04 BRIDGED VOICE MODULE

A. The voice module shall be capable of bridging up to four (4) telephone lines through to nine (9) outlet locations (1 input block x 9 output blocks).

B. The voice module shall be a 110-style module with a printed circuit board.

2.05 VIDEO SPLITTERS

A. The Video Splitters shall be UL Listed. It shall be of die-cast housing and printed circuit board construction. Frequency Range 5 MHz - 1 GHz.

B. The in-unit splitter assignments shall be as follows:

1. One-bedroom and two-bedroom units shall be equipped with 4-way splitters.
2. Three-bedroom and higher units shall be equipped with 6-way splitters.

PART 3 - EXECUTION

3.01 STRUCTURED MEDIA ENCLOSURE

A. Structured Media Enclosures shall be installed as per the requirements specified by the manufacturer's installation guidelines and best industry practice.

B. Structured Media Enclosures shall be installed in accordance with the recommendations made in the ANSI/TIA-570-B standard.

C. Structured Media Enclosures shall be bonded and grounded in accordance with the recommendations made in the ANSI/TIA-607-B standard.

END OF SECTION

SECTION 27 15 13
COMMUNICATIONS COPPER HORIZONTAL CABLING

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. Applicable requirements of Division 27 - Communications shall be considered a part of this section and shall have the same force as if printed herein full.

B. This document describes the products and execution requirements relating to Communications Copper Horizontal Cabling.

C. Product specifications, general design considerations, and installation guidelines are provided in this document. The successful vendor shall meet or exceed all requirements described in this document and on the drawings.

1.02 SUBMITTALS

A. Provide product data from manufacturer’s specifications.

1.03 WORK INCLUDED

A. The work included under this specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the Specification or not.

B. The work shall include, but not be limited to the following:

1. Furnish and install all horizontal copper cable.

PART 2 - PRODUCTS

2.01 APPROVED PRODUCTS

A. Approved Horizontal Copper Cable Manufacturer(s)

1. General Cable
2. OCC
3. Superior Essex
4. Or Approved Equal

2.02 HORIZONTAL COPPER CABLE

A. 100 OHM Category 6/6A Balanced Twisted Pair Cable

1. The horizontal balanced twisted pair cable shall meet or exceed the Category 6/6A transmission characteristics per issue of ANSI/TIA/EIA-568-C.2.
2. Cable jacket shall be CMR or CMP rated (according to the space it occupies).
3. Jacket color shall be:

    a. Gray for voice.
    b. Blue for data

PART 3 - EXECUTION

3.01 HORIZONTAL CABLES

A. Cable shall be installed in accordance with manufacturer's recommendations and best industry practices.

B. A plastic or nylon pull cord with a minimum test rating of 90 Kg (200 lb.) shall be co-installed with all cable installed in any conduit.

C. Cable raceways shall not be filled greater than the ANSI/TIA/EIA-569-B maximum fill for the particular raceway type.

D. Cables shall be installed in continuous lengths from origin to destination (no splices) except for transition points, or consolidation points.

E. Riser rated cable shall be installed in metallic conduit when installed in a plenum space.

F. Where transition points or consolidation points are allowed, they shall be located in accessible locations and housed in an enclosure intended and suitable for the purpose.

G. The cable's minimum bend radius and maximum pulling tension shall not be exceeded. Refer to manufacturer's requirements.

H. If a J-hook or trapeze system is used to support cable bundles all horizontal cables shall be supported at a maximum of 48 to 60 inch (1.2 to 1.5 meter) intervals. At no point shall cable(s) rest on acoustic ceiling grids or panels.

I. Horizontal distribution cables shall be bundled in groups of no more than 50 cables. Cable bundle quantities in excess of 50 cables may cause deformation of the bottom cables within the bundle and degrade cable performance.

J. Cable shall be installed above fire-sprinkler systems and shall not be attached to the system or any ancillary equipment or hardware. The cable system and support hardware shall be installed so that it does not obscure any valves, fire alarm conduit, boxes, or other control devices.

K. Cables shall not be attached to ceiling grid or lighting fixture wires. Where support for horizontal cable is required, the Contractor shall install appropriate carriers to support the cabling.

L. Any cable damaged or exceeding recommended installation parameters during installation shall be replaced by the Contractor prior to final acceptance at no cost to the Owner.

M. Cables shall be dressed and terminated in accordance with the recommendations made in the ANSI/TIA/EIA-568-C.2 document, manufacturer's recommendations and best industry practices.

N. Leave a minimum of 12" of slack for twisted pair cables at the outlet. Cables shall be coiled in the in-wall box, surface-mount box or modular furniture raceway if adequate space is present to house the cable coil without exceeding the manufacturers bend radius. In hollow-wall installations where box-eliminators are used, excess wire can be stored in the wall. Excess slack shall be loosely coiled and stored in the ceiling above each drop location when there is not enough space present in the outlet box to store slack cable.

O. Cables shall be neatly bundled and dressed to their respective termination device. Each terminating device shall be fed by an individual bundle separated and dressed back to the point of cable entrance into the rack or frame.

P. Each cable shall be clearly labeled on the cable jacket behind the termination device at a location that can be viewed without removing the bundle support ties. Cables labeled within the bundle, where the label is obscured from view shall not be acceptable.

3.02 IDENTIFICATION

A. Refer to Section 27 05 53 - Identification for Communications Systems for labeling details.

END OF SECTION

SECTION 27 15 23
COMMUNICATIONS OPTICAL FIBER HORIZONTAL CABLING

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. Applicable requirements of Division 27 - Communications shall be considered a part of this section and shall have the same force as if printed herein full.

B. This document describes the products and execution requirements relating to Communications Optical Fiber Horizontal Cabling.

C. Product specifications, general design considerations, and installation guidelines are provided in this document. The successful vendor shall meet or exceed all requirements described in this document and on the drawings.

1.02 SUBMITTALS

A. Provide product data from manufacturer’s specifications.

1.03 WORK INCLUDED

A. The work included under this specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the specification or not.

B. The work shall include, but not be limited to the following:

1. Furnish and install all horizontal optical fiber cable.

PART 2 - PRODUCTS

2.01 APPROVED PRODUCTS

A. Approved Horizontal Optical Fiber Cable Manufacturer(s)

1. Berk-Tek
2. General Cable
3. OCC
4. Superior Essex
5. Corning
6. Or Approved Equal

2.02 HORIZONTAL OPTICAL FIBER CABLE

A. Plenum - Indoor Distribution 850nm Laser-Optimized 50/125 Multimode Optical Fiber Non-Conductive, Tight Buffered Cable (OM3)

1. Generic Characteristics

   a. The indoor optical fiber cable shall be available with up to twelve 900-micron tight-buffered 250-micron fibers placed in a color-coded sub-unit bundle with aramid strength elements.
   b. The indoor optical fiber cable shall meet or exceed the performance criteria found in ANSI/TIA-568-C.3.
   c. The indoor optical fiber cable shall have sequential length marking printed on the cable jacket.
   d. Maximum attenuation dB/Km @ 850/1300 nm: 3.5/1.5
   e. Minimum overfilled modal bandwidth: 1500 MHz-km @ 850 nm.
   f. Minimum overfilled modal bandwidth: 500 MHz-km @ 1300 nm.
   g. Minimum effective modal bandwidth: 2000 MHz-km @ 850nm
   h. Cable jacket shall be CMR or CMP rated (according to the space it occupies).

PART 3 - EXECUTION

3.01 HORIZONTAL CABLES

A. Cable shall be installed in accordance with manufacturer's recommendations and best industry practices.

B. A plastic or nylon pull cord with a minimum test rating of 90 Kg (200 lb.) shall be co-installed with all cable installed in any conduit.

C. Cable raceways shall not be filled greater than the ANSI/TIA-569-B maximum fill for the particular raceway type.

D. Cables shall be installed in continuous lengths from origin to destination (no splices) except for transition points, or consolidation points.

E. Riser rated cable shall be installed in metallic conduit when installed in a plenum space.

F. Where transition points or consolidation points are allowed, they shall be located in accessible locations and housed in an enclosure intended and suitable for the purpose.

G. The cable's minimum bend radius and maximum pulling tension shall not be exceeded. Refer to manufacturer's requirements.

H. If a J-hook or trapeze system is used to support cable bundles all horizontal cables shall be supported at a maximum of 48 to 60 inch (1.2 to 1.5 meter) intervals. At no point shall cable(s) rest on acoustic ceiling grids or panels.

I. Horizontal distribution cables shall be bundled in groups of no more than 50 cables. Cable bundle quantities in excess of 50 cables may cause deformation of the bottom cables within the bundle and degrade cable performance.

J. Cable shall be installed above fire-sprinkler systems and shall not be attached to the system or any ancillary equipment or hardware. The cable system and support hardware shall be installed so that it does not obscure any valves, fire alarm conduit, boxes, or other control devices.

K. Cables shall not be attached to ceiling grid or lighting fixture wires. Where support for horizontal cable is required, the Contractor shall install appropriate carriers to support the cabling.

L. Any cable damaged or exceeding recommended installation parameters during installation shall be replaced by the Contractor prior to final acceptance at no cost to the Owner.

M. Cables shall be dressed and terminated in accordance with the recommendations made in ANSI/TIA-568-C.0 and/or ANSI/TIA-568-C-1, manufacturer's recommendations and best industry practices.

N. Leave a minimum of 36" of slack for optical fiber at the outlet. Cables shall be coiled in the in-wall box, surface-mount box or modular furniture raceway if adequate space is present to house the cable coil without exceeding the manufacturers bend radius. Excess slack shall be loosely coiled and stored in the ceiling above each drop location where there is not enough space present in the outlet box to store slack cable.

O. Cables shall be neatly bundled and dressed to their respective termination device. Each terminating device shall be fed by an individual bundle separated and dressed back to the point of cable entrance into the rack or frame.

P. Each cable shall be clearly labeled on the cable jacket behind the termination device at a location that can be viewed without removing the bundle support ties. Cables labeled within the bundle, where the label is obscured from view shall not be acceptable.

3.02 IDENTIFICATION

A. Refer to Section 27 05 53 - Identification for Communications Systems for labeling details.

END OF SECTION

SECTION 27 15 33
COMMUNICATIONS COAXIAL HORIZONTAL CABLING

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. Applicable requirements of Division 27 - Communications shall be considered a part of this section and shall have the same force as if printed herein full.

B. This document describes the products and execution requirements relating to Communications Coaxial Horizontal Cabling.

C. Product specifications, general design considerations, and installation guidelines are provided in this document. The successful vendor shall meet or exceed all requirements described in this document and on the drawings.

1.02 SUBMITTALS

A. Provide product data from manufacturer’s specifications.

1.03 WORK INCLUDED

A. The work included under this specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the Specification or not.

B. The work shall include, but not be limited to the following:

1. Furnish and install all horizontal coaxial cable.

PART 2 - PRODUCTS

2.01 APPROVED PRODUCTS

A. Approved Horizontal Coaxial Cable Manufacturer(s)

1. General Cable
2. CommScope
3. Belden
4. Or Approved Equal

2.02 HORIZONTAL COAXIAL CABLE

A. Series 6 Coax

1. Series-6 coaxial cable shall be used for horizontal runs less than 150'.

2. Series-6 coaxial cable shall be 75-Ohm impedance with a nominal attenuation value of less than 29dB/100m at 1 GHz for CMP rated jacket and less than 22dB/100M at 1 GHz for CMR rated jacket.
3. Cable construction shall be 18 AWG solid-copper or copper-clad steel center-conductor and foam FEP dielectric. Cables shall be provided with 60% / 40% quad shields with braid constructed of aluminum or tinned copper wire.
4. Cable jacket shall be CMR or CMP rated (according to the space it occupies).

B. Series 11 Coax

1. Series-11 coaxial cable shall be used for horizontal runs that exceed 150'.
2. Series-11 coaxial cable shall be 75-Ohm impedance with a nominal attenuation value of less than 21dB/100m at 1 GHz for CMP rated jacket and less than 15dB/100M at 1 GHz for CM rated jacket.
3. Cable construction shall be 14 AWG solid-copper or copper-clad steel center-conductor and foam FEP dielectric. Cables shall be provided with 60%/40% quad shields with braid constructed of aluminum or tinned copper wire.
4. Cable jacket shall be CMR or CMP rated (according to the space it occupies).

PART 3 - EXECUTION

3.01 HORIZONTAL CABLES

A. Cable shall be installed in accordance with manufacturer's recommendations and best industry practices.

B. A plastic or nylon pull cord with a minimum test rating of 90 Kg (200 lb.) shall be co-installed with all cable installed in any conduit.

C. Cable raceways shall not be filled greater than the ANSI/TIA-569-B maximum fill for the particular raceway type.

D. Cables shall be installed in continuous lengths from origin to destination (no splices) except for transition points, or consolidation points.

E. Riser rated cable shall be installed in metallic conduit when installed in a plenum space.

F. Where transition points or consolidation points are allowed, they shall be located in accessible locations and housed in an enclosure intended and suitable for the purpose.

G. The cable's minimum bend radius and maximum pulling tension shall not be exceeded. Refer to manufacturer's requirements.

H. If a J-hook or trapeze system is used to support cable bundles all horizontal cables shall be supported at a maximum of 48 to 60 inch (1.2 to 1.5 meter) intervals. At no point shall cable(s) rest on acoustic ceiling grids or panels.

I. Horizontal distribution cables shall be bundled in groups of no more than 50 cables. Cable bundle quantities in excess of 50 cables may cause deformation of the bottom cables within the bundle and degrade cable performance.

J. Cable shall be installed above fire-sprinkler systems and shall not be attached to the system or any ancillary equipment or hardware. The cable system and support hardware shall be installed so that it does not obscure any valves, fire alarm conduit, boxes, or other control devices.

K. Cables shall not be attached to ceiling grid or lighting fixture wires. Where support for horizontal cable is required, the Contractor shall install appropriate carriers to support the cabling.

L. Any cable damaged or exceeding recommended installation parameters during installation shall be replaced by the Contractor prior to final acceptance at no cost to the Owner.

M. Cables shall be dressed and terminated in accordance with the recommendations made in ANSI/TIA-568-C.0 and/or ANSI/TIA-568-C.1, manufacturer's recommendations and best industry practices.

N. Leave a minimum of 12" of slack for coax cables at the outlet. Cables shall be coiled in the in-wall box, surface-mount box or modular furniture raceway if adequate space is present to house the cable coil without exceeding the manufacturers bend radius. In hollow-wall installations where box-eliminators are used, excess wire can be stored in the wall. Excess slack shall be loosely coiled and stored in the ceiling above each drop location when there is not enough space present in the outlet box to store slack cable.

O. Cables shall be neatly bundled and dressed to their respective termination device. Each terminating device shall be fed by an individual bundle separated and dressed back to the point of cable entrance into the rack or frame.

P. Each cable shall be clearly labeled on the cable jacket behind the termination device at a location that can be viewed without removing the bundle support ties. Cables labeled within the bundle, where the label is obscured from view shall not be acceptable.

3.02 IDENTIFICATION

A. Refer to Section 27 05 53 - Identification for Communications Systems for labeling details.

END OF SECTION

SECTION 27 15 43
COMMUNICATIONS FACEPLATES AND CONNECTORS

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. Applicable requirements of Division 27 - Communications shall be considered a part of this section and shall have the same force as if printed herein full.

B. This document describes the products and execution requirements relating to Communications Faceplates and Connectors.

C. Product specifications, general design considerations, and installation guidelines are provided in this document. The successful vendor shall meet or exceed all requirements described in this document and on the drawings.

1.02 SUBMITTALS

A. Provide product data from manufacturer’s specifications.

1.03 WORK INCLUDED

A. The work included under this Specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the Specification or not.

B. The work shall include, but not be limited to the following:

1. Furnish and install all copper connectivity.
2. Furnish and install all optical fiber connectivity.
3. Furnish and install all coaxial connectivity.
4. Furnish and install all faceplates.
5. Furnish and install all surface mount boxes.

PART 2 - PRODUCTS

2.01 APPROVED PRODUCTS

A. Approved Copper Connectivity Manufacturer(s)

1. Leviton
2. OCC
3. Panduit
4. CommScope
5. Or Approved Equal

B. Approved Optical Fiber Connectivity Manufacturer(s)

1. Leviton
2. OCC
3. Panduit
4. CommScope
5. Corning
6. Or Approved Equal

C. Approved Coaxial Connectivity Manufacturer(s)

1. Cable Connectors

a. Leviton
b. OCC
c. Panduit
d. CommScope
e. Or Approved Equal

2. F-Connectors

a. Leviton
b. OCC
c. Panduit
d. CommScope
e. Or Approved Equal

D. Approved Faceplate Manufacturer(s)

1. Leviton
2. OCC
3. Panduit
4. CommScope
5. Or Approved Equal

E. Approved Surface Mount Box manufacturer(s)

1. Leviton
2. OCC
3. Panduit
4. CommScope
5. Or Approved Equal

2.02 COPPER CONNECTIVITY

A. Voice/Data Jacks

1. Category 6/6A, 8-Position, 8-Contact (8P8C) Modular Jack

a. The connector module shall meet or exceed the Category 6/6A performance criteria per ANSI/TIA-568-C.2.
b. The eight-position connector module shall accommodate six-position modular plug modular cords without damage to either the cord or the module.
c. The connector module shall be designed for use at the work area (WA), communications room (TR) and/or equipment room (ER) without modification.
d. The connector module shall be available in both the T568A and T568B wiring configurations within the same module.

e. The connector module shall have an insulation displacement connection featuring insulation slicing of 22 to 24 AWG plastic-insulated solid copper conductors forming a gas-tight connection.
f. Icons shall be used if offered from the manufacturer.
g. Jack/Icon colors shall be:

1) Gray for voice
2) Blue for data

2.03 FIBER CONNECTIVITY

A. Laser Optimized Multimode Fiber Connectivity OM3

1. The optical fiber field-installable connector shall be LC, for installation onto multimode a laser optimized 50/125-micron fiber.
2. The optical fiber field-installable connector shall be compatible with 900-micron buffered fibers.
3. The optical fiber field-installable connector shall meet or exceed the performance criteria found in ANSI/TIA-568-C.3.
4. The optical fiber field-installable connector shall have a maximum Loss of 0 .5 dB.
5. The optical fiber adapter module that occupies the faceplate shall be equipped with zirconia sleeve.
6. Laser optimized connector color shall be aqua.

2.04 COAXIAL CONNECTIVITY

A. Connectors shall be solderless, 75-Ohm impedance and be designed for the specific type of cable used.

B. Series-6 connectors shall be one piece. Series-11 connectors shall use the cable's center conductor as the connector's center pin.

C. All Series-6 and Series-11 connections shall be made with compression-type connectors.

D. Screw-on connectors are not acceptable.

E. The coaxial adapter module that occupies the faceplate shall be a 75-ohm, F-type connector.

2.05 FACEPLATES

A. Faceplates

1. The faceplate housing the connector modules shall have no visible mounting screws.
2. Faceplates shall be midsize.
3. It shall be possible to install the connector modules in wall-mounted single- and dual-gang electrical boxes, utility poles and modular furniture (cubicle) access points using manufacturer-supplied faceplates and/or adapters.
4. The faceplate housing the connector modules shall have the option of being mounted on adapter boxes for surface mount installation.
5. The faceplate housing the connector modules shall have a labeling capability using built-in labeling windows, to facilitate outlet identification and ease network management.

6. The faceplate housing the connector modules shall provide flexibility in configuring multimedia workstation outlets that respond to present or future network needs such as audio, video, coaxial and optical fiber applications.
7. Color shall be same as electrical faceplates. Coordinate with Architect.

2.06 SURFACE MOUNT BOXES

A. The surface mount box shall accommodate connections of any type, UTP, optical fiber or coax.

B. The surface mount box shall have internal storage space for slack cabling and a built-in spool for controlling cable bend radius.

C. Color shall be same as electrical faceplates. Coordinate with Architect.

PART 3 - EXECUTION

3.01 COPPER CONNECTIVITY

A. 8-position, 8-contact (8P8C) modular jacks shall be installed in accordance with manufacturer's recommendations and installation guides, and best industry practices.

B. Pair untwist at the termination shall not exceed 13 mm (0.5 inch).

C. Data jacks, unless otherwise noted in Drawings or fiber adapter modules are present, shall be located in the bottom position(s) of each faceplate. Data jacks in horizontally oriented faceplates shall occupy the right-most position(s).

D. Voice jacks, unless otherwise noted in Drawings, shall occupy the top position(s) on the faceplate. Voice jacks in horizontally oriented faceplates shall occupy the left-most position(s).

3.02 OPTICAL FIBER CONNECTIVITY

A. Optical fiber connectors shall be installed in accordance with manufacturer's recommendations and installation guides, and best industry practices.

B. Fiber adapter modules, unless otherwise noted in Drawings, shall be located in the bottom position(s) of each faceplate. Fiber adapter modules in horizontally oriented faceplates shall occupy the right-most position(s).

3.03 COAXIAL CONNECTIVITY

A. F-connectors shall be installed in accordance with manufacturer's recommendations and installation guides, and best industry practices.

B. Cable preparation and connector application shall be done only with tools approved for use with the connector.

3.04 FACEPLATES

A. Blank inserts shall be installed where ports are not used.

B. The same orientation and positioning of jacks and connectors shall be utilized throughout the installation.

C. Faceplates shall be installed straight and level.

D. Faceplates shall be installed at heights as noted on the Drawings and same as electrical faceplates. Coordinate with electrical and Architect.

3.05 SURFACE MOUNT BOXES

A. Blank inserts shall be installed where ports are not used.

B. The same orientation and positioning of jacks and connectors shall be utilized throughout the installation.

C. Surface mount boxes shall be installed straight and level.

D. Surface mount shall be installed at heights as noted on the Drawings.

3.06 IDENTIFICATION

A. Refer to Section 27 05 53 - Identification for Communications Systems for labeling details.

END OF SECTION

SECTION 27 16 19
COMMUNICATIONS PATCH CORDS AND STATION CORDS

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. Applicable requirements of Division 27 - Communications shall be considered a part of this section and shall have the same force as if printed herein full.

B. This document describes the products and execution requirements relating to Voice and Data Cross-Connect/Patching Equipment.

C. Product specifications, general design considerations, and installation guidelines are provided in this document. The successful vendor shall meet or exceed all requirements described in this document and on the drawings.

1.02 SUBMITTALS

A. Provide product data from manufacturer’s specifications.

1.03 WORK INCLUDED

A. The work included under this specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the Specification or not.

B. The work hall include, but not be limited to the following:

1. Furnish and install all copper patch cords/station cords.
2. Furnish and install fiber patch cords/station cords.

PART 2 - PRODUCTS

2.01 APPROVED PRODUCTS

A. Approved Copper Patch Cord/Station Cord Manufacturer(s)

1. General Cable
2. OCC
3. Superior Essex
4. Or Approved Equal

B. Approved Fiber Patch Cord/Station Cord Manufacturer(s)

1. Berk-Tek
2. General Cable
3. OCC

4. Superior Essex
5. Corning
6. Or Approved Equal

2.02 COPPER PATCH CORDS/STATION CORDS

A. Category 6/6A Patch Cords/Station Cords

1. The Category 6/6A patch cord/station cord shall be 4-pair, with 24 AWG solid or stranded copper conductors and 8-position modular plug.
2. The Category 6/6A modular cord cable shall be UL Listed as Type CMR.
3. The Category 6/6A patch cord/station cord shall meet or exceed the requirements of ANSI/TIA-568-C.2.

a. The Category 6/6A patch cord/station cord color for voice shall be: Gray
b. The Category 6/6A patch cord/station cord color for data shall be: Blue

2.03 FIBER PATCH CORDS / STATION CORDS

A. Multimode Fiber Patch Cords/Station Cords

1. 50/125-Micron 850nm Laser Optimized Multimode Fiber Patch Cord/Station Cord (OM3)

a. The 50/125-micron fiber used in the multimode fiber patch cord/station cord shall have a maximum attenuation of 3.5dB/km@ 850 nm and 1.5 dB/km @1300 nm.
b. The 50/125-micron 850nm laser optimized multimode fiber patch cord/station cord shall meet or exceed the requirements of ANSI/TIA-568-C.3.
c. The optical fiber cord connector shall be LC.
d. The multimode fiber patch cord assembly shall be dual zip jacketed.

B. Singlemode Fiber Patch Cords

1. 8.3/125-micron singlemode fiber patch cord:

a. The 8.3/125-micron fiber used in the singlemode fiber patch cord shall have a maximum attenuation of 1.0 dB/km @ 1310 nm and 1.0 dB/km @ 1550 nm.
b. The optical fiber cord connector shall have a maximum insertion loss of 0.5 dB and a reflectance of -30 dB.
c. The 8.3/125-micron singlemode fiber patch cord/station cord shall meet or exceed the requirements of ANSI/TIA-568-C.3.
d. The optical fiber cord connector shall be LC.
e. The singlemode fiber patch cord assembly shall be dual zip jacketed.
f. Angle polish connectors shall be used for video distribution.

PART 3 - EXECUTION

3.01 COPPER PATCH CORDS/STATION CORDS

A. Copper patch cords/station cords shall be installed as per the requirements specified by the manufacturer’s installation guidelines.

3.02 FIBER PATCH CORDS/STATION CORDS

A. Fiber patch cords/station cords shall be installed as per the requirements specified by the manufacturer's installation guidelines.

3.03 IDENTIFICATION

A. Refer to Section 27 05 53 - Identification for Communications Systems for labeling details.

END OF SECTION

SECTION 27 21 33
WIRELESS ACCESS POINTS

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. Applicable requirements of Division 27 - Communications shall be considered a part of this section and shall have the same force as if printed herein full.

B. This document describes the products and execution requirements relating to Wireless Access Points requirements.

C. Product specifications, general design considerations, and installation guidelines are provided in this document. The successful vendor shall meet or exceed all requirements described in this document and on the drawings.

D. All equipment supplied shall be listed for the purpose for which it is used and installed in accordance with any instructions included in its listing.

E. All cabling for Wireless Access Points shall be Category 6A. All cabling routed in exposed areas shall be in conduit.

F. See Section 27 15 13, “Communications Copper Horizontal Cabling,” for further detailed requirements for cabling materials and installations.

1.02 SUBMITTALS

A. Provide product data from manufacturers’ specifications.

B. See Section 27 00 00 “Communications” for additional requirements.

1.03 WORK INCLUDED

A. The work included under this specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the Specification or not.

B. The work shall include, but not be limited to the following:

1. Furnish and install all wireless access points.
2. Furnish and install all PoE switches.

1.04 PERFORMANCE REQUIREMENTS

A. Wireless Access Points (Indoor and Outdoor)

1. IEEE 802.11ac Multi-user MIMO compliant.
2. Dual-band 2.4/5GHz support
3. 80MHz channelization
4. 256-QAM modulation support

5. 1733 Mbps PHY rates at 5GHz
6. Backward compatibility with legacy 802.11 clients
7. IEEE 802.3af/at Power over Ethernet compatibility
8. IEEE 802.11ac Tx beamforming capability
9. Integrated NAT and DHCP support
10. Wall or ceiling mountable
11. WPA-PSK (AES) IEEE 802.1X RADIUS and AD capability

B. PoE Switches

1. IEEE 802.3af Power over Ethernet compliant
2. 2.68Mbps throughput
3. 3.6Gbps switching capacity
4. Broadcast storm control capability
5. 20MB RAM minimum
6. Auto MDI/MDI-X capability
7. 95W minimum PoE budget
8. 19” rack-mountable
9. UL listed
10. RoHS compliant

1.05 ACCEPTABLE MANUFACTURERS

A. Wireless Access Points

1. Ruckus Wireless – ZoneFlex Series
2. Cisco Meraki – MR Series
3. Ubiquiti Networks – UniFi Series
4. Or Approved Equal

B. PoE Switches

1. Cisco
2. Allied Telesis
3. HP – ProCurve Series
4. Or Approved Equal

1.06 RECORD DRAWINGS

A. Provide a complete set of Wireless Access Point manufacturer’s product data and shop drawings incorporating all addenda and field changes.

B. Provide operating and maintenance manuals.

PART 2 - PRODUCTS

2.01 PRODUCT/MATERIAL DESCRIPTION

A. Wireless Access Points shall be IEEE 802.11ac compliant, capable of dual-band operation at 2.4 and 5GHz. Each Wireless Access Point location shall be cabled with two (2) Category 6A cables for full IEEE 802.11ac performance.

B. Wireless Access Points shall have the following basic features and capabilities:

1. 80MHz channelization
2. 256-QAM modulation support
3. 1733 Mbps PHY rates at 5GHz
4. Backward compatibility with legacy 802.11 clients
5. IEEE 802.3af/at Power over Ethernet compatibility
6. IEEE 802.11ac Tx beamforming capability
7. Integrated NAT and DHCP support
8. Wall or ceiling mountable
9. WPA-PSK (AES) IEEE 802.1X RADIUS and AD capability

C. Power for Wireless Access Points shall be via Power over Ethernet (PoE) compliant with the IEEE 802.3af standard.

D. PoE Switches shall have IEEE 802.3af compliance, and be compatible with Category 6A cabling.

E. PoE Switches shall have the following basic features and capabilities:

1. 2.68Mbps throughput
2. 3.6Gbps switching capacity
3. Broadcast storm control capability
4. 20MB RAM minimum
5. Auto MDI/MDI-X capability
6. 95W minimum PoE budget
7. 19” rack-mountable
8. UL listed
9. RoHS compliant
10. Telnet remote login capability
11. Non-blocking architecture
12. SNMP v1 and v2 compatibility
13. Wirespeed performance
14. Rapid Spanning-Tree capability
15. WPA-PSK (AES) IEEE 802.1X RADIUS capability
16. VLAN tagging
17. Port mirroring
18. Link aggregation – LACP capability
19. SNTP capability
20. GVRP capability

PART 3 - EXECUTION

3.01 WIRELESS ACCESS POINTS

A. Wireless access points and supporting equipment shall be installed as per the requirements specified by the manufacturers’ installation guidelines and best industry practice.

B. Provide all necessary interconnections, services, and adjustments required for a complete and operable system.

C. Install control signal, communications, and data transmission line grounding as necessary to preclude ground loops, noise, and surges from adversely affecting system operation.

3.02 FIELD QUALITY CONTROL

A. Testing

1. All devices shall be tested for full operational compliance.
2. Testing of system shall be the sole responsibility of the Contractor.

3.03 LABELING

A. Label all cables at each end of each cable. Labels shall be machine generated, wrap-around type.

B. Labeling system shall designate the cable's origin and destination on each end of each distribution/horizontal cable.

3.04 LABELING

A. All outdoor Wireless Access Point cabling shall have surge protection devices installed at each end that complies with manufacturer recommendations.

3.05 WARRANTY

A. All equipment, components, etc., shall be guaranteed free of defects and any faulty workmanship for a period of one year after final acceptance.

B. The Contractor shall replace defective materials and repair faulty workmanship within 24 hours of discovery at no cost to the Owner.

END OF SECTION

SECTION 27 41 13
MULTI-ZONE AUDIO

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. Applicable requirements of Division 27 - Communications shall be considered a part of this section and shall have the same force as if printed herein full.

B. This document describes the products and execution requirements relating to Multi-Zone Audio requirements.

C. Product specifications, general design considerations, and installation guidelines are provided in this document. The successful vendor shall meet or exceed all requirements described in this document and on the drawings.

D. Coordinate with Architectural reflected-ceiling plans to confirm all ceiling types and to ensure proper mounting brackets are utilized (i.e. ceiling-mounted, pendant-mounted, beam-mounted, etc.)

E. Digital signage/displays are not included within the JSE Low Voltage scope of work. Coordinate provision of proprietary hardware and software for these systems with the Owner's contracted vendor. JSE's Low Voltage scope include provision of Category 6 data connectivity only for these devices/locations.

1.02 SUBMITTALS

A. Provide product data from manufacturers' specifications.

1.03 WORK INCLUDED

A. The work included under this specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the Specification or not.

B. Provide all required head end equipment (amplifiers, digital signal processors, zone controllers, local volume controls, audio sources, etc.) required for a fully functional system. Coordinate audio source preferences and requirements with the Owner prior to procurement and installation.

C. The work shall include, but not be limited to the following:

1. Furnish and install all controllers.
2. Furnish and install all audio sources (sources shall allow multiple options for sources/channels including but not limited to AM/FM, XM/satellite radio, Pandora/Spotify/streaming services, CD/MP3/media players, auxiliary/iPad/phone connection, etc.).
3. Furnish and install all rack mount kits.
4. Furnish and install all power supplies.
5. Furnish and install all hubs/repeaters.
6. Furnish and install all touchpanels/keypads.

7. Furnish and install all IR emitters.
8. Furnish and install all CD/MP3 players.
9. Furnish and install all zone processors.
10. Furnish and install all power amplifiers.
11. Furnish and install all audio baluns.
12. Furnish and install all power conditioners.
13. Furnish and install all speakers.
14. Furnish and install all cables.
15. Furnish and install all racks.

PART 2 PRODUCTS

2.01 APPROVED PRODUCTS

A. Approved Controller Manufacturer(s)

1. Crestron
2. Extron
3. AMX

B. Approved Audio Source Manufacturer(s)

1. Confirm preferences and requirements with Owner prior to installation:

a. MOOD Media
b. Crestron
c. Extron
d. AMX
e. Or Approved Equal

C. Approved Rack Mount Kit Manufacturer(s)

1. Crestron
2. Extron
3. AMX

D. Approved Power Supply Manufacturer(s)

1. Crestron
2. Extron
3. AMX

E. Approved Hub/Repeater Manufacturer(s)

1. Crestron
2. Extron
3. AMX

F. Approved Touchpanel/Keypad Manufacturer(s)

1. Crestron
2. Extron
3. AMX

G. Approved IR Emitter Manufacturer

1. Crestron
2. Extron
3. AMX

H. Approved Zone Processor Manufacturer(s)

1. Crestron
2. Extron
3. AMX

I. Approved Power Amplifier Manufacturer(s)

1. QSC

J. Approved Audio Balun Manufacturer(s)

1. Crestron
2. Extron
3. AMX

K. Approved Power Conditioner Manufacturer(s)

1. Furman

L. Approved Speaker and Subwoofer Manufacturer(s)

1. Ceiling-Mounted Speakers

    a. JBL – Control Contractor Series
    b. Crestron
    c. Extron
    d. AMX

2. Wall-Mounted Speakers

    a. JBL – Control Contractor Series
    b. Crestron
    c. Extron
    d. AMX

3. Pendant-Mounted Speakers

    a. JBL – Control Contractor Series
    b. Crestron
    c. Extron
    d. AMX

4. Beam-Mounted Speakers

    a. JBL – Control Contractor Series
    b. Crestron
    c. Extron
    d. AMX

5. Hidden/In-Wall Subwoofer

a. Sonance – Invisible Series

6. Wall-Mounted or In-Millwork Subwoofer

a. JBL – Professional Series
b. Sonance – Professional Series

M. Approved Projector Manufacturer(s)

1. Epson
2. Samsung
3. Sony

N. Approved Projector Ceiling Mount Manufacturer(s)

1. Chief

O. Approved Speaker Cable Manufacturer(s)

1. Belden

P. Approved Control Cable Manufacturer(s)

1. Crestron
2. Extron
3. AMX

Q. Approved Mic/Line Cable Manufacturer(s)

1. Belden

R. Approved Rack Manufacturer(s)

1. Chatsworth Products, Inc.
2. Middle Atlantic
3. Panduit

PART 3 EXECUTION

3.01 MULTI-ZONE AUDIO SYSTEM

A. The multi-zone audio system shall be installed by a certified contractor as per the requirements specified by the manufacturers' installation guidelines and best industry practice.

B. Provide all necessary head end equipment, audio sources, controls, interconnections, services, and adjustments required for a complete and operable system.

C. Install control signal, communications, and data transmission line grounding as necessary to preclude ground loops, noise, and surges from adversely affecting system operation.

3.02 FIELD QUALITY CONTROL

A. Testing

1. All devices shall be tested for full operational compliance.
2. Testing of system shall be the sole responsibility of the Contractor.

3.03 LABELING

A. Label all cables at each end of each cable. Labels shall be machine generated, wrap-around type.

B. Labeling system shall designate the cable's origin and destination on each end of each distribution/horizontal cable.

3.04 WARRANTY

A. All equipment, components, etc., shall be guaranteed free of defects and any faulty workmanship for a period of one year after final acceptance.

B. The Contractor shall replace defective materials and repair faulty workmanship within 24 hours of discovery at no cost to the Owner.

END OF SECTION

SECTION 27 70 10
SURGE PROTECTIVE DEVICES

PART 1 GENERAL

1.01 SUMMARY

A. These specifications describe the electrical and mechanical requirements for a hybrid, high energy, suppression filter system that integrates Surge Protective Devices (SPDs) with high frequency electrical line noise filtering for high exposure applications.

B. The specified unit(s) shall provide effective high energy transient voltage suppression, surge current diversion, and noise attenuation for all electrical modes of equipment connected downstream from a facility's meter or main over current device in high exposure ANSI/IEEE C62.41category C, B or A environments.

C. The unit shall be designed and manufactured by a qualified manufacturer of surge suppression equipment. The qualified manufacturer shall have been engaged in the commercial design and manufacture of such products for a minimum of ten (10) years. These specifications are based on DITEK Surge Protective Devices (SPDs). For consideration, other manufacturers shall provide detailed compliance or exception statements to all provisions of this specification fifteen (15) days prior to bid.

1.02 STANDARDS

A. The specified unit shall be designed, manufactured, tested and installed in compliance with the following standards:

1. ANSI/IEEE C62.33 Standard Test Specifications for Varistor Protection Devices
2. ANSI/IEEE C62.35 Standard Test Specifications for Avalanche Semiconductor Protection Devices
3. ANSI/IEEE C62.41.1 IEEE Guide on the Surge Environment in Low-Voltage (1000V and Less) AC Power Circuits
4. ANSI/IEEE C62.42.2 IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits
5. ANSI/IEEE C62.45 IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and Less) AC Power Circuits
6. UL -1283 Standard for Safety - Electromagnetic Interference Filters
7. UL -1449, Standard for Safety - Surge Protective Devices
8. NFPA 70 National Electrical Code
9. NFPA 75 Standard for the Protection of Electronic Computer Systems
10. NFPA 780 Standard for the Installation of Lightning Protection Systems
11. Military Standard (Mil Std) 220A Federal Information Processing Standards Publication 94 (FIPS PUB 94)CCITT
12. National Electrical Manufacturers Association;(NEMA LS1-1992 Guidelines) Low Voltage Surge Protective Devices

1.03 ENVIRONMENTAL REQUIREMENTS

A. Storage Temperature

1. Storage temperature range shall be -40° to +85° C (-40° to +185° F).
2. Internally mounted devices may be 0° to 40° C (32° to +104° F).

B. Operating Temperature

1. Operating temperature range shall be -40° to +60° C (-40° to +140° F).
2. Internally mounted devices may be 0° to 40° C (32° to +104° F).

C. Relative Humidity

1. Unit shall be operable within 0% to 95% non-condensing relative humidity.

D. Operating Altitude

1. The unit shall be capable of operation in altitudes up to 12,000 feet (3,658 meters) above sea level.

E. Audible Noise

1. The unit shall not generate any audible noise.

F. Magnetic Fields

1. 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.

1.04 SYSTEM DESCRIPTION

A. Surge Protective Devices (SPDs) are the equipment required for the suppression, within specified limits, of AC electrical circuits and electronic equipment from the effects of lightning induced voltages, external switching transients and internally generated switching transients. Individual suppressors shall be installed as indicated on drawings.

1.05 OPERATING VOLTAGE

A. The nominal operating voltage and configuration shall be as indicated on the drawings.

1.06 SUBMITTALS

A. Submit installation details for all suppressors demonstrating mechanical and electrical connections to equipment being protected.

B. Submittals shall include, but are not limited to, the following data:

1. Complete data for each suppressor type indicating conductor sizes, circuit type, operating voltage, and all appropriate dimensions.
2. Dimensions for each suppressor type indicating mounting dimensions and required accessory hardware.
3. Drawings shall be provided indicating suppressor mounting, lead configuration and mounting of remote diagnostic equipment and assemblies (where applicable).
4. List and detail all protection systems such as fuses, disconnecting and protective materials.

5. Listing to UL 1449, including voltage protection rating, nominal discharge current and short circuit current rating for each SPD specified.
6. Conformance to appropriate referenced standards and publications listed in section 1.02.
7. The submittal shall include a listed comparison and proof of compliance with each paragraph of these specifications.

C. Submitted suppressors shall have specifications equal to or better than the characteristics specified herein.

1.07 QUALITY ASSURANCE

A. Surge suppression, along with proper grounding and bonding, shall effectively protect within tested limits. This is protection against lightning transients, internal and external switching transients, and other surge transients throughout the useful life of the system.

B. Any SPD which shows evidence of defects in materials or workmanship during the warranty period shall be replaced or repaired at the Manufacturer's discretion.

C. Installation of an SPD in or on electrical or electronic systems shall in no way compromise or violate equipment listing, function or warranty of the distribution equipment.

D. All SPDs shall be guaranteed by the installing contractor to be free of defects in material and workmanship for a period of ten (10) years from the date of manufacture.

1.08 QUALIFICATIONS

A. Manufacturer: Company specializing in surge suppression equipment of the type herein specified with a minimum of ten (10) years documented experience.

B. Installer: Installation shall be by a duly licensed and trained electrical contractor.

1.09 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on shop drawings.

1.10 COORDINATION

A. Coordinate work with electrical installations.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. The intent of this specification is to allow manufacturers with similar equipment utilizing metal oxide varistor (MOV) technology to provide transient voltage surge suppression within the guidelines set forth herein.

B. The SPD manufacturer shall offer factory service and replacement for all units, within warranty guidelines. The manufacturer shall provide this service within a reasonable time frame.

C. Single source of supply. All AC power SPD's shall be manufactured by a single manufacturer.

1. Acceptable manufacturer:

a. DITEK Corp

2. The following products are recommended for main distribution panel applications:

a. D200 Series

3. The following products are recommended for distribution or sub-panels:

a. D200 Series
b. D100 Series
c. D50 Series

4. All electronics, voice/data, video surveillance, access control, or fire system suppressors shall be manufactured by a single manufacturer. Acceptable manufacturer: DITEK Corp., models as further identified herein for each individual system specification. Manufacturers listed herein have demonstrated that they can provide equipment that meets or exceeds all requirements, however other manufacturers demonstrating compliance of specifications contained herein will also be considered.

2.02 COMPONENTS

A. Main service and distribution equipment suppressors: AC voltage SPDs shall be high speed, high current devices designed to protect electrical systems and electronic equipment from transient over-voltage events. SPDs shall provide continuous protection, and automatically reset. The SPD shall utilize Thermally Protected Metal Oxide Varistor TP-MOV™ technology. The SPD shall be installed in parallel with the service main disconnect, distribution or branch panel main lugs as applicable. SPDs shall be connected to overcurrent protection sized as indicated in installation instructions, with an AIC rating equal to or greater than panel rating. The suppressor shall have status indicator light(s). Dry contacts with remote alarm capabilities, audible alarm, and a surge counter are optional equipment.

1. Electrical Service

a. Voltage shall be as indicated on drawings.
b. Frequency -- 50/60 Hz
c. Phases -- shall be as indicated on drawings.
d. Wiring configuration – shall be as indicated on drawings

2. IEEE 62.41 Location Categories unless otherwise indicated on drawings:

Location Category		Low	Medium	High
Service Entrance/Outbuilding/Meter	C	C1	C2	C3
Sub-Panel/ Distribution Panel	B	B1	B2	B3
Outlets/Long Branch Circuits	A	A1	A2	A3

3. Electrical Performance

a. Response time < 50 nanoseconds
b. MCOV 125% minimum.

4. Minimum Surge Current:

a. Service Entrance 00,000 Amps/Phase Minimum
b. Distribution and Sub-panels 50,000 Amps/Phase Minimum

5. Suppression system protected modes shall be L-N, L-G, N-G, and L-L for Wye Systems L-L, and L-G for Delta systems. Ungrounded Delta Systems shall be L-L.
6. Power on indicators and failure detection: Light Emitting Diodes (LEDs) on the cover shall provide indication that the suppressor is properly activated and shall also indicate mode failure. If the suppressor fails, an isolated contact shall close. In addition, an audible alarm may be provided with manual reset, for those so equipped.

B. Enclosures: Enclosures for main service suppressors shall be, at a minimum, NEMA 3R/12.

C. Operation Status Indicator: Audible Remote Signaling and Visual Systems

1. Visual System

a. Protection: Suppressor Functioning Normally – Green LED(s) on.
b. Warning/Fault: Suppressor Failure – Green LED(s) off.
c. Other visual indicators where approved.

2. Remote Signaling

a. For units that are so equipped, relay with Auxiliary for Form C (dry) relay contacts: Two sets @ 1 Ampere, 120 volts each. 1 set N.O. and 1 set N.C. to operate upon failure of suppression module, blown fuse or tripped circuit breaker in suppressor module, AC power loss, or in disconnect switch for alarm connection to remote location.

3. Audible

a. For units that are so equipped, the audible alarm shall activate upon a fault condition within the suppressor. An alarm silence/reset switch and push-to test switch shall be provided.

D. Communication Lines:

1. The following standard for separately mounted telephone and signal line suppressors shall apply. All protectors shall be securely mounted at protected equipment location. All suppressors shall provide common (L-G) mode protection on all lines. Suppressors shall be tested in accordance with IEEE C62.36 as a minimum. Protective interfacing with the telephone wire pairs shall be listed to UL 497A.

E. Network Data Protection:

1. Solid state, silicon avalanche diode components shall be the main protection technology utilized. Interfaces shall be RJ45, or 110 punch block connectors. The SPDs shall have a verified data transmission rate, without attenuation, of Category 6 speed minimum. The maximum clamp voltage of the SPD shall be no greater than 18 Volts on a 5 Volt circuit.

F. Power Over Ethernet (PoE) / Voice over Internet Protocol (VoIP) Protection:

1. Solid state, silicon avalanche diode components shall be the main protection technology utilized. RJ45 modular jacks shall be the connection method used. Connector pinouts shall conform to IEEE 802.3af for power distribution pairs and data transmission pairs. The maximum clamp voltage of the SPD on the power transmission pairs shall be no higher than 72 Volts. The maximum clamp voltage of the data transmission pairs shall be no higher than 72 Volts. The SPD shall have a verified data transmission rate, without attenuation, of Category 6 speed minimum.

G. Data Line Protection:

1. Solid state, silicon avalanche diode circuitry for protection from over voltages on long cable runs employing standard RS-232, RS422, or RS485. Appropriate connectors shall be utilized to interface a remote station with a host CPU.

H. Signal Line Protection:

1. Solid state, silicon avalanche diode, metal oxide varistor, and/or gas discharge tube technologies may be used. Hybrid circuitry for protection from over voltages on 2 or 4 wire signal lines such as balanced pair telephone, metallic pair telephone, buried and overhead field cable, remote radio equipment, and control systems. Unit shall be listed UL497B.

I. Modular, Twisted Pair Protection:

1. Solid state, silicon avalanche diode or metal oxide varistor circuitry for protection from over voltages on twisted pair data or audio lines. Protectors shall clip mount on 66 punch down blocks furnished with grounding bar or studs and shall be totally enclosed. Units shall be securely mounted at terminal locations where shown and shall be grounded to the main building ground with a minimum No.12 stranded copper green insulated ground conductor kept as short as possible. Ground terminals shall be screw insertion lug type. No crimp, fork or ring type permitted.

J. Coaxial Cable Protectors:

1. Solid state, silicon avalanche diode, metal oxide varistor and/or gas tube circuitry for non-interrupting over voltage protection of coaxial cable. Unit shall be provided with one female input connector and one female output connector. Securely mount adjacent to protection equipment and ground to equipment or local building ground.

2.03 SYSTEM EQUIPMENT SPECIFICATIONS

A. Telephone and Intercom Systems

1. Suppressors shall be installed on the AC power at the point of service and shall meet the following criteria:

a. UL 1449 Listed
b. UL 1449 V.P.R. of 500 Volts or lower
c. Diagnostic Indicator Light(s)
d. Integrated ground terminating post (where case/chassis ground exists)
e. Minimum Surge Current Capacity of 36,000 Amps (8 x 20 µSec)
f. Ten Year Limited Warranty
g. Acceptable Manufacturer:

1) DITEK CORP. (800-753-2345) – DTK- 3GTP, or approved equal.

2. Suppressors shall be installed on incoming central office lines and shall meet the following criteria:

a. UL 497A Listed
b. Multi Stage protection design
c. Auto-reset current protection with current limiting not to exceed 150mA per line
d. Minimum Surge Current of 1,000 Amps per pair (8 x 20 µSec) 5.Ten Year Limited Warranty
e. Acceptable Manufacturer:

1) DITEK CORP. (800-753-2345) – DTK-SL Series or approved equal.

3. Suppressors shall be installed on all telephone/intercom circuits that enter or leave separate buildings and shall meet the following criteria:

a. UL 497A Listed (where applicable)
b. UL 497B Listed (speakers or communication circuits)
c. Multi Stage protection design
d. Auto-reset over-current protection with current limiting not to exceed 150mA per line -UL 497A units
e. Over-current protection not to exceed 5 Amps per pair-UL497B units
f. Minimum Surge Current of 1000 Amps per pair (8 x 20 µSec)
g. Ten Year Limited Warranty
h. Acceptable Manufacturer:

1) DITEK CORP. (800-753-2345)

a) DTK-SL Series
b) DTK-2MHLP/2MHTP Series
c) DTK-LVLP Series, or approved equal.

B. Fire Alarm Systems – Engineering Documentation – Fire Alarm Surge Specification

1. Line Voltage Surge Protective Devices

a. Line voltage surge protective devices (SPDs) shall be provided to suppress all voltage transients which might damage fire alarm panel components. The surge protection device shall wire in series to the power supply of the protected equipment. Line voltage surge protection device shall be installed directly adjacent to FACP.

2. Nominal 120 Volt Surge Protective Device

a. SPDs for nominal 120 volt supply voltage shall be UL 1449 Third Edition listed or recognized with a minimum peak surge current of 54,000 amps. The SPD shall also meet IEEE C62.41 category B tests for surge capacity. The SPD shall feature multi- stage construction and be provided with dry contacts for monitoring and a long life indicator lamp for unit status of protected components.

3. Nominal 24 Volt Surge Protective Device

a. SPDs for nominal 24 volt circuits shall be UL 497B listed and with a minimum surge rating of 20,000 amps. The SPD shall feature multi-stage construction and be self-

resetting. Surge protective device shall be a base & plug style. The base assembly shall have screw terminals for fire alarm circuits. Base assembly shall accept a replaceable "plug in" surge protection module.

4. Alarm Dialer / Networking Surge Protective Device

   a. SPDs for alarm telephone dialer circuits shall be UL 497A listed. The SPD shall feature multi-stage construction and be self-resetting. Surge protective device shall be RJ connections or base & plug style. The base assembly shall have screw terminals for fire alarm dialer circuits. Base assembly shall accept a replaceable "plug in" surge protection module.

5. Acceptable Manufacturers

   a. All Surge Protective Devices (SPDs) shall be the standard product of a single manufacturer and be equal or better than one of the following:

      1) For 120 Volt nominal line voltage, DITEK DTK-120SRD series-connected, Dry Contact for remote notification of sacrifice ,20A AC power SPD;
      2) For 24 Volt nominal voltage, DITEK DTK-2MHLP24BWB series-connected, modular, 5A maximum current SPD.
      3) For alarm telephone dialers, DITEK DTK-2MHTPWB series-connected, modular SPD or RJ31X style, DITEK DTK-MRJ31XSCPWP
      4) For Ethernet networked systems DITEK DTK-MRJ45C5E, modular RJ45 style SPD.
      5) For Wireless GSM, DITEK DTK-VSPN
      6) For an all-inclusive surge solution using the above components, DTK-TSS1, DTK-TSS2, DTK-TSS3 and DTK-TSS4D.
      7) Acceptable Manufacturer: DITEK CORP. (800-753-2345)

C. Energy Management and Control Systems (EMCS)

1. Suppressors shall be installed on the incoming AC EMCS Panel and shall meet the following criteria:

   a. Parallel connected
   b. Suppression between L-N, L-G, N-G and L-L
   c. Surge Current Capacity: 32,500 Amps (8 x 20 µSec)
   d. Ten Year Limited Warranty
   e. Acceptable Manufacturer: DITEK CORP. (800-753-2345)

      1) DTK-120/240HW, or approved equal.

D. Suppressors shall be installed on all EMCS LV circuits on points of entry and exit from separate buildings. Suppressors shall meet the following criteria:

1. UL 497B Listed
2. Multi-stage protection design.
3. Fail-short/fail-safe mode.
4. Minimum Surge Capacity: 2,000 Amps per pair (8x20 µSec)
5. System Voltage: 12 Vrms or 24Vrms
6. Ten Year Limited Warranty
7. Acceptable Manufacturer: DITEK CORP. (800-753-2345)

   a. DTK-2MHLP Series

b. DTK-TSS3
c. DTK-LVLP Series, or approved equal.

E. Security Systems (Intrusion Detection)

1. Suppressors shall be installed on AC at the point of service and shall meet the following criteria:

a. UL 1449 Listed
b. UL 1449 V.P.R. of 500 Volts or lower
c. Status Indicator Light(s)
d. Center screw for terminating Class II transformers
e. Minimum Surge Current Capacity of 32,000 Amps (8 x 20 µSec)
f. Ten Year Limited Warranty
g. Acceptable Manufacturer: DITEK CORP. (800-753-2345)

1) DTK-1F or approved equal.

F. Suppressors shall be installed on all Telephone Communication Interface circuits and shall meet the following criteria:

1. UL 497A Listed
2. Multi Stage protection design
3. Surge Current Capacity: 9,000 Amps(8x20 µSec)
4. Clamp Voltage: 180VDC, +/- 10%
5. Auto reset current protection with current limiting not to exceed 150mA
6. Ten Year Limited Warranty
7. Acceptable Manufacturer: DITEK CORP. (800-753-2345)

a. DTK- MRJ31XSCPWP, or approved equal.

G. Suppressors shall be installed on all burglar alarm initiating circuits, and signaling circuits which enter or leave separate buildings. The following criteria shall be met:

1. UL 497B for data communications or annunciation (powered loops)
2. Fail-short/fail-safe mode.
3. Surge Current Capacity: 20,000 Amp (8x20 µSec)
4. Ten Year Limited Warranty
5. Acceptable Manufacturer: DITEK CORP. (800-753-2345)

a. DTK-2MHLP_ _B Series and DTK-MB10 base

2.04 COMPUTER / DATA SYSTEMS

A. Suppressors shall be installed on AC power at the point of service and shall meet the following criteria:

1. UL 1449 Listed
2. UL 1449 V.P.R. of 400 Volts or lower
3. Status Indicator LED(s)
4. 12 Amp circuit breaker (rack mount) or 15 Amp circuit breaker (wall or desktop)
5. Minimum Surge Current Capacity of 36,000 Amps (8 x 20 µSec)
6. Minimum of 6 foot cord
7. Ten Year Limited Warranty

8. Acceptable Manufacturer: DITEK CORP. (800-753-2345)

    a. DTK-8FF
    b. DTK-RMAC12, or approved equal.

B. Suppressors shall be installed on all computer/data circuits on points of entry and exit from separate buildings and shall meet the following criteria:

1. All pins must be protected
2. Must be Category 6 minimum, Gigabit Ethernet
3. Connection method: RJ45 (8-pin) or 110 Block.
4. Surge Current Capacity: Minimum 30 Amps per pair (8x20 µSec)
5. Ten Year Limited Warranty
6. Acceptable Manufacturer: DITEK CORP. (800-753-2345)

    a. DTK-MRJ45C5E (single device)
    b. DTK-MRJPOE (single device)
    c. DTK-RM12C5RJ (12-port, RJ45, 1U rack mount, or approved equal)
    d. DTK-RM12POE (12-port, RJ45, 1U rack mount, or approved equal)

2.05 VIDEO SURVEILLANCE

A. Protectors shall be installed on coaxial cable systems on points of entry and exit from separate buildings. Suppressors shall be installed at each exterior camera location and shall include protection for 12 and/or 24 volt power, data signal and motor controls (for Pan, Tilt and Zoom systems). SPDs shall protect all modes herein mentioned and shall contain all modes in a single unit system. Protection for all systems mentioned above shall be incorporated at the head end equipment. Additionally a minimum 600VA battery back up shall be used to protect the DVR or VCR and monitor. Protectors shall meet the following criteria:

1. Head-End Power

    a. Battery Back Up
    b. Minimum Surge Current Capacity: 65,000 Amps (8x20µsec)
    c. Minimum of 2 NEMA 5-15R Receptacles (1 AC power only, 1 with UPS)
    d. All modes protected (L-N, L-G, N-G)
    e. EMI/RFI Filtering
    f. Maximum Continuous Current: 12 Amps
    g. Ten Year Limited Warranty
    h. Acceptable Manufacturer: DITEK CORP. (800-753-2345)

        1) DTK-DRP16
        2) DTK-BU600PLUS, or approved equal.

2. Camera Power

    a. Minimum Surge Current Capacity: 2,000 Amps (8X20µsec); 30 Amps per pair for IP Video/PoE cameras
    b. Screw Terminal Connection
    c. All protection modes L-G (all Lines)
    d. Ten Year Limited Warranty
    e. Acceptable Manufacturer: DITEK CORP. (800-753-2345)

        1) DTK-DP4P Series (PTZ Cameras)

2) DTK-PVP Series (Fixed Cameras)
3) DTK-RM12POE (12 port, 1U rack mount Power over Ethernet)
4) DTK-MRJPOE (Single camera Power Over Ethernet), or approved equal.

3. Video and Data

a. Minimum Surge Current Capacity 114 Amps per pair-Analog; 30 Amps per pair-IP Video/PoE Cameras
b. "BNC" Connection (Coax); RJ45 IP Video/PoE Cameras
c. Protection modes: L-G (Data), Center Pin-G, Shield-G (Coax)
d. Minimum Band Pass 0-10MHz
e. Ten Year Limited Warranty
f. Acceptable Manufacturer: DITEK CORP. (800-753-2345)

1) DTK-DRP16 (Head End)
2) DTK-RM16NM (16 channel, 1U rack mount)
3) DTK-DP4P Series (PTZ Camera)
4) DTK-PVP Series (Fixed Camera)
5) DTK-iBNC28 (Coax video only)
6) DTK-PVPIP (Single camera video, data and power)
7) DTK-RM12C5RJ (12 port, 1U rack mount mount)
8) DTK-RM12POE (12 port, 1U rack mount Power over Ethernet)
9) DTK-MRJPOE (Single camera Power Over Ethernet), or approved Equal

2.06 CABLE TELEVISION SYSTEMS

A. Suppressors shall be installed at the point of AC service to the head end equipment and meet the following criteria:

1. Minimum Surge Current Capacity: 27,000 Amps (8 x 20 µSec)
2. All mode protection: L-N, L-G, N-G
3. EMI/RFI Filtering
4. UL 1449 Listed
5. UL V.P.R. of 500 Volts or less
6. Diagnostic Indicator Light(s)
7. Ten Year Limited Warranty
8. Acceptable Manufacturer: DITEK CORP. (800-753-2345)

a. DTK-1F
b. DTK-8FF, or approved equal

B. Suppressors shall be installed on all coaxial cable systems on points of entry and exit from separate buildings. Suppressors shall be installed at each exterior camera location and shall meet the following criteria:

1. Impedance: Match the existing system being protected (75 Ohm).
2. Band pass: 0 - 2GHz
3. Surge Current Capacity: At least 20 kA (8 x 20 µSec waveform)
4. Clamping Voltage: 75VDC Center Pin to shield
5. Response Time: Less than one nanosecond.
6. Acceptable Manufacturer: DITEK CORP. (800-753-2345)

a. DTK-VSPA
b. DTK-VSPA2 or approved equal.

2.07 ACCESS CONTROL SYSTEMS

A. Suppressors shall be installed on AC power at the point of service and shall meet the following criteria:

1. UL1449 3rd Edition Listed
2. UL1449 V.P.R. of 500 Volts or lower
3. Status Indicator Light(s)
4. Minimum Surge Current Capacity: 144,000 Amps (8 x 20 µsec)
5. Maximum Continuous Current: 15 Amps
6. MCOV: 125VAC
7. Service Voltage: 110-120 VAC
8. Ten Year Limited Warranty
9. Acceptable Manufacturer: DITEK CORP. (800-753-2345)

    a. DTK-8FF or approved equal.

B. Suppressors shall be installed on the Burg/Fire Low Voltage circuit at both the point of entrance and exit of the building. Suppressors shall meet the following criteria:

1. UL 497B
2. Minimum Surge Current Capacity: 2,000 Amps per pair
3. Maximum Continuous Current: 5 Amps
4. MCOV: 33 Volts
5. Service Voltage: 24Volts
6. Ten Year Limited Warranty
7. Acceptable Manufacturer – DITEK CORP. (800-753-2345)

    a. DTK-2MHLP24BWB
    b. DTK-1LVLPLV or approved equal.

C. Suppressors shall be installed on the communication circuit between the access controller and card reader at both the entrance and exit of the building. Suppressors shall meet the following criteria:

1. Conforms with UL497B standard (where applicable)
2. Clamp level for 12 and 24V power: 18VDC / 38VDC
3. Clamp level for Data/LED: 6.8VDC
4. Service Voltage for Power: 12VDC/24VDC
5. Service Voltage for Data/LED: <5VDC
6. Clamp level – PoE Access Power: 72V
7. Clamp level – PoE Access Data: 72V
8. Service Voltage – PoE Access: 48V-54V
9. Service Voltage – PoE Data: 5V-24V
10. Ten Year Limited Warranty
11. Acceptable Manufacturer – DITEK CORP. (800-753-2345)

    a. DTK-4LVLPCR (use DTK-3LVLP-X for “Wiegand” type readers)
    b. DTK-4LVTEP (commercial telephone entry)
    c. DTK-4LVXR (residential telephone entry)
    d. DTK-MRJPOE (Power over Ethernet access control), or approved equal.

2.08 ELECTRONIC EQUIPMENT

A. Suppressors shall be installed at the point of AC service to the electronic equipment and meet the following criteria:

1. UL1449 Listed
2. Must have 3 AC outlets capable of handling 15 Amps.
3. Minimum Surge Current Capacity: 36,000 Amps (8 x 20 µSec)
4. All mode protection: L-N, L-G, N-G
5. EMI/RFI Filtering
6. Diagnostic Indicator Light(s)
7. Ten Year Limited Warranty
8. Acceptable Manufacturer: DITEK CORP. (800-753-2345)

a. DTK-3GTP or approved equal.

PART 3 EXECUTION

3.01 INSTALLATION

A. Main Service and Distribution Equipment Surge Suppressors

1. Suppressors shall be installed at Service Entrance switchboards and distribution equipment where shown as close as practical to equipment to be protected consistent with the available space. Where installation space permits and where no code restrictions apply, suppressors may be installed within protected equipment. Suppressors installed in this manner shall utilize the equipment ground bus as a medium for bonding of their ground terminals. Bolted connections with star washers shall be used to insure electrical and mechanical integrity of connections to the ground bus. Conductors from suppressors shall attach to main service bus in the entrance equipment on the load side of any electrical metering equipment.
2. Suppressors shall be installed according to manufacturer instructions provided with each device. Lead dress shall be consistent with recommended industry practices for the system on which these devices are installed.
3. All wiring between surge suppressors and protected equipment shall be considered protected and connected in accordance with the latest edition of the NEC.
4. A minimum of three inches of separation shall be provided between parallel runs of protected and unprotected wiring in control panels, terminal cabinets, terminal boards and other locations. In no case shall protected and unprotected wiring be bundled together or routed through the same conduit.

B. Low Voltage and Comm/Data Equipment Surge Suppressors

1. Install SPD equipment according to manufacturer’s recommendations.
2. All electronic equipment/systems utilizing cord, plug or hardwired connectors shall be bonded to the building electrical system ground, building frame or driven ground rod and shall be provided with a multi-stage suppression system.
3. Contractor must properly match SPD equipment to equipment being protected, including wire sizes, operating voltages, currents and number of conductors.
4. Contractor must coordinate with providers of all equipment being protected and provide SPD equipment which meets these specifications.
5. Suppressors shall be installed in a neat manner. All hardwired low-voltage circuit lead lengths (conductor/wire distance) shall be a minimum of 3 wire feet. Make certain that the

referenced ground connections are of a lesser distance (conductor/wire length) than that of the suppressor to the protected equipment.

6. Equipment shall be installed following manufacturer's recommendations and guide- lines in compliance with NEC Article 280/250 for grounding and bonding; and NEC Article 110-9 and 110-10 for over-current protection.
7. Provide required enclosures (indoor or outdoor) for protectors adjacent to each electronic system. Supplier to provide cabinet large enough to include mounting protectors within system cabinet.

C. Quality Control

1. Disconnect suppressor prior to testing of service entrance distribution equipment and panel boards.
2. Supply certified test reports for all tested parts, elements and/or systems or where required by the Owner to substantiate published ratings of claims.

END OF SECTION

SECTION 28 00 00
ELECTRONIC SECURITY

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. Applicable requirements of Division 01 - General Requirements shall be considered a part of this section and shall have the same force as if printed herein full.

1.02 QUALITY ASSURANCE

A. Specifications, Standards and Codes: All work shall be in accordance with the following:

1. The 2017 edition of the National Electrical Code (NFPA 70), with South Carolina Amendments
2. The latest adopted edition of the Life Safety Code (NFPA 101)
3. The 2018 edition of the International Building Code (IBC), with South Carolina Amendments
4. Building Industry Consulting Service International (BICSI)
5. Telecommunications Distribution Methods Manual (TDMM)
6. American National Standards Institute (ANSI)
7. The National Electrical Safety Code (NESC)
8. The National Electrical Safety Code (ANSI C-2)
9. National Electrical Manufacturers Association (NEMA)
10. Telecommunications Industries Association (TIA)
11. Electronic Industries Association (EIA)
12. Institute of Electrical & Electronics Engineers (IEEE)
13. Underwriters Laboratories (UL)
14. American Standards Association (ASA)
15. Federal Communications Commission (FCC)
16. Occupational Safety and Health Administration (OSHA)
17. American Society of Testing Material (ASTM)
18. Americans with Disabilities Act (ADA)
19. Local city and county ordinances governing electrical work
20. In the event of conflicts, the more stringent provisions shall apply.

1.03 SCOPE

A. The work to be performed under this section of the Specifications shall include all labor, material, equipment and tools required for the complete installation of the work indicated on the Drawings and as specified herein.

B. All materials, that are a part of the Electronic Security Infrastructure and necessary to its proper operation, but not specifically mentioned and shown on the Drawings, shall be furnished and installed without additional charge.

C. The Drawings and Specifications are complementary to each other and what is called for by one shall be as binding as if called for by both. If a discrepancy exists between the Drawing and Specifications, the higher cost shall be included, and the engineer shall be notified of the discrepancy.

1.04 WORK INCLUDED

The Electronic Security Infrastructure installed and work performed under this division of the Specifications shall include but not necessarily be limited to the following:

A. IP Video Surveillance

B. Access Control

C. Intrusion Detection

D. All other applicable Division 27 sections

E. Conduits, Raceways, Racks, Cabinets and Equipment Mounting Boards

F. Grounding and Bonding

1.05 DEFINITIONS

A. Terms: The following definitions of terms supplement those of the General Requirements and are applicable to Division 27 - Communications:

1. Provide: As used herein shall mean “furnish, install and test (if applicable) complete.”
2. Infrastructure: As used herein shall mean cable, conduit, raceway, cable tray or j-hooks with all required boxes, fittings, connectors, and accessories; completely installed.
3. Work: As used herein shall be understood to mean the materials completely installed, including the labor required.

1.06 DRAWINGS

A. Drawings are generally diagrammatic and show the arrangement and location of pathways, outlets, support structures and equipment. The Contractor shall coordinate the structural and finish conditions affecting his work and arrange his work accordingly. Should conditions on the job make it necessary to make adjustments to pathways or materials, the Contractor shall so advise the Engineer and secure approval before proceeding with such work.

B. Where exact locations are required by equipment for stubbing-up and terminating conduit concealed in floor slabs, the Contractor shall provide shop drawings, equipment location drawings, foundation drawings, and any other data required to locate the concealed conduit before the floor slab is poured.

C. Materials, equipment or labor not indicated but which can be reasonably inferred to be necessary for a complete installation shall be provided. Drawings and Specifications do not undertake to indicate every item of material, equipment, or labor required to produce a complete and properly operating installation.

D. The right is reserved to make reasonable changes in locations of equipment indicated on Drawings prior to rough-in without increase in contract cost.

E. The Contractor shall not reduce the size or number of conduit runs indicated on the Drawings without the written approval of the Engineer.

F. Any work installed contrary to Contract Drawings shall be subject to change as directed by the Engineer, and no extra compensation will be allowed for making these changes.

G. The location of equipment, support structures, outlets, and similar devices shown on the Drawings are approximate only. While drawings will be scaled, they shall not be used to dimension device locations. Obtain layout dimensions for equipment from Architectural plans unless otherwise noted.

H. Schematic diagrams shown on the Drawings indicate the required functions only. The technology of a particular manufacturer may be used to accomplish the functions indicated without exact adherence to the schematic Drawings shown. Additional labor and materials required for such deviations shall be furnished at the Contractor's expense.

I. Verify the ceiling type, ceiling suspension systems, and clearance above hung ceilings prior to ordering cabling and associated hardware. Notify the Engineer of any discrepancies.

J. Review all architectural drawings for modular furniture.

K. Portions of these Drawings and Specifications are abbreviated and may include incomplete sentences. Omissions of words or phrases such as "the Contractor shall," "shall be," "as indicated on the Drawings," "in accordance with," "a," "the" and "all are intended" shall be supplied by inference.

1.07 SUBMITTALS

A. Provide submittals for the following systems:

1. IP Video Surveillance
2. Access Control
3. Intrusion Detection
4. Conduits, Raceways, Racks, Cabinets and Equipment Mounting Boards
5. Grounding and Bonding

B. Submit for approval, details of all materials, equipment and systems to be furnished. Work shall not proceed without the Owner and/or the Project Manager's approval of the submitted items.

1. Submittals for individual systems and equipment assemblies that consist of more than one item or component shall be made for the system or assembly as a whole. Partial submittals will not be considered, reviewed or stored, and such submittals will not be returned except at the request and expense of the Contractor.
2. Contractor shall generate shop drawings. Modify reviewed and accepted shop drawings to include revisions based upon completion of work. Submit shop drawings with record drawings on hard copy.
3. Shop drawings shall include equipment racks, patch panels, termination blocks, connection details, rack mounting details and any other details not included in the construction drawings.

C. Any materials and equipment listed that are not in accordance with Specification requirements may be rejected.

D. The approval of material, equipment, systems and shop drawings is a general approval subject to the Drawings, Specifications and verification of all measurements at the job. Approval does not relieve the Contractor from the responsibility of shop drawing errors. The Contractor shall carefully check and correct all shop drawings prior to submission for approval.

E. Materials List: Submit a complete materials list indicating all equipment to be provided as part of this section.

F. Samples: Submit selection and verification samples of finishes, colors, and textures as requested.

G. Complete details of equipment mounting configuration.

H. Manufacturing assembly and testing procedures and forms.

I. Installation testing and check out procedures and forms to be used by the Contractor and Architect and/or Consultant.

J. The conduit plans, equipment plans, riser diagrams, block diagrams and details are to be submitted in the latest version of MicroStation or AutoCAD, and shall be submitted on a minimum of 'D' size drawings. Documents submitted in any other manner including marked up sets of the bid documents shall receive immediate rejection and will not be reviewed. A complete, electronic set of as-built documents will be issued at the completion of the project.

K. Submittals issued in a manner inconsistent with the requirements of these specifications shall receive immediate rejection and will not be reviewed. Submittals issued containing materials, products and/or equipment that is not listed or approved by addendum shall receive immediate rejection and will not be reviewed.

1.08 QUALITY ASSURANCE

A. Equipment and materials required for installation under these Specifications shall be the current model and new (less than one [1] year from the date of manufacture), unused and without blemish or defect.

B. Equipment shall bear labels attesting to Underwriters Laboratories, where subject to label service. Manufacturers of equipment and materials pertinent to these items shall have been engaged in the manufacture of said equipment a minimum of three (3) years and, if so directed by the Owner, be able to furnish proof of their ability by submitting affidavits and descriptive data about their product including size and magnitude comparable to requirements specified herein.

1.09 CONTRACTOR QUALIFICATIONS

A. The Contractor shall have total responsibility for the coordination and installation of the work shown and described in the Drawings and Specifications. The Contractor shall be a company specializing in the design, fabrication and installation of integrated communications systems.

B. Electronic Security Systems specified shall be installed under the direction of a qualified Contractor. Qualification requirements shall include submittal by the Contractor to the Architect of the following:

1. List of previous projects of this scope, size and nature; including names and sizes of projects, description of work, time of completion and names of contact persons for reference.
2. Shall certify that they are manufacturer-authorized for work to be performed.

C. Contractor must employ at least one (1) full-time Registered Communications Distribution Designer (RCDD).

1.10 COORDINATION WITH OTHER TRADES

A. The Contractor shall coordinate Electronic Security work with that of other sections as required ensuring that the entire communications work will be carried out in an orderly, complete and coordinated fashion.

1.11 SITE INVESTIGATION

A. Prior to submitting bids of the project, visit the site of the work to become aware of existing conditions that may affect the cost of the project. Where work under this project requires extension, relocation, reconnections or modifications to existing equipment or systems, the existing equipment or systems, shall be restored to their original condition before the completion of this project.

1.12 PERMITS

A. Obtain all permits and inspections for the installation of this work and pay all charges incident thereto. Deliver to the Owner all certificates of said inspection issued by authorities having jurisdiction.

1.13 RENOVATIONS AND ADDITIONS

A. All work that would adversely affect the normal operation of the other portions of the Owner's property shall be done at a time other than normal working hours.

B. Prior to submitting bids on the project, visit the site of the work to become aware of existing conditions that may affect the cost of the project.

C. Where work under this project requires extension, relocation, reconnections or modifications to existing equipment or systems, the existing equipment or systems shall be restored to their original and operating condition. Remove all equipment indicated to be demolished, including outlets, devices, raceways and support structures.

D. Care shall be exercised in the removal and storage of equipment indicated to be relocated or removed and reused. Prior to placing back into service, equipment shall be cleaned and marred or chipped paint surfaces touched-up.

E. Provide all coring, cutting and patching to existing walls, floors, etc., required for the removal of existing work or the installation of new work.

1.14 OPERATION & MAINTENANCE MANUALS

A. The Contractor shall furnish two (2) hard copies and one electronic copy of operational and maintenance manuals for all systems furnished. The manuals shall include component lists, instructions for care, operation instructions, instructions for ordering replacement equipment and personnel to contact for warranty work.

1.15 APPROVALS

A. Deviations from this specification must be documented in writing to the Architect and Engineer at least twenty-one (21) business days prior to the bid date.

B. Complete catalogue data, product specifications and technical information on alternative equipment must be provided including all associated cost savings or additions, including but not limited to equipment, equipment installation, power wiring and materials, programming, documentation and project management.

1.16 DELIVERY & HANDLING

A. General: Comply with Division 1 Product Requirements Section.

B. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

C. Storage and Protection: Store materials and equipment in an area protected from harmful weather conditions and at temperature conditions recommended by manufacturer. After initial installation, protect equipment from exposure to dust, dirt, paint and other contaminants.

1.17 PROJECT CONDITIONS

A. Field Measurements: Verify actual measurements/openings by field measurements before fabrication; show recorded measurements on shop drawings.

B. Scheduling: Coordinate taking field measurements, fabrication schedule and deliveries with construction progress schedule to avoid construction delays.

1.18 WARRANTY

A. Warranty: All equipment and labor provided under this section is warranted for two (2) years from Substantial Completion or System Commissioning, whichever occurs first.

B. During the warranty period, the Contractor shall perform quarterly preventative maintenance inspections on all installed equipment.

C. Nothing in the above warranty shall apply to material which has been misused or abused as follows: neglect by the owner, defects or damage caused by work or failure of work by others, ordinary wear or normal equipment adjustment.

D. Additionally, any unauthorized modifications, repairs or tampering shall constitute termination of the warranty.

1.19 TRAINING

A. The Contractor shall provide four (4) hours of on-site training for operational purposes and forty (40) hours of training for maintenance purposes at the turnover of the project.

PART 2 PRODUCTS

2.01 SUBSTITUTIONS

A. Where equipment is identified by manufacturer and catalog number, it shall be as the base of requirements for quality and performance. Where manufacturers for equipment are identified by name, the Contractor may submit for approval, similar equipment of other manufacturers as substitution. The Engineer's decision as to whether the submitted equipment is acceptable shall be final and binding.

B. All changes necessary to accommodate the substituted equipment shall be made at the Contractor's expense, and shall be as approved by the Engineer. Detailed drawings indicating the required changes shall be submitted for approval at the time the substitution is requested.

C. If substitutions are made in lieu of device specified; form, dimension, design and profile shall be submitted to the Engineer for approval.

D. Submit request for approval of substitute materials in writing to the Architect at least ten (10) days prior to bid opening.

2.02 MATERIALS

A. All materials used in this work shall be new and shall bear the inspection label of Underwriters' Laboratories Inc. or certification by other recognized laboratory.

B. The published standards and requirements of the Telecommunications Industries Association (TIA), National Electrical Manufacturers Association (NEMA), the American National Standard Institute (ANSI), the Institute of Electrical and Electronic Engineers (IEEE), and the American Society of Testing Materials (ASTM), are made a part of these Specifications and shall apply wherever applicable.

C. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, for which replacement parts are available.

D. When more than one unit of the same class of equipment or material is required, such units shall be the products of a single manufacturer or partner manufacturers that offer a certified solution.

E. Components of an assembled unit need not be products of the same manufacturer, but must offer a certified end-to-end solution.

F. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.

G. Components shall be compatible with each other and with the total assembly for the intended service.

PART 3 EXECUTION

3.01 EXAMINATION OF CONDITIONS

A. Prior to the start of work, the Contractor shall carefully inspect the installed work of other trades and verify that such work is complete to the point where installation may properly commence. Start of work indicates acceptance of conditions.

B. Install equipment in accordance with applicable codes and regulations, and the referenced standards.

C. In the event of a discrepancy, immediately notify the Project Manager.

D. Do not proceed with installation until unsatisfactory conditions and discrepancies have been fully resolved.

3.02 PROTECTION OF SYSTEMS AND EQUIPMENT

A. Protect materials and equipment from damage during storage at the site and throughout the construction period. Equipment and materials shall be protected during shipment and storage against physical damage, dirt, theft, moisture, extreme temperature and rain.

B. Damage from rain, dirt, sun and ground water shall be prevented by storing the equipment on elevated supports and covering the sides with securely fastened protective rigid or flexible waterproof coverings.

C. During installation, equipment shall be protected against entry of foreign matter on the inside and be vacuum cleaned both inside and outside before testing, operating or painting.

D. As determined by the Project Manager, damaged equipment shall be fully repaired or shall be removed and replaced with new equipment to fully comply with requirements of the Contract Documents.

E. Damaged paint on equipment and materials shall be repainted with painting equipment and finished with the same quality of paint and workmanship as used by the manufacturer.

3.03 ACCESS TO EQUIPMENT

A. Equipment shall be installed in location and manner that will allow access for maintenance and inspection.

B. Working spaces shall be not less than specified in the National Electrical Code (NEC/NFPA 70) for voltages specified.

C. Where the Project Manager determines that the Contractor has installed equipment not accessible for operation and maintenance, equipment shall be removed and reinstalled as directed by the Project Manager, at no additional cost to the Owner. “Accessible” is defined as being capable of being reached without the use of ladders or without climbing or crawling under or over obstacles such as motors, pumps, belt guards, transformers, piping and duct work.

3.04 CLEANING

A. During construction, and prior to Owner acceptance of the building, remove from the premises and dispose of packing material and debris caused by communications work.

B. Remove dust and debris from interiors and exteriors of components. Clean accessible current carrying elements prior to being energized.

C. General: Upon completion of the work, remove excess dust & debris, materials, equipment, apparatus, tools and similar items. Leave the premises clean, neat and orderly.

3.05 COMPLETION

A. Results Expected: Systems shall be complete and operational and controls shall be set and calibrated. Testing, start-up and cleaning work shall be complete.

B. Maintenance Materials: Special tools for proper operation and maintenance of the equipment provided under this Specification shall be delivered to the Owner.

3.06 TESTING AND VERIFICATION

A. See specific Division 28 sections for testing parameters of sub-systems.

B. The Contractor shall verify that requirements of this Specification are met. Verification shall be through a combination of analyses, inspections, demonstrations and tests, as described below.

C. Verification by inspection includes examination of items and comparison of pertinent characteristics against the qualitative or quantitative standard set forth in the Specifications. Inspection may require moving or partially disassembling the item to accomplish the verification, included as part of the work at no additional cost to the Owner.

D. The Contractor shall verify by demonstrations and/or tests that the requirements of this Specification have been met. The Contractor shall demonstrate that the communications systems, components and subsystems meet Specification requirements in the “as-installed” operating environment during the “System Operation Test.” The Contractor shall measure and record temperature, humidity and other environmental parameters.

E. The Contractor shall schedule and coordinate the final acceptance tests. The Contractor shall provide necessary instruments, labor and materials required for tests. Provide equipment manufacturer’s technical representative and qualified technicians.

F. The Contractor shall satisfy all items detailed in the final acceptance check-off list (punch list). The list shall be a complete representation of specified installation requirements. At the time of final acceptance punch list items shall be corrected until the system is found to be acceptable to the Owner and the Project Manager.

END OF SECTION

SECTION 28 07 00
IP VIDEO SURVEILLANCE SYSTEM

PART 1 GENERAL

1.01 SUMMARY

A. Provide IP Video Surveillance System (IPVSS) equipment as specified herein and as shown on the schedules and drawings. Installing contractor shall receive, place, connect, and mount all equipment specified in this Section per the manufacturer's instructions. Installing contractor shall furnish all hardware, wire, connectors, and other necessary items as required for a complete and functional IPVSS system.

B. Related Sections

1. Electrical
2. Electronic Security
3. Access Control Systems

1.02 REFERENCES

A. The General Conditions, Supplementary Conditions, and Division 1 Specifications shall apply to all work of this section.

B. Standards listed by reference, including revisions by issuing authority, form a part of this specification section to extent indicated. Standards listed are identified by issuing authority, authority abbreviation, designation number, title, or other designation established by issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation.

C. Underwriter's Laboratories (UL)

1. UL 508 Industrial Control Equipment
2. NEC National Electrical Code (latest edition)

1.03 WORK INCLUDED

A. Included under this Section of the work shall be the furnishing, installation, connection, aiming and testing of the complete IPVSS system including, but not limited to, cameras, housings, mounts, cables, monitors, network switches, network video recorders and storage equipment, and fiber optic systems.

B. Major Sub-systems include:

1. Access Control System
2. Intercom System

C. The lenses provided for cameras shall be changed as required, at no cost, to provide the Owner with an acceptable field of view.

D. Provide 1 spare interior IP fixed camera.

E. Provide 1 spare exterior IP fixed camera.

F. All interior cameras shall be 3 mega pixel minimum.

G. All exterior cameras monitoring parking areas or intended for License Plate Recognition (LPR) shall be 5 mega pixel minimum.

1.04 APPROVALS

A. General

1. Submittals shall be made in accordance with the General Provisions of these specifications.

B. Specific Requirements

1. Submit catalog cuts for all equipment and devices being furnished under this Section.
2. Submit a complete IPVSS System riser diagram. Diagram shall include labeling of each camera and its corresponding head end equipment input, interconnecting wiring of all components including, but not limited to, digital controllers, network video recorders, camera power supplies, monitors, control keyboards, and interface connections.
3. Submit plan drawings showing location, mounting and viewing angle of each camera.

1.05 DESCRIPTION

A. The IPVSS shall monitor spaces as shown on the drawings and function as shown on the IPVSS functional schematic.

B. A Virtual Matrix Controller shall be furnished and installed to provide auto-select and manual selection of video cameras.

C. All IPVSS cameras shall be equipped with auto-iris lens.

D. Video Switching/Control

1. Some consoles are equipped with two intercom call-up monitors for movement control. These are designated as shown on the drawings. The first monitor (ex. M1) shall view the side of the door from which the intercom call was initiated. The second monitor (ex. M2) shall view the opposite side of the door. Cameras on both sides of a door will be called up and display simultaneously upon acknowledging an intercom call. If a door has only one IPVSS camera viewing it, the monitor displaying the side without a camera shall be blank. Activating an intercom by touching the intercom icon on the touch screen shall switch the associated cameras to these intercom call-up monitors. For conditions such as elevator lobbies, monitors shall display lobby video and cab video.

E. The IPVSS system shall be 100% IP based.

F. All interior camera wiring shall be Category 6. Category 5e is not acceptable for video.

G. All exterior cameras located more than 300’-0” away from the nearest Telecom Room shall be fiber optic video transmission.

H. All the pan tilt zoom cameras shall have programmable pre-set positions.

I. All cameras shall have digital motion detection built in the software. System recording shall be dormant for areas that have no activity. Real time recording shall occur upon motion.

PART 2 PRODUCTS

2.01 MATERIALS

A. Except as otherwise specified herein or in the General Conditions, the equipment and materials of this Section shall be products of the following listed manufacturers, subject to compliance with the specification requirements and provided each manufacturer meets all requirements of the Quality Assurance Section of this specification.

B. Cameras

1. IPVSS cameras shall be U.L. listed and shall be the standard product of one manufacturer complying with not less than the specifications contained herein. Installation of each camera shall include mounting brackets and/or camera housings fully compatible with the camera provided. All interior and exterior cameras shall be high resolution color equal the models specified following.
2. Integrated Camera System, Mini Dome, Surface Mounted

    a. Fully-Integrated Enclosure with Camera and Lens
    b. Rugged, High-Impact and Vandal Resistant, Puncture Proof Domes
    c. Tamper-Resistant Hardware
    d. 12 VDC or 24 VAC Operation
    e. Circuitry Protected
    f. Operating Temperature Range +14 to 131° F (-10 to 55° C).
    g. Manual Pan and Tilt Adjustments
    h. Available with Smoked or Clear Dome (1.5 f-stop Light Loss with Smoked Dome)
    i. NTSC/PAL or EIA/CCIR Camera Formats
    j. Varifocal Lens of 3.3 mm to 12 mm with Auto Iris Available with High Resolution Color Camera
    k. The VC-600WS incorporates a camera and lens package into a small, high-security enclosure for medium/high-security installations subject to vandalism.
    l. Camera options include 1/3-inch format CCD high resolution CCD color imager.
    m. Exterior wall mounted locations shall include a V910-PH pendant housing and SVFT-WM wall mount.

3. Pan-Tilt-Zoom (PTZ) High- Performance Integrated Dome Systems

    a. Auto Focus with Manual Override
    b. 22X Optical Zoom
    c. Equivalent 70-300mm zoom lens
    d. 79 Programmable Presets
    e. 8 Programmable tours, 32 steps available for each tour
    f. Color (NTSC/PAL) Camera with Auto Iris
    g. Auto Iris with Manual Override
    h. Variable Scan Speed (0.5-360 degrees/Second)
    i. “Auto Flip” Dome Rotation
    j. 360 Degrees Continuous Pan Rotation
    k. Integral Multi-protocol Receiver/Driver

l. Shall be available with integral fiber transmission or UTP transmission options.
m. Power-up Recovery Mode
n. Built-in Power Line Surge and Lightning Protection

C. All camera installations shall be securely attached to mounting surface. Use lead shields on solid masonry, toggle bolts for hollow masonry, and machine bolts for steel. All anchoring devices shall be rated to support not less than five times the total equipment weight.

D. Cameras shall have automatic iris control and shall be for interior or exterior use under normal and low light conditions of illumination and shall be provided with a weatherproof or tamper-proof housing as specified. Camera shall be mounted as shown and shall include electronic components for automatic adjustment of iris to varying levels of illumination.

E. Cameras other than those which are mini dome type shall be solid state type with auto iris lens, with vari-focal lens shall be field adjusted as directed by the Architect. Power supplies shall be internally protected. Camera light and sensitivity under low light conditions shall be with incandescent, infrared and high intensity discharge light sources. Cameras shall have line lock to avoid roll during switching operations.

1. The camera shall have high resolution color and have the following minimum specifications:

a. Horizontal resolution – Color 540 lines
b. Picture Elements – 768 (H) x 494 (V)
c. Minimum Illumination 0.5 lux, f1.2, 40 IRE, AGC on, 75% reflectance
d. Signal-to-Noise Ratio 52 dB
e. Vertical Phase Adjustable 0° ±120°
f. Video Output 1 Vp-p, 75 ohms
g. Operating Temperature 14° to 122°F (-10° to 50°C)
h. Line voltage - 24 VAC
i. Power Consumption Less than 4 watts
j. Shall be provided with a 3-9mm Auto Iris Vari-focal lens

F. Camera Housings and Supports

1. All camera housings and support brackets shall be compatible with IPVSS camera specified to be installed within housings and/or mounted on brackets. Housings shall be provided with all cable entrance facilities for camera control and shall be adaptable to mounting devices used with cameras. All camera housings and support brackets shall be securely attached to mounting surfaces. Escutcheon plates attached with security screws shall be used to conceal holes in walls or ceilings.
2. Exterior weatherproof, tamper-proof housings shall be constructed of aluminum and finished with a weatherproof, heat reflecting paint. Housing shall be internally insulated. Hinged cover shall be secured in place with tamper-proof bolts. Housings shall be supplied with a fan, heater, sun-shield and defroster glass. Control of blower and heater shall be automatic when camera power circuit is energized.
3. Interior tamper-proof housings for cameras shall be constructed of 18 gauge sheet steel, all joints welded, with all surfaces finished with rust inhibiting prime coat and baked on vinyl finished coat. Access shall be through locked hinged continuous side panels. All locks shall be keyed alike for similar camera enclosures on this project. Knockouts shall be provided for entry of power control and video wiring.
4. Camera mounting brackets shall be heavy duty type and shall be suitable for outdoor use. Bracket shall be provided with locking, swivel, adjustable head for maximum tilt angle of 60 degrees.

5. Wall mounting brackets shall be suitable for camera and enclosures specified and shall be rated for support of not less than 150 lbs. Brackets with extension of 24" or larger shall be provided with support strut.

G. Monitors

1. IPVSS monitors shall be the standard products of one manufacturer and compatible with the total system specified herein and complying with these specifications. Monitors and cameras shall be provided by the same manufacturer.
2. IPVSS monitors shall be color solid state TFT LCD flat panel type as indicated on the drawings and as specified herein. Monitor controls shall be on-off, brightness, contrast, vertical hold and horizontal hold. All monitors shall be U.L. listed.
3. 32” monitors shall be mounted as shown on the drawings. Monitors shall comply with not less than the following specifications:

    a. LCD Panel Pixel Array 1280 x 1024, 75 Hz
    b. Panel Aspect Ratio 4:3 composite, 5:4 VGA
    c. Pixel Pitch 0.294 x 0.294mm
    d. Contrast Ratio500:1
    e. Viewing Angle (H/V) 150°/130°
    f. Response Time 8 ms

4. Thirty-Two (32) inch monitors shall be mounted as shown on the drawings. Monitors shall comply with not less than the following specifications:

    a. Native Resolution 1366 x 768 WXGA
    b. Pixel Pitch 0.681 x 0.681 mm
    c. Contrast Ratio 10,000:1
    d. Viewing Angle 178°/178°
    e. Response Time 5 ms
    f. Power Consumption 375 W

H. Virtual Matrix Controller

1. Unit shall be able to display any camera on any monitor over the network.
2. Shall have compatible decoders and multi-channel viewing stations available from the same manufacturer as the Virtual Matrix Controller.
3. Shall offer fully functional IPVSS control keyboards for camera to monitor selection, PTZ control, and tour control.
4. Incorporates graphic map features to depict camera locations.
5. The switching system shall be a digital based controller capable of automatically routing video signals from a requested camera position to a specified monitor.
6. The Virtual Matrix Controller shall be software-based and shall run on a preconfigured PC-based controller or an owner provided PC meeting manufacturer’s minimum requirements. Controller and PC meeting manufacturer’s requirements shall be rack mounted.
7. Each Virtual Matrix shall support up to 2 keypads/serial host interface and 32 concurrent video streams.
8. The Virtual Matrix shall offer the simultaneous display and playback of any camera in the system, on any analog monitor connected to a decoder on that same system. Monitors shall display single full screen views or quad views. The monitors shall be graphically depicted on the PC GUI interface; the selected monitor shall be highlighted in red. Additionally, the monitor shall be spotlighted and displayed in the display area. Video shall be played back on a selected monitor. Playback shall be selected by date and time from a calendar or, by right mouse click, quick playback.

9. Titles shall display to the monitor; up to 20 characters shall be able to display. Certain monitors shall be able to be dedicated for alarms or alarms shall display on all monitors.
10. The software shall support playback from the main screen without losing live video viewing in the following formats:

    a. Quick playback – the user shall be able to select and launch playback for a specific camera in a pre-defined number of seconds before the live image. The playback window shall open in selected monitor location.
    b. Playback from time – shall allow setting the playback to start from a specific date, time and database on the network. This shall allow playing back the same camera several times.

11. The software shall provide an advanced method for creating and executing software commands. This shall be achieved by the use of macros. Macro configuration shall be defined for recorded cameras and microphones, command duration, recording location, local viewing, device ID, picture quality, refresh mode, recording rate (fps), related devices (sensors) and alarm activation.
12. Macros shall allow an authorized user to create and schedule software commands that shall include, but are not limited to:

    a. Sequencing cameras, including multi-screen displays on selected monitors.
    b. Execute remote macros existing on recorders currently connected to the network.
    c. Record cameras at different qualities and frame rates from any recorder on the network.
    d. Send alarm condition to any recorder and workstation on the network. By the use of macros, an authorized user shall be able to program the destination component of the alarm condition.
    e. An authorized user shall be able to program and execute macros remotely without the need to be physically located at the recorder that the macros will be programmed on.
    f. The Schedule/Macro button shall allow the running of preconfigured combinations of camera, sensor and PTZ programmed routines.
    g. Macro scheduling shall include, but is not limited to:

        1) Days of the week when a macro is active.
        2) Start and end time for when a macro is active.
        3) If a macro is to run continuously or not.

I. Video Decoder

1. The Video Decoder shall decode network data from a digital IP source into an analog output for display on any monitor with an S-Video, mini-D-sub VGA or coaxial input.
2. Rack mounting accessories shall be available to mount up to 8 decoders in a single, standard 19-inch rack space. A 2-unit rack mount for standard 19-inch racks shall also be available. A wall mount shall also be available.
3. Number of Video Channels: 3
4. Supports NTSC, PAL, EIA and CCIR video formats
5. Shall transmit up to 30 fps per channel NTSC.
6. Composite video resolution shall be 450 TV lines

J. Multi-Channel Viewer

1. View up to 64 video streams from a single PC.
2. Shall have the ability to view up to 16 video images per monitor across up to 4 monitors on a single PC.
3. Ability to display up to 64 video streams on a single monitor.

4. Compatible with the digital video decoders, Virtual Matrix Controller, NVRs and keypads throughout the system.

K. Network Video Recording System (Long Term Recording and Playback)

1. The NVR(s), network video recorder(s), shall utilize the latest digital technology with recorder capabilities to display multiple cameras, record, archive and instantly retrieve images. All cameras within the facility shall be recorded simultaneously on the network video recording system. The NVR(s) shall have the following characteristics:

   a. Simultaneous playback, recording and archiving of images from one to sixteen sources.
   b. Graphical Map feature supports realistic camera location
   c. Hybrid compression based on MPEG4
   d. Museum Search (Smart Search) feature scans hours of video in minutes
   e. Archive segments of video to a CD-R/CD-RW/DVD with viewer for playback on a standard PC
   f. Maximum resolution of 480 TV lines @ 720 x 488 (576 TVL @ 864 x 586 PAL) pixel capture without loss of video quality
   g. 16 individual RS-422 ports for PTZ/Dome Control
   h. Four alarm recording options; Record last alarmed cameras images, record all alarmed camera images, allow last camera first priority or all alarmed camera images higher priority.
   i. Five levels of image quality for each camera.
   j. Automatic recording speed increase for alarm events.
   k. Instant retrieval recording with capability to instantly locate and playback recorded images through an alarm event, time index or on the fly search.
   l. Advanced compression permitting high resolution 720 x 488 pixel digital image recording and noise-free playback.
   m. Time, date, recording mode, alarm number, camera number and power outages displayed on screen.
   n. On screen programming.
   o. Full-screen or multi-screen display with up to 16 split views.
   p. Automatic conditional refresh technology to update images prior to compression and storage.
   q. Event trigger option for pre-alarm and post-alarm playback.
   r. Windows operating environment with iconic on-screen display.
   s. Up to 16 camera inputs.
   t. DCT encoding and compression.
   u. Video transport over fiber.
   v. Quantity/sizes of network video recorders shall be provided in order to simultaneously record all cameras throughout the facility.
   w. Shall furnish 30 days of recorded video at 7.5 frames per second and 4 CIF resolution (704 X 480).
   x. Shall be furnished with remote view software at no additional charge to the owner.

L. Digital Video Network Equipment

1. The digital IPVSS network shall be a stand-alone 1000 MB network furnished and installed by the ESC contractor. The owner’s network may be, at the option of the owner, linked to the digital video network for accommodation of remote viewing PCs, but shall not be used as the primary means of transporting digital video.
2. Switches shall be 12, 24 or 48 port as applicable and defined below.
3. Each switch can operate as both a master controller and a forwarding processor.
4. Dynamic Host Configuration Protocol (DHCP) auto configuration of multiple switches through a boot server.

5. Dynamic Trunking Protocol (DTP) to facilitate dynamic trunk configuration across all switch ports.
6. Protocol Independent Multicast (PIM) for IP multicast routing is supported, including PIM sparse mode (PIM-SM), PIM dense mode (PIM-DM), and PIM sparse-dense mode. The IP Services image is required.
7. Inter-VLAN IP routing for full Layer 3 routing between 2 or more VLANs.
8. Distance Vector Multicast Routing Protocol (DVMRP) tunneling interconnects 2 multicast-enabled networks across non-multicast networks.
9. IEEE 802.1x allows dynamic, port-based security, providing user authentication.
10. IEEE 802.1x with VLAN assignment allows a dynamic VLAN assignment for a specific user regardless of where the user is connected.
11. IEEE 802.1x and port security are provided to authenticate the port and manage network access for all MAC addresses, including that of the client.
12. Port-based ACLs for Layer 2 interfaces allow security policies to be applied on individual switch ports.
13. VLAN trunks can be created from any port, using either standards-based 802.1Q tagging.
14. 4000 VLAN IDs are supported.
15. IGMP snooping provides fast client joins and leaves of multicast streams and limits bandwidth intensive video traffic to only the requestors.
16. Shall support Uni-cast routing protocol RIP v2.
17. Shall support Protocol Independent Multicast (PIM).
18. 32-Gbps switching fabric.
19. Ethernet switches shall be as manufactured by Cisco or HP.

M. PoE Switches

1. Category 6 PoE Switch

    a. IEEE 802.3af Power over Ethernet compliant
    b. 2.68Mbps throughput
    c. 3.6Gbps switching capacity
    d. Broadcast storm control capability
    e. 20MB RAM minimum
    f. Auto MDI/MDI-X capability
    g. 95W minimum PoE budget
    h. 19” rack-mountable
    i. UL listed
    j. RoHS compliant
    k. Telnet remote login capability
    l. Non-blocking architecture
    m. SNMP v1 and v2 compatibility
    n. Wirespeed performance
    o. Rapid Spanning-Tree capability
    p. WPA-PSK (AES) IEEE 802.1X RADIUS capability
    q. VLAN tagging
    r. Port mirroring
    s. Link aggregation – LACP capability
    t. SNTP capability
    u. GVRP capability

N. Equipment Racks

1. ESC Contractor shall provide one (1) – 19" LCD monitor at each NVR rack location to be able to view NVR/VMC/VI server(s) display. Monitor shall be rack mounted.
2. ESC Contractor shall provide combination keyboard/monitor shelf at each NVR location.

3. ESC Contractor shall provide a mounted KVM Switch and all required cables and power supplies when more than one NVR is installed in a rack location. KVM capacity shall support connection of all NVRs in a rack location.
4. All IPVSS equipment is to be furnished with UPS backup per the UPS specification section. This is not including actual camera power. All 120 VAC camera circuits shall be connected to an emergency power circuit.
5. Top and bottom shall be 14-gauge steel, horizontal braces shall be 16-gauge steel welded to integral structural side panels of 16-gauge steel
6. Shall be fully enclosed and provided with front door, rear door, side panels and top panel with cooling fans.
7. Cooling fans shall be provided in a capacity to fully exhaust the heat dissipated by the equipment.
8. Rack shall come equipped with two pairs of 11-gauge steel rackrail with tapped 10-32 mounting holes in universal EIA spacing.
9. Contractor to provided 6 RU of blank space at the top to be enclosed using rack blank panels.
10. There shall be no spacing between components within the rack.
11. Equipment racks shall be Middle Atlantic Products or Atlas Soundolier.

O. Camera Poles

1. The heavy duty pole is for exterior applications and is designed to be weatherproof against the outdoor environmental element effects of discoloration and as well shall be designed to meet or exceed the local requirements for wind load resistance. The installer shall be responsible for checking the local codes for compliance.
2. The poles staff shall be round and extruded from all new 6063 alloy aluminum tubing and heat-treated to produce a T6 temper. The pole shaft shall be 6" in diameter by 18 feet tall non-tapered and shall be of one-piece seamless construction. Shafts with seams welded or not will not be acceptable.
3. The pole shaft shall be continuously welded to a 12" base plate. The base plate shall be cast from A356 aluminum alloy and tempered to Aluminum Association T6 standards.
4. The anchor bolts shall be fabricated from structural quality, hot rolled carbon bar, having a minimum yield strength of 50,000 PSI. The anchor bolts shall be an “L” design and shall be galvanized.
5. An extruded handhole to provide for internal wiring shall be provided and shall have a cover with tamper-resistant security screws.
6. The unit shall be designed and manufactured to allow the conduit and wiring to be totally concealed and run within the unit.
7. The unit shall be finished in a standard dark bronze (DB) powder coating. Other finishes are available.
8. Concrete Mounting Base.
9. The pole shall mount to a round concrete base. The concrete base will be furnished under the General Construction Contract.
10. Poles shall be United Lighting Standards or approved equal.

P. History Video Storage:

1. The camera system shall store all video for all cameras for a minimum of 30 days. Provide calculations for review.

2.02 APPROVED PRODUCTS

A. Approved Cameras (Indoor/Outdoor, License Plate Recognition/PTZ) Manufacturer(s)

1. Avigilon

B. Approved Network Video Recorder (NVR) Manufacturer(s)

1. Avigilon
2. Hanwha
3. Bosch
4. Axis Communications
5. Vicon
6. Or Approved Equal

C. Approved PoE Switch Manufacturer(s)

1. Cisco
2. Allied Telesis
3. HP – ProCurve Series
4. Or Approved Equal

PART 3 EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

A. Compliance: Comply with manufacturer's product data; including product technical bulletins, product catalog, installation instructions, submittal sketches or drawings, and product carton instructions for installation.

3.02 EXAMINATION

A. Site Verification of Conditions: Verify that related conditions, including equipment that has been previously installed under other sections, are acceptable for product installation in accordance with manufacturer's instructions.

B. All devices connected to equipment specified in this section shall bear the UL, cUL, or CSA label and comply with all applicable National Electrical Code (NEC) standards

3.03 PREPARATION

A. The ESC contractor shall develop custom software as required to affect the functions of the system as dictated by the drawings and Specifications.

B. The ESC contractor shall provide equipment cabinets for installation of the control equipment and cable terminations to the equipment.

C. All equipment related to the system shall be factory tested before shipment.

3.04 INSTALLATION

A. Contractor shall furnish all equipment, labor, system setup, and other services necessary for the proper installation of the products/system as indicated on the drawings and specified herein.

B. Install in accordance with manufacturer's handling and installation instructions.

C. Install in accordance with all local and pertaining codes and regulations.

D. All equipment and systems shall be installed by the ESC. Subcontracting of equipment installation shall not be permitted.

E. Equipment shall be ready to use condition at end of installation.

F. Energize equipment in accordance with manufacturer's instructions.

3.05 PROTECTION AND CLEANING

A. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.

B. Touch up, repair, or replace damaged components before Substantial Completion.

C. Remove temporary tags, coverings, and construction debris from interior and exterior surfaces of equipment. Remove construction debris from equipment area and dispose of debris.

D. Clean integral air filters, heatsinks, grills, and fans before Substantial Completion and Commissioning Services.

3.06 WARRANTY

A. The ESC shall provide a single source warranty for all supplied equipment specified in this section to be free of defects in material and workmanship for a period of two (2) year from the date of substantial completion.

END OF SECTION

SECTION 28 13 00
ACCESS CONTROL SYSTEM

PART 1 GENERAL

1.01 SUMMARY

A. Provide Card Access Control equipment as specified herein and as shown on the schedules and drawings. Installing contractor shall receive, place, connect, and mount all equipment specified in this Section per the manufacturer's instructions. Installing contractor shall furnish all hardware, wire, connectors, and other necessary items as required for a complete and functional Card Access Control system.

B. The terms "card" and "fob" may be used interchangeably throughout this specification document. Ensure that the provided system meets all Owner requirements regarding credential compatibility with cards, fobs, Bluetooth technology, etc.

C. Door hardware such as crashbars, handles, locking devices, escutcheons, hinges, kickplates, door assemblies, etc. are not included within the JSE Low Voltage scope of work. Coordinate provision of these components with the Owner's contracted Door hardware Consultant. Coordinate all access controlled door locations with the door hardware schedule to confirm exact locking mechanisms used, assemblies, surrounding conditions, etc.

D. Access control system shall fully integrate with the Fire Alarm system to ensure that access controlled doors are automatically unlocked during an alarm event. Follow all local codes and coordinate with the Fire Alarm system designer.

E. Coordinate with all local codes and the authority-having-jurisdiction regarding provisions of electronic egress devices and rules/regulations concerning access controlled doors in paths of egress to ensure full code-compliance.

F. Related Sections

1. 27 00 00 Communications
2. 27 15 13 Communications Copper Horizontal Cabling
3. 28 00 00 Electronic Security

1.02 REFERENCES

A. The General Conditions, Supplementary Conditions, and Division 1 Specifications shall apply to all work of this section.

B. Standards listed by reference, including revisions by issuing authority, form a part of this specification section to extent indicated. Standards listed are identified by issuing authority, authority abbreviation, designation number, title, or other designation established by issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation.

C. Underwriter's Laboratories (UL)

1. UL 508 Industrial Control Equipment

2. NEC National Electrical Code (latest edition)

1.03 WORK INCLUDED

A. The Electronic Security Contractor shall furnish labor, equipment, and materials for the Access Control system including but not limited to:

1. Wiring
2. Equipment cabinets
3. Card reader data gathering panels, readers, system software, access control host computer, badging station and system software & programming
4. PoE (Power-over-Ethernet) power supplies PoE (Power-over-Ethernet) switches

B. This Section consists of furnishing and installing a card access system as part of the Security Monitoring and Control System to include the following:

1. File Server
2. Remote Interfaces and Processors
3. Enrollment Terminal/Photo ID System
4. Administrative Terminal
5. Proximity/RFID Card Readers
6. PoE (Power-over-Ethernet) Power Supplies
7. PoE (Power-over-Ethernet) Switches
8. Logging Printer
9. Proximity/RFID Fobs
10. Vehicle Entry Gate RFID Transmitters and Receivers
11. Telephone Entry Stations
12. Video Intercom Stations
13. Request-to-Exit Pushbuttons (REX's)
14. Passive Infrared Request-to-Exit Motion Sensors (PIR's)

1.04 APPROVALS

A. General

1. Submittals shall be made in accordance with the General Provisions of these specifications.

B. Specific Requirements

1. Submit catalog cuts for all equipment and devices being furnished under this Section.
2. Submit a complete Access Control System riser diagram. Diagram shall include labeling of each reader and its corresponding head end equipment connection point and interconnecting wiring of all components.
3. Submit floor plan drawings showing location and mounting of each card reader.

1.05 DESCRIPTION

A. The Access Control System shall provide a means to control and monitor access at specified doors throughout the facility.

B. Each system shall consist of proximity/RFID-type Card/Fob sensor devices, status input devices, output control devices, control processor(s), interface modules, file server, remote terminals, printers, software and programming.

C. Hardware and software to interface the Access Control System with the Touch Screen and/or Graphic Control Panel Systems.

D. An enrollment terminal for programming the card access system security functions shall be provided for the system. No other terminal shall be capable of entering or modifying the card access system. The enrollment station shall be capable of having a color photo ID badging system as an integral component.

E. The software shall run on a Microsoft Windows operating system.

F. The contractor shall provide the latest version of operating system at the end of the project. At closeout and at the end of the warrantee period, the latest version of software shall be loaded onto the operating system. In addition, a backup copy of the software shall be turned over to the Owner.

G. The software shall be user programmable. All source codes, passwords and any other codes shall be turned over to the Owner such that the Owner can have access to any and all parts of the software and any other components. The intent is for the Owner to have complete access to all components of the system he is purchasing without the need of a maintenance contract. Although an after-warrantee maintenance contract may be considered by the Owner. See additional requirements herein and in the Security General specification sections.

H. System shall be equipped for expansion to remote sites by the addition of an interface card and modem.

I. The new system shall have a 6 TB hard drive minimum.

PART 2 PRODUCTS

2.01 MATERIALS

A. Acceptable Manufacturers

1. Head end equipment/software – Lenel OnGuard, Software House, Honeywell, Avigilon, Gallagher, LATCH
2. Proximity/RFID Readers – HID, DoorKing, Gallagher, LATCH
3. RFID Long-Range Readers – HID, DoorKing, Gallagher, LATCH
4. Keypads – HID, DoorKing, Gallagher, LATCH
5. PoE Power Supplies – Altronix, Securitron
6. PoE Switches – Cisco, Allied Telesis, HP (ProCurve Series)
7. Proximity/RFID Cards/Fobs – HID, DoorKing, MiFARE, Gallagher
8. Vehicle Entry Gate RFID Transmitters and Receivers – DoorKing, LiftMaster, HID, GAO RFID
9. Telephone Entry Stations – DoorKing, Linear, Viking, LATCH
10. Video Intercom Stations – Aiphone, ButterflyMX, Viking
11. Request-to-Exit Pushbuttons (REX's) – Honeywell, Securitron, Alarm Controls, Dynalock
12. Passive Infrared Request-to-Exit Motion Sensors (PIR's) – Honeywell, Gallagher, Schlage, Bosch
13. Or Approved Equals

14. *Ensure that selected devices from all categories provide a cohesive, integrated system capable of using the same credentials (single fob/credential system with additional Bluetooth capability) for all access controlled doors such as common/amenity doors, building entries, vehicle gates, residential unit electronic door locks (where applicable), etc.
15. *Battery backups shall be specified by the Door Hardware Consultant

B. Scope

1. This specification outlines the requirements for a single local controller up to a centrally controlled distributed processing and centrally programmed monitored access control system capable of running on an industry standard computer with the manufacturer's priority software.

C. Computer Hardware Requirements

1. The computer shall be configured at a minimum in a following manner.
2. Furnish and commission a centrally located host computer and software as described following:

    a. IBM PC 100% compatible computer, Intel Core i7-3770 CPU at 3.4 MHz
    b. 64 GB of RAM
    c. 6 TB Hard Drive
    d. DVD +/- RW Optical Drive
    e. 25" LCD Color Display
    f. Printer port and line printer for event printing
    g. Two RS232 and one RS485 serial communication ports
    h. Microsoft compatible bus mouse
    i. Surge protector
    j. Uninterruptable Power Supply

D. Computer Software Requirements

1. The computer shall include the following software:

    a. Windows 7, minimum
    b. Access control system software

E. Computer Software Features

1. The following features shall be provided for the computer:

    a. Programming of users and system configuration information across multiple systems.
    b. Password protected, multilevel operator programming capabilities
    c. Issue of commands to any controller from the computer, like momentarily unlocking a door.
    d. Storage to hard disk of all event transactions.
    e. Archive to floppy or tape of stored event transactions for long term storage.
    f. User customizable reports generated from stored event transactions.
    g. User, door and alarm input English text names appear on screen, printer and reports.
    h. Host operator action logging to disk.
    i. Customizable event and report print.
    j. The system shall provide for a minimum of 1,000 users.
    k. The system shall provide for a maximum of 10,000 users.

F. Host Computer to Controller Communication Protocols

1. Communications between the computer and the controller shall be accomplished utilizing a standard 10/100 TCIP connection.

G. Maximum System Wide Capacities

1. The following shall be the maximum system-wide capacities. Actual numbers shall be dependent upon mix of controllers that make up the system.

a. 32,640 readers
b. 261,120 monitor alarm inputs
c. 4032 control relay inputs
d. 2,040 controllers which can be any combination of access control; alarm monitoring and relay controllers

H. Head End Components

1. Controller

a. There shall be three primary types of controllers: access control, alarm monitoring and relay control.
b. The controller board shall be microprocessor-based incorporating ROM, on board battery backup RAM and a clock calendar. The ROM shall be modularly upgradeable in the field for enhancements to systems features. All power connections to the controller board shall be protected by fuses. All wiring connections to the controller board shall be screw terminals. Each door connection shall consist of terminals for two readers, one 5 amp rated form c dry output relay for lock control and one input for monitoring and status switch, a request to exit device and tamper switch. There shall be status indicator lights for active relays as well as diagnostic indicator lights to aid in system trouble shooting.
c. There shall be dedicated alarm output relays for external reporting of the following conditions: Alarm, Duress, Tamper, Trouble.
d. The controller enclosure shall be a NEMA style metal cabinet designed for surface mounting. It shall have a tamper proof removable hinge door with a high security lock.
e. The controller shall have an internal power supply that will accept 60 Hz 120V AC. The primary site of the power supply shall be protected with a fuse. The power supply shall provide 28V DC power to the controller board, internal battery charger, scrambling keypads (if applicable), selected card readers and reader interface boards.

I. Standby Battery

1. The controller shall have an internal standby battery that is capable of running the system during AC power interruption which shall be automatically recharged by a charging circuit incorporated into the controller board. This standby battery shall be capable of operating the system for 4 hours minimum.

J. Expansion Options

1. A maximum of 5 expansion boards can be installed in each controller. An interface board is included with each controller.
2. Alarm Inputs:

a. Each controller shall be capable of accepting up to 16 additional supervised alarm inputs in increments of 4 and/or 8. Alarm expansion boards shall be mounted in the controller cabinet and connect to the controller board by an expansion bus cable.

3. Relay Outputs:

a. The two access control and one alarm monitoring controller shall be capable of accepting up to 32 additional relay outputs in increments of 8. The outputs shall be used for control applications other than standard door access such as elevator floor control, local door annunciator, HVAC interface etc. The relay expansion boards shall be mounted in the control room cabinet and connect to the controller board via an expansion bus cable.

4. Code Database:

a. The controller shall be capable of expanding the code database up to a minimum of 50,000 users with the addition of a memory expansion board. The board shall be mounted in the controller cabinet connected to the controller board via an expansion bus cable.

5. Event Transaction Buffer:

a. The controller shall be capable of expanding the event transaction buffer up to a maximum 3500 alarms with in each board. The board shall be mounted in the controller cabinet and connected to the controller board via an expansion bus cable.

6. Serial Communication Interface:

a. The controller shall be capable of interfacing to a serial printer for event transaction printing or to a serial terminal for programming with the addition of a serial interface board.

K. Proximity/RFID Readers

1. The controller shall accept all of the reader technologies concurrently.

a. Proximity/RFID

2. The readers can be used for access control, alarm management and or/relay control and shall be capable of being used in combined operation with keypad and any other reader technology to operate as a dual technology reader where two valid IDs are required.
3. Proximity Card Readers:

a. The controller shall be capable of using proximity/RFID card readers that output a standard Wiegand data format. The readers can have a short or long read range and be unidirectional or bi-directional.
b. Provide a slim line reader for builders store front doors with 2" jambs.

L. Vehicle Entry Gate RFID Transmitters and Receivers

1. Transmitters and receivers shall allow for long-range, remote open functionality of vehicle gates for authorized Users.

M. PoE Power Supplies

1. Each access controlled door shall be provided with a PoE power supply, meeting the following minimum performance requirements:

    a. Input: Category 6
    b. Output: Power-over-Ethernet to devices
    c. Output Current: 1A
    d. Battery Backup
    e. UL Class 2 Listed

2. Multiple controlled doors, in close proximity to one another, may connect to the same Power Supply dependent upon available outputs and manufacturer's recommended electrical specifications.

N. PoE Switches

1. Category 6 PoE Switch

    a. IEEE 802.3af Power over Ethernet compliant
    b. 2.68Mbps throughput
    c. 3.6Gbps switching capacity
    d. Broadcast storm control capability
    e. 20MB RAM minimum
    f. Auto MDI/MDI-X capability
    g. 95W minimum PoE budget
    h. 19" rack-mountable
    i. UL listed
    j. RoHS compliant
    k. Telnet remote login capability
    l. Non-blocking architecture
    m. SNMP v1 and v2 compatibility
    n. Wirespeed performance
    o. Rapid Spanning-Tree capability
    p. WPA-PSK (AES) IEEE 802.1X RADIUS capability
    q. VLAN tagging
    r. Port mirroring
    s. Link aggregation – LACP capability
    t. SNTP capability
    u. GVRP capability

O. Telephone Entry Systems

1. Telephone Entry stations shall meet the following minimum performance requirements:

    a. Up to 1,000 4-digit entry codes
    b. Up to 8,000 device codes
    c. Single line LCD display
    d. Elevator control support
    e. PC programmable
    f. Vandal-resistant
    g. 12VAC
    h. Compatible with Cellular, VoIP, Wireless, or POTS connectivity methods
    i. Compatible with Wiegand devices

2. Telephone Entry stations shall be home run to the MDF Room via Category 6 cabling.

P. Video Intercom Systems

1. Video Intercom door stations shall meet the following minimum performance requirements:

    a. Color video CMOS camera with audio intercom
    b. Pan-Tilt-Zoom (PTZ) camera lens
    c. 2-way hands-free communication
    d. Call button to initiate calls to master station
    e. LED illuminator for low-light conditions

2. Video Intercom door stations shall connect back to the master station (and any sub-master stations as required) via 2-cnductor wiring, per manufacturer recommendations.
3. Wiring distances shall not exceed 330'.

Q. Access Control Features

1. The controller shall have the following access control features at a minimum:

    a. Restrict access by time of day, day of week, door or holiday.
    b. Momentary unlock of door.
    c. Relock of door by code, card or time zone.
    d. Door status monitoring shall allow for door forced monitoring, door open too long monitoring, door opened too long while door is unlocked, auto relock of door when open or closed.
    e. Request exit alarms and/or unlocks.
    f. Two person requirement per door.
    g. Passback control including use restriction based on status.
    h. Absentee rule limits.
    i. Temporary day limits.
    j. Occupancy counting minimum/maximum limits.
    k. Coordinate with the Owner for any other operating features required.

R. Hot Redundant CPU & Software

1. Provide a complete redundant CPU equipped with all software and hardware necessary, hot and on line, ready to take over in case of failure of the primary CPU operating system.
2. Provide a second workstation with complete operating software. Coordinate location with the Owner.

S. Fobs and Users:

1. Provide 1000 Fobs.
2. Each User shall require only a single Fob for access control.
3. Where multiple systems are utilized on the property (i.e. conventional hard-wired access control in addition to battery-operated controlled doors), coordinate to ensure single Fob compatibility between systems.

T. Pedestals

1. Provide mounting pedestals, per manufacturer recommendations, for all Proximity/RFID Readers, Telephone Entry stations, and/or Video Intercom stations located at vehicle entry gates.
2. Pedestals shall be of steel construction.

3. Style of pedestal and number of arms/face plates shall be as noted in the Drawings and Details.

U. Request-to-Exit Pushbuttons (REX's) and Passive Infrared Request-to-Exit Motion Sensors (PIR's)

1. Coordinate provision of electronic exit devices with the Door Hardware Consultant to ensure compatibility with the door's hardware set, locking devices, etc.
2. Coordinate aesthetics and mounting of electronic exit devices with the Architect prior to installation; provide slimline pushbuttons where possible.
3. Provide all electronic exit devices per applicable codes.

PART 3 EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

A. Compliance: Comply with manufacturer's product data; including product technical bulletins, product catalog, installation instructions, submittal sketches or drawings, and product carton instructions for installation.

3.02 EXAMINATION

A. Site Verification of Conditions: Verify that related conditions, including equipment that has been previously installed under other sections, are acceptable for product installation in accordance with manufacturer's instructions.

B. All devices connected to equipment specified in this section shall bear the UL, cUL, or CSA label and comply with all applicable National Electrical Code (NEC) standards.

3.03 PREPARATION

A. The electronic security contractor shall develop custom software as required to affect the functions of the system as dictated by the drawings and Specifications.

B. The electronic security contractor shall provide equipment cabinets for installation of the control equipment and cable terminations to the equipment.

C. All equipment related to the system shall be factory tested before shipment.

3.04 INSTALLATION

A. Contractor shall furnish all equipment, labor, system setup, and other services necessary for the proper installation of the products/system as indicated on the drawings and specified herein.

B. Install in accordance with manufacturer's handling and installation instructions.

C. Install in accordance with all local and pertaining codes and regulations.

D. All equipment and systems shall be installed by the ESC. Subcontracting of equipment installation shall not be permitted.

E. Equipment shall be ready to use condition at end of installation.

F. Energize equipment in accordance with manufacturer’s instructions.

3.05 PROTECTION AND CLEANING

A. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.

B. Touch up, repair, or replace damaged components before Substantial Completion.

C. Remove temporary tags, coverings, and construction debris from interior and exterior surfaces of equipment. Remove construction debris from equipment area and dispose of debris.

D. Clean integral air filters, heatsinks, grills, and fans before Substantial Completion and Commissioning Services.

3.06 WARRANTY

A. The ESC shall provide a single source warranty for all supplied equipment specified in this section to be free of defects in material and workmanship for a period of two (2) years from the date of substantial completion.

END OF SECTION

SECTION 28 16 00
INTRUSION DETECTION

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. Applicable requirements of Division 28 - Electronic Security shall be considered a part of this section and shall have the same force as if printed herein full.

B. This document describes the products and execution requirements relating to furnishing and installing Intrusion Detection System.

C. All cables and related terminations, support and grounding hardware shall be furnished, installed, wired, tested, labeled, and documented by the Contractor as detailed in this document.

D. Product specifications, general design considerations, and installation guidelines are provided in this document. The successful vendor shall meet or exceed all requirements for the system(s) described in this document and on the drawings.

E. Refer to architectural section for the Windows and Glass Specifications.

F. Intrusion Detection system shall be compatible and integrated with the components specified in Access Control System and Video Surveillance System.

1.02 SUBMITTALS

A. Provide product data from manufacturer’s specifications.

1.03 WORK INCLUDED

A. The work included under this specification consists of furnishing all labor, equipment, materials, and supplies and performing all operations necessary to complete the installation of this system. The Contractor will provide and install all of the required material to form a complete system whether specifically addressed in the Specification or not.

B. The work shall include, but not be limited to the following:

1. Furnish and install a complete intrusion detection system.
2. Furnish and install all motion detection devices.
3. Furnish and install all glass break detectors.
4. Furnish and install all duress devices.
5. Furnish and install all door and window contacts.
6. Furnish and install all horns.
7. Furnish any other material required to form a complete system.
8. Perform testing of all components.
9. Furnish test results of all cabling to the Owner on disk and paper format.
10. Provide Owner training and documentation.

11. Verify all AC power requirements for all systems and components. Confirm AC voltage and frequency of all systems and components match the facility power distribution system. Coordinate the above with Electrical Contractor.
12. Shop drawings shall include door schedule showing hardware pertaining to the security system as provided by the Contractor.
13. Shop drawings shall include window schedule showing hardware pertaining to the security system as provided by the Contractor.

PART 2 PRODUCTS

2.01 APPROVED PRODUCTS

A. Approved System Controller

1. Bosch
2. Radionics
3. Tyco Security
4. Honeywell
5. Or Approved Equal

B. Approved Input Module

1. Bosch
2. Radionics
3. Tyco Security
4. Honeywell
5. Or Approved Equal

C. Approved Output Module

1. Bosch
2. Radionics
3. Tyco Security
4. Honeywell
5. Or Approved Equal

D. Enclosures & Batteries

1. Bosch
2. Radionics
3. Tyco Security
4. Honeywell
5. Or Approved Equal

E. Approved Access Control Monitoring Software

1. Bosch
2. Radionics
3. Tyco Security
4. Honeywell
5. Lenel
6. Or Approved Equal

F. Approved Keypad

1. Bosch
2. Radionics
3. Tyco Security
4. Honeywell
5. Or Approved Equal

G. Approved Motion Detector

1. Bosch
2. Radionics
3. Tyco Security
4. Honeywell
5. Or Approved Equal

H. Approved Glass Break Device

1. Bosch
2. Radionics
3. Tyco Security
4. Honeywell
5. Or Approved Equal

I. Approved Window/Door Contact

1. Bosch
2. Radionics
3. Tyco Security
4. Honeywell
5. Or Approved Equal

J. Approved Horn

1. Bosch
2. Radionics
3. Tyco Security
4. Honeywell
5. Edwards Signaling
6. ATW Security
7. Or Approved Equal

K. Approved Duress Button

1. United Security
2. Honeywell
3. Bosch
4. Eaton/Cutler-Hammer
5. Schneider
6. Or Approved Equal

L. Approved Wiring

1. RS-485 (2-conductor, shielded, 24 AWG)

    a. Non-Plenum – Belden

b. Plenum – Belden
c. Or Approved Equal

2. Device Cable (2-conductor, shielded, 22 AWG)

a. Non-Plenum – Belden
b. Plenum – Belden
c. Or Approved Equal

3. 12 VDC Cable (2-conductor, unshielded, 18 AWG)

a. Non-Plenum – Belden
b. Plenum – Belden
c. Or Approved Equal

4. 12 VDC Cable (2-conductor, unshielded, 16 AWG)

a. Non-Plenum – Belden
b. Plenum – Belden
c. Or Approved Equal

5. Keypad & Motion Detector Cable (4-conductor, shielded, 18 AWG)

a. Non-Plenum – Belden
b. Plenum – Belden
c. Or Approved Equal

6. RS-232 (2-conductor, shielded, 24 AWG)

a. Non-Plenum – Belden
b. Plenum – Belden
c. Or Approved Equal

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

A. Install system components and appurtenances in accordance with the printed instructions.

B. Provide all necessary interconnections, services, and adjustments required for a complete and operable system.

C. Install control signal, communications, and data transmission line grounding as necessary to preclude ground loops, noise, and surges from adversely affecting system operation.

3.02 FIELD QUALITY CONTROL

A. Testing

1. All devices shall be tested for full operational compliance.
2. Testing of system shall be the sole responsibility of the Contractor.
3. Communications Tests

a. Controllers to manager server
b. Manager server to client
c. Remote dial-up support

4. Device Tests

a. All system devices requiring power shall be tested.

B. Inspection

1. Provide an on-sight, factory-trained technician to assist, advise or manage installing personnel.
2. All final connections shall be made under the direct supervision of the Systems Integrator.

C. Field Service

1. Provide first line support for both the hardware and software properties of the selected system.
2. Provided second line support directly from the manufacturer for all components and computer hardware, and all operating and application software that comprise the complete system.
3. Determine and report all problems to the manufacturer's customer service departments.
4. Support shall be available to the integrator via the following methods:

a. Phone inquiries
b. Direct dial-in to the customer system for remote system troubleshooting by a qualified Field Service Engineer
c. On-site visits if required, upon approval by the manufacturer's Customer Service Manager

3.03 LABELING

A. Label all devices with machine generated labels.

B. Label all cables at each end of each cable. Labels shall be machine generated, wrap-around type.

C. Labeling system shall designate the cable's origin and destination on each end of each distribution/horizontal cable.

3.04 FINAL ACCEPTANCE

A. Perform the following performance standards before final acceptance:

1. Operate all mechanical devices without down time for a period of 10 days.
2. Operate all electronic devices and equipment without downtime or programming problems for a period of 30 days.

3.05 WARRANTY

A. All equipment, components, etc., shall be guaranteed free of defects and any faulty workmanship for a period of one year after final acceptance.

B. The Contractor shall replace defective materials and repair faulty workmanship within 24 hours of discovery, except emergency conditions (system failures), which must be placed in service within six (6) hours after notification, all at no cost to the Owner.

END OF SECTION

SECTION 28 31 11
FIRE ALARM SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section covers the complete installation of a new automatic fire alarm system, as well as necessary materials, labor, calibration, testing and training.

B. The complete installation shall be in compliance with NFPA 70, 72, 101 (Life Safety Code) and NEC Article 760. The installation shall also comply with state and local ordinances, as well as the Americans with Disabilities Act (Public Law 101-336).

C. All equipment supplied shall be listed for the purpose and area in which it is used and installed in accordance with any instructions included in its listing.

D. All equipment must be new and bear the UL (Underwriters Laboratories Inc.) Label.

1.02 SHOP DRAWINGS

A. Fire alarm shop drawings shall contain the following:

1. Specification sheet(s) of technical data on each hardware component
2. Specification sheet(s) on wiring to be utilized
3. One-line schematic riser diagram made specifically for this job
4. Calculation for sizing batteries and power supplies
5. Sequence of operation for the entire system
6. Copy of vendor’s NICET fire alarm certificate (level III or higher)
7. Verification of central supervising station (UL Certified)
8. Equipment and service warranty
9. Scaled floor plans showing fire alarm device locations and wire routing

1.03 ACCEPTABLE MANUFACTURERS

A. Products of the following manufacturers which comply with these specifications are acceptable:

1. Honeywell – Notifier/Gamewell-FCI/Farenhyt
2. Siemens
3. E.S.T.
4. Johnson Controls - SimplexGrinnell

1.04 STORAGE AND HANDLING

A. Smoke detectors shall be covered with plastic wrapping if installed prior to the completion of painting, sanding and other work producing dust, etc.

B. The fire alarm control panel(s) shall not be installed until its designated room has been completely painted and cleaned.

PART 2 - PRODUCTS

2.01 CONTROL PANEL/SYSTEM DESCRIPTION

A. The fire alarm system shall be an electrically supervised, power limited, low voltage (24 VDC), non-coded, multiplexed, fully analog, addressable system. The fire alarm control panel shall be of modular design for ease of future system addition or modification (up to 20% additional capacity).

B. The control panel shall provide system status via an 80-character liquid crystal display and shall also have the following features:

1. Power “ON” Light Emitting Diode (LED)
2. System Reset Switch
3. System Alarm LED
4. System Trouble LED
5. Alarm Silence Display
6. Trouble Silence Display
7. Control panel shall be lockable.
8. Normally open and normally closed sets of contacts for control of remote equipment/devices.

C. Batteries shall be mounted in space provided in the fire alarm control panel. Control panel shall include automatic charging circuit to maintain battery/batteries in charged condition. Batteries may be lead acid or nicad; charging circuit shall match battery type.

D. The battery/batteries shall have sufficient ampere-hour capacity to operate the system under normal supervisory conditions with A.C. power disconnected for 24 hours, and at the end of that period to operate all alarm notification appliances for 5 minutes. For calculation purposes, all audible devices shall be tapped at a minimum of one (1) watt.

E. The system shall operate from one (1) 20-ampere, single-phase, 3-wire 120 V.A.C. circuit. The circuit breaker shall be labeled “Fire Alarm Circuit Control.”

F. The fire alarm system shall respond to a fire emergency as follows:

1. Smoke damper control and automatic shutdown of HVAC air systems shall occur upon activation of respective duct smoke detector.
2. Automatic audible/visual notification (via horns/strobes) shall be provided upon activation of a flow switch, manual station, or area smoke detector.
3. Signal output to the UL Listed central station (for fire system reporting) shall be installed in accordance to the project specifications and drawings. Communicator shall be in the FACP located in the clubhouse building. All remote building FACPs shall be connected to the communicator via fiber optic loop. Fiber shall be installed between buildings in underground conduit with tracer wire.
    a. Basic Performance:
        1) The Communicator will communicate to GSM networks in the area including 2G, 3G and 4G. The multi-GSM platform technology automatically detects and chooses the best network in the area based on signal strength and immediately self-adjusts for operation.
        2) Supervision of communication path with be monitored and automatically tested per the NFPA requirements listed below based on local NFPA adoptions:
        NFPA72 2010 GSM Single Path (cellular only) 5 minutes
        NFPA72 2013 GSM Single Path (cellular only) 1 hour
        3) Diagnostic LEDs: Signal strength and status indications.

4) All circuits shall be power-limited, per UL864 requirements.
5) In areas where the GSM network signal strength is poor or not allowed by the AHJ, a D.A.C.T. communication device (or similar UL Listed “fire” device) shall be provided in lieu of cellular communicator. Provide and install 3/4" conduit from the panel to the main telephone backboard.

4. Smoke door release (where applicable) shall occur generally throughout the entire facility.
5. Tamper switch operation shall cause a supervisory signal to indicate audibly and visually at the control panel.
6. Fire alarm system shall electrically supervise the signal boosters and batteries of the Emergency Responder Radio Coverage System (where applicable).

G. Supervision

1. Fire alarm pathways shall be Class B.
2. Pathway survivability for notification appliances shall be as follows:
   a. Pathways shall be protected from the point at which they exit the control unit until they enter the evacuation signaling zone they serve and shall meet survivability requirements Level 0 or 1.
3. Each independently supervised circuit shall include a discrete panel readout to indicate disarrangement conditions per circuit.
4. Power failures, opens, or grounds shall be audibly and visually indicated at the control panel and the remote annunciator (where applicable). A green “power on” LED shall be displayed continuously while incoming power is present.
5. Power wiring to sprinkler pipe heat tracing shall be supervised by fire alarm system.

H. Provide remote annunciator panel with 80-character liquid crystal display, audible signal and alarm/trouble lights.

I. Underground Signaling Line Circuits

1. All underground signaling line circuits (SLC) routed exterior to building shall be fiber optic cabling. Cabling shall be installed in conduit with tracer wire.

J. Transient Voltage Surge Suppression

1. Approved manufacturer/model: DITEK DTK-TSS1.
2. Provide all necessary components to provide complete protection of the control panel, data, signal, and dialer circuits/connections.
3. Surge protection shall be provided for any copper NAC, IDC and SLC circuits which are installed underground outside of a building.
4. All underground pathways entering the building to be protected by surge protectors on both ends and properly grounded.
5. Modules shall be mounted in NEMA 12 steel enclosure adjacent to FACP.

2.03 FIELD DEVICES

A. Manual Stations: Semi-flush, addressable, double action type. Station shall be constructed of high impact red polycarbonate.

B. Area Smoke Detectors: Smoke detectors shall be of the analog, addressable, photoelectric type. A pulsed diode pilot lamp, visible from the floor, shall be provided to indicate alarm

condition or component failure. Diode pilot lamp may be pulsed diode type for normal and steady for alarm trouble indication. Detectors shall be self-supervising for component failure as well as line failure. Detector failure or removal of detector shall initiate (zone) trouble signal. Detector shall be capable of monitoring 900 square feet of unobstructed area with spacing not to exceed 30 feet on center. Smoke detectors shall be ceiling mounted and shall be interconnected into alarm system to function in same manner as the manual station. Detectors shall report analog level of smoke/dirt to panel.

C. Duct Smoke Detectors: Detectors shall be of the analog, addressable, photoelectric type. The unit shall consist of a detector and an air sampling assembly housed in a casting designed for duct mounting. The sampling tubes shall extend completely across the duct. Detectors shall report analog level of smoke/dirt to panel. Where detector LEDs are concealed, not easily observable, or greater than 10' above floor, detectors shall have remote LED alarm indicators in a nearby observable location for alarm identification. Each LED shall be labeled to identify location of duct smoke detector.

D. Audible/Visual Devices: Audible/visual devices shall be horns with flashing visual appliances with the word “FIRE” written on the lens. The horns shall produce at least 15 dBa above ambient noise level. Audible and visual devices (including the combination device) shall utilize a 4" electrical backbox. Visual devices shall be multi-candela, field-selectable, with a constant flash rate of one (1) flash per second. The device color shall be white.

E. Any audible device installed in a sleeping room, including living rooms, shall have a low-frequency sounder approved for fire protective service, and shall be listed to UL 464. The device shall be powered from a notification appliance circuit output and shall operate on nominal 12 or 24 volts (includes fire alarm panels with built in sync). All notification appliances shall be backward compatible.

F. Any visual device in a sleeping area shall be minimum 110 candela, unless noted otherwise.

G. Addressable relays shall be provided as required to accomplish all mechanical systems and other related control functions.

H. Addressable input monitoring devices shall be provided as required to monitor existing water flow, tamper switch, and other devices.

I. Heat detectors shall be addressable, fixed temperature type rated at 135 degrees F, unless noted otherwise on drawings.

J. Monitoring of remote fire protection valves on site (if applicable) shall be accomplished via fire alarm system connection.

PART 3 - EXECUTION

3.01 GENERAL

A. The Contractor shall obtain approval from Owner as to the final and exact location of each control panel and remote annunciator prior to installation.

B. All wiring shall be suitably protected from damage. Wiring shall be routed within conduit where installed in the following areas:

1. Underground
2. Damp and wet locations
3. Where exposed on interior walls
4. For all input and output signal wiring for smoke exhaust (including stairwell pressurization) equipment

C. All wiring installed exposed within a plenum shall be UL Listed accordingly. Plenum rated cable shall be tied to the building structure at approximately 6'-0" on center using cable ties.

D. Conduit sleeves with bushings shall be installed for fire alarm cabling that passes through walls and floor assemblies. Seal the opening around the conduit and the hole in the conduit with a UL Listed fire rated sealant as required.

E. All detection and control wiring to mechanical smoke control systems shall be fully enclosed within continuous raceways.

F. Provide necessary programming to accomplish the indicated system operation and control functions.

G. All conduit, control wiring, power wiring, relays, and other equipment and devices required to form a complete and operational system shall be provided as part of this Contract.

H. All wiring requirements for shielding certain conductors from others or routing in separate raceways shall be as recommended by the manufacturer.

I. The Fire Alarm Contractor shall coordinate all electrical branch circuit identification requirements listed in NFPA 72, Chapter 10 with the Electrical Contractor.

3.02 WARRANTY

A. Equipment, materials, workmanship and system performance incorporated into the work shall be guaranteed for a period of one (1) year from the time the Owner receives beneficial use of the fire alarm system and the acceptance tests herein specified have been satisfactorily completed. Any defects due to faulty materials, methods or installation or workmanship within this period shall be promptly repaired or replaced.

B. Vendor shall provide pricing for system inspections for a period of four (4) additional years after the initial 12-month warranty as a bid alternate to the Owner. Provide inspections per NFPA 72 and NFPA 101.

C. Spare Parts: Provide the following spare equipment items to the Owner upon project completion:

1. Addressable modules: 2
2. Smoke detectors: 2
3. Manual stations: 2
4. Duct mounted smoke detectors: 1
5. Audible/visual devices: 4

3.03 TESTING AND CERTIFICATION

A. Testing and certification of the life safety system per NFPA 72 shall be as required by the Fire Marshal and Engineer. The Contractor shall be responsible for identifying the required

testing, coordinate scheduling, and conducting the test necessary to achieve occupancy certification, and assurance of complete system operation. The Contractor shall submit proof of complete system operation signed by the Fire Marshal to Engineer and Owner.

B. Contractor shall notify the Owner's representative in writing that the Owner is responsible for hiring a monitoring agency for remote supervision of the fire alarm system.

END OF SECTION

SECTION 31 10 00
CLEARING

PART 1 GENERAL

1.01 SUMMARY

A. Clear the site as shown on the Civil Drawings and as specified in this Section.

PART 2 PRODUCTS

2.01 MATERIALS

A. Provide materials, not specifically described but required for proper completion of the work of this Section, as selected by the Contractor subject to the approval of the Owner.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which the work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.02 PROTECTION

A. Protect existing utilities indicated or made known.

B. Protect trees and shrubs, where indicated to remain, by providing a fence around the tree or shrub of sufficient distance away and of sufficient height so trees and shrubs will not be damaged in any way as part of this Work.

C. Protection of persons and property:
   1. Barricade open depressions and holes occurring as part of this Work, and post warning lights on property adjacent to or with public access.
   2. Operate warning lights during hours from dusk to dawn each day and as otherwise required.
   3. Protect structures, utilities, sidewalks, pavements and other facilities from damage caused by settlement, lateral movement, undermining, washout and other hazards created by operations under this Section.

D. Use means necessary to prevent dust becoming a nuisance to the public, to neighbors and to other work being performed on or near the site.

E. Maintain access to the site at all times.

3.03 CLEARING

A. In areas that are to be excavated, clean out roots one inch in diameter and larger to a depth of at least 12 inches below the existing ground surface or subgrade of new graded surface, whichever is lower. Treat roots remaining in the soil with a weed killer approved by the Owner.

3.04 DISPOSAL

A. General:
   1. Remove brush, grass, roots, trash, and other material from clearing operations.
   2. Dispose of all debris away from the site in a legal manner.
   3. Do not store or permit debris to accumulate on the job site.

B. If permitted by the Owner, debris may be burned in conformance with the requirements of local governmental agencies.

3.05 UTILITIES

A. Coordinate with utility companies and agencies as required.

B. Where utility cutting, capping or plugging is required, perform such work in accordance with requirements of the utility or governmental agency having jurisdiction.

END OF SECTION

SECTION 31 21 13
RADON MITIGATION

PART 1 GENERAL

1.01 SUMMARY

A. Provide all work necessary to design and install a passive mitigation system to reduce and maintain indoor radon concentration levels below 4.0 picoCuries per liter (pCi/L) as specified herein and as needed for a complete and proper installation including but not limited to:
   1. Pre-mitigation radon testing
   2. Complete radon mitigation design, construction drawings, and installation, meeting the approval of the Owner, Contractor, Architect, and all governmental agencies having jurisdiction.
   3. Post mitigation radon testing.

B. Related Requirements: Provide inspections and testing in accordance with applicable U.S. Environmental Protection Agency (EPA) and ASTM International (ASTM) standards.

1.02 QUALITY ASSURANCE

A. Radon Mitigation System Provider Qualifications:
   1. Provider to meet the standards of the National Environmental Health Association (NEHA) and the National Radon Safety Board (NRSB) for radon mitigation service providers.
   2. Provider to be authorized to operate in State of Florida.
   3. System design to meet basic requirements of ASTM E1465, “Standard Practice for Radon Control Options for the Design and Construction of New Low-Rise Residential Buildings”.
   4. Equipment used in performing diagnostic testing to be calibrated at reasonable intervals by devices of accuracy traceable to either:
      a. National Bureau of Standards.
      b. Accepted values of natural physical constants.

1.03 DESIGN AND TESTING REQUIREMENTS

A. Design Requirements:
   1. Prepare design, construction and installation drawings and assemble and provide product data for construction of a passive radon mitigation system for each building. Provide plans and details indicating suction points and routing of piping to the building exterior. Indicate pipe size for each system.
   2. Prepare design narrative supporting the system design indicated in the design, construction and installation drawings. Indicate radon mitigation chosen to reduce radon concentrations below specified levels. Provide data and calculations to verify negative pressure exists throughout the soil gas to the atmosphere under all weather and building operating conditions.

B. Testing Requirements:
   1. Perform pre-mitigation testing to determine existing radon levels.
   2. Perform post mitigation radon testing in all buildings upon completion of installation of radon mitigation system. Verify radon levels are at concentrations below specified levels. Provide data, reports and logs documenting radon test results in all buildings.
   3. Post mitigation test results indicating concentrations above specified radon levels will require system modifications by the mitigation system provider to achieve results below these levels.

1.04 SUBMITTALS

A. Provide complete construction and installation drawings and submittals, prepared by the certified radon mitigation provider, for review and approval of the Owner, Contractor, Architect and all governmental agencies having jurisdiction. Submittals to include:
   1. Certification of radon mitigation system provider's qualifications.
   2. Radon mitigation system construction and installation drawings.
   3. Product data for system components.
   4. Design narrative supporting the system design indicated in the construction and installation drawings.
   5. Test reports indicating pre-mitigation and post mitigation radon levels.
   6. System maintenance data.
   7. As-built drawings indicating variations, if any, between construction drawings and actual system installation.

PART 2 PRODUCTS

2.01 SYSTEM PERFORMANCE

A. Radon mitigation systems shall reduce and maintain radon concentration levels below 4.0 picoCuries per liter (pCi/L) at all buildings after installation of the mitigation systems.

2.02 SYSTEM COMPONENTS

A. Poly vinyl chloride (PVC) piping: ASTM D2665, Schedule 40, size to be determined by system design requirements

B. Gravel: 1/2" to 3/4" clean with no fines.

C. Vapor retarder: See Section 07190 for vapor retarder sheeting.

D. Accessories: Provide sealants, fittings and flashings required for the installation of a complete system

PART 3 EXECUTION

3.01 SYSTEM INSTALLATION

A. Provide radon mitigation systems as indicated in the approved design drawings and as required by the specifications and standards referenced herein.

B. Install piping plumb and parallel to enclosure walls, partitions and ceilings and secure in place in a rigid and substantial manner.

C. Seal and firestop all penetrations, cracks and openings around floor and wall penetrations. Insure all penetrations to the building exterior are weathertight.

D. Layout all work in advance. Exercise care where cutting, channeling, chasing or drilling floors, walls, partitions, ceilings, or other surfaces as necessary for proper installation, support or anchorage. Patch and repair any damage using skilled workmen in the trade involved.

3.02 FIELD QUALITY CONTROL

A. Supervision: Installation of the systems shall be supervised by a certified radon mitigation system provider.

B. Inspection: All systems shall be inspected by a certified radon mitigation system provider. Verify all penetrations are sealed and firestopped. Deficiencies shall be corrected by the mitigation system provider.

C. Post mitigation testing: Prior to building occupancy, perform post mitigation radon testing in all buildings as specified herein.

3.03 ADJUSTMENTS

A. Where post mitigation testing indicates concentrations above 4.0 picoCuries per liter (pCi/L), modify system as required to achieve results below these levels prior to building occupancy.

3.04 MAINTENANCE

A. Provide maintenance data and instruct the Owner’s personnel in the proper maintenance of all installed systems.

3.05 AS-BUILT DRAWINGS

A. Provide as-built drawings documenting any variations between construction and installation drawings and actual system installation.

END OF SECTION

SECTION 31 23 01
EXCAVATING, BACKFILLING, AND COMPACTING FOR STRUCTURES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Section includes the excavation, backfilling and compacting required for the structures shown in the Contract Drawings.

1.2 RELATED SECTIONS

A. Section 01 33 30 – Submittal Procedures.

1.3 REFERENCES

A. ASTM D422 – Standard Test Method for Particle-Size Analysis of Soils.

B. ASTM D698 – Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3).

C. ASTM D1556 – Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.

D. ASTM D1586 – Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils.

E. ASTM D3017 – Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

F. ASTM D4318 – Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

1.4 DEFINITIONS

A. Granular subbase: Granular fill directly beneath slabs-on-grade.

B. Backfill: Fill immediately behind foundation elements or retaining walls.

C. Structural fill: Fill under the structure other than the granular subbase.

1.5 SUBMITTALS

A. Upon request, submit soil test reports performed by the Structural Testing/Inspection Agency.

1.6 QUALITY ASSURANCE

A. Structural Testing/Inspection Agency shall perform the following quality related items:

1. Verify structural fill complies with specifications.
2. Determine particle size, liquid limit, plastic limit, plasticity index and maximum density of each type of soil.
3. Observe proofrolling.
4. Perform a sufficient number of field density tests to verify compaction of structural fill. As a minimum, perform one test per lift for every 2500 square feet of fill placed.
5. Verify foundation bearing capacity.
6. Verify quantities of material removed and quantities of material placed where Unit Prices are involved.

1.7 SURVEY

A. Prior to construction, have structure location staked and certified by a licensed surveyor. If discrepancies between actual lines and elevations exist, notify Design Professional before proceeding with layout of structure.

1.8 SUBSURFACE CONDITIONS

A. Copies of a subsurface investigation of the site will be made available upon request. The data is not intended as a representation or warranty of the continuity of such conditions. Owner will not be responsible for interpretation or conclusions drawn therefrom by the Contractor. The data is made available for the convenience of the Contractor and is not guaranteed to represent all conditions that may be encountered.

B. Contractor may examine the site and make his own subsurface explorations at no additional cost to the Owner. Notify Owner prior to making any subsurface explorations.

1.9 EXISTING UTILITIES

A. Locate existing underground utilities by careful hand excavation. If utilities are to remain in place, provide protection from damage during construction operations.

B. Cooperate with Owner and utility companies in keeping respective services and facilities in operation. Do not interrupt existing utility service facilities occupied and used by Owner or others, unless written permission is given by the Design Professional and then only after temporary utility services have been provided.

C. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, consult the Design Professional immediately for directions.

D. Repair damaged utilities to satisfaction of utility owner.

1.10 NOTICE

A. Notify the Design Professional 48 hours prior to the beginning of any excavation work.

PART 2- PRODUCTS

2.1 GRANULAR SUBBASE

A. Granular subbase shall be sound and free-draining, such as sand, gravel or crushed stone with less than 10% passing the 200 sieve. Maximum diameter shall be 1-1/2 inches.

2.2 BACKFILL

A. Backfill shall meet the requirements of the granular subbase.

2.3 STRUCTURAL FILL

A. Structural fill shall be silty sand, clay, silty clay, or sandy clay with a plasticity index of less than 30.

B. Structural fill shall be free of organics, debris and deleterious materials.

PART 3 - EXECUTION

3.1 STRIPPING

A. Strip vegetation, topsoil, roots, and other unsuitable material to a depth determined by the Structural Testing/Inspection Agency but not less than one foot, nor less than 10 feet outside the perimeter of the structure.

B. Stockpile sufficient amounts of topsoil as required to cover areas to be landscaped with a minimum of six inches of material.

3.2 EXCAVATION

A. Excavation shall be considered unclassified.

B. Perform excavation to the depths and limits on the Drawings and as specified herein.

C. Do not excavate to full depth when there is probability of frost forming or ground freezing in excavation before concrete is placed.

D. Ground water may be encountered during the foundation excavation. Provide a system for controlling the ground water to a level at least three feet below the lowest point of the excavation.

E. Keep excavations dry by sloping ground away from holes and trenches.

3.3 PROOFROLLING

A. After stripping or excavation and before any fill placement, fill areas shall be proofrolled with a minimum of two coverages of a loaded dump truck or scraper in each of two perpendicular directions.

B. Areas found to be soft or pumping shall have the soft soil removed and replaced with structural fill and compacted as outlined herein.

3.4 PLACEMENT OF STRUCTURAL FILL

A. Do not place structural fill on subgrade that contains frost, mud or is frozen.

B. Structural fill shall be placed and compacted in 8-inch thick loose layers.

C. Compact structural fill to 95 percent of the maximum dry density as measured by Standard Proctor, ASTM D698, with water content within 3 percent of the optimum moisture content. The upper 2 feet of fill beneath foundations or slab should be compacted to 98 percent.

3.5 PLACEMENT OF GRANULAR SUBBASE

A. Do not place granular subbase on subgrade that contains frost, mud or is frozen.

B. Compact granular subbase to 95 percent of the maximum dry density as measured by Standard Proctor, ASTM D698, with the water content within +3 percent of the optimum moisture content.

3.6 PLACEMENT OF BACKFILL

A. Backfill behind wall shall be placed in layers of six inches.

B. Compact backfill behind walls to 95 percent of the maximum dry density as measured by Standard Proctor, ASTM D698, with water content within +3 percent of the optimum moisture content.

3.7 CLEAN UP

A. Remove excess excavated materials from job site and upon completion leave site in clean condition.

END OF SECTION

SECTION 31 31 16
TERMITE CONTROL

PART 1 GENERAL

1.01 SUMMARY

A. Provide pre-construction application of termiticide for the control of termite infestations in an around structures and construction as shown on the Drawings, as specified herein and as needed for a complete and proper installation.

1.02 SUBMITTALS

A. Toxicant manufacturer's instructions: Indicate chemical to be used and application instructions.

B. Provide EPA Registration Numbers for products used.

C. Provide termite letter for each residential unit at time of closing.

1.03 PROJECT CONDITIONS

A. Scheduling:
1. Make application during normal working hours.
2. Allow not less than 12 hours for drying after application before covering treated area.

B. Post signs in areas of application, warning that soil treatment has been applied. Remove signs before treated areas are covered by other construction.

1.04 QUALITY ASSURANCE

A. Use applicator company specializing in performing the work of this Section licensed by the state where the project is located.

B. Conform to applicable codes, EPA regulations, and federal, state and local regulations.

C. Qualification of toxicant: Toxicant shall be acceptable to Forest Service of the U.S. Department of Agriculture, Division of Forest Research for use in controlling termite infestation of buildings, without being injurious to plant life.

1.05 WARRANTY

A. Warrant effectiveness for ten year period without additional cost to Owner during warranty period. Warranty shall be in form of insurance policy, written in amount of Fifty Thousand Dollars ($50,000.00) for damages to building and contents.

B. State dates of application and chemicals used, include quantities and concentrations.

C. Provide renewable warranty on year-to-year basis at end of one year period, at Owner's option, for fee agreed upon at renewal.

D. Make retreatment at no charge to Owner, upon evidence of subterranean termite activity.

PART 2 PRODUCTS

2.01 MATERIALS

A. Acceptable products:
   1. Product specified as standard of quality is Premise Pre-Construction manufactured by Bayer Environmental Science.
   2. Products and manufacturers listed below meeting indicated standards and specified manufacturer's product data characteristics are acceptable for use, subject to approval by Owner:
      a. Termidor manufactured by BASF Corporation.
      b. Cyper TC manufactured by Control Solutions, Inc.
      c. Transport manufactured by FMC Corporation.

B. Other mixtures of above chemicals or use with or use of other chemicals not specified are prohibited.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

B. Verify that soil surfaces are not frozen, sufficiently dry to absorb toxicant, and ready to receive treatment.

C. Verify that the area is well ventilated.

D. Verify that anticipated weather conditions comply with label recommendations prior to application.

3.02 PREPARATION

A. Remove all non-essential wood and material containing cellulose from around foundation walls, crawl spaces and porches.

B. Repair faulty plumbing to eliminate termite access to moisture.

C. Refer to manufacturer's instructions on package label.

D. Mix products with water to produce the emulsions on the job site.

3.03 APPLICATION

A. Apply in accordance with manufacturer's instructions. Soil treatment when soil is wet is prohibited. Avoid flow of toxicant from treated surfaces.

B. Remove and handle all termiticide containers as per label instructions after application.

E. Re-treat area if movement of soil is required.

3.04 PROTECTION OF FINISHED WORK

A. Cover treated soil with a waterproof barrier if slab will not be poured the same day as treatment.

B. Keep all personnel off of the treated area until completely dry.

END OF SECTION

SECTION 32 84 00
IRRIGATION

PART 1 GENERAL

1.01 SUMMARY

A. Provide landscape irrigation system as shown on the drawings, as specified herein and as needed for a complete and proper installation.

B. Related Requirements: Provide inspections and testing in accordance with applicable U.S. Environmental Protection Agency (EPA) and ASTM International (ASTM) standards.

1.02 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

1.03 SUBMITTALS

A. Provide complete installation shop drawings and submittals, prepared by the irrigation system installer, for review and approval of the Owner, Contractor, and Architect.

PART 2 PRODUCTS

2.01 MATERIALS

A. Acceptable manufacturers:
1. Hunter Industries.
2. Rain Bird Corporation.
3. The Toro Company.

B. Components:
1. Pipe:
   a. PVC complying with ASTM D2411; solvent weld sockets
   b. ABS complying with ASTM D2282; solvent weld sockets.
2. Fittings: Type and style of connection to match pipe.
3. Outlets: Brass or bronze construction.
4. Rotors and spray heads:
   a. Rotary sprinkler head: Fixed/pop-up type with screens.
   b. Spray type sprinkler head: Fixed surface/pop-up head with adjustable spray pattern.
5. Drip irrigation: Black poly tubing with drip emitters.
6. Valves: Type recommended by system manufacturer.
7. Backflow preventer: Type recommended by system manufacturer and as required by local governing agencies.
8. Irrigation meter: Provide separate irrigation system meter as required by local governing agencies.
9. Controller: Programmable, multi-zone controller.
10. Accessories: Provide all accessories required as needed for a complete and proper installation.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

B. Piping layout indicated in the drawings for irrigation mains is diagrammatic. Route piping to avoid plants and structures.

3.02 INSTALLATION

A. Install pipe, valves, controls and outlets in accordance with manufacturer's instructions.

B. Set sprinkler heads and box covers at finish grade elevations.

3.03 BACKFILLING

A. Prior to backfilling, test system for leakage for whole system to maintain 100 psi pressure for one hour.

B. Provide 3" cover over piping. Backfill and compact to subgrade elevation.

END OF SECTION

SECTION 32 90 00
LANDSCAPE

1.01 SUMMARY

A. Provide trees, plants and ground cover as shown on the drawings, as specified herein and as needed for a complete and proper installation.

B. Related Documents: See landscape drawings for complete planting requirements and specifications.

1.02 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. All plant material shall conform to the standards indicated in Grades and Standards of Nursery Plants published by the AAN.

C. Related Documents: See landscape drawings for complete planting requirements and specifications.

1.03 WARRANTY

A. Provide one year warranty from date of final acceptance including coverage of plants from death or unhealthy conditions.

B. Related Documents: See landscape drawings for complete warranty requirements.

PART 2 PRODUCTS

2.01 MATERIALS

A. Required plant material:
1. Trees and shrubs.
2. Groundcover.
3. Grasses.
4. Seasonal color and annuals.

B. Other materials:
1. Topsoil.
2. Fertilizer.
3. Soil amendments.
4. Mulch.
5. Provide other materials not specifically described but required for a complete and proper installation.

C. Related Documents: See landscape drawings for complete material requirements

PART 3 EXECUTION

3.01 INSTALLATION AND MAINTENANCE

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

B. Related Documents: See landscape drawings for complete installation and maintenance requirements.

END OF SECTION