

## **SECTION 01 1000**

### **SUMMARY**

#### **PART I - GENERAL**

##### **I.1 RELATED DOCUMENTS**

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

##### **I.2 SUMMARY**

- A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Work under separate contracts.
4. Access to site.
5. Coordination with occupants.
6. Work restrictions.
7. Specification and drawing conventions.

- B. Related Requirements:

- I. Division I Section "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

##### **I.3 PROJECT INFORMATION**

- A. Project Identification: The Village at Oakview, Virginia, Project #: TVO-1460.00.MF.09155.

- B. Project Locations: 2 story buildings along Oakview Ave., Bristol, Virginia.

- C. Developer: Bristol Community Development owned by Bristol Redevelopment & Housing Authority, 809 Edmond Street, Bristol, Virginia 24201.

- I. Developer's Representative and Contracting Officer: Todd Musick. VP Capital Investments, Bristol Redevelopment and Housing Authority, 809 Edmond Street, Bristol, Virginia 24201, Fax: (276) 642-2009.

- D. Owner: Village at Oakview L.L.C.

- E. Construction Manager: Bristol Redevelopment & Housing Authority, 809 Edmond Street, Bristol, Virginia 24201.

- I. Construction Manager for this Project is the Developer's Representative. The terms "Construction Manager" and "Contracting Officer" are synonymous.

- F. Architect / Engineer: Thompson & Litton, 100 Fifth Street, Suite 400, Bristol, Tennessee, 37620, Phone (423) 989-9491, Fax: (423) 989-9010

#### 1.4 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of Project is defined by the Contract Documents and consists of the following:
- I. The construction of 17 two story buildings on the recently demolished Bonham Circle development 4.43 acre site. The buildings are a combination of 2 bedroom duplexes and 3 bedroom quadplexes, which total 48 rental units. Universally Design features are incorporated into 24 of the rental units. Site grading, new utilities, asphalt parking lot with concrete curb, bus shelter, playground, landscaping, and community/ mailbox shelter are also part of the project scope. The project is subject to compliance with HUD, VHDA, and Earthcraft requirements.

B. Type of Contract:

- I. Project will be constructed under a single prime contract.

#### 1.5 WORK UNDER SEPARATE CONTRACTS

- A. General: Cooperate fully with separate contractors so work on those contracts may be carried out smoothly, without interfering with or delaying work under this Contract or other contracts. Coordinate the Work of this Contract with work performed under separate contracts.

#### 1.6 ACCESS TO SITE

- A. General: Contractor shall have full use of Project site for construction operations as indicated on Drawings by the Property Lines and as indicated by requirements of this Section.
- B. Use of Site: Limit use to Project site to work in areas indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
- I. Limits: Confine construction operations to immediately adjacent to the apartment units.
  - II. Driveways, Walkways and Entrances: Keep driveways and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.
    - a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
    - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

#### 1.7 WORK RESTRICTIONS

- A. Work Restrictions, General: Comply with restrictions on construction operations.
- I. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.
- B. On-Site Work Hours:
- I. Limit work, mobilization and demobilization on the site to 7:00 a.m. to 7:00 p.m., Monday through Friday, unless otherwise indicated.

- C. Existing Utility Interruptions: Do not interrupt utilities serving adjacent facilities or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:
  - I. Notify Owner not less than two days in advance of proposed utility interruptions.
  - 2. Obtain Owner's written permission before proceeding with utility interruptions.
- D. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption with Owner.
  - I. Notify Owner not less than two days in advance of proposed disruptive operations.
  - 2. Obtain Owner's written permission before proceeding with disruptive operations.
- E. Nonsmoking Building: Smoking is not permitted within the building or within **25 feet** of entrances, operable windows, or outdoor-air intakes.
- F. Controlled Substances: Use of tobacco products and other controlled substances on Project site is not permitted.
- G. Employee Identification: Owner will provide identification tags for Contractor personnel working on Project site. Require personnel to use identification tags at all times.
- H. Employee Screening: Comply with Owner's requirements for drug and background screening of Contractor personnel working on Project site.
  - I. Maintain list of approved screened personnel with Owner's representative.

#### I.8 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
  - I. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
  - 2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division I General Requirements: Requirements of Sections in Division I apply to the Work of all Sections in the Specifications.
- C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
  - I. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
  - 2. Abbreviations: Materials and products are identified by abbreviations scheduled on Drawings.

#### PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01100

**SECTION 01 2200**  
**UNIT PRICES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Measurement and payment criteria applicable to Work performed under a unit price payment method.

**1.02 COSTS INCLUDED**

- A. Unit Prices included on the Bid Form shall include full compensation for all required labor, products, tools, equipment, plant, transportation, services and incidentals; erection, application or installation of an item of the Work; overhead and profit.

**1.03 UNIT QUANTITIES SPECIFIED**

- A. Quantities indicated in the Bid Form are for bidding and contract purposes only. Quantities and measurements of actual Work will determine the payment amount.
- B. Removal and replacement of materials shall be performed only when directed and documented by the testing laboratory service or the Engineer of Record.

**1.04 MEASUREMENT OF QUANTITIES**

- A. Contractor shall submit measurements and compute quantities. Measurements and quantities may be verified by Architect.

**1.05 PAYMENT**

- A. Payment for Work governed by unit prices will be made on the basis of the actual measurements and quantities of Work that is incorporated in or made necessary by the Work and accepted by the Architect, multiplied by the unit price.
- B. Payment will not be made for any of the following:
  1. Products determined as unacceptable before or after placement.
  2. Products remaining on hand after completion of the Work.
  3. Loading, hauling, and disposing of rejected Products.

**1.06 DEFECT ASSESSMENT**

- A. Replace Work, or portions of the Work, not conforming to specified requirements.
- B. The authority of Architect to assess the defect and identify payment adjustment is final.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION - NOT USED**

**END OF SECTION 01 2200**

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**SECTION 01 2300**  
**ALTERNATES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Procedures for pricing Deductive Alternate #1.

**1.02 ACCEPTANCE OF ALTERNATES**

- A. Deductive Alternate #1 quoted on Bid Forms will be reviewed and accepted or rejected at Owner's option. Accepted Alternates will be identified in the Owner-Contractor Agreement.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION - NOT USED**

**END OF SECTION 01 2300**

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**SECTION 01 3000**  
**ADMINISTRATIVE REQUIREMENTS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Electronic document submittal service.
- B. Preconstruction meeting.
- C. Progress meetings.
- D. Construction progress schedule.
- E. Progress photographs.
- F. Coordination drawings.
- G. Submittals for review, information, and project closeout.
- H. Number of copies of submittals.
- I. Submittal procedures.

**1.02 PROJECT COORDINATION**

- A. Project Coordinator: Architect.
- B. During construction, coordinate use of site and facilities through the Project Coordinator.
- C. Comply with Project Coordinator's procedures for intra-project communications; submittals, reports and records, schedules, coordination drawings, and recommendations; and resolution of ambiguities and conflicts.
- D. Comply with instructions of the Project Coordinator for use of temporary utilities and construction facilities.
- E. Coordinate field engineering and layout work under instructions of the Project Coordinator.
- F. Make the following types of submittals to Architect:
  - 1. Requests for interpretation.
  - 2. Requests for substitution.
  - 3. Shop drawings, product data, and samples.
  - 4. Test and inspection reports.
  - 5. Manufacturer's instructions and field reports.
  - 6. Applications for payment and change order requests.
  - 7. Progress schedules.
  - 8. Coordination drawings.
  - 9. Closeout submittals.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION**

**3.01 ELECTRONIC DOCUMENT SUBMITTAL SERVICE**

- A. In addition to the paper copies mentioned in other section, All documents transmitted for purposes of administration of the contract are to be in electronic (PDF) format and transmitted via an Internet-based submittal service that receives, logs and stores documents, provides electronic stamping and signatures, and notifies addressees via email.
  - 1. Besides submittals for review, information, and closeout, this procedure applies to requests for information (RFIs), progress documentation, contract modification documents (e.g. supplementary instructions, change proposals, change orders), applications for payment, field reports and meeting minutes, and any other document any participant wishes to make part of the project record.
  - 2. Contractor and Architect are required to use this service.
  - 3. It is Contractor's responsibility to submit documents in PDF format.

4. Subcontractors, suppliers, and Architect's consultants will be permitted to use the service at no extra charge.
  5. Users of the service need an email address, Internet access, and PDF review software that includes ability to mark up and apply electronic stamps (such as Adobe Acrobat, www.adobe.com, or Bluebeam PDF Revu, www.bluebeam.com), unless such software capability is provided by the service provider.
  6. Paper document transmittals will not be reviewed; emailed PDF documents will not be reviewed.
  7. All other specified submittal and document transmission procedures apply, except that electronic document requirements do not apply to samples or color selection charts.
- B. Submittal Service: The selected service is:
1. Submittal Exchange (tel: 1-800-714-0024): [www.submittalexchange.com](http://www.submittalexchange.com).
- C. Training: One, one-hour, web-based training session will be arranged for all participants, with representatives of Architect and Contractor participating; further training is the responsibility of the user of the service.
1. Representatives of Owner are scheduled and included in this training.
- D. Project Closeout: Architect will determine when to terminate the service for the project and is responsible for obtaining archive copies of files for Owner.

### **3.02 PRECONSTRUCTION MEETING**

- A. Architect will schedule a meeting after Notice of Award.
- B. Attendance Required:
  1. Owner.
  2. Architect.
  3. Contractor.
  4. Earthcraft Representative.
- C. Agenda:
  1. Execution of Owner-Contractor Agreement.
  2. Submission of executed bonds and insurance certificates.
  3. Distribution of Contract Documents.
  4. Submission of list of Subcontractors, list of Products, schedule of values, and progress schedule.
  5. Designation of personnel representing the parties to Contract, \_\_\_\_\_ and Architect.
  6. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
  7. Scheduling.
- D. Record minutes and distribute copies within two days after meeting to participants, with one copy to Architect, Owner, participants, and those affected by decisions made.

### **3.03 PROGRESS MEETINGS**

- A. Schedule and administer meetings throughout progress of the Work at maximum monthly intervals.
- B. Make arrangements for meetings, prepare agenda with copies for participants, preside at meetings.
- C. Attendance Required: Job superintendent, major Subcontractors and suppliers, Owner, Architect, as appropriate to agenda topics for each meeting.
- D. Agenda:
  1. Review minutes of previous meetings.
  2. Review of Work progress.
  3. Field observations, problems, and decisions.
  4. Identification of problems that impede, or will impede, planned progress.
  5. Review of submittals schedule and status of submittals.

6. Review of off-site fabrication and delivery schedules.
  7. Maintenance of progress schedule.
  8. Corrective measures to regain projected schedules.
  9. Planned progress during succeeding work period.
  10. Maintenance of quality and work standards.
  11. Effect of proposed changes on progress schedule and coordination.
  12. Other business relating to Work.
- E. Record minutes and distribute copies within two days after meeting to participants, with one copy to Architect, Owner, participants, and those affected by decisions made.

### **3.04 CONSTRUCTION PROGRESS SCHEDULE**

- A. Within 10 days after date of the Agreement, submit preliminary schedule defining planned operations for the first 60 days of Work, with a general outline for remainder of Work.
- B. Within 20 days after review of preliminary schedule, submit draft of proposed complete schedule for review.
- C. Within 10 days after joint review, submit complete schedule.
- D. Submit updated schedule with each Application for Payment.

### **3.05 PROGRESS PHOTOGRAPHS**

- A. Submit photographs with each application for payment, taken not more than 3 days prior to submission of application for payment.
- B. Photography Type: Digital; electronic files and photographer quality prints.
- C. Provide photographs of site and building construction throughout progress of Work.
- D. In addition to periodic, recurring views, take photographs of each of the following events:
  1. Foundations in progress and upon completion.
  2. Structural framing in progress and upon completion.
  3. Enclosure of building, upon completion.
  4. Building elements prior to concealment of those elements.

### **3.06 COORDINATION DRAWINGS**

### **3.07 SUBMITTALS FOR REVIEW**

- A. When the following are specified in individual sections, submit them for review:
  1. Product data.
  2. Shop drawings.
  3. Samples for selection.
  4. Samples for verification.
- B. Submit to Architect for review for the limited purpose of checking for conformance with information given and the design concept expressed in the contract documents.
- C. Samples will be reviewed only for aesthetic, color, or finish selection.
- D. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below and for record documents purposes described in Section 01 7800 - Closeout Submittals.

### **3.08 SUBMITTALS FOR INFORMATION**

- A. When the following are specified in individual sections, submit them for information:
  1. Design data.
  2. Certificates.
  3. Test reports.
  4. Inspection reports.
  5. Manufacturer's instructions.
  6. Manufacturer's field reports.
  7. Other types indicated.

- B. Submit for Architect's knowledge as contract administrator or for Owner.

### **3.09 SUBMITTALS FOR PROJECT CLOSEOUT**

- A. When the following are specified in individual sections, submit them at project closeout:
1. Project record documents.
  2. Operation and maintenance data.
  3. Warranties.
  4. Bonds.
  5. Other types as indicated.
- B. Submit for Owner's benefit during and after project completion.

### **3.10 NUMBER OF COPIES OF SUBMITTALS**

- A. Documents: Submit one electronic copy in PDF format; an electronically-marked up file will be returned. Create PDFs at native size and right-side up; illegible files will be rejected.
- B. Documents for Review:
1. Small Size Sheets, Not Larger Than 8-1/2 x 11 inches: Submit the number of copies that Contractor requires, plus two copies that will be retained by Architect.
  2. Larger Sheets, Not Larger Than 30 x 42 inches: Submit two reproducible opaques .
- C. Samples: Submit the number specified in individual specification sections; one of which will be retained by Architect.
1. Retained samples will not be returned to Contractor unless specifically so stated.

### **3.11 SUBMITTAL PROCEDURES**

- A. Shop Drawing Procedures:
1. Prepare accurate, drawn-to-scale, original shop drawing documentation by interpreting the Contract Documents and coordinating related Work.
  2. Do not reproduce the Contract Documents to create shop drawings.
  3. Generic, non-project specific information submitted as shop drawings do not meet the requirements for shop drawings.
- B. Transmit each submittal with a copy of approved submittal form.
- C. Sequentially number the transmittal form. Revise submittals with original number and a sequential alphabetic suffix.
- D. Identify Project, Contractor, Subcontractor or supplier; pertinent drawing and detail number, and specification section number, as appropriate on each copy.
- E. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of Products required, field dimensions, adjacent construction Work, and coordination of information is in accordance with the requirements of the Work and Contract Documents.
- F. Schedule submittals to expedite the Project, and coordinate submission of related items.
- G. For each submittal for review, allow 15 days excluding delivery time to and from the Contractor.
- H. Identify variations from Contract Documents and Product or system limitations that may be detrimental to successful performance of the completed Work.
- I. Provide space for Contractor and Architect review stamps.
- J. When revised for resubmission, identify all changes made since previous submission.
- K. Distribute reviewed submittals as appropriate. Instruct parties to promptly report any inability to comply with requirements.
- L. Submittals not requested will not be recognized or processed.
- M.

**END OF SECTION 01 3000**

**SECTION 01 3300**  
**SUBMITTAL PROCEDURES**

**PART I - GENERAL**

**I.1 RELATED DOCUMENTS**

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

**I.2 SUMMARY**

- A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.
- B. Related Requirements:

**I.3 DEFINITIONS**

- A. Action Submittals: Written and graphic information and physical samples that require Architect and Construction Manager's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."
- B. File Transfer Protocol (FTP): Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.
- C. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

**I.4 ACTION SUBMITTALS**

- A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and Construction Manager and additional time for handling and reviewing submittals required by those corrections.

I. Format: Arrange the following information in a tabular format:

- a. Scheduled date for first submittal.
- b. Specification Section number and title.
- c. Submittal category: Action; informational.
- d. Name of subcontractor.
- e. Description of the Work covered.
- f. Scheduled date for Architect and Construction Manager's final release or approval.
- g. Scheduled date of fabrication.

- h. Scheduled dates for purchasing.
- i. Scheduled dates for installation.
- j. Activity or event number.

## 1.5 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

- A. Architect's Digital Data Files: Electronic digital data files of the Contract Drawings will be provided by Architect for Contractor's use in preparing submittals.
  - I. Architect will furnish Contractor one set of digital data drawing files of the Contract Drawings for use in preparing Shop Drawings and Project record drawings.
    - a. Architect makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.
    - b. Digital Drawing Software Program: The Contract Drawings are available in AutoCAD Architecture 2010.
    - c. Contractor shall execute a data licensing agreement in the form of Agreement form acceptable to Owner and Architect..
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
  - I. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
  - 2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
  - 3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
  - 4. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
    - a. Architect and Construction Manager reserve the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect and Construction Manager's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
  - I. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect and Construction Manager will advise Contractor when a submittal being processed must be delayed for coordination.
  - 2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
  - 3. Resubmittal Review: Allow 15 days for review of each resubmittal.
  - 4. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect, Construction Manager and to Architect's consultants, allow 15 days for review of each submittal. Submittal will be returned to Architect before being returned to Contractor.
- D. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:

- I. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
  2. Name file with submittal number or other unique identifier, including revision identifier.
    - a. File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., LNHS-06100.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., LNHS-06100.01.A).
  3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect and Construction Manager.
  4. Transmittal Form for Electronic Submittals: Use electronic form acceptable to Owner, containing the following information:
    - a. Project name.
    - b. Date.
    - c. Name and address of Architect and Construction Manager.
    - d. Name of Contractor.
    - e. Name of firm or entity that prepared submittal.
    - f. Names of subcontractor, manufacturer, and supplier.
    - g. Category and type of submittal.
    - h. Submittal purpose and description.
    - i. Specification Section number and title.
    - j. Specification paragraph number or drawing designation and generic name for each of multiple items.
    - k. Drawing number and detail references, as appropriate.
    - l. Location(s) where product is to be installed, as appropriate.
    - m. Related physical samples submitted directly.
    - n. Indication of full or partial submittal.
    - o. Transmittal number, numbered consecutively.
    - p. Submittal and transmittal distribution record.
    - q. Other necessary identification.
    - r. Remarks.
  5. Metadata: Include the following information as keywords in the electronic submittal file metadata:
    - a. Project name.
    - b. Number and title of appropriate Specification Section.
    - c. Manufacturer name.
    - d. Product name..
- E. Options: Identify options requiring selection by Architect.
- F. Deviations and Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect and Construction Manager on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.
- G. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
  1. Note date and content of previous submittal.
  2. Note date and content of revision in label or title block and clearly indicate extent of revision.

3. Resubmit submittals until they are marked with approval notation from Architect and Construction Manager's action stamp.
- H. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- I. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect and Construction Manager's action stamp.

## PART 2 - PRODUCTS

### 2.I SUBMITTAL PROCEDURES

- A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
  - I. Submit electronic submittals via email as PDF electronic files.
    - a. Architect and Construction Manager will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.
    - a. Action Submittals: Submit three paper copies of each submittal unless otherwise indicated. Architect and Construction Manager will return two copies.
  2. Certificates and Certifications Submittals: Provide a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
    - a. Provide a digital signature with digital certificate on electronically submitted certificates and certifications where indicated.
    - b. Provide a notarized statement on original paper copy certificates and certifications where indicated.
- B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
  - I. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
  2. Mark each copy of each submittal to show which products and options are applicable.
  3. Include the following information, as applicable:
    - a. Manufacturer's catalog cuts.
    - b. Manufacturer's product specifications.
    - c. Standard color charts.
    - d. Statement of compliance with specified referenced standards.
    - e. Testing by recognized testing agency.
    - f. Application of testing agency labels and seals.
    - g. Notation of coordination requirements.
    - h. Availability and delivery time information.
  4. For equipment, include the following in addition to the above, as applicable:
    - a. Wiring diagrams showing factory-installed wiring.

- b. Printed performance curves.
  - c. Operational range diagrams.
  - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
5. Submit Product Data before or concurrent with Samples.
  6. Submit Product Data in the following format:
    - a. PDF electronic file.
    - b. Three paper copies of Product Data unless otherwise indicated. Architect and Construction Manager will return two copies.
- C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data, unless submittal based on Architect's digital data drawing files is otherwise permitted.
- I. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
    - a. Identification of products.
    - b. Schedules.
    - c. Compliance with specified standards.
    - d. Notation of coordination requirements.
    - e. Notation of dimensions established by field measurement.
    - f. Relationship and attachment to adjoining construction clearly indicated.
    - g. Seal and signature of professional engineer if specified.
  2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least **8-1/2 by 11 inches**, but no larger than **30 by 42 inches**.
  3. Submit Shop Drawings in the following format:
    - a. PDF electronic file.
- D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
- I. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
  2. Identification: Attach label on unexposed side of Samples that includes the following:
    - a. Generic description of Sample.
    - b. Product name and name of manufacturer.
    - c. Sample source.
    - d. Number and title of applicable Specification Section.
    - e. Specification paragraph number and generic name of each item.
  3. For projects where electronic submittals are required, provide corresponding electronic submittal of Sample transmittal, digital image file illustrating Sample characteristics, and identification information for record.
  4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.

- a. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
- 5. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
  - a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.
- E. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
  - 1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
  - 2. Manufacturer and product name, and model number if applicable.
  - 3. Letter designation of building.
  - 4. Location on building.
  - 5. Submit product schedule in the following format:
    - a. PDF electronic file.
    - b. Three paper copies of product schedule or list unless otherwise indicated. Architect and Construction Manager will return two copies.
- F. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Division I Section "Closeout Procedures."
- G. Maintenance Data: Comply with requirements specified in Division I Section "Operation and Maintenance Data."
- H. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
- I. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
- J. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- K. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

### PART 3 - EXECUTION

#### 3.I CONTRACTOR'S REVIEW

- A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect and Construction Manager.

- B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

### 3.2 ARCHITECT AND CONSTRUCTION MANAGER'S ACTION

- A. General: Architect and Construction Manager will not review submittals that do not bear Contractor's approval stamp and will return them without action.
- B. Action Submittals: Architect and Construction Manager will review each submittal, make marks to indicate corrections or revisions required, and return it. Architect and Construction Manager will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action.
- A. Informational Submittals: Architect and Construction Manager will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect and Construction Manager will forward each submittal to appropriate party.
- B. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.
- C. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- D. Submittals not required by the Contract Documents may be returned by the Architect without action.

END OF SECTION 01330

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**SECTION 01 3329**  
**SUSTAINABLE DESIGN REPORTING**

**PART 1 GENERAL**

**1.01 PROJECT GOALS**

- A. This project has been registered and designed to achieve the Earthcraft Virginia Multifamily V4 Platinum rating as defined in the ECMF V4 2014 Guidelines. The Earthcraft Multifamily Project Worksheet is included for the Contractor to reference in order to ensure that the project is in compliance. The ECMF 2014 Technical Guidelines are included in the Project Manual as Appendix-One.
- B. Contractor is not responsible for the application for certification, nor for determination of methods of achieving sustainable design credits unless specifically so indicated.
- C. Many of the sustainable design credits can be achieved only through intelligent design of the project and are beyond the control of the Contractor. However, certain credits relate to the products and procedures used for construction. Therefore, the full cooperation of the Contractor and subcontractors is essential to achieving final certification.
- D. Contractor shall familiarize himself with the relevant requirements and provide the necessary information and instruction to all subcontractors and installers.
- E. Since Contractor and subcontractors may not be familiar with sustainable design requirements, this section includes a summary of the products and procedures intended to achieve sustainable design credits.
  - 1. Some credits are dependent on proper performance by Contractor and subcontractors.

**1.02 RELATED REQUIREMENTS**

- A. Section 01 3000 - Administrative Requirements: Additional submittal requirements.
- B. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

**1.03 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for additional submittal procedures.
- B. Sustainable Design Documentation: The scope of required documentation is specified in some individual specification sections; other scope is specified in this section and its related forms only.
- C. New Product Documentation: For each new product in the Product Reporting Scope, submit the Material Content Form, with evidence of compliance attached.

**1.04 ELECTRONIC DOCUMENT SUBMITTAL SERVICE**

- A. Sustainable design documentation is to be in electronic (PDF) format and transmitted via an Internet-based submittal service that receives, logs and stores documents, notifies participants, and provides electronic submission to the certifying agency.
  - 1. The types of submittals for which this service must be used include those for credits that relate to materials, and any others designated by Architect.
  - 2. For credits for which achievement requires substantiation of material type, quantity, and cost, submit receipts showing purchase of materials for this project.
  - 3. Contractor and Architect are required to use this service.
  - 4. It is Contractor's responsibility to submit documents in PDF format.
  - 5. Subcontractors, suppliers, and Architect's consultants will be permitted to use the service at no extra charge.
  - 6. Users of the service need an email address, Internet access, and PDF review software that includes ability to mark up and apply electronic stamps (such as Adobe Acrobat, [www.adobe.com](http://www.adobe.com), or Bluebeam PDF Revu, [www.bluebeam.com](http://www.bluebeam.com)), unless such software capability is provided by the service provider.
  - 7. Paper document transmittals will not be reviewed; emailed PDF documents will not be reviewed.

8. All other specified submittal and document transmission procedures apply, except that electronic document requirements do not apply to samples or color selection charts.
- B. Submittal Service: The selected service is:
  1. Submittal Exchange (tel: 1-800-714-0024): [www.submittalexchange.com..](http://www.submittalexchange.com..)

## **PART 2 PRODUCTS (NOT USED)**

## **PART 3 EXECUTION**

### **3.01 PROCEDURES**

- A. All sustainable design documentation is to be submitted by Contractor, using the procedures defined for Submittals for Information in Section 01 3000.
- B. Use of electronic submittal service specified in this section is required.
- C. Submit sustainable design documentation to Architect, unless otherwise indicated.

### **3.02 DIVISION 1 - GENERAL REQUIREMENTS**

- A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions: List of indoor-emissions-restricted products and VOC-content-restricted products, requirements, evidence required, and reporting.

**END OF SECTION 01 3329**

	Points	Planned	Status	Documentation
<b>SITE PLANNING (SP)</b>				
<b>SP1: SITE SELECTION</b>				
<b>OPTIONAL AT ALL LEVELS</b>				
<b>SP 1.0</b> Type of site:			Select all that apply:	
1. Brownfield site	3			
2. Previously developed site	1	1		
3. Infill site			Select one:	
A. >50%	1			
B. >75%	2			
<b>SP 1.1</b> Dwelling units per acre:			Select one:	
1. ≥ 15 dwelling units per acre	1			
2. ≥ 20 dwelling units per acre	2			
3. ≥ 25 dwelling units per acre	3			
<b>SP 2: SITE DESIGN</b>				
<b>OPTIONAL AT ALL LEVELS</b>				
<b>SP 2.0</b> Connectivity to existing:			Select One:	
1. Walking distance to bus line ( $\leq 1/4$ mile)	2	2		
A. Existing	1			
B. Planned				
2. Walking distance to rail/rapid transit ( $\leq 1/2$ mile)			Select One:	
A. Existing	3			
B. Planned	1			
3. Biking distance to bike path ( $\leq 1/2$ mile)			Select One:	
A. Existing	2			
B. Planned	1			
4. Walking distance to public openspace or greenspace $\geq 3/4$ acre in size ( $\leq 1/2$ mile)			Select One:	
A. Existing	2			
B. Planned	1			
5. Walking distance to mixed uses ( $\leq 1/4$ mile)			Select One:	
A. 6 or more mixed uses	2			
B. 4 or more mixed uses	1			
<b>SP 2.1</b> Shade at least 50% of hardscape within 30' of building	2			
<b>SP 2.2</b> Reduce light pollution - all exterior lights full cutoff	4	4		
<b>SP 2.3</b> Permanent stormwater control:			Select one:	
A. $\geq 25\%$ of onsite impervious surface areas	2			
B. $\geq 50\%$ of onsite impervious surface areas	3			
C. $\geq 75\%$ of onsite impervious surface areas	4			
<b>SP 2.4</b> Pervious paving for hardscapes and surface parking with appropriate sublayers	4			
<b>SP 2.5</b> Protect and restore riparian, wetland, and shoreline buffers	2			
<b>SP 2.6</b> Street Trees are $\leq 40'$ on center at minimum	1			
<b>SP 2.7</b> Connectivity to adjacent sites:			Select all that apply:	
1. Vehicular access (2+ connections)	1			
2. Dedicated pedestrian and bike access	1			
<b>SP 2.8</b> Community Gardens	1			
<b>SP 2.9</b> Outdoor Community gathering space	2	2		
<b>SP 2.10</b> Install local endangered plant species on site to promote ecological productivity	1			
<b>SP 2.11</b> Install plant species that serve as pollinators on site for regional wildlife	1			
<b>SP 2.12</b> Parking reduced below local ordinance (1:1 ratio)	1			Local ordinance
<b>SP 3: SITE PREPARATION AND PRESERVATION MEASURES</b>				
<b>REQUIRED AT ALL LEVELS</b>				
<b>SP 3.0</b> Workshop on erosion and sediment control	-	-		Certificate
<b>SP 3.1</b> Site assessment identifying all greenspace and tree save potential	-	-		Greenspace/Tree survey
<b>SP 3.2</b> Erosion and sedimentation control plan	-	-		E&S plan
<b>SP 3.3</b> Do not install invasive plants on site	-	-		Plant list
<b>SP 3.4</b> Comply with all federal, state, and local government erosion control and tree protection measures	-	-		
<b>SP 3.5</b> Phase I environmental testing and remediation plan (if applicable)	-	-		Phase I
<b>SP 3.6</b> On-call personnel designated for erosion control during rain events	-	-		Contact Person
<b>SP 3.7</b> Downstream water quality testing (if applicable)	-	-		Test data
<b>SP 3.8</b> Label all storm drains or storm inlets to discourage dumping of pollutants	-	-		Photographs
<b>SP 3.9</b> Road/vehicle cleaning protocols posted and enforced	-	-		Photographs
<b>OPTIONAL AT ALL LEVELS</b>				
<b>SP 3.10</b> Tree preservation and protection measures employed on site	2	2		
<b>SP 3.11</b> Leave site undisturbed and protect greenspace from future development (min 25%)	2			
<b>SP 3.12</b> Mill cleared logs (100%)	1			Contract
<b>SP 3.13</b> Grind stumps and limbs for mulch ( $\geq 80\%$ )	1	1		Photographs
<b>SP 3.14</b> Tree planting (12 trees per acre; trees $\geq 3"$ diameter)	2			Site plan
<b>SP 4: ALTERNATIVE TRANSPORTATION ACCOMODATIONS</b>				
<b>OPTIONAL AT ALL LEVELS</b>				
<b>SP 4.0</b> Bike racks	1	1		
<b>SP 4.1</b> Covered bike storage facility	1	1		
<b>SP 4.2</b> Tenant access to business center	1			
<b>SP 4.3</b> Covered bus stop	2	2		
<b>SITE PLANNING TOTAL</b>			18	0
<b>CONSTRUCTION WASTE MANAGEMENT (CW)</b>				
<b>REQUIRED AT ALL LEVELS</b>				
<b>CW 1.0</b> No construction materials burned or buried on site	-	-		
<b>CW 1.1</b> Only state-approved landfills may be utilized	-	-		

<b>OPTIONAL AT ALL LEVELS</b>			
<b>CW 1.2</b> Post waste management plan and divert 75% from landfill of:	Select all that apply:		
1. Wood	2	2	
2. Cardboard	1	1	
3. Metal (including beverage containers)	1	1	
4. Drywall (recycle or grind and spread on site)	2	2	
5. Plastic (including beverage containers)	1	1	
6. Shingles	2	2	
CONSTRUCTION WASTE MANAGEMENT TOTAL		9 0	
<b>RESOURCE EFFICIENCY (RE)</b>			
<b>RE 1: RESOURCE EFFICIENT DESIGN</b>			
<b>REQUIRED AT ALL LEVELS</b>			
<b>RE 1.0</b> Limit framing at all windows and doors	-	-	
<b>RE 1.1</b> Engineered roof framing (90%)	-	-	
<b>REQUIRED AT PLATINUM AND GOLD, OPTIONAL AT CERTIFIED</b>			
<b>RE 1.2</b> Advanced Framing:	Select all that apply:		
1. 2-stud corners where structurally feasible	3	3	
2. Ladder T-walls where structurally feasible	2	2	
3. Size headers for loads (non-structural headers in non-load bearing walls)	1	1	
<b>OPTIONAL AT ALL LEVELS</b>			
<b>RE 1.3</b> Average floor area of unit:	Select one:		
A. < 800 square feet	2		
B. 800-1100 square feet	1		
<b>RE 1.4</b> Floor joists are 24" on center ( $\geq 80\%$ )	1		
<b>RE 1.5</b> Non-load bearing wall studs are 24" on center	1		
<b>RE 2: ADVANCED FRAMING PRODUCTS</b>			
<b>OPTIONAL AT ALL LEVELS</b>			
<b>RE 2.0</b> Precast insulated foundation walls ( $\geq 90\%$ )	2		
<b>RE 2.1</b> Insulated concrete forms or precast autoclaved aerated concrete ( $\geq 90\%$ ):	Select all that apply:		
1. Foundation walls	2		
2. Exterior walls	3		
<b>RE 2.2</b> Engineered wall framing ( $\geq 90\%$ )	1		
<b>RE 2.3</b> Deliver panelized construction or SIPs to the site pre-framed ( $\geq 90\%$ ):	Select all that apply:		
1. Floors	2		
2. Exterior walls	2		
3. Roof	2		
4. Modular construction	2		
<b>RE 2.4</b> Structural headers are steel or engineered wood ( $\geq 90\%$ )	2	2	
<b>RE 3: LOCAL, RECYCLED AND/OR NATURAL CONTENT MATERIALS</b>			
<b>OPTIONAL AT ALL LEVELS</b>			
<b>RE 3.0</b> Use recycled concrete or alternate material as aggregate in foundation	1		Product literature
<b>RE 3.1</b> Replace $\geq 25\%$ of cement in concrete with fly ash or slag:	Select all that apply:		Product literature
1. Slab and/or foundation walls (100%)	1	1	
2. Exterior cladding and trim ( $\geq 75\%$ )	1		
<b>RE 3.2</b> Sustainably harvested, FSC certified:	Select all that apply:		Product literature
1. Lumber ( $\geq 50\%$ )	2		
2. Lumber/millwork: use no tropical wood	2		
<b>RE 3.3</b> Use building materials extracted, processed and manufactured $\leq 500$ miles from site (1 point per product maximum 5 points)	1-5	2	Product literature
<b>RE 3.4</b> Reused, recycled, MDF with no added urea-formaldehyde, local species or FSC certified wood in all:	Select all that apply:		Product literature
1. Cabinet faces	2		
2. Countertops	2		
<b>RE 3.5</b> Exterior cladding and trim ( $\geq 25\%$ recycled content material on $\geq 75\%$ area)	2		Product literature
<b>RE 3.6</b> Insulation ( $\geq 25\%$ recycled content material)	1		Product literature
<b>RE 3.7</b> Flooring:	Select all that apply:		Product literature
1. Cork, natural linoleum, sealed concrete or bamboo flooring ( $\geq 20\%$ of total floor area)	2		
2. Recycled content tiles ( $\geq 30\%$ recycled content material on 100% of tile floor area)	2		
3. Carpet ( $\geq 50\%$ recycled content material on $\geq 50\%$ of all carpeted floor area)	1		
4. Biodegradable carpet and backing ( $\geq 50\%$ of all carpeted floor area)	2		
<b>RE 3.8</b> Engineered trim:	Select all that apply:		Product literature
1. Interior ( $\geq 80\%$ )	1		
2. Exterior, including soffit, fascia and trim ( $\geq 75\%$ )	1	1	
<b>RE 3.9</b> Roofing material ( $\geq 50\%$ recycled content material on $\geq 90\%$ area)	2		Product literature
<b>RE 4: BUILDING REUSE</b>			
<b>RE 4.0</b> Gut Rehab (project exposing wall cavities or removing exterior cladding) or Adaptive Reuse (for adaptive reuse see addendum to worksheet)	8		
RESOURCE EFFICIENCY TOTAL		12 0	
<b>DURABILITY AND MOISTURE MANAGEMENT (DU)</b>			
<b>DU 1: PRODUCTS AND APPLICATIONS</b>			
<b>REQUIRED AT ALL LEVELS</b>			
<b>DU 1.0</b> All roof valleys direct water away from walls, dormers, chimneys, etc.	-	-	
<b>DU 1.1</b> Install drainage plane per manufacturer's specifications	-	-	
<b>DU 1.2</b> Integrate drainage plane with:	All must comply:		
1. Window and door pan flashing at sills and side flashing	-	-	
2. Window and door head/top flashing	-	-	

<b>DU 1.3</b>	Double layer of building paper or housewrap behind cementitious stucco, stone veneer or synthetic stone veneer on framed walls	-	-	
<b>DU 1.4</b>	Roof gutters discharge water ≥5' from foundation	-	-	
<b>DU 1.5</b>	Flashing:	All must comply:		
	1. Self-sealing bituminous membrane or equivalent at valleys and roof deck penetrations	-	-	
	2. Step and kick-out flashing at wall/roof and wall/porch intersections, flashing ≥4" on wall surface and integrated with wall and roof/deck/porch drainage planes	-	-	
<b>DU 1.6</b>	Continuous foundation termite flashing (Required if slab edge is insulated)	-	-	
<b>DU 1.7</b>	Maintain 2" clearance between wall siding and roof surface	-	-	
<b>DU 1.8</b>	Install air conditioner condensing unit pad	-	-	
<b>DU 1.9</b>	Roof drip edge with ≥1/4" overhang	-	-	
<b>DU 1.10</b>	Drain pan for water heaters and washing machines	-	-	
<b>REQUIRED AT PLATINUM, OPTIONAL AT GOLD AND CERTIFIED</b>				
<b>DU 1.11</b>	Enclosed crawlspace, if applicable to design	2		
<b>DU 1.12</b>	Moisture-resistant wallboard in bathrooms	2	2	
<b>OPTIONAL AT ALL LEVELS</b>				
<b>DU 1.13</b>	Alternative termite treatment with no soil pretreatment	2	2	
<b>DU 1.14</b>	Non-toxic pest treatment:	Select all that apply:		
	1. All lumber in contact with foundation (≥36" above foundation)	1	1	
	2. All lumber	2		
	3. Mold inhibitor with warranty applied to all lumber	1		
<b>DU 1.15</b>	Vented rain screen behind exterior cladding	2		
<b>DU 1.16</b>	Install termite mesh system	3		
<b>DU 1.17</b>	Exterior cladding (≥75% facade) with 30-year warranty	2		Warranty
<b>DU 1.18</b>	Windows, doors and skylights with ≥25-year warranty	1	1	Warranty
<b>DU 1.19</b>	Insulate cold water pipes ≥R-2	1	1	
<b>DU 1.20</b>	All entrance doors have overhang ≥3' depth	1	1	
<b>DU 1.21</b>	Roofing warranty:	Select one:		
	1. ≥40-year	1	1	
	2. ≥50-year	2		
<b>DU 2: MOISTURE MANAGEMENT</b>				
<b>REQUIRED AT ALL LEVELS</b>				
<b>DU 2.0</b>	Gravel bed (57's, no fines) beneath sub-grade slabs, on grade slabs, or raised slabs	-	-	
<b>DU 2.1</b>	100% coverage of ≥6mil vapor barrier beneath all slabs, in all crawlspaces	-	-	Photographs
<b>DU 2.2</b>	Foundation drain on top of sub-grade footing	-	-	Photographs
<b>DU 2.3</b>	Patio slabs, walks and driveways sloped ≥1/4" per 1' away from building for ≥10' or to the edge of the surface, whichever is less	-	-	
<b>DU 2.4</b>	Final site grade sloped ≥1/2" per 1' away from home for ≥10' or to the edge of the site, whichever is less	-	-	
<b>DU 2.5</b>	Do not install wet or water-damaged building materials	-	-	
<b>DU 2.6</b>	Capillary break between foundation and framing at exterior walls	-	-	
<b>DU 2.7</b>	Drainage board and damp proofing for below-grade walls	-	-	
<b>DU 2.8</b>	Design for or install additional dehumidification:	Select one:		
	1. Rough-in electrical plumbing for dehumidifier	-	-	
	2. Install whole-house ENERGY STAR dehumidifier	-	-	
<b>REQUIRED AT PLATINUM AND GOLD, OPTIONAL AT CERTIFIED</b>				
<b>DU 2.9</b>	Foundation drain at outside perimeter edge of footing surrounded with 6" clean gravel and fabric filter	2	2	Photographs
<b>OPTIONAL AT ALL LEVELS</b>				
<b>DU 2.10</b>	Slab and crawlspace vapor barrier ≥10 mil or reinforced	1	1	
<b>DU 2.11</b>	Humidistat or thermistat used with whole-house variable speed cooling system	2		Product literature
<b>DU 2.12</b>	Capillary break:	Select all that apply:		
	1. Between ground/footing or footing/foundation	2		
	2. Between foundation and framing for all walls	1	1	
<b>DURABILITY AND MOISTURE MANAGEMENT TOTAL</b>				
		13	0	
<b>INDOOR AIR QUALITY (IAQ)</b>				
<b>IAQ 1: COMBUSTION SAFETY</b>				
<b>REQUIRED AT ALL LEVELS</b>				
<b>IAQ 1.0</b>	No unvented combustion fireplaces, appliances, or space heaters	-	-	
<b>IAQ 1.1</b>	No atmospherically vented water heaters or furnaces	-	-	
<b>IAQ 1.2</b>	Sealed-combustion or electric water heater, must be installed in conditioned space	-	-	
<b>IAQ 1.3</b>	Carbon monoxide detector required if combustion appliances exist (one per bedroom)	-	-	
<b>IAQ 2: INDOOR POLLUTANT CONTROL</b>				
<b>REQUIRED AT ALL LEVELS</b>				
<b>IAQ 2.0</b>	Protect all ducts until floor/wall finishing is complete	-	-	
<b>IAQ 2.1</b>	Filter(s) easily accessible for property maintenance to service	-	-	
<b>IAQ 2.2</b>	Provide rodent and corrosion proof screens with mesh ≤0.5" for all openings not fully sealed or caulked	-	-	
<b>IAQ 2.3</b>	All outdoor supply air crosses filter prior to distribution	-	-	
<b>IAQ 2.4</b>	All interior paints are ≤ 100g/L VOC content	-	-	Product literature
<b>IAQ 2.5</b>	No carpet in below grade units	-	-	
<b>REQUIRED AT PLATINUM AND GOLD, OPTIONAL AT CERTIFIED</b>				
<b>IAQ 2.6</b>	Filters are ≥ MERV 6	1	1	Product literature
<b>REQUIRED AT PLATINUM, OPTIONAL AT GOLD AND CERTIFIED</b>				
<b>IAQ 2.7</b>	Certified low or no VOC materials:	Select all that apply:		
	1. Interior paints	1	1	
	2. Stains and finishes on wood floors	2	2	
	3. Sealants and adhesives	2	2	
	4. Carpet	1	1	
	5. Carpet pad	1	1	

<b>6.</b> Carpet pad adhesive	2	2	
<b>IAQ 2.8</b> Protect all bath fans until floor/wall finishing is complete	1	1	
<b>IAQ 2.9</b> Flush home before occupancy	1	1	
<b>OPTIONAL AT ALL LEVELS</b>			
<b>IAQ 2.10</b> No added urea-formaldehyde:	Select all that apply		
1. Insulation	1	1	
2. Subfloor	1	1	
3. All cabinets, shelves, and countertops	2	2	
<b>IAQ 2.11</b> Seal all particle board surfaces with water-based sealant	1		
<b>IAQ 2.12</b> No carpet in all units	3		
<b>IAQ 2.13</b> No carpet in main living area of all units	1		
<b>IAQ 2.14</b> Permanent walk-off mats installed at each entry	1		
INDOOR AIR QUALITY TOTAL	16	0	
<b>HIGH PERFORMANCE BUILDING ENVELOPE (BE)</b>			
<b>REQUIRED AT ALL LEVELS</b>			
<b>BE 0.1</b> IECC adopted by jurisdiction plus applicable state amendments	-	-	
<b>BE 0.2</b> Certified level projects must achieve a confirmed HERS Index $\leq 80$	-	-	
<b>BE 0.3</b> Gold level projects must achieve a confirmed HERS Index of $\leq 75$	-	-	
<b>BE 0.4</b> Platinum level projects must achieve a confirmed HERS Index of $\leq 70$	-	-	
<b>BE 1: AIR SEALING MEASURES</b>			
<b>REQUIRED AT ALL LEVELS - DESIGN FOR UNIT COMPARTMENTALIZATION</b>			
<b>BE 1.0</b> Vapor barriers installed under slabs and crawls only and not on any vertical surfaces	-	-	
<b>BE 1.1</b> Seal bottom plates to subfloor or foundation for entire unit envelope	-	-	
<b>BE 1.2</b> Block and seal joists cavities:	All must comply:		
1. Above supporting walls at cantilevered floors	-	-	
2. Under attic kneewalls	-	-	
<b>BE 1.3</b> Block stud cavities at change in ceiling height	-	-	
<b>BE 1.4</b> Install blocking and baffles in insulated and vented attics	-	-	
<b>BE 1.5</b> Seal penetrations through:	All must comply:		
1. Foundations and exterior wall assemblies	-	-	
2. Top and bottom plates	-	-	
3. Band and rim joists	-	-	
4. Insulated subfloor	-	-	
5. Sheathing	-	-	
6. Walls and ceilings in attached garages	-	-	
7. All ceilings	-	-	
<b>BE 1.6</b> Seal penetrations around:	All must comply:		
1. Shower, sinks, toilets and tub drains	-	-	
2. HVAC supply and return boots sealed to subfloor or drywall (floor, walls, or ceilings)	-	-	
3. Window and door rough openings	-	-	
4. All drywall penetrations (common walls between attached units included)	-	-	
5. Exhaust fans to drywall	-	-	
6. Attic pull-down stairs, scuttle holes and kneewall doors	-	-	
7. Chases	-	-	
<b>BE 1.7</b> Seal seams and gaps in:	All must comply:		
1. Band joist sheathing	-	-	
2. Exterior wall sheathing	-	-	
3. All seams in SIP's	-	-	
<b>BE 1.8</b> Install rigid air barriers:	All must comply:		
1. Behind tubs and showers on insulated walls	-	-	
2. At attic kneewall on attic-side (including skylight shafts)	-	-	
3. At chases in contact with the building envelope (including fireplace chases)	-	-	
4. Along staircases on insulated walls	-	-	
5. Along porch roofs	-	-	
6. At dropped ceiling/soffit	-	-	
7. At all band joists above unit separation walls	-	-	
<b>BE 1.9</b> Install weather-stripping at:	All must comply:		
1. All exterior doors (if not included in door assembly)	-	-	
2. Attic kneewall doors, scuttle holes and pull down stairs	-	-	
<b>BE 1.10</b> All recessed can lights must be air tight, gasketed at all floors and also IC-rated in insulated ceilings; in Climate Zone 4, insulate exterior surface of fixture to $\geq R-10$	-	-	
<b>BE 1.11</b> Fire rated assemblies that do not use draft block in band areas must comply with Air Tight Drywall approach	-	-	
<b>BE 1.12</b> Units adjacent to fire walls or CMU walls with an air gap assembly must follow Air Tight Drywall approach	-	-	
<b>REQUIRED AT PLATINUM AND GOLD, OPTIONAL AT CERTIFIED</b>			
<b>BE 1.13</b> Seal top plate to drywall at the attic level	2	2	
<b>OPTIONAL AT ALL LEVELS</b>			
<b>BE 1.14</b> Comply with Air tight drywall approach (required if band area draft blocking is not used)	4		
<b>BE 1.15</b> Gypcrete on all framed floors separating unit envelopes	1		
<b>BE 1.16</b> Two pour application of gypcrete to include areas blocked by drywall	1		
<b>BE 1.17</b> Firewalls/party walls that eliminate air gap (UL 370 or equivalent)	2	2	
<b>BE 1.18</b> No recessed can lights installed	2	2	
<b>BE 2: BLOWER DOOR TEST</b>			
<b>REQUIRED AT ALL LEVELS</b>			
<b>BE 2.0</b> Air Changes per Hour $\leq 6 \text{ ACH}_{50}$	-	-	
<b>REQUIRED AT PLATINUM AND GOLD, OPTIONAL AT CERTIFIED</b>			
<b>BE 2.1</b> Air Changes per Hour $\leq 5 \text{ ACH}_{50}$	7	7	
<b>OPTIONAL AT ALL LEVELS</b>			

<b>BE 2.2</b> Air Changes per Hour $\leq$ 3 ACH50	10		
<b>BE 3: INSULATION</b>			
<b>REQUIRED AT ALL LEVELS</b>			
<b>BE 3.0</b> Floors:	All must comply:		
1. Framed $\geq$ R-19	-	-	
2. Cantilevered $\geq$ R-30	-	-	
3. Podium/Elevated Slab $\geq$ R-19	-	-	
<b>BE 3.1</b> Walls:	All must comply:		
1. Exterior walls and band joists $\geq$ R-13	-	-	
2. Elevator walls adjacent to dwelling units $\geq$ R-13	-	-	
3. Foundation walls $\geq$ R-10 continuous or $\geq$ R-13 cavity Climate Zone 2/3 $\geq$ R-5 continuous or $\geq$ R-13 cavity Climate Zone 4 $\geq$ R-10 continuous or $\geq$ R-13 cavity	-	-	
<b>BE 3.2</b> Ceilings/Roof:	All must comply:		
1. Vented Flat: Climate Zone 4 $\geq$ R-38	-	-	
2. Continuous Roof Deck: Climate Zone 4 $\geq$ R-20	-	-	
3. Sloped: Climate Zone 4 $\geq$ R-38	-	-	
<b>BE 3.3</b> Attic/Roof:	All must comply:		
1. Install wind baffles at eaves in every vented bay, or equivalent air barrier at edge of ceiling	-	-	
2. Energy heel trusses or raised top plate	-	-	
3. Attic platforms allow for full-depth insulation below	-	-	
<b>BE 3.4</b> Attic kneewall:	All must comply:		
1. Doors $\geq$ R-19	-	-	
2. Insulation and attic-side air barrier $\geq$ R-19	-	-	
<b>BE 3.5</b> Attic pull-down/ scuttle hole $\geq$ R-38	-	-	
<b>BE 3.6</b> When installing loose-fill attic insulation, card and rulers must be installed	-	-	
<b>BE 3.7</b> Steel framed buildings require thermal break $\geq$ R-7.5	-	-	
<b>BE 3.8</b> Grade II insulation quality at all building envelope locations	-	-	
<b>BE 3.9</b> Slab edge insulation $\geq$ R-10	-	-	
<b>BE 3.10</b> Exterior band areas have interior air barrier meeting required insulation values	-	-	
<b>REQUIRED AT PLATINUM AND GOLD, OPTIONAL AT CERTIFIED</b>			
<b>BE 3.11</b> Insulation installation quality (floors, walls and ceilings):	Select one:		
1. Grade I	3		
2. Grade II with insulated sheathing $\geq$ R-3 (100%)	2		
<b>BE 3.12</b> Corners $\geq$ R-6	1	1	
<b>BE 3.13</b> Headers $\geq$ R-3	1	1	
<b>BE 3.14</b> Fiberglass batts are unfaced/friction fit	1		
<b>OPTIONAL AT ALL LEVELS</b>			
<b>BE 3.15</b> Insulate with foam applied insulation:	Select all that apply:		
1. Exterior walls including band area	4	4	
2. Floor system over crawlspace or basement	2		
<b>BE 3.16</b> Walls:	Select all that apply:		
1. Seal and insulate crawlspace walls $\geq$ R-10 continuous	2		
2. Insulate unfinished basement walls instead of ceiling	1		
3. Insulate basement walls with continuous insulation	2		
4. Insulate exterior walls and band joist $\geq$ R-19	2		
5. Insulate exterior walls and band joist $\geq$ R-20 or $\geq$ R-13 cavity plus R-5 insulated sheathing	3	3	
<b>BE 3.17</b> Continuous exterior insulation:	Select one:		
1. $\geq$ R-3	5		
2. $\geq$ R-5	7		
<b>BE 3.18</b> Ceilings:	Select one:		
1. Flat Vented: Climate Zone 4 $\geq$ R-49	2		
2. Continuous Roof Deck: Climate Zone 4 $\geq$ R-30	2		
3. Sloped: Climate Zone 4 $\geq$ R-49	2		
<b>BE 3.19</b> Attic kneewall insulated $\geq$ R-22	2	2	
<b>BE 3.20</b> Insulate roofline $\geq$ R-30	4		
<b>BE 4: WINDOWS</b>			
<b>REQUIRED AT ALL LEVELS</b>			
<b>BE 4.0</b> Door U-factors and SHGC:	All must comply:		
1. U-factor $\leq$ 0.35	-	-	
2. SHGC $\leq$ 0.30	-	-	
<b>BE 4.1</b> Window U-factor and SHGC:	All must comply:		
1. U-factor $\leq$ 0.35	-	-	
2. SHGC $\leq$ 0.30	-	-	
<b>BE 4.2</b> Skylight U-factor and SHGC:	All must comply:		
1. U-factor $\leq$ 0.60	-	-	
2. SHGC $\leq$ 0.30	-	-	
<b>BE 4.3</b> NFRC certified doors, windows and skylights with label	-	-	
<b>REQUIRED AT PLATINUM AND GOLD, OPTIONAL AT CERTIFIED</b>			
<b>BE 4.4</b> Door U-factor:	Select all that apply:		
1. Opaque door: U factor $\leq$ 0.21	2	2	
2. Door with $\leq$ 50% glass: U-factor $\leq$ 0.27	1	1	
3. Door with $>$ 50% glass: U-factor $\leq$ 0.32	1		
<b>BE 4.5</b> Window U-factor and SHGC:	Select all that apply:		
1. U-factor $\leq$ 0.32	1	1	
2. SHGC $\leq$ 0.27	2	2	
<b>BE 4.6</b> Skylight U-factor and SHGC:	Select all that apply:		

<b>1.</b> U-factor ≤0.55	1	
<b>2.</b> SHGC ≤0.27	2	
<b>OPTIONAL AT ALL LEVELS</b>		
<b>BE 4.7</b> Window U-factor and SHGC:	Select all that apply:	
<b>1.</b> U-factor ≤0.25	2	
<b>2.</b> SHGC ≤0.24	3	
<b>BE 4.8</b> Skylight U-factor and SHGC:	Select all that apply:	
<b>1.</b> U-factor ≤0.43	2	
<b>2.</b> SHGC ≤0.24	3	
<b>BE 4.9</b> Glazing facing:	Select all that apply:	
<b>1.</b> West ≤ 2% of floor area	1	
<b>2.</b> East ≤ 3% of floor area	1	
<b>BE 4.10</b> 1.5' overhangs over ≥80% of south windows	1	
<b>BE 4.11</b> Solar shade screens (min all east and west windows)	2	
<b>BE 4.12</b> Certified passive solar design (25% load reduction)	4	
<b>BE 4.13</b> Window area is ≤15% of conditioned floor area (all units)	2	2
<b>BE 5: ROOF</b>		
<b>OPTIONAL AT ALL LEVELS</b>		
<b>BE 5.0</b> Install green roof system:	Select one:	
<b>1.</b> ≥ 20% of roof area	2	
<b>2.</b> ≥ 40% of roof area	3	
<b>3.</b> ≥ 60% or above	4	
<b>HIGH PERFORMANCE BUILDING ENVELOPE TOTAL</b>		
	43	0
<b>ENERGY EFFICIENT SYSTEMS (ES)</b>		
<b>ES 1: HEATING AND COOLING EQUIPMENT</b>		
<b>REQUIRED AT ALL LEVELS</b>		
<b>ES 1.0</b> Size and select all HVAC equipment in accordance with ACCA Manuals J and S:	All must comply:	
<b>1.</b> Complete load calculation utilizing ACCA Manual J 8th Edition Software or current ASHRAE based software (Trane Trace or Carrier HAP) and submit to EarthCraft for review prior to issuing construction drawings. Loads must include detailed inputs.	-	-
<b>2.</b> Based on worst case unit orientation per unit type	-	-
<b>3.</b> Use 2009 ASHRAE Handbook of Fundamentals Climate Design Information for outdoor design temperatures	-	-
<b>4.</b> Indoor temperatures 70°F for heating and 75° for cooling	-	-
<b>5.</b> Base infiltration on project team selected infiltration goal	-	-
<b>6.</b> Use actual area, U-factor and SHGC for windows and doors, actual area and R-values of floors, walls, and ceilings	-	-
<b>7.</b> Base mechanical ventilation on ASHRAE 62.2 or BSC-01 standard	-	-
<b>8.</b> Cooling equipment and/or single-stage heat pump between 95%-125%	-	-
<b>9.</b> Provide OEM data for each unique system type	-	-
<b>10.</b> Internal loads that reflect design and occupancy ≤2400 Btu/h	-	-
<b>ES 1.1</b> If programmable thermostat installed for heat pump, include adaptive recovery technology	-	-
<b>ES 1.2</b> AHRI performance match all indoor/outdoor coils	-	-
<b>ES 1.3</b> Non-CFC and non-HCFC refrigerant	-	-
<b>ES 1.4</b> No electric resistant heat as primary heat source or reheat	-	-
<b>ES 1.5</b> Heat pump efficiency ≥ 8.0 HSPF or equivalent COP	-	-
<b>ES 1.6</b> Furnace efficiency ≥ 90 AFUE	-	-
<b>ES 1.7</b> Cooling equipment ≥ 14 SEER or 11.5 EER	-	-
<b>REQUIRED AT PLATINUM AND GOLD, OPTIONAL AT CERTIFIED</b>		
<b>ES 1.8</b> Heating equipment efficiency:	Select one:	
<b>1.</b> ENERGY STAR qualified furnace(s) ≥90 AFUE and within 40% of load calculation	2	
<b>2.</b> ENERGY STAR qualified heat pump(s) ≥8.5 HSPF and within 25% of load calculation	2	
<b>ES 1.9</b> Verification of proper refrigerant charge with subcooling deviation ±3°F or superheat deviation ±5°F	1	1
<b>ES 1.10</b> ENERGY STAR qualified cooling equipment ≥SEER 14.5	2	2
<b>OPTIONAL AT ALL LEVELS</b>		
<b>ES 1.11</b> Variable speed blower	2	
<b>ES 1.12</b> Ground-source heat pump(s) ≥ EER 17	3	
<b>ES 1.13</b> ENERGY STAR qualified cooling equipment ≥ SEER 16	3	
<b>ES 1.14</b> Heat pump efficiency ≥9.0 HSPF	2	
<b>ES 1.15</b> Dual-stage compressors	3	
<b>ES 1.16</b> Condenser units are spaced 2 feet apart	2	2
<b>ES 1.17</b> Variable Refrigerant/Mini-Split system utilized for primary heating and cooling	6	
<b>ES 2: DUCTWORK / AIR HANDLER</b>		
<b>REQUIRED AT ALL LEVELS</b>		
<b>ES 2.0</b> Seal air handlers and duct systems with mastic	-	-
<b>ES 2.1</b> Code approved solid connector for all flex-to-flex connections	-	-
<b>ES 2.2</b> Fully duct all supply and return ducts	-	-
<b>ES 2.3</b> Duct insulation:	All must comply:	
<b>1.</b> ≥ R-4: Ducts in conditioned and interstitial spaces (between floors)	-	-
<b>2.</b> ≥ R-8: Ducts in unconditioned space	-	-
<b>ES 2.4</b> No ducts in exterior walls or vaulted ceilings and no plenum within 2' of roofline.	-	-
<b>ES 2.5</b> Locate all air handlers within conditioned space	-	-
<b>ES 2.6</b> Indoor coil protected until finished floor installed	-	-
<b>REQUIRED AT PLATINUM AND GOLD, OPTIONAL AT CERTIFIED</b>		
<b>ES 2.7</b> Install ducts per ACCA Manual D duct design	3	3
<b>ES 2.8</b> Minimize pressure imbalance within units:	Select all that apply:	
<b>1.</b> Install jumper ducts, transfer grills, or dedicated return for each room	2	2
<b>2.</b> Measured pressure differential ≤ 3pa between bedroom and return	3	3

<b>ES 2.9</b> Install rigid duct work or pull all flex ducts with no pinches and support at intervals $\leq 5'$	2	2		
<b>ES 2.10</b> Measure and balance airflow for each duct run ( $\pm 20\%$ of design)	3	3		
<b>ES 2.11</b> Verify supply and return duct static pressure	2	2		
<b>ES 2.12</b> HVAC system and ductwork is dry and clean	1	1		
<b>REQUIRED AT PLATINUM, OPTIONAL AT GOLD AND CERTIFIED</b>				
<b>ES 2.13</b> Locate entire duct system within conditioned space	5	5		
<b>OPTIONAL AT ALL LEVELS</b>				
<b>ES 2.14</b> Duct design and installation:	Select all that apply:			
1. No duct take-offs within 6" of supply plenum cap	1	1		
2. Rigid metal supply trunk line	2	2		
3. Space all supply duct take-offs $\geq 6"$ apart	1	1		
4. Install rigid circular duct as supply plenum	2	2		
<b>ES 2.15</b> Duct insulation in unconditioned spaces $\geq R-10$	1			
<b>ES 2.16</b> Return plenum duct take-off free area is 120% of supply plenum duct take-off free area	2			
<b>ES 2.17</b> Design and construct accessible mechanical closets	2			
<b>ES 3: DUCT LEAKAGE TEST RESULTS</b>				
<b>REQUIRED AT ALL LEVELS</b>				
<b>ES 3.0</b> Test duct leakage based on conditioned floor area (CFA):	All must comply:			
1. Leakage to outside $\leq 5\%$	-	-	Test results	
2. Total leakage $\leq 8\%$	-	-		
<b>OPTIONAL AT ALL LEVELS</b>				
<b>ES 3.1</b> Test duct leakage based on conditioned floor area (CFA):	Select all that apply:			
1. Leakage to outside $\leq 3\%$	8	8	Test results	
2. Total leakage $\leq 5\%$	8	8		
<b>ES 4: VENTILATION</b>				
<b>REQUIRED AT ALL LEVELS</b>				
<b>ES 4.0</b> Install exhaust fans in all bathrooms and duct to outside	-	-	Test results	
<b>ES 4.1</b> Gas kitchen range vented to exterior $\geq 100$ cfm fan	-	-		
<b>ES 4.2</b> Outside air ventilation strategy complies with ASHRAE 62.2-2007 or BSC-01 and must be conditioned prior to distribution	-	-		
<b>ES 4.3</b> When installed to achieve ES 4.1, design and install fresh air intakes:	All must comply:			
1. $\geq 10'$ away from exhaust outlets , vehicle idling zones, parking garages	-	-	Test results	
2. $\geq 2'$ above grade	-	-		
3. When run to soffit the duct must be extended and affixed through the soffit vent	-	-		
4. Fresh air duct may not be run to the roof	-	-		
5. Fresh air shutoff may not be controlled by humidistat	-	-		
6. Install rigid duct with insulation	-	-		
7. All intakes must be ducted to exterior of building	-	-		
<b>ES 4.4</b> Seal seams of all intake and exhaust ducts with mastic	-	-		
<b>ES 4.5</b> Duct clothes dryers to outside	-	-		
<b>ES 4.6</b> No power roof vents	-	-		
<b>ES 4.7</b> Back-draft dampers for kitchen and bathroom exhaust	-	-		
<b>REQUIRED AT PLATINUM AND GOLD, OPTIONAL AT CERTIFIED</b>				
<b>ES 4.8</b> If installed, ceiling fans must be ENERGY STAR qualified (1/bedroom and 1 in living room)	1	1	Product literature	
<b>ES 4.9</b> ENERGY STAR bath fans with properly sized ductwork and measured airflow $\geq 50$ cfm	2	2		
<b>ES 4.10</b> Electric kitchen range vented to exterior $\geq 100$ cfm fan	3	3	Test results	
<b>ES 4.11</b> Verify outdoor air supply ventilation airflow test within +/- 20% of design values	2	2	Test results	
<b>ES 4.12</b> Install and label accessible ventilation controls; with override controls for continuously operating ventilation fans	1	1		
<b>ES 4.13</b> Supply/exhaust fans rated at $\leq 3$ sones (intermittent) and $\leq 1$ sone (continuous)	1	1		
<b>REQUIRED AT PLATINUM, OPTIONAL AT GOLD AND CERTIFIED</b>				
<b>ES 4.14</b> Radon resistant construction:	Select all that apply:			
1. Passive, radon/soil gas vent system labeled on each floor	1		AHRI Certificate	
2. Radon test of building prior to occupancy	1			
<b>ES 4.15</b> Exhaust fan wired with light in bathroom	1	1		
<b>ES 4.16</b> Duct all exhaust fans with rigid duct	1	1		
<b>OPTIONAL AT ALL LEVELS</b>				
<b>ES 4.17</b> Automatic (timer and/or humidistat) bathroom exhaust fan controls	2			
<b>ES 4.18</b> Energy recovery ventilator	3			
<b>ES 4.19</b> Vent storage room to outside	1			
<b>ES 5: WATER HEATER</b>				
<b>REQUIRED AT ALL LEVELS</b>				
<b>ES 5.0</b> If gas, direct vent	-	-		
<b>ES 5.1</b> Heat trap on all storage water heaters	-	-		
<b>ES 5.2</b> Electric water heaters $\geq .93$ EF	-	-	AHRI Certificate	
<b>ES 5.3</b> Pipe insulation on first 2'	-	-		
<b>REQUIRED AT PLATINUM AND GOLD, OPTIONAL AT CERTIFIED</b>				
<b>ES 5.4</b> High efficiency water heater Energy Factor (EF):	Select one:			
1. Storage Gas $\geq .67$ EF, Electric $\geq .95$ EF	2	2	AHRI Certificate	
2. Tankless: Gas $\geq .90$ EF	3			
<b>OPTIONAL AT ALL LEVELS</b>				
<b>ES 5.5</b> Type of water heater:	Select one:			
1. Solar domestic ( $\geq 40\%$ annual load based on unit demand)	6		Product literature	
2. High efficiency tankless water heater ( $\geq .92$ EF) with insulated buffer tank	4			
3. ENERGY STAR qualified heat pump hot water heater	4			
<b>ES 5.6</b> Hot water piping insulation $\geq R-4$ (100%)	2	2		
<b>ES 6: LIGHTING/APPLIANCES</b>				
<b>REQUIRED AT ALL LEVELS</b>				

<b>ES 6.0</b>	High-efficacy lighting in 100% of all permanent fixtures	-	-		
<b>ES 6.1</b>	If installed, ENERGY STAR dishwasher	-	-		Product Literature
<b>ES 6.2</b>	If installed, ENERGY STAR refrigerator	-	-		Product Literature
<b>REQUIRED AT PLATINUM AND GOLD, OPTIONAL AT CERTIFIED</b>					
<b>ES 6.3</b>	ENERGY STAR® Advanced Lighting Package	3	3		
<b>OPTIONAL AT ALL LEVELS</b>					
<b>ES 6.4</b>	Control systems:	Select all that apply:			
	1. Automatic indoor lighting controls	2	2		
	2. Automatic outdoor lighting controls	2			
<b>ES 6.5</b>	Fixtures and bulbs:	Select one:			
	A. ENERGY STAR qualified compact fluorescent fixtures or LED bulbs (100%)	2			
	B. Ballasted compact fluorescents or LED bulbs at all recessed light fixtures	1	2		
	C. Compact fluorescent bulbs ( $\geq 90\%$ )	1			
<b>ES 7: COMMON AREA LIGHTING/APPLIANCES</b>					
<b>REQUIRED AT PLATINUM AND GOLD, OPTIONAL AT CERTIFIED</b>					
<b>ES 7.0</b>	Ballasted compact fluorescents and/or LED bulbs in all corridor/breezeway and all common spaces	2	2		
<b>ES 7.1</b>	If installed, ENERGY STAR qualified clothes washer	2	2		Product literature
<b>ES 7.2</b>	If installed, high efficiency clothes dryer with moisture sensor	2	2		Product literature
<b>OPTIONAL AT ALL LEVELS</b>					
<b>ES 7.3</b>	High Efficiency Exterior Lighting:	Select all that apply:			
	1. Design to Reach IES guidelines: Lighting For Exterior Environments	2			
	2. Achieve 50% reduction based on Advanced Energy Design Guide (ASHRAE/IES)	1			
	3. High efficiency exterior lighting using 100% fluorescent and/or LED bulbs	2			
<b>ES 7.4</b>	High efficiency elevators	2			
<b>ENERGY EFFICIENT SYSTEMS TOTAL</b>					
		79	0		
<b>WATER EFFICIENCY (WE)</b>					
<b>WE 1: INDOOR WATER USE</b>					
<b>REQUIRED AT ALL LEVELS</b>					
<b>WE 1.0</b>	Meet National Energy Policy Act low flow standards for all fixtures	-	-		
<b>WE 1.1</b>	Detect no leaks at any water-using fixture, appliance or equipment	-	-		
<b>REQUIRED AT PLATINUM , OPTIONAL AT GOLD AND CERTIFIED</b>					
<b>WE 1.2</b>	If installed, water treatment system NSF certified, $\geq 85\%$ efficient	2			
<b>WE 1.3</b>	If installed, water softeners certified to NSF/ANSI Standard 44	2			
<b>WE 1.4</b>	Store $\leq 0.5$ gal of water between water heater and fixture (not applicable to central systems)	2	2		Test results
<b>WE 1.5</b>	Low-flow fixtures (units and common facilities):	Select all that apply:			
	1. WaterSense labeled toilet ( $\leq 1.28$ avg. gal/flush)	2	2		
	2. WaterSense labeled urinal ( $\leq 0.5$ gal/flush)	1			
	3. WaterSense lavatory faucet and accessories ( $\leq 1.5$ gpm at 60 psi)	1	1		
	4. WaterSense labeled Showerhead (2.0 gpm)	2	2		
<b>OPTIONAL AT ALL LEVELS</b>					
<b>WE 1.6</b>	Toilet ( $\leq 1.1$ avg. gal/flush)	2			
<b>WE 1.7</b>	Waterless urinals in common areas	2			
<b>WE 1.8</b>	Greywater system for toilet flushing	4			
<b>WE 1.9</b>	Rainwater harvest system for indoor water use	4			
<b>WE 1.10</b>	Hot water demand $\leq 0.13$ gal of water between loop and fixture and $\leq 2$ gal of water in loop between water heater and furthest fixture (not applicable to central systems)	2			Test results
<b>WE 2: OUTDOOR WATER USE</b>					
<b>REQUIRED AT ALL LEVELS</b>					
<b>WE 2.0</b>	Cover all exposed soil with 2"-3" mulch layer	-	-		
<b>WE 2.1</b>	Irrigation system:	All must comply:			
	1. Must have rain sensor shutoff switch	-	-		
	2. Provide operating manual to property management	-	-		
	3. Provide irrigation system layout to property management	-	-		
<b>WE 2.2</b>	If installed, ornamental water features must recirculate water and serve beneficial use	-	-		
<b>WE 2.3</b>	Install plants to maintain distance $\geq 2'$ from home at maturity	-	-		
<b>REQUIRED AT PLATINUM, OPTIONAL AT GOLD AND CERTIFIED</b>					
<b>WE 2.4</b>	Turf $\leq 40\%$ of landscaped area	2	2		Landscape plan
<b>WE 2.5</b>	Vegetate slopes exceeding 4:1	1	1		Landscape plan
<b>WE 2.6</b>	If installed, irrigation system is: (Max 4 points)	Select all that apply:			
	1. Design, install, and audit irrigation system by WaterSense Irrigation Partner with no leaks	2			
	2. Micro-irrigation system (e.g., drip irrigation) includes pressure regulator, filter and flush end assemblies	2			
	3. Distribution uniformity $\geq 65\%$ lower quarter	2			
	4. Install sprinklers only on turfgrass, pop-up height $\geq 4"$	1			
	5. Establish grow-in phase and post landscape seasonal water schedules at irrigation controller	2			
<b>WE 2.7</b>	Drought-tolerant/native landscaping turf and plants	1	1		Plant list
<b>WE 2.8</b>	xeriscape™ guidebook given to property management or owner	1	1		Resource
<b>OPTIONAL AT ALL LEVELS</b>					
<b>WE 2.9</b>	Test and amend soil	1			Test results
<b>WE 2.10</b>	Irrigation: (Max 5 points)	Select all that apply:			
	1. Greywater irrigation system	3			
	2. Rainwater irrigation system	3			
	3. Zone irrigation system for specific water needs in each planting area	2			
	4. Provide weather station or soil moisture sensor on irrigation system	2			
<b>WE 2.11</b>	Timer on exterior water spigots	1			
<b>WATER EFFICIENCY TOTAL</b>					
		12	0		

<b>EDUCATION AND OPERATIONS (EO)</b>			
<b>EO 1: EDUCATION</b>			
<b>REQUIRED AT ALL LEVELS</b>			
<b>EO 1.0</b> Provide property manager with project-specific owner's manual	-	-	Copy
<b>OPTIONAL AT ALL LEVELS</b>			
<b>EO 1.1</b> Local recycling contact	1	1	Contact
<b>EO 1.2</b> Label all storm drain or storm inlets to discourage dumping of pollutants	1	1	Picture
<b>EO 1.3</b> Household hazardous waste resources	1		
<b>EO 2: OPERATIONS AND MANAGEMENT</b>			
<b>REQUIRED AT ALL LEVELS</b>			
<b>EO 2.0</b> Provide all subcontractors with EarthCraft Multifamily worksheet	-	-	
<b>OPTIONAL AT ALL LEVELS</b>			
<b>EO 2.1</b> Property Maintenance Staff representative attends design review and/or kick off meeting	1	1	
<b>EO 2.2</b> Market EarthCraft Multifamily program	1		Signage
<b>EO 2.3</b> Provide pre-occupancy briefing for tenant	2		
<b>EO 2.4</b> Project participates in post occupancy project debriefing	2		
<b>EO 2.5</b> Environmental management and building maintenance guidelines for staff	2	2	Copy
<b>EO 2.6</b> Landscape maintenance guide for maintenance and management personnel	2	2	
<b>EO 3: THIRD PARTY PROGRAMS</b>			
<b>OPTIONAL AT ALL LEVELS</b>			
<b>EO 3.0</b> ENERGY STAR Version 3	2		
<b>EO 3.1</b> Indoor airPLUS	2		
<b>EO 3.2</b> Qualify for WaterSense	1		
<b>EO 3.3</b> EarthCraft Community Certification	3		
<b>EO 3.4</b> EarthCraft Light Commercial for Community Center	2		
<b>EO 3.5</b> EarthCraft Light Commercial Ready Spaces	1		
<b>EO 3.6</b> Building America Builders Challenge	1		
<b>EDUCATION AND OPERATIONS TOTAL</b>		7	0
<b>INNOVATION (INV)</b>			
<b>OPTIONAL AT ALL LEVELS</b>			
<b>IN 1.0</b> On-site fuel cell or co-generation system	4		System design
<b>IN 1.1</b> Solar, micro-hydro or wind electric system	4		System design
<b>IN 1.2</b> Solar-ready design	2		System design
<b>IN 1.3</b> Solar electric system (10% of project requirements)	5		System design
<b>IN 1.4</b> 100% of stormwater kept on site and used for development operations	4		System design
<b>IN 1.5</b> Common areas use solar electric system (80% of demand)	4		System design
<b>IN 1.6</b> Housing Affordability:	Select one:		
<b>1</b> ≥20% total units	1		
<b>2</b> ≥50% total units	2		
<b>IN 1.7</b> Developer contracts for at least 12 months post construction energy monitoring	6		Unit Level Utility Data
<b>IN 1.8</b> Project specific innovation points: builder submits specifications for innovative products or design features to EarthCraft prior to construction completion	TBD		
<b>INNOVATION TOTAL</b>		0	0
<b>WORKSHEET TOTAL</b>		209	0

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**SECTION 01 4000**  
**QUALITY REQUIREMENTS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Mock-ups.
- B. Control of installation.
- C. Testing and inspection services.

**1.02 SUBMITTALS**

- A. Testing Agency Qualifications:
  - 1. Prior to start of Work, submit agency name, address, and telephone number, and names of full time specialist and responsible officer.
  - 2. Submit copy of report of laboratory facilities inspection made by NIST Construction Materials Reference Laboratory during most recent inspection, with memorandum of remedies of any deficiencies reported by the inspection.
- B. Design Data: Submit for Architect's knowledge as contract administrator for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents, or for Owner's information.
- C. Test Reports: After each test/inspection, promptly submit two copies of report to Architect and to Contractor.
  - 1. Include:
    - a. Date issued.
    - b. Project title and number.
    - c. Name of inspector.
    - d. Date and time of sampling or inspection.
    - e. Identification of product and specifications section.
    - f. Location in the Project.
    - g. Type of test/inspection.
    - h. Date of test/inspection.
    - i. Results of test/inspection.
    - j. Conformance with Contract Documents.
    - k. When requested by Architect, provide interpretation of results.
  - 2. Test report submittals are for Architect's knowledge as contract administrator for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents, or for Owner's information.

**1.03 TESTING AND INSPECTION AGENCIES**

- A. Contractor shall employ and pay for services of an independent testing agency to perform specified testing and inspection.
- B. Employment of agency in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.
- C. Contractor Employed Agency:
  - 1. Laboratory: Authorized to operate in the State in which the Project is located.
  - 2. Laboratory Staff: Maintain a full time specialist on staff to review services.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION**

**3.01 CONTROL OF INSTALLATION**

- A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.
- B. Comply with manufacturers' instructions, including each step in sequence.

- C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect before proceeding.
- D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Have Work performed by persons qualified to produce required and specified quality.
- F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.
- G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.

### **3.02 MOCK-UPS**

- A. Before installing portions of the Work where mockups are required, construct mockups in location and size indicated for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work. The purpose of mock-up is to demonstrate the proposed range of aesthetic effects and workmanship.
- B. Accepted mock-ups establish the standard of quality the Architect will use to judge the Work.
- C. Room Mockups: Construct room mockups as indicated on Drawings. Coordinate installation of materials, products, and assemblies as required in Specification Sections; finish according to requirements. Provide required lighting and any supplemental lighting where required to enable Architect to evaluate quality of the mock-up.
- D. Notify Architect fifteen (15) working days in advance of dates and times when mockups will be constructed.
- E. Tests will be performed under provisions identified in this section and identified in the respective product specification sections.
- F. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.
- G. Accepted mock-ups shall be a comparison standard for the remaining Work.
- H. Where mock-up has been accepted by Architect and is specified in product specification sections to be removed, remove mock-up and clear area when directed to do so.

### **3.03 TESTING AND INSPECTION**

- A. See individual specification sections for testing and inspection required.
- B. Testing Agency Duties:
  - 1. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
  - 2. Perform specified sampling and testing of products in accordance with specified standards.
  - 3. Ascertain compliance of materials and mixes with requirements of Contract Documents.
  - 4. Promptly notify Architect and Contractor of observed irregularities or non-conformance of Work or products.
  - 5. Perform additional tests and inspections required by Architect.
  - 6. Submit reports of all tests/inspections specified.
- C. Limits on Testing/Inspection Agency Authority:
  - 1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
  - 2. Agency may not approve or accept any portion of the Work.
  - 3. Agency may not assume any duties of Contractor.
  - 4. Agency has no authority to stop the Work.
- D. Contractor Responsibilities:
  - 1. Deliver to agency at designated location, adequate samples of materials proposed to be used that require testing, along with proposed mix designs.

2. Cooperate with laboratory personnel, and provide access to the Work and to manufacturers' facilities.
  3. Provide incidental labor and facilities:
    - a. To provide access to Work to be tested/inspected.
    - b. To obtain and handle samples at the site or at source of Products to be tested/inspected.
    - c. To facilitate tests/inspections.
    - d. To provide storage and curing of test samples.
  4. Notify Architect and laboratory 48 hours prior to expected time for operations requiring testing/inspection services.
  5. Employ services of an independent qualified testing laboratory and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
  6. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
- E. Re-testing required because of non-conformance to specified requirements shall be performed by the same agency on instructions by Architect.
  - F. Re-testing required because of non-conformance to specified requirements shall be paid for by Contractor.

#### **3.04 DEFECT ASSESSMENT**

- A. Replace Work or portions of the Work not conforming to specified requirements.
- B. If, in the opinion of Architect, it is not practical to remove and replace the Work, Architect will direct an appropriate remedy or adjust payment.

**END OF SECTION 01 4000**

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**SECTION 01 4533**  
**CODE-REQUIRED SPECIAL INSPECTIONS**

**PART 1 GENERAL - NOT USED**

**1.01 SECTION INCLUDES**

- A. Code-required special inspections.
- B. Submittals.

**1.02 DEFINITIONS**

- A. Code or Building Code: VUSBC 2012 Edition (of the International Building Code) and, more specifically, Chapter 17 - Structural Tests and Inspections, of same.
- B. Authority Having Jurisdiction (AHJ): Agency or individual officially empowered to enforce the building, fire and life safety code requirements of the permitting jurisdiction in which the Project is located.
- C. Special Inspection:
  - 1. Special inspections are inspections and testing of materials, installation, fabrication, erection or placement of components and connections mandated by the AHJ that also require special expertise to ensure compliance with the approved contract documents and the referenced standards.
  - 2. Special inspections are separate from and independent of tests and inspections conducted by Owner or Contractor for the purposes of quality assurance and contract administration.

**1.03 REFERENCE STANDARDS**

- A. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; 2011.
- B. ASTM C31/C31M - Standard Practice for Making and Curing Concrete Test Specimens in the Field; 2012.
- C. ASTM C172/C172M - Standard Practice for Sampling Freshly Mixed Concrete; 2010.
- D. ASTM D3740 - Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction; 2012a.
- E. ASTM E2174 - Standard Practice for On-Site Inspection of Installed Firestops; 2014.
- F. ASTM E2393 - Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers; 2010a.
- G. AWS D1.4/D1.4M - Structural Welding Code - Reinforcing Steel; 2011.

**1.04 SUBMITTALS**

- A. Special Inspection Agency Qualifications: Prior to the start of work, the Special Inspection Agency shall:
  - 1. Submit agency name, address, and telephone number, names of full time specialist and responsible officer.
  - 2. Submit copy of report of laboratory facilities inspection made by NIST Construction Materials Reference Laboratory during most recent inspection, with memorandum of remedies of any deficiencies reported by the inspection.
- B. Testing Agency Qualifications: Prior to the start of work, the Testing Agency shall:
  - 1. Submit agency name, address, and telephone number, and names of full time specialist and responsible officer.
  - 2. Submit copy of report of laboratory facilities inspection made by NIST Construction Materials Reference Laboratory during most recent inspection, with memorandum of remedies of any deficiencies reported by the inspection.
- C. Special Inspection Reports: After each special inspection, Special Inspector shall promptly submit two copies of report; one to Architect and one to the AHJ.
  - 1. Include:

- a. Date issued.
- b. Project title and number.
- c. Name of Special Inspector.
- d. Date and time of special inspection.
- e. Identification of product and specifications section.
- f. Location in the Project.
- g. Type of special inspection.
- h. Date of special inspection.
- i. Results of special inspection.
- j. Conformance with Contract Documents.

## **1.05 SPECIAL INSPECTION AGENCY**

## **1.06 QUALITY ASSURANCE**

- A. Special Inspection Agency Qualifications:
  - 1. Independent firm specializing in performing testing and inspections of the type specified in this section.
- B. Copies of Documents at Project Site: Maintain at the project site a copy of each referenced document.

## **PART 2 PRODUCTS - NOT USED**

## **PART 3 EXECUTION**

### **3.01 SCHEDULE OF SPECIAL INSPECTIONS, GENERAL**

- A. Frequency of Special Inspections: Special Inspections are indicated as continuous or periodic.
  - 1. Periodic Special Inspection: Special Inspection Agency shall be present in the area where work is being performed and observe the work part-time or intermittently and at the completion of the work.

### **3.02 SPECIAL INSPECTIONS FOR CONCRETE CONSTRUCTION**

- A. Reinforcing Steel, Including Prestressing of Tendons and Placement: Verify compliance with approved contract documents and ACI 318, 3.5 and 7.1 through 7.7; periodic.
- B. Reinforcing Steel Welding: Verify compliance with AWS D1.4 and ACI 318, 3.5.2; periodic.
- C. Design Mix: Verify plastic concrete complies with the design mix in approved contract documents and with ACI 318, Chapter 4 and 5.2; periodic.
- D. Concrete Sampling Concurrent with Strength Test Sampling: Each time fresh concrete is sampled for strength tests, verify compliance with ASTM C172, ASTM C31 and ACI 318, 5.6 and 5.8 and record the following, continuous:
  - 1. Slump.
  - 2. Air content.
  - 3. Temperature of concrete.
- E. Specified Curing Temperature and Techniques: Verify compliance with approved contract documents and ACI 318, 5.11 through 5.13; periodic.
- F. Concrete Strength in Situ: Verify concrete strength complies with approved contract documents and ACI 318, 6.2, for the following.
- G. Formwork Shape, Location and Dimensions: Verify compliance with approved contract documents and ACI 318, 6.1.1; periodic.

### **3.03 SPECIAL INSPECTIONS FOR SOILS**

- A. Materials and Placement: Verify each item below complies with approved construction documents and approved geotechnical report.
  - 1. Design bearing capacity of material below shallow foundations; periodic.
  - 2. Design depth of excavations and suitability of material at bottom of excavations; periodic.
  - 3. Materials, densities, lift thicknesses; placement and compaction of backfill: continuous.

4. Subgrade, prior to placement of compacted fill; periodic.
- B. Testing: Classify and test excavated material; periodic.

### **3.04 SPECIAL INSPECTIONS FOR FIRE RESISTANT PENETRATIONS AND JOINTS**

- A. Verify penetration firestops in accordance with ASTM E2174.
- B. Verify fire resistant joints in accordance with ASTM E2393.

### **3.05 SPECIAL INSPECTION AGENCY DUTIES AND RESPONSIBILITIES**

- A. Special Inspection Agency shall:
  1. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
  2. Perform specified sampling and testing of products in accordance with specified reference standards.
  3. Ascertain compliance of materials and products with requirements of Contract Documents.
  4. Promptly notify Architect and Contractor of observed irregularities or non-conformance of work or products.
  5. Perform additional tests and inspections required by Architect.
  6. Submit reports of all tests or inspections specified.
- B. Limits on Special Inspection Agency Authority:
  1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
  2. Agency may not approve or accept any portion of the work.
  3. Agency may not assume any duties of Contractor.
  4. Agency has no authority to stop the work.
- C. Re-testing required because of non-conformance to specified requirements shall be performed by the same agency on instructions by Architect.
- D. Re-testing required because of non-conformance to specified requirements shall be paid for by Contractor.

### **3.06 CONTRACTOR DUTIES AND RESPONSIBILITIES**

- A. Contractor Responsibilities, General:
  1. Deliver to agency at designated location, adequate samples of materials for special inspections that require material verification.
  2. Cooperate with agency and laboratory personnel; provide access to the work, to manufacturers' facilities, and to fabricators' facilities.
  3. Provide incidental labor and facilities:
    - a. To provide access to work to be tested or inspected.
    - b. To obtain and handle samples at the site or at source of Products to be tested or inspected.
    - c. To facilitate tests or inspections.
    - d. To provide storage and curing of test samples.
  4. Notify Architect and laboratory 48 hours prior to expected time for operations requiring testing or inspection services.
  5. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.

**END OF SECTION 01 4533**

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**SECTION 01 5000**  
**TEMPORARY FACILITIES AND CONTROLS**

**PART I - GENERAL**

**I.1 RELATED DOCUMENTS**

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

**I.2 SUMMARY**

- A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
- B. Related Requirements:
- I. Division I Section "Summary" for limitations on work restrictions and utility interruptions.

**I.3 INFORMATIONAL SUBMITTALS**

- A. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.
- B. Moisture-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage.
- I. Describe delivery, handling, and storage provisions for materials subject to water absorption or water damage.
  2. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water-damaged Work.
  3. Indicate sequencing of work that requires water and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.
- C. Dust- and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust- and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Identify further options if proposed measures are later determined to be inadequate. Include the following:
- I. Locations of dust-control method at each phase of work.
  2. Waste handling procedures.
  3. Other dust-control measures.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Insulation: Unfaced mineral-fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.

### 2.2 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
  - I. Locate facilities to limit site disturbance as specified in Division I Section "Summary."
  - B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

### 3.2 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
- B. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- C. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.
  - I. Prohibit smoking in construction areas.
  - 2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
  - 3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.

### 3.3 MOISTURE AND MOLD CONTROL

- A. Contractor's Moisture-Protection Plan: Avoid trapping water in finished work. Document visible signs of mold that may appear during construction.

- B. Exposed Construction Phase: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:
1. Protect porous materials from water damage.
  2. Protect stored and installed material from flowing or standing water.
  3. Keep porous and organic materials from coming into prolonged contact with concrete.
  4. Remove standing water from decks.
  5. Keep deck openings covered or dammed.

### 3.4 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- C. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
  2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
  3. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Division I Section "Closeout Procedures."

END OF SECTION 01500

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**SECTION 01 5100**  
**TEMPORARY UTILITIES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Temporary Utilities: Electricity, lighting, heat, ventilation, and water.

**1.02 TEMPORARY ELECTRICITY**

- A. Cost: By Contractor.
- B. Provide power service required from utility source.
- C. Provide power outlets for construction operations, with branch wiring and distribution boxes located as required. Provide flexible power cords as required.
- D. Permanent convenience receptacles may be utilized during construction.

**1.03 TEMPORARY LIGHTING FOR CONSTRUCTION PURPOSES**

- A. Provide and maintain lighting for construction operations .
- B. Provide branch wiring from power source to distribution boxes with lighting conductors, pigtails, and lamps as required.
- C. Maintain lighting and provide routine repairs.
- D. Permanent building lighting may be utilized during construction.

**1.04 TEMPORARY HEATING**

- A. Cost of Energy: By Contractor.
- B. Provide heating devices and heat as needed to maintain specified conditions for construction operations.
- C. Maintain minimum ambient temperature of 50 degrees F in areas where construction is in progress, unless indicated otherwise in specifications.
- D. Prior to operation of permanent equipment for temporary heating purposes, verify that installation is approved for operation, equipment is lubricated and filters are in place. Provide and pay for operation, maintenance, and regular replacement of filters and worn or consumed parts.

**1.05 TEMPORARY COOLING**

- A. Cost of Energy: By Contractor.
- B. Provide cooling devices and cooling as needed to maintain specified conditions for construction operations.
- C. Maintain maximum ambient temperature of 80 degrees F in areas where construction is in progress, unless indicated otherwise in specifications.

**1.06 TEMPORARY VENTILATION**

**1.07 TEMPORARY WATER SERVICE**

- A. Cost of Water Used: By Contractor.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION - NOT USED**

**END OF SECTION 01 5100**

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**SECTION 01 6000**  
**PRODUCT REQUIREMENTS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. General product requirements.
- B. Sustainable design-related product requirements.
- C. Transportation, handling, storage and protection.
- D. Product option requirements.
- E. Substitution limitations and procedures.
- F. Maintenance materials, including extra materials, spare parts, tools, and software.

**1.02 RELATED REQUIREMENTS**

- A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions: Requirements for VOC-restricted product categories.

**1.03 REFERENCE STANDARDS**

- A. 16 CFR 260 - Guides for the Use of Environmental Marketing Claims; Federal Trade Commission; current edition.
- B. GreenScreen (LIST) - GreenScreen for Safer Chemicals List Translator; Clean Production Action; [www.greenscreenchemicals.org](http://www.greenscreenchemicals.org).
- C. GreenScreen (METH) - GreenScreen for Safer Chemicals Method v1.2; Clean Production Action; [www.greenscreenchemicals.org](http://www.greenscreenchemicals.org).

**1.04 SUBMITTALS**

- A. Product Data Submittals: Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.
- B. Shop Drawing Submittals: Prepared specifically for this Project; indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- C. Sample Submittals: Illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
  - 1. For selection from standard finishes, submit samples of the full range of the manufacturer's standard colors, textures, and patterns.

**1.05 QUALITY ASSURANCE**

- A. GreenScreen Chemical Hazard Analysis: All ingredients of 100 parts-per-million or greater evaluated using GreenScreen for Safer Chemicals Method v1.2.
  - 1. Good: GreenScreen List Translator evaluation to identify Benchmark 1 hazards; a Health Product Declaration includes this information.
  - 2. Better: GreenScreen Full Assessment.
  - 3. Best: GreenScreen Full Assessment by GreenScreen Licensed Profiler.
  - 4. Acceptable Evidence: GreenScreen report.
- B. Recycled Content: Determine percentage of post-consumer and post-industrial content separately, using the guidelines contained in 16 CFR 260.7(e).
  - 1. Previously used, reused, refurbished, and salvaged products are not considered recycled.
  - 2. Wood fabricated from timber abandoned in transit to original mill is considered reused, not recycled.
  - 3. Determine percentage of recycled content of any item by dividing the weight of recycled content in the item by the total weight of all material in the item.
  - 4. Determine value of recycled content of each item separately, by multiplying the content percentage by the value of the item.

5. Acceptable Evidence:
  - a. For percentage of recycled content, information from manufacturer.
  - b. For cost, Contractor's cost data.
- C. Sustainably Harvested Wood: Solid wood, wood chips, and wood fiber certified or labeled by an organization accredited by one of the following:
  1. The Forest Stewardship Council, The Principles for Natural Forest Management; for Canada visit <http://www.fsccanada.org>, for the USA visit <http://www.fscus.org>.
  2. Acceptable Evidence: Copies of invoices bearing the certifying organization's certification numbers.

## PART 2 PRODUCTS

### 2.01 NEW PRODUCTS

- A. Provide new products unless specifically required or permitted by the Contract Documents.
- B. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
- C. 2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
- D. Basis-of-Design Product Specification: A specification in which a specific manufacturer's product is named and accompanied by the words "Basis-of-Design," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable, or equal, products of additional manufacturers named in the specification.
- E. Comparable Product: Product that is demonstrated and approved through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- F. DO NOT USE products having any of the following characteristics:
  1. Made using or containing CFC's or HCFC's.
  2. Containing lead, cadmium, asbestos.
- G. Where all other criteria are met, Contractor shall give preference to products that:
  1. If used on interior, have lower emissions, as defined in Section 01 6116.
  2. If wet-applied, have lower VOC content, as defined in Section 01 6116.
  3. If made of wood, are made of sustainably harvested wood, wood chips, or wood fiber.
  4. Have a published GreenScreen Chemical Hazard Analysis.

### 2.02 PRODUCT OPTIONS

- A. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.
- B. Products Specified by Naming One or More Manufacturers: Use a product of one of the manufacturers named and meeting specifications, no options or substitutions allowed.
- C. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.

### 2.03 MAINTENANCE MATERIALS

- A. Furnish extra materials, spare parts, tools, and software of types and in quantities specified in individual specification sections.
- B. Deliver to Project site; obtain receipt prior to final payment.

## PART 3 EXECUTION

### 3.01 SUBSTITUTION PROCEDURES

- A. Instructions to Bidders specify time restrictions for submitting requests for substitutions during the bidding period. Comply with requirements specified in this section.
- B. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents.
- C. A request for substitution constitutes a representation that the submitter:
  1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
  2. Will provide the same warranty for the substitution as for the specified product.
  3. Will coordinate installation and make changes to other Work that may be required for the Work to be complete with no additional cost to Owner.
  4. Waives claims for additional costs or time extension that may subsequently become apparent.
  5. Will reimburse Owner and Architect for review or redesign services associated with re-approval by authorities.
- D. Substitution Submittal Procedure:
  1. Submit three copies of request for substitution for consideration. Limit each request to one proposed substitution.
  2. Submit shop drawings, product data, and certified test results attesting to the proposed product equivalence. Burden of proof is on proposer.
  3. The Architect will notify Contractor in writing of decision to accept or reject request.

### 3.02 TRANSPORTATION AND HANDLING

- A. Package products for shipment in manner to prevent damage; for equipment, package to avoid loss of factory calibration.
- B. If special precautions are required, attach instructions prominently and legibly on outside of packaging.
- C. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.
- D. Transport and handle products in accordance with manufacturer's instructions.
- E. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.
- F. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.
- G. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.
- H. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

### 3.03 STORAGE AND PROTECTION

- A. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication.
- B. Store and protect products in accordance with manufacturers' instructions.
- C. Store with seals and labels intact and legible.
- D. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.
- E. For exterior storage of fabricated products, place on sloped supports above ground.
- F. Provide bonded off-site storage and protection when site does not permit on-site storage or protection.

- G. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.
- H. Comply with manufacturer's warranty conditions, if any.
- I. Do not store products directly on the ground.
- J. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- K. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
- L. Prevent contact with material that may cause corrosion, discoloration, or staining.
- M. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- N. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

**END OF SECTION 01 6000**

**SECTION 01 6116**  
**VOLATILE ORGANIC COMPOUND (VOC) CONTENT RESTRICTIONS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Requirements for Indoor-Emissions-Restricted products.
- B. Requirements for VOC-Content-Restricted products.

**1.02 RELATED REQUIREMENTS**

- A. Section 01 3000 - Administrative Requirements: Submittal procedures.

**1.03 DEFINITIONS**

- A. Indoor-Emissions-Restricted Products: All products in the following product categories, whether specified or not:
  1. Interior paints and coatings.
  2. Interior adhesives and sealants, including flooring adhesives.
  3. Flooring.
  4. Composite wood.
  5. Thermal and acoustical insulation.
- B. VOC-Content-Restricted Products: All products in the following product categories, whether specified or not:
  1. Interior paints and coatings.
  2. Interior adhesives and sealants, including flooring adhesives.
- C. Interior of Building: Anywhere inside the exterior weather barrier.
- D. Adhesives: All gunnable, trowelable, liquid-applied, and aerosol adhesives, whether specified or not; including flooring adhesives, resilient base adhesives, and pipe jointing adhesives.
- E. Sealants: All gunnable, trowelable, and liquid-applied joint sealants and sealant primers, whether specified or not; including firestopping sealants and duct joint sealers.

**1.04 REFERENCE STANDARDS**

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; current edition.
- B. ASTM D3960 - Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings; 2005 (Reapproved 2013).
- C. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions From Indoor Sources Using Environmental Chambers; California Department of Public Health; v1.1, 2010.
- D. CARB (ATCM) - Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products; California Air Resources Board; current edition.
- E. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board; 2007.
- F. CHPS (HPPD) - High Performance Products Database; Collaborative for High Performance Schools (CHPS); current edition at [www.chps.net/](http://www.chps.net/).
- G. CRI (GLP) - Green Label Plus Testing Program - Certified Products; Carpet and Rug Institute; Current Edition.
- H. GreenSeal GS-36 - Commercial Adhesives; Green Seal, Inc.; 2011.
- I. SCAQMD 1113 - South Coast Air Quality Management District Rule No.1113; current edition; [www.aqmd.gov](http://www.aqmd.gov).
- J. SCAQMD 1168 - South Coast Air Quality Management District Rule No.1168; current edition; [www.aqmd.gov](http://www.aqmd.gov).

- K. SCS (CPD) - SCS Certified Products; Scientific Certification Systems; current listings at [www.scscertified.com](http://www.scscertified.com).
- L. UL (GGG) - GREENGUARD Gold Certified Products; UL Environment; current listings at <http://productguide.ulenvironment.com/QuickSearch.aspx>.

#### **1.05 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: For each VOC-restricted product used in the project, submit evidence of compliance.

#### **1.06 QUALITY ASSURANCE**

- A. Indoor Emissions Standard and Test Method: CAL (CDPH SM), using Standard Private Office exposure scenario and the allowable concentrations specified in the method, and range of total VOC's after 14 days.
  - 1. Wet-Applied Products: State amount applied in mass per surface area.
  - 2. Paints and Coatings: Test tinted products, not just tinting bases.
  - 3. Evidence of Compliance: Acceptable types of evidence are the following:
    - a. Current UL (GGG) certification.
    - b. Current SCS (CPD) Floorscore certification.
    - c. Current SCS (CPD) Indoor Advantage Gold certification.
    - d. Current listing in CHPS (HPPD) as a low-emitting product.
    - e. Current CRI (GLP) certification.
    - f. Test report showing compliance and stating exposure scenario used.
  - 4. Product data submittal showing VOC content is NOT acceptable evidence.
  - 5. Manufacturer's certification without test report by independent agency is NOT acceptable evidence.
- B. VOC Content Test Method: 40 CFR 59, Subpart D (EPA Method 24), or ASTM D3960, unless otherwise indicated.
  - 1. Evidence of Compliance: Acceptable types of evidence are:
    - a. Report of laboratory testing performed in accordance with requirements.
- C. Composite Wood Emissions Standard: CARB (ATCM) for ultra-low emitting formaldehyde (ULEF) resins.
  - 1. Evidence of Compliance: Acceptable types of evidence are:
    - a. Current SCS "No Added Formaldehyde (NAF)" certification; [www.scscertified.com](http://www.scscertified.com).
    - b. Report of laboratory testing performed in accordance with requirements.
    - c. Published product data showing compliance with requirements.
- D. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

### **PART 2 PRODUCTS**

#### **2.01 MATERIALS**

- A. All Products: Comply with the most stringent of federal, State, and local requirements, or these specifications.
- B. Indoor-Emissions-Restricted Products: Comply with Indoor Emissions Standard and Test Method, except for:
  - 1. Composite Wood, Wood Fiber, and Wood Chip Products: Comply with Composite Wood Emissions Standard or contain no added formaldehyde resins.
  - 2. Inherently Non-Emitting Materials.
- C. VOC-Content-Restricted Products: VOC content not greater than required by the following:
  - 1. Adhesives, Including Flooring Adhesives: SCAQMD 1168 Rule.
  - 2. Aerosol Adhesives: GreenSeal GS-36.
  - 3. Joint Sealants: SCAQMD 1168 Rule.

4. Paints and Coatings: Each color; most stringent of the following:
  - a. 40 CFR 59, Subpart D.
  - b. SCAQMD 1113 Rule.
  - c. CARB (SCM).

### **PART 3 EXECUTION**

#### **3.01 FIELD QUALITY CONTROL**

- A. Owner reserves the right to reject non-compliant products, whether installed or not, and require their removal and replacement with compliant products at no extra cost to Owner.

**END OF SECTION 01 6116**

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**SECTION 01 6350**  
**SUBSTITUTION PROCEDURES**

**PART I - GENERAL**

**I.1 SUMMARY**

- A. Section includes administrative and procedural requirements for substitutions.
- B. Related Requirements:
  - I. Section 01600 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

**I.2 DEFINITIONS**

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.

**I.3 ACTION SUBMITTALS**

- A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
  - I. Substitution Request Form: Use CSI Form 13.1A.
  - 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
    - a. Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.
    - b. Coordination information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.
    - c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
    - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
    - e. Samples, where applicable or requested.
    - f. Certificates and qualification data, where applicable or requested.
    - g. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
    - h. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
    - i. Research reports evidencing compliance with building code in effect for Project, from VUSBC (IBC 2012).

- j. Detailed comparison of Contractor's construction schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
  - k. Cost information, including a proposal of change, if any, in the Contract Sum.
  - l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents except as indicated in substitution request, is compatible with related materials, and is appropriate for applications indicated.
  - m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
- a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
  - b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

#### 1.4 QUALITY ASSURANCE

- A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

### PART 2 - PRODUCTS

#### 2.1 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.
- I. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied:
- a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
  - b. Requested substitution provides sustainable design characteristics that specified product provided.
  - c. Requested substitution will not adversely affect Contractor's construction schedule.
  - d. Requested substitution has received necessary approvals of authorities having jurisdiction.
  - e. Requested substitution is compatible with other portions of the Work.
  - f. Requested substitution has been coordinated with other portions of the Work.
  - g. Requested substitution provides specified warranty.
  - h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

B. Substitutions for Convenience: Architect will consider requests for substitution if received within 60 days after the Notice of Award.

I. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied:

- a. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
- b. Requested substitution does not require extensive revisions to the Contract Documents.
- c. Requested substitution is consistent with the Contract Documents and will produce indicated results.
- d. Requested substitution provides sustainable design characteristics that specified product provided.
- e. Requested substitution will not adversely affect Contractor's construction schedule.
- f. Requested substitution has received necessary approvals of authorities having jurisdiction.
- g. Requested substitution is compatible with other portions of the Work.
- h. Requested substitution has been coordinated with other portions of the Work.
- i. Requested substitution provides specified warranty.
- j. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

PART 3 - EXECUTION (Not Used)

END OF SECTION 01635

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**SECTION 01 7000**  
**EXECUTION AND CLOSEOUT REQUIREMENTS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Examination, preparation, and general installation procedures.
- B. Pre-installation meetings.
- C. Cutting and patching.
- D. Surveying for laying out the work.
- E. Cleaning and protection.
- F. Starting of systems and equipment.
- G. Demonstration and instruction of Owner personnel.
- H. Closeout procedures, including Contractor's Correction Punch List, except payment procedures.
- I. General requirements for maintenance service.

**1.02 RELATED REQUIREMENTS**

- A. Section 07 8400 - Firestopping.

**1.03 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Survey work: Submit name, address, and telephone number of Surveyor before starting survey work.
  - 1. On request, submit documentation verifying accuracy of survey work.
  - 2. Submit a copy of site drawing signed by the Land Surveyor, that the elevations and locations of the work are in conformance with Contract Documents.
  - 3. Submit surveys and survey logs for the project record.
- C. Cutting and Patching: Submit written request in advance of cutting or alteration that affects:
  - 1. Structural integrity of any element of Project.
  - 2. Integrity of weather exposed or moisture resistant element.
  - 3. Efficiency, maintenance, or safety of any operational element.
  - 4. Visual qualities of sight exposed elements.
  - 5. Work of Owner or separate Contractor.
  - 6. Include in request:
    - a. Location and description of affected work.
    - b. Necessity for cutting or alteration.
    - c. Description of proposed work and products to be used.
    - d. Alternatives to cutting and patching.
    - e. Effect on work of Owner or separate Contractor.
    - f. Written permission of affected separate Contractor.
    - g. Date and time work will be executed.
- D. Project Record Documents: Accurately record actual locations of capped and active utilities.

**1.04 QUALIFICATIONS**

- A. For survey work, employ a land surveyor registered in the State in which the Project is located and acceptable to Architect. Submit evidence of Surveyor's Errors and Omissions insurance coverage in the form of an Insurance Certificate.
- B. For field engineering, employ a professional engineer of the discipline required for specific service on Project, licensed in the State in which the Project is located.

**1.05 PROJECT CONDITIONS**

- A. Use of explosives is not permitted.

- B. Protect site from puddling or running water. Provide water barriers as required to protect site from soil erosion.
- C. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.
- D. Dust Control: Execute work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into atmosphere and over adjacent property.
- E. Erosion and Sediment Control: Plan and execute work by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.
  - 1. Minimize amount of bare soil exposed at one time.
  - 2. Provide temporary measures such as berms, dikes, and drains, to prevent water flow.
  - 3. Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.
- F. Noise Control: Provide methods, means, and facilities to minimize noise produced by construction operations.
  - 1. Outdoors: Limit conduct of especially noisy exterior work to the hours of 8 am to 5 pm.
- G. Pest and Rodent Control: Provide methods, means, and facilities to prevent pests and insects from damaging the work.
- H. Pollution Control: Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations. Comply with federal, state, and local regulations.

## 1.06 COORDINATION

- A. Coordinate scheduling, submittals, and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.
- B. Notify affected utility companies and comply with their requirements.
- C. Verify that utility requirements and characteristics of new operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.
- D. Coordinate space requirements, supports, and installation of mechanical and electrical work that are indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- E. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.
- F. Coordinate completion and clean-up of work of separate sections.
- G. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

## PART 2 PRODUCTS

### 2.01 PATCHING MATERIALS

- A. New Materials: As specified in product sections; match existing products and work for patching and extending work.
- B. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing work as a standard.
- C. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 01 6350 - Sustitution Procedures.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work.  
Start of work means acceptance of existing conditions.
- B. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.
- C. Examine and verify specific conditions described in individual specification sections.
- D. Take field measurements before confirming product orders or beginning fabrication, to minimize waste due to over-ordering or misfabrication.
- E. Verify that utility services are available, of the correct characteristics, and in the correct locations.
- F. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions.

### 3.02 PREPARATION

- A. Clean substrate surfaces prior to applying next material or substance.
- B. Seal cracks or openings of substrate prior to applying next material or substance.
- C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

### 3.03 PREINSTALLATION MEETINGS

- A. When required in individual specification sections, convene a preinstallation meeting at the site prior to commencing work of the section.
- B. Require attendance of parties directly affecting, or affected by, work of the specific section.
- C. Notify Architect 14 days in advance of meeting date.
- D. Prepare agenda and preside at meeting:
  1. Review conditions of examination, preparation and installation procedures.
  2. Review coordination with related work.
- E. Record minutes and distribute copies within two days after meeting to participants, with one copies to Architect, Owner, participants, and those affected by decisions made.

### 3.04 LAYING OUT THE WORK

- A. Verify locations of survey control points prior to starting work.
- B. Promptly notify Architect of any discrepancies discovered.
- C. Contractor shall locate and protect survey control and reference points.
- D. Control datum for survey is that indicated on Drawings.
- E. Protect survey control points prior to starting site work; preserve permanent reference points during construction.
- F. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect.
- G. Utilize recognized engineering survey practices.
- H. Establish elevations, lines and levels. Locate and lay out by instrumentation and similar appropriate means:
  1. Site improvements including pavements, stakes for grading, fill and topsoil placement, utility locations, slopes, and invert elevations.
  2. Grid or axis for structures.
  3. Building foundation, column locations, ground floor elevations.

- I. Periodically verify layouts by same means.
- J. Maintain a complete and accurate log of control and survey work as it progresses.

### **3.05 GENERAL INSTALLATION REQUIREMENTS**

- A. Install products as specified in individual sections, in accordance with manufacturer's instructions and recommendations, and so as to avoid waste due to necessity for replacement.
- B. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.
- C. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.
- D. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.
- E. Make neat transitions between different surfaces, maintaining texture and appearance.

### **3.06 CUTTING AND PATCHING**

- A. Whenever possible, execute the work by methods that avoid cutting or patching.
- B. Perform whatever cutting and patching is necessary to:
  1. Complete the work.
  2. Fit products together to integrate with other work.
  3. Provide openings for penetration of mechanical, electrical, and other services.
  4. Match work that has been cut to adjacent work.
  5. Repair areas adjacent to cuts to required condition.
  6. Repair new work damaged by subsequent work.
  7. Remove samples of installed work for testing when requested.
  8. Remove and replace defective and non-conforming work.
- C. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to original condition.
- D. Employ original installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.
- E. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.
- F. Restore work with new products in accordance with requirements of Contract Documents.
- G. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- H. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Section 07 8400, to full thickness of the penetrated element.
- I. Patching:
  1. Finish patched surfaces to match finish that existed prior to patching. On continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
  2. Match color, texture, and appearance.
  3. Repair patched surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. If defects are due to condition of substrate, repair substrate prior to repairing finish.

### **3.07 PROGRESS CLEANING**

- A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.
- B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.
- C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.

- D. Collect and remove waste materials, debris, and trash/rubbish from site periodically and dispose off-site; do not burn or bury.

### **3.08 PROTECTION OF INSTALLED WORK**

- A. Protect installed work from damage by construction operations.
- B. Provide special protection where specified in individual specification sections.
- C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.
- D. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- E. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
- F. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- G. Prohibit traffic from landscaped areas.
- H. Remove protective coverings when no longer needed; reuse or recycle plastic coverings if possible.

### **3.09 SYSTEM STARTUP**

- A. Coordinate schedule for start-up of various equipment and systems.
- B. Notify Architect and owner seven days prior to start-up of each item.
- C. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions that may cause damage.
- D. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
- E. Verify that wiring and support components for equipment are complete and tested.
- F. Execute start-up under supervision of applicable Contractor personnel in accordance with manufacturers' instructions.
- G. Submit a written report that equipment or system has been properly installed and is functioning correctly.

### **3.10 DEMONSTRATION AND INSTRUCTION**

- A. Demonstrate operation and maintenance of products to Owner's personnel two weeks prior to date of Substantial Completion.
- B. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at scheduled time, at equipment location.
- C. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.
- D. Provide a qualified person who is knowledgeable about the Project to perform demonstration and instruction of owner personnel.
- E. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with Owner's personnel in detail to explain all aspects of operation and maintenance.

### **3.11 ADJUSTING**

- A. Adjust operating products and equipment to ensure smooth and unhindered operation.
- B. Testing, adjusting, and balancing HVAC systems: See Section 23 0593 - Testing, Adjusting, and Balancing for HVAC.

### **3.12 FINAL CLEANING**

- A. Execute final cleaning prior to Substantial Completion.

1. Clean areas to be occupied by Owner prior to final completion before Owner occupancy.
- B. Use cleaning materials that are nonhazardous.
- C. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.
- D. Remove all labels that are not permanent. Do not paint or otherwise cover fire test labels or nameplates on mechanical and electrical equipment.
- E. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.
- F. Clean filters of operating equipment.
- G. Clean debris from roofs, gutters, downspouts, and drainage systems.
- H. Clean site; sweep paved areas, rake clean landscaped surfaces.
- I. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.

### **3.13 CLOSEOUT PROCEDURES**

- A. Make submittals that are required by governing or other authorities.
  1. Provide copies to Architect and Owner.
- B. Accompany Project Coordinator on preliminary inspection to determine items to be listed for completion or correction in the Contractor's Correction Punch List for Contractor's Notice of Substantial Completion.
- C. Notify Architect when work is considered ready for Architect's Substantial Completion inspection.
- D. Submit written certification containing Contractor's Correction Punch List, that Contract Documents have been reviewed, work has been inspected, and that work is complete in accordance with Contract Documents and ready for Architect's Substantial Completion inspection.
- E. Conduct Substantial Completion inspection and create Final Correction Punch List containing Architect's and Contractor's comprehensive list of items identified to be completed or corrected and submit to Architect.
- F. Correct items of work listed in Final Correction Punch List and comply with requirements for access to Owner-occupied areas.
- G. Notify Architect when work is considered finally complete and ready for Architect's Substantial Completion final inspection.
- H. Complete items of work determined by Architect listed in executed Certificate of Substantial Completion.

### **3.14 MAINTENANCE**

- A. Provide service and maintenance of components indicated in specification sections.
- B. Maintenance Period: As indicated in specification sections or, if not indicated, not less than one year from the Date of Substantial Completion or the length of the specified warranty, whichever is longer.
- C. Examine system components at a frequency consistent with reliable operation. Clean, adjust, and lubricate as required.
- D. Include systematic examination, adjustment, and lubrication of components. Repair or replace parts whenever required. Use parts produced by the manufacturer of the original component.
- E. Maintenance service shall not be assigned or transferred to any agent or subcontractor without prior written consent of the Owner.

**END OF SECTION 01 7000**

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**SECTION 01 7800**  
**CLOSEOUT SUBMITTALS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Project Record Documents.
- B. Operation and Maintenance Data.
- C. Warranties and bonds.

**1.02 RELATED REQUIREMENTS**

- A. Individual Product Sections: Specific requirements for operation and maintenance data.
- B. Individual Product Sections: Warranties required for specific products or Work.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION**

**3.01 PROJECT RECORD DOCUMENTS**

- A. Maintain on site one set of the following record documents; record actual revisions to the Work:
  - 1. Drawings.
  - 2. Specifications.
  - 3. Addenda.
  - 4. Change Orders and other modifications to the Contract.
  - 5. Reviewed shop drawings, product data, and samples.
  - 6. Manufacturer's instruction for assembly, installation, and adjusting.
- B. Ensure entries are complete and accurate, enabling future reference by Owner.
- C. Store record documents separate from documents used for construction.
- D. Record information concurrent with construction progress.
- E. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:
  - 1. Manufacturer's name and product model and number.
  - 2. Product substitutions or alternates utilized.
  - 3. Changes made by Addenda and modifications.
- F. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:
  - 1. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
  - 2. Field changes of dimension and detail.
  - 3. Details not on original Contract drawings.

**3.02 OPERATION AND MAINTENANCE DATA**

- A. Source Data: For each product or system, list names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.
- B. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.
- C. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.
- D. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

**3.03 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES**

- A. For Each Product, Applied Material, and Finish:

1. Product data, with catalog number, size, composition, and color and texture designations.
2. Information for re-ordering custom manufactured products.
- B. Instructions for Care and Maintenance: Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental cleaning agents and methods, and recommended schedule for cleaning and maintenance.
- C. Additional information as specified in individual product specification sections.
- D. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

### **3.04 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS**

- A. For Each Item of Equipment and Each System:
  1. Description of unit or system, and component parts.
  2. Identify function, normal operating characteristics, and limiting conditions.
  3. Include performance curves, with engineering data and tests.
  4. Complete nomenclature and model number of replaceable parts.
- B. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.
- C. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; typed.
- D. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
- E. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- F. Provide servicing and lubrication schedule, and list of lubricants required.
- G. Include manufacturer's printed operation and maintenance instructions.
- H. Include sequence of operation by controls manufacturer.
- I. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- J. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- K. Additional Requirements: As specified in individual product specification sections.

### **3.05 ASSEMBLY OF OPERATION AND MAINTENANCE MANUALS**

- A. Assemble operation and maintenance data into durable manuals for Owner's personnel use, with data arranged in the same sequence as, and identified by, the specification sections.
- B. Where systems involve more than one specification section, provide separate tabbed divider for each system.
- C. Binders: Commercial quality, 8-1/2 by 11 inch three D side ring binders with durable plastic covers; 3 inch maximum ring size. When multiple binders are used, correlate data into related consistent groupings.
- D. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.
- E. Project Directory: Title and address of Project; names, addresses, and telephone numbers of Architect, Consultants, Contractor and subcontractors, with names of responsible parties.

- F. Tables of Contents: List every item separated by a divider, using the same identification as on the divider tab; where multiple volumes are required, include all volumes Tables of Contents in each volume, with the current volume clearly identified.
- G. Dividers: Provide tabbed dividers for each separate product and system; identify the contents on the divider tab; immediately following the divider tab include a description of product and major component parts of equipment.
- H. Text: Manufacturer's printed data, or typewritten data on 20 pound paper.
- I. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- J. Arrangement of Contents: Organize each volume in parts as follows:
  1. Project Directory.
  2. Table of Contents, of all volumes, and of this volume.
  3. Operation and Maintenance Data: Arranged by system, then by product category.
    - a. Source data.
    - b. Product data, shop drawings, and other submittals.
    - c. Operation and maintenance data.
    - d. Field quality control data.
    - e. Photocopies of warranties and bonds.

### **3.06 WARRANTIES AND BONDS**

- A. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within 10 days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until the Date of Substantial completion is determined.
- B. Verify that documents are in proper form, contain full information, and are notarized.
- C. Co-execute submittals when required.
- D. Retain warranties and bonds until time specified for submittal.

**END OF SECTION 01 7800**

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**SECTION 03 3000**  
**CAST-IN-PLACE CONCRETE**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Floors and slabs on grade.
- B. Concrete footings.
- C. Concrete reinforcement.

**1.02 REFERENCE STANDARDS**

- A. ACI 301 - Specifications for Structural Concrete; American Concrete Institute International; 2010.
- B. ACI 305R - Hot Weather Concreting; American Concrete Institute International; 2010.
- C. ACI 306R - Cold Weather Concreting; American Concrete Institute International; 2010.
- D. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; American Concrete Institute International; 2011.
- E. ACI 347 - Guide to Formwork for Concrete; American Concrete Institute International; 2004.
- F. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon Billet-Steel Bars for Concrete Reinforcement; 2014.
- G. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2013.
- H. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2013.
- I. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2014.
- J. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2014.
- K. ASTM C150/C150M - Standard Specification for Portland Cement; 2012.
- L. ASTM C173/C173M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method; 2014.
- M. ASTM C330/C330M - Standard Specification for Lightweight Aggregates for Structural Concrete; 2014.
- N. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2013.
- O. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; 2012.
- P. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types); 2004 (Reapproved 2013).

**1.03 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Submit manufacturers' data on manufactured products showing compliance with specified requirements and installation instructions.
  - 1. For curing compounds, provide data on method of removal in the event of incompatibility with floor covering adhesives.
- C. Mix Design: Submit proposed concrete mix design.
  - 1. Indicate proposed mix design complies with requirements of ACI 301, Section 4 - Concrete Mixtures.
  - 2. Indicate proposed mix design complies with requirements of ACI 318, Chapter 5 - Concrete Quality, Mixing and Placing.

- D. Project Record Documents: Accurately record actual locations of embedded utilities and components that will be concealed from view upon completion of concrete work.

#### 1.04 QUALITY ASSURANCE

- A. Perform work of this section in accordance with ACI 301 and ACI 318.
  - 1. Maintain one copy of each document on site.
- B. Follow recommendations of ACI 305R when concreting during hot weather.
- C. Follow recommendations of ACI 306R when concreting during cold weather.
- D. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.
- E. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
- F. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.
- G. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
  - 1. ACI 301, "Specifications for Structural Concrete," Sections 1 through 5.
  - 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
- H. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

#### 1.05 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

### PART 2 PRODUCTS

#### 2.01 REINFORCEMENT

- A. Reinforcing Steel: ASTM A615/A615M, Grade 60 - 60,000 psi.
  - 1. Type: Deformed billet-steel bars.
  - 2. Finish: Unfinished, unless otherwise indicated.
- B. Steel Welded Wire Reinforcement (WWR): Galvanized, plain type, ASTM A1064/A1064M.
- C. Reinforcement Accessories:
  - 1. Tie Wire: Annealed, minimum 16 gage, 0.0508 inch.
  - 2. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement.

#### 2.02 CONCRETE MATERIALS

- A. Cement: ASTM C150, Type I - Normal Portland type.
  - 1. Acquire all cement for entire project from same source.
- B. Fine and Coarse Aggregates: ASTM C 33.
- C. Fly Ash: ASTM C618, Class C or F.
- D. Water: Clean and not detrimental to concrete, complying with ASTM C94/94M.

#### 2.03 ADMIXTURES

- A. 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.
- B. Chemical Admixture Manufacturers:
  - 1. BASF Construction Chemicals; [www.master-builders-solutions.bASF.us](http://www.master-builders-solutions.bASF.us).
  - 2. Euclid Chemical Company; [www.euclidchemical.com](http://www.euclidchemical.com).

3. Grace Construction Products, W.R. Grace & Co.; [www.grace.com](http://www.grace.com).
  4. Sika Corporation: [www.sikausa.com](http://www.sikausa.com).
  5. Substitutions: See Section 01 6000 - Product Requirements.
- C. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.
- D. Air Entrainment Admixture: ASTM C260/C260M.
- E. High Range Water Reducing and Retarding Admixture: ASTM C494/C494M Type G.
- F. High Range Water Reducing Admixture: ASTM C494/C494M Type F.
- G. Water Reducing and Accelerating Admixture: ASTM C494/C494M Type E.
- H. Water Reducing and Retarding Admixture: ASTM C494/C494M Type D.
- I. Accelerating Admixture: ASTM C494/C494M Type C.
- J. Retarding Admixture: ASTM C494/C494M Type B.
- K. Water Reducing Admixture: ASTM C494/C494M Type A.

## 2.04 ACCESSORY MATERIALS

- A. Underslab Vapor Retarder: Multi-layer, fabric-, cord-, grid-, or aluminum-reinforced polyethylene or equivalent, complying with ASTM E1745, Class C; stated by manufacturer as suitable for installation in contact with soil or granular fill under concrete slabs. The use of single ply polyethylene is prohibited.
1. Accessory Products: Vapor retarder manufacturer's recommended tape, adhesive, mastic, prefabricated boots, etc., for sealing seams and penetrations in vapor retarder.
  2. Products:
    - a. Insulation Solutions, Inc; Viper VaporCheck II 15-mil (Class A): [www.insulationsolutions.com](http://www.insulationsolutions.com).
    - b. Insulation Solutions, Inc; Viper VaporCheck II 10-mil C (Class C): [www.insulationsolutions.com](http://www.insulationsolutions.com).
    - c. Stego Industries, LLC; Stego Wrap Vapor Barrier 15-mil (Class A): [www.stegoindustries.com](http://www.stegoindustries.com).
    - d. W.R. Meadows, Inc.; PERMINATOR Class A - 15 mils: [www.wrmeadows.com](http://www.wrmeadows.com).
    - e. Substitutions: See Section 01 6000 - Product Requirements.

## 2.05 BONDING AND JOINTING PRODUCTS

- A. Latex Bonding Agent: Non-redispersable acrylic latex, complying with ASTM C1059/C1059M, Type II.
1. Products:
    - a. Sika Corporation; Sika Latex: [www.sikausa.com](http://www.sikausa.com).
    - b. SpecChem, LLC; Strong Bond Acrylic Bonder: [www.specchemllc.com](http://www.specchemllc.com).
    - c. W.R. Meadows, Inc.; ACRY-LOK: [www.wrmeadows.com](http://www.wrmeadows.com).
    - d. Substitutions: See Section 01 6000 - Product Requirements.
- B. Slab Expansion and Isolation Joint Filler: 1/2 inch thick, height equal to slab thickness, with removable top section that will form 1/2 inch deep sealant pocket after removal.
1. Material: ASTM D1751, cellulose fiber.
- C. Semi Rigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 per ASTM D 2240.

## 2.06 CURING MATERIALS

- A. Evaporation Reducer: Liquid thin-film-forming compound that reduces rapid moisture loss caused by high temperature, low humidity, and high winds; intended for application immediately after concrete placement.
1. Products:
    - a. BASF Construction Chemicals - Building Systems; Confilm: [www.master-builders-solutions.bASF.us](http://www.master-builders-solutions.bASF.us).

- b. Dayton Superior Corporation; AquaFilm Concentrate J74: [www.daytonsuperior.com](http://www.daytonsuperior.com).
  - c. SpecChem, LLC; SpecFilm Concentrate or SpecFilm RTU: [www.specchemllc.com](http://www.specchemllc.com).
  - d. Euclid Chemical Company; Eucobar: [www.euclidchemical.com](http://www.euclidchemical.com).
  - e. Sika Corporation; SikaFilm: [www.sikausa.com](http://www.sikausa.com).
  - f. Substitutions: See Section 01 6000 - Product Requirements.
- B. Moisture-Retaining Sheet: ASTM C171.
    - 1. Polyethylene film, clear, minimum nominal thickness of 0.0040 in..
    - 2. White-burlap-polyethylene sheet, weighing not less than 10 oz./per linear yd, 40 inches wide.
  - C. Polyethylene Film: ASTM D2103, 10 mil thick, clear.
  - D. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.
  - E. Water: Potable, not detrimental to concrete.

## 2.07 CONCRETE MIX DESIGN

- A. Proportioning Normal Weight Concrete: Comply with ACI 211.1 recommendations.
- B. Limit water-soluble, chloride-ion content in hardened concrete to 0.06 percent by weight of cement.
- C. Concrete Strength: Establish required average strength for each type of concrete on the basis of field experience or trial mixtures, as specified in ACI 301.
- D. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended or required by manufacturer.
- E. Limit Fly Ash to 15% of total cementitious weight.
- F. Footings: Proportion normal-weight concrete mixture as follows:
  - 1. Minimum Compressive Strength: 3000 psi (20.7 MPa) at 28 days.
  - 2. Maximum Water-Cementitious Materials Ratio: 0.50.
  - 3. Slump Limit: 4 inches (100 mm), plus or minus 1 inch (25 mm).
  - 4. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch (38-mm) nominal maximum aggregate size.
- G. Slabs-on-Grade: Proportion normal-weight concrete mixture as follows:
  - 1. Minimum Compressive Strength: 3500 psi (24.1 MPa) at 28 days.
  - 2. Minimum Cementitious Materials Content: 470 lb/cu. yd. (279 kg/cu. m).
  - 3. Slump Limit: 4 inches (100 mm), plus or minus 1 inch (25 mm).
  - 4. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.

## PART 3 EXECUTION

### 3.01 PREPARATION

- A. Formwork: Comply with requirements of ACI 301. Design and fabricate forms to support all applied loads until concrete is cured, and for easy removal without damage to concrete.
- B. Verify that forms are clean and free of rust before applying release agent.
- C. Coordinate placement of embedded items with erection of concrete formwork and placement of form accessories.
- D. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.
- E. Where new concrete is to be bonded to previously placed concrete, prepare existing surface by cleaning with steel brush and applying bonding agent in accordance with manufacturer's instructions.
  - 1. Use epoxy bonding system for bonding to damp surfaces, for structural load-bearing applications, and where curing under humid conditions is required.
  - 2. Use latex bonding agent only for non-load-bearing applications.

- F. Interior Slabs on Grade: Install vapor retarder under interior slabs on grade. Lap joints minimum 6 inches. Seal joints, seams and penetrations watertight with manufacturer's recommended products and follow manufacturer's written instructions. Repair damaged vapor retarder before covering.

### **3.02 INSTALLING REINFORCEMENT AND OTHER EMBEDDED ITEMS**

- A. Comply with requirements of ACI 301. Clean reinforcement of loose rust and mill scale, and accurately position, support, and secure in place to achieve not less than minimum concrete coverage required for protection.
- B. Install welded wire reinforcement in maximum possible lengths, and offset end laps in both directions. Splice laps with tie wire. Lap ends and edges six-inches or at least one mesh spacing.
- C. Verify that anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not interfere with concrete placement.

### **3.03 PLACING CONCRETE**

- A. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.
- B. Place concrete in accordance with ACI 304R.
- C. Place concrete for floor slabs in accordance with ACI 302.1R.
- D. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.
- E. Ensure reinforcement, inserts, embedded parts, and formed construction joint devices will not be disturbed during concrete placement.
- F. Finish floors level and flat, unless otherwise indicated, within the tolerances specified below.
- G. 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. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches (150 mm) into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- H. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
  1. When average high and low temperature is expected to fall below 40 deg F (4.4 deg C) for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
  2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
  3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- I. Hot-Weather Placement: Comply with ACI 301 and as follows:
  1. Maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
- J. Finish floors level and flat, unless otherwise indicated, within the tolerances specified below.

### **3.04 SLAB JOINTING**

- A. Locate joints as indicated on the Drawings.
- B. Anchor joint fillers and devices to prevent movement during concrete placement.
- C. Saw Cut Contraction Joints: Saw cut joints before concrete begins to cool, within 4 to 12 hours after placing; use 3/16 inch thick blade and cut at least 1 inch deep but not less than one quarter (1/4) the depth of the slab.
- D. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
- E. Construction Joints: Where not otherwise indicated, use metal combination screed and key form, with removable top section for joint sealant.

### **3.05 FLOOR FLATNESS AND LEVELNESS TOLERANCES**

- A. An independent testing agency, as specified in Section 01 4000, will inspect finished slabs for conformance to specified tolerances.
- B. Maximum Variation of Surface Flatness:
  - 1. Exposed Concrete Floors: 1/8 inch in 10 ft.
- C. Correct the slab surface if tolerances are less than specified.
- D. Minimum F(F) Floor Flatness and F(L) Floor Levelness Values:
  - 1. Exposed to View and Foot Traffic: F(F) of 20; F(L) of 15, on-grade only.
- E. Correct defects by grinding or by removal and replacement of the defective work. Areas requiring corrective work will be identified. Re-measure corrected areas by the same process.

### **3.06 CONCRETE FINISHING**

- A. Concrete Slabs: Finish to requirements of ACI 302.1R, and as follows:
  - 1. Other Surfaces to Be Left Exposed: "Steel trowel" as described in ACI 302.1R, minimizing burnish marks and other appearance defects.
- B. In areas with floor drains, maintain floor elevation at walls; pitch surfaces uniformly to drains as indicated on drawings.
- C. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.

### **3.07 CURING AND PROTECTION**

- A. Comply with requirements of ACI 308R. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
  - 1. 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.
  - 2. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching  $0.2 \text{ lb/sq. ft.} \times h$  ( $1 \text{ kg/sq. m} \times h$ ) 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.
- B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
  - 1. Normal concrete: Not less than 7 days.
- 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 with the following materials:
    - a. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. 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. Removal: 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].

### **3.08 JOINT FILLING**

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
  1. Defer joint filling until concrete has aged at least one month(s). Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.
- C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches (50 mm) deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

### **3.09 FIELD QUALITY CONTROL**

- A. Testing and Inspecting: Engage a qualified testing and inspecting agency approved by the Owner to perform tests and inspections and to submit reports.
- B. Inspections:
  1. Steel reinforcement placement.
  2. Verification of use of required design mixture.
  3. Concrete placement, including conveying and depositing.
  4. Verification of concrete strength before removal of shores and forms from beams and slabs.
- C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
  1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd. (4 cu. m), but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.
  2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
  3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; ASTM C173/173M, volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
  4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when 80 deg F (27 deg C) and above, and one test for each composite sample.
  5. Compression Test Specimens: ASTM C 31/C 31M.
    - a. Cast and laboratory cure two sets of two standard 6" cylinder specimens for each composite sample.
  6. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
    - a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.

7. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa).
  8. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
  9. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
  10. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
  11. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.
- D. Measure floor and slab flatness and levelness according to ASTM E 1155 (ASTM E 1155M) within 24 hours of finishing.

### **3.10 DEFECTIVE CONCRETE**

- A. Test Results: The testing agency shall report test results in writing to Architect and Contractor within 24 hours of test.
- B. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.
- C. Repair or replacement of defective concrete will be determined by the Architect. The cost of additional testing shall be borne by Contractor when defective concrete is identified.
- D. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Architect for each individual area.

**SECTION 04 0511**  
**MASONRY MORTARING AND GROUTING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Mortar for masonry.
- B. Grout for masonry.

**1.02 RELATED REQUIREMENTS**

- A. Section 04 2000 - Unit Masonry: Installation of mortar and grout.

**1.03 REFERENCE STANDARDS**

- A. ASTM C91/C91M - Standard Specification for Masonry Cement; 2012.
- B. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2014.
- C. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2012.
- D. ASTM C387/C387M - Standard Specification for Packaged, Dry, Combined Materials for Concrete and High Strength Mortar; 2011b.
- E. ASTM C476 - Standard Specification for Grout for Masonry; 2010.
- F. ASTM C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry; 2012.
- G. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete; 2010.
- H. ASTM C1019 - Standard Test Method for Sampling and Testing Grout; 2013.
- I. ASTM C1148 - Standard Test Method for Measuring the Drying Shrinkage of Masonry Mortar; 1992a (Reapproved 2008).
- J. ASTM C1314 - Standard Test Method for Compressive Strength of Masonry Prisms; 2012.
- K. ASTM C1357 - Standard Test Methods for Evaluating Masonry Bond Strength; 2009.
- L. ASTM E514/E514M - Standard Test Method for Water Penetration and Leakage Through Masonry; 2014.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Include design mix and indicate whether the Proportion or Property specification of ASTM C270 is to be used.

**1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Maintain packaged materials clean, dry, and protected against dampness, freezing, and foreign matter.

**1.06 FIELD CONDITIONS**

- 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.

**PART 2 PRODUCTS**

**2.01 MORTAR AND GROUT APPLICATIONS**

- A. Use only factory premixed packaged dry materials for mortar and grout, with addition of water only at project site.
- B. Mortar Color: Natural gray unless otherwise indicated.
- C. Mortar Mix Designs: ASTM C270, Property Specification.

1. Mortar Mix Design: 1,500 psi strength at 28 days.
2. Masonry below grade and in contact with earth: Type S.
3. Exterior, Loadbearing Masonry: Type N.
4. Exterior, Non-loadbearing Masonry: Type N.

## 2.02 MATERIALS

- A. Packaged Dry Material for Mortar for Unit Masonry: Premixed masonry cement and mason's sand; complying with ASTM C387/C387M and capable of producing mortar of the specified strength in accordance with ASTM C270 with the addition of water only.
  1. Type: Type N.
  2. Color: Standard gray.
- B. Water: Clean and potable.
- C. Moisture-Resistant Admixture: Water repellent compound designed to reduce capillarity.
- D. Bonding Agent: Latex type.
- E. Integral Water Repellent Admixture: Polymeric liquid admixture added to mortar and grout at the time of manufacture.
  1. Performance of Mortar and Grout with Integral Water Repellent:
    - a. Water Permeance: When tested per ASTM E514/E514M and for a minimum of 72 hours:
      - 1) No water visible on back of wall above flashing at the end of 24 hours.
      - 2) No flow of water from flashing equal to or greater than 0.032 gallons per hour at the end of 24 hours.
      - 3) No more than 25% of wall area above flashing visibly damp at end of test.
    - b. Flexural Bond Strength: ASTM C1357; minimum 10% increase.
    - c. Compressive Strength: ASTM C1314; maximum 5% decrease.
    - d. Drying Shrinkage: ASTM C1148; maximum 5% increase in shrinkage.
  2. Use only in combination with masonry units produced with integral water repellent admixture.

## 2.03 MORTAR MIXING

- A. Thoroughly mix mortar ingredients using mechanical batch mixer, in accordance with ASTM C270 and in quantities needed for immediate use.
- B. Maintain sand uniformly damp immediately before the mixing process.
- C. Add admixtures in accordance with manufacturer's instructions; mix uniformly.
- D. Do not use anti-freeze compounds to lower the freezing point of mortar.
- E. If water is lost by evaporation, re-temper only within two hours of mixing.

## 2.04 GROUT MIXING

- A. Mix grout in accordance with ASTM C94/C94M.
- B. Thoroughly mix grout ingredients in quantities needed for immediate use in accordance with ASTM C476 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.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. Install mortar and grout to requirements of section(s) in which masonry is specified.

### 3.02 GROUTING

- A. Perform all grouting by means of low-lift technique. Do not employ high-lift grouting.
- B. Low-Lift Grouting:
  1. Limit height of pours to 12 inches.

2. Limit height of masonry to 36 inches above each pour.
3. Pour grout only after vertical reinforcing is in place; place horizontal reinforcing as grout is poured. Prevent displacement of bars as grout is poured.
4. Place grout for each pour continuously and consolidate immediately; do not interrupt pours for more than 1-1/2 hours.

### **3.03 FIELD QUALITY CONTROL**

- A. Testing and Inspecting: Engage a qualified testing and inspecting agency approved by the Owner to perform tests and inspections and to submit reports.
- B. Test and evaluate mortar in accordance with ASTM C780 procedures.
- C. Test and evaluate grout in accordance with ASTM C1019 procedures.

**END OF SECTION 04 0511**

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**SECTION 04 2000  
UNIT MASONRY**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Concrete Block.
- B. Clay Facing Brick.
- C. Common Brick.
- D. Reinforcement and Anchorage.
- E. Flashings.
- F. Accessories.

**1.02 RELATED REQUIREMENTS**

- A. Section 04 0511 - Masonry Mortaring and Grouting.
- B. Section 07 9200 - Joint Sealants: Sealing control and expansion joints.

**1.03 REFERENCE STANDARDS**

- A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.
- B. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement; 2014.
- C. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2013.
- D. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units; 2014.
- E. ASTM C216 - Standard Specification for Facing Brick (Solid Masonry Units Made From Clay or Shale); 2014.
- F. ASTM C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry; 2012.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data for masonry units, fabricated wire reinforcement, mortar, and masonry accessories.
- C. Manufacturer's Certificate: Certify that masonry units meet or exceed specified requirements.

**1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.

**PART 2 PRODUCTS**

**2.01 CONCRETE MASONRY UNITS**

- A. Concrete Block: Comply with referenced standards and as follows:
  - 1. Size: Standard units with nominal face dimensions of 16 x 8 inches and nominal depths as indicated on the drawings for specific locations.
  - 2. Load-Bearing Units: ASTM C90, normal weight.
    - a. Hollow block, as indicated.

**2.02 BRICK UNITS**

- A. Manufacturers:
  - 1. General Shale Brick: [www.generalshale.com](http://www.generalshale.com).
  - a. Basis of Design:
    - 1) M/S Spalding Tudor Brick

- 2) M/S Nottingham Tudor Brick
- 3) Q/M Millstone Brick
- B. Facing Brick: ASTM C216, Type FBX, Grade SW.
  - 1. Nominal size: 7.625 W x 2.25 H x 3.5 L.
  - 2. Special shapes: Molded units as required by conditions indicated, unless standard units can be sawn to produce equivalent effect.

## **2.03 MORTAR AND GROUT MATERIALS**

- A. Mortar and Grout: As specified in Section 04 0511.

## **2.04 REINFORCEMENT AND ANCHORAGE**

- A. Reinforcing Steel: ASTM A615/A615M, Grade 60 - 60,000 psi, deformed billet bars; uncoated.
- B. Single Wythe Joint Reinforcement: Truss or ladder type; ASTM A1064/A1064M steel wire, mill galvanized to ASTM A641/A641M, Class 3; 0.1875 inch side rods with 0.1875 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.
- C. Flexible Anchors: 2-piece anchors that permit differential movement between masonry and building frame, sized to provide not more than 1 inch and not less than 1/2 inch of mortar coverage from masonry face.
- D. Two-Piece Wall Ties: Formed steel wire, 0.1875 inch thick, adjustable, eye and pintle type, hot dip galvanized to ASTM A 153/A 153M, Class B, sized to provide not more than 1 inch and not less than 1/2 inch of mortar coverage from masonry face and to allow vertical adjustment of up to 1-1/4 in.

## **2.05 FLASHINGS**

- A. Copper/Polymer Fabric Flashing: 3 oz/sq ft copper sheet laminated between two sheets of polymer or fiberglass fabric.

## **2.06 ACCESSORIES**

- A. Cavity Mortar Control: Semi-rigid polyethylene or polyester mesh panels, sized to thickness of wall cavity, and designed to prevent mortar droppings from clogging weeps and cavity vents and allow proper cavity drainage.
  - 1. Mortar Diverter: Semi-rigid mesh designed for installation at flashing locations.
    - a. Manufacturers:
      - 1) Basis of Design: Mortar Net Solutions; Mortar Net with Insect Barrier: [www.mortarnet.com](http://www.mortarnet.com).
- B. Weeps: Cotton rope.
- C. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- 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.

### **3.02 PREPARATION**

- A. Direct and coordinate placement of metal anchors supplied for installation under other sections.
- B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

### **3.03 COLD AND HOT WEATHER 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.

### **3.04 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.
  - 2. Coursing: One unit and one mortar joint to equal 8 inches.
  - 3. Mortar Joints: Concave.
- D. Brick Units:
  - 1. Bond: Running.
  - 2. Coursing: Three units and three mortar joints to equal 8 inches.
  - 3. Mortar Joints: Concave.

### **3.05 PLACING AND BONDING**

- A. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.
- B. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.
- C. Interlock intersections and external corners.
- D. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
- E. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.

### **3.06 WEEPS/CAVITY VENTS**

- A. Install weeps in veneer and cavity walls at 32 inches on center horizontally above through-wall flashing, above shelf angles and lintels, and at bottom of walls.

### **3.07 CAVITY MORTAR CONTROL**

- A. Do not permit mortar to drop or accumulate into cavity air space or to plug weep/cavity vents.
- B. Install cavity mortar diverter at base of cavity and at other flashing locations as recommended by manufacturer to prevent mortar droppings from blocking weep/cavity vents.

### **3.08 REINFORCEMENT AND ANCHORAGE - GENERAL**

- A. Unless otherwise indicated on drawings or specified under specific wall type, install horizontal joint reinforcement 16 inches on center.
- B. Place continuous joint reinforcement in first and second joint below top of walls.
- C. Lap joint reinforcement ends minimum 6 inches.
- D. Fasten anchors to structural framing and embed in masonry joints as masonry is laid. Unless otherwise indicated on drawings or closer spacing is indicated under specific wall type, space anchors at maximum of 36 inches horizontally and 16 inches vertically.

### **3.09 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 6 inches into adjacent masonry or turn up at least 8 inches to form watertight pan at non-masonry construction.
  - 2. Seal lapped ends and penetrations of flashing before covering with mortar.
- B. Extend metal flashings to within 1/4 inch of exterior face of masonry.
- C. Lap end joints of flashings at least 6 inches and seal watertight with flashing sealant/adhesive.

**3.10 LINTELS**

- A. Install loose steel lintels over openings.

**3.11 CONTROL AND EXPANSION JOINTS**

- A. Do not continue horizontal joint reinforcement through control or expansion joints.
- B. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.
- C. Size control joints as indicated on drawings; if not shown, 3/4 inch wide and deep.

**3.12 FIELD QUALITY CONTROL**

- A. Mortar Tests: Test mortar in accordance with ASTM C780, testing with same frequency as masonry samples.

**3.13 CLEANING**

- A. Remove excess mortar and mortar droppings.
- B. Clean soiled surfaces with cleaning solution.
- C. Use non-metallic tools in cleaning operations.

**3.14 PROTECTION**

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

**3.15 SCHEDULES**

- A. Refer to Masonry Schedule on drawings for locations.

**END OF SECTION 04 2000**

**SECTION 04 7200**  
**CAST STONE MASONRY**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Architectural cast stone.

**1.02 RELATED REQUIREMENTS**

- A. Section 04 0511 - Masonry Mortaring and Grouting: Mortar for setting cast stone.
- B. Section 04 2000 - Unit Masonry: Installation of cast stone in conjunction with masonry.
- C. Section 07 9200 - Joint Sealants: Sealing joints indicated to be left open for sealant.

**1.03 REFERENCE STANDARDS**

- A. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; American Concrete Institute International; 2011.
- B. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2015.
- C. ASTM A767/A767M - Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement; 2009.
- D. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2014a.
- E. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2013.
- F. ASTM C1364 - Standard Specification for Architectural Cast Stone; 2010b.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Test results of cast stone components made previously by the manufacturer.
- C. Mortar Color Selection Samples.
- D. Manufacturer's Qualification Data: Documentation showing compliance with specified requirements.

**1.05 QUALITY ASSURANCE**

- A. Manufacturer Qualifications:
  1. A firm with a minimum of 5 years experience producing cast stone of types required for project.
  2. Adequate plant capacity to furnish quality, sizes, and quantity of cast stone required without delaying progress of the work.
- B. Mock-Up: Provide full size cast stone components for installation in mock-up of exterior wall.
  1. Approved mock-up will become standard for appearance and workmanship.
  2. Remove mock-up not incorporated into the work and dispose of debris.

**1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver cast stone components secured to shipping pallets and protected from damage and discoloration. Protect corners from damage.
- B. Number each piece individually to match shop drawings and schedule.
- C. Store cast stone components and installation materials in accordance with manufacturer's instructions.
- D. Store cast stone components on pallets with nonstaining, waterproof covers. Ventilate under covers to prevent condensation. Prevent contact with dirt.
- E. Protect cast stone components during handling and installation to prevent chipping, cracking, or other damage.
- F. Store mortar materials where contamination can be avoided.

- G. Schedule and coordinate production and delivery of cast stone components with unit masonry work to optimize on-site inventory and to avoid delaying the work.

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

- A. Architectural Cast Stone:
1. General Shale Brick: [www.generalshale.com](http://www.generalshale.com).
  - a. Basis of Design:
    - 1) Citadel Silver Slate
    - 2) Citadel Iron Mountain

### 2.02 ARCHITECTURAL CAST STONE

- A. Cast Stone: Architectural concrete product manufactured to simulate appearance of natural limestone, complying with ASTM C1364.
1. Compressive Strength: As specified in ASTM C1364; calculate strength of pieces to be field cut at 80 percent of uncut piece.
  2. Freeze-Thaw Resistance: Demonstrated by laboratory testing in accordance with ASTM C1364.
  3. Surface Texture: Fine grained texture, with no bugholes, air voids, or other surface blemishes visible from distance of 20 feet.
  4. Remove cement film from exposed surfaces before packaging for shipment.
- B. Reinforcement: Provide reinforcement as required to withstand handling and structural stresses; comply with ACI 318.

### 2.03 MATERIALS

- A. Admixtures: ASTM C494/C494M.
- B. Water: Potable.
- C. Reinforcing Bars: ASTM A615/A615M deformed bars, galvanized.
  1. Galvanized in accordance with ASTM A767/A767M, Class I.
- D. Embedded Anchors, Dowels, and Inserts: Type 304 stainless steel, of type and size as required for conditions.
- E. Mortar: Portland cement-lime, as specified in Section 04 0511; do not use masonry cement.
- F. Cleaner: General-purpose cleaner designed for removing mortar and grout stains, efflorescence, and other construction stains from new masonry surfaces without discoloring or damaging masonry surfaces; approved for intended use by cast stone manufacturer and by cleaner manufacturer for use on cast stone and adjacent masonry materials.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. Install cast stone components in conjunction with masonry, complying with requirements of Section 04 2000.
- B. Mechanically anchor cast stone units indicated; set remainder in mortar.
- C. Setting:
  1. Drench cast stone components with clear, running water immediately before installation.
  2. Set units in a full bed of mortar unless otherwise indicated.
  3. Fill vertical joints with mortar.
  4. Fill dowel holes and anchor slots completely with mortar or non-shrink grout.
- D. Joints: Make all joints 3/8 inch, except as otherwise detailed.
  1. Rake mortar joints 3/4 inch for pointing.
  2. Remove excess mortar from face of stone before pointing joints.
  3. Point joints with mortar in layers 3/8 inch thick and tool to a slight concave profile.
  4. Leave the following joints open for sealant:

- a. Joints in projecting units.
  - b. Joints between rigidly anchored units, including soffits, panels, and column covers.
  - c. Joints below lugged sills and stair treads.
  - d. Joints below ledge and relieving angles.
  - e. Joints labeled "expansion joint".
- E. Repairs: Repair chips and other surface damage noticeable when viewed in direct daylight at 20 feet.
- 1. Repair with matching touchup material provided by the manufacturer and in accordance with manufacturer's instructions.
  - 2. Repair methods and results subject to Architect 's approval.

### **3.02 CLEANING**

- A. Clean completed exposed cast stone after mortar is thoroughly set and cured.
  - 1. Wet surfaces with water before applying cleaner.
  - 2. Apply cleaner to cast stone in accordance with manufacturer's instructions.
  - 3. Remove cleaner promptly by rinsing thoroughly with clear water.
  - 4. Do not use acidic cleaners.

### **3.03 PROTECTION**

- A. Protect completed work from damage.
- B. Clean, repair, or restore damaged or mortar-splashed work to condition of new work.

### **3.04 SCHEDULES**

- A. Refer to Masonry Schedule on drawings for locations.

**END OF SECTION 04 7200**

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**SECTION 06 0573  
WOOD TREATMENT**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Site applied termiteicide for wood materials.

**1.02 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide technical data on application instructions.
- C. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

**1.03 WARRANTY**

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Site Applied Termiteicide and Mildicide: Correct defective Work within a five year period after Date of Substantial Completion.

**PART 2 PRODUCTS**

**2.01 SITE APPLIED WOOD TREATMENT**

- A. Site Applied Termiteicide for Wood: Borate mineral salt based, spray applied, penetrating termiteicide.
  - 1. Products:
    - a. Basis of Design: Nisus Corporation: [www.nisuscorp.com](http://www.nisuscorp.com).

**PART 3 EXECUTION**

**3.01 PREPARATION**

- A. Remove dust, dirt and other contaminants from treatment surfaces. Remove tarpaulins, dropcloths, strippable protective films, etc., from areas to be treated Move equipment and stored materials that block or prevent product application.

**3.02 INSTALLATION - GENERAL**

**3.03 SITE APPLIED WOOD TREATMENT**

- A. Comply with manufacturers written mixing and installation instructions.
- B. Termiteicide: Apply to foundations, structure and other items as listed.
  - 1. All structural wood and sill plates within 36 inches, minimum, of point of contact with foundation.
  - 2. All wood, wood based and cellulosic sheathing within 36 inches, minimum, of point of contact with foundation.
  - 3. Concrete foundations 2 inches, minimum, from sill plate.
  - 4. All pipe and plumbing penetrations up to 36 inches, minimum, above slab and slab surface within 6 inches, minimum, of pipe or penetration.
  - 5. Six inches, minimum, on either side of control joints and construction joints in slabs and joints between slabs and abutting material.

**END OF SECTION 06 0573**

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**SECTION 06 1000  
ROUGH CARPENTRY**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Structural dimension lumber framing.
- B. Non-structural dimension lumber framing.
- C. Rough opening framing for doors, windows, and roof openings.
- D. Sheathing.
- E. Subflooring.
- F. Underlayment.
- G. Preservative treated wood materials.
- H. Miscellaneous framing and sheathing.
- I. Concealed wood blocking, nailers, and supports.
- J. Miscellaneous wood nailers, furring, and grounds.

**1.02 RELATED REQUIREMENTS**

- A. Section 03 3000 - Cast-in-Place Concrete: Setting anchors in concrete.
- B. Section 06 1753 - Shop-Fabricated Wood Trusses.
- C. Section 07 6200 - SHEET METAL FLASHING AND TRIM: Sill flashings.

**1.03 REFERENCE STANDARDS**

- A. AFPA (WFCM) - Wood Frame Construction Manual for One- and Two-Family Dwellings; American Forest and Paper Association; 2012.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2013.
- D. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2014.
- E. AWPA U1 - Use Category System: User Specification for Treated Wood; American Wood Protection Association; 2012.
- F. PS 2 - Performance Standard for Wood-Based Structural-Use Panels; National Institute of Standards and Technology, U.S. Department of Commerce; 2010.
- G. PS 20 - American Softwood Lumber Standard; National Institute of Standards and Technology, Department of Commerce; 2010.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide technical data on insulated sheathing, wood preservative materials, and application instructions.
- C. Manufacturer's Certificate: Certify that wood products supplied for rough carpentry meet or exceed specified requirements.
- D. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

**1.05 DELIVERY, STORAGE, AND HANDLING**

- A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

## 1.06 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.

## PART 2 PRODUCTS

### 2.01 GENERAL REQUIREMENTS

- A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
  - 1. Species: Spruce-Pine-Fir (South), unless otherwise indicated.
  - 2. If no species is specified, provide any species graded by the agency specified; if no grading agency is specified, provide lumber graded by any grading agency meeting the specified requirements.
  - 3. Grading Agency: Any grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee ([www.alsc.org](http://www.alsc.org)) and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.
- B. Lumber fabricated from old growth timber is not permitted.
- C. Provide sustainably harvested wood; see Section 01 6000 for requirements.
- D. Provide wood harvested within a 500 mile radius of the project site.
- E. 50% or greater of lumber used in project must be Forestry Stewardship Council (FSC) certified. FSC certified wood comes from forests that are managed to maintain ecological health and biodiversity.

### 2.02 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

- A. Sizes: Nominal sizes as indicated on drawings, S4S.
- B. Moisture Content: S-dry or MC19.
- C. Stud Framing (2 by 2 through 2 by 6 ):
  - 1. Grade: No. 2.
- D. Joist, Rafter, and Small Beam Framing (2 by 6 through 4 by 16 ):
  - 1. Machine stress-rated (MSR) as follows:
    - a. F<sub>b</sub>-single (minimum extreme fiber stress in bending): 1500 psi.
    - b. E (minimum modulus of elasticity): 1,400,000 psi.
- E. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
  - 1. Lumber: S4S, No. 2 or Standard Grade.

### 2.03 STRUCTURAL COMPOSITE LUMBER

- A. Structural Composite Lumber: Factory fabricated beams, headers, and columns, of sizes and types indicated on drawings; structural capacity as published by manufacturer.
  - 1. Beams: Use laminated veneer lumber, laminated strand lumber, or parallel strand lumber with manufacturer's published E (modulus of elasticity): 1,800,000 psi, minimum.
  - 2. Headers Not Longer Than 72 inches: Use laminated veneer lumber, laminated strand lumber, or parallel strand lumber.
  - 3. Manufacturers:
    - a. Boise Cascade: [www.bc.com](http://www.bc.com)
    - b. Georgia-Pacific Corp.: [www.buildgp.com](http://www.buildgp.com).
    - c. Substitutions: See Section 01 6000 - Product Requirements.

### 2.04 CONSTRUCTION PANELS

- A. Subfloor/Underlayment Combination: Any PS 2 type, rated Single Floor.
  - 1. Bond Classification: Exterior.
  - 2. Span Rating: 24.
  - 3. Performance Category: 3/4 PERF CAT.
  - 4. Edges: Tongue and groove.

- B. Subflooring: Any PS 2 type, rated Sheathing.
  - 1. Bond Classification: Exterior.
  - 2. Span Rating: 24.
  - 3. Performance Category: 3/4 PERF CAT.
- C. Roof Sheathing: Any PS 2 type, rated Structural I Sheathing.
  - 1. Bond Classification: Exterior.
  - 2. Span Rating: 24.
  - 3. Performance Category: 5/8 PERF CAT.
- D. Wall Sheathing: Wood construction panel laminated to insulation board.
  - 1. Construction Panel: 7/16 inch (11 mm) oriented strand board (OSB).
  - 2. Insulation Board: Polyisocyanurate foam plastic with cellulosic felt facer or glass fiber mat facer on major surface opposite construction panel.
  - 3. Finished Panel: Comply with ASTM C1289, Type V.
  - 4. Manufacturers:
    - a. Basis of design: Huber Engineered Woods; Zip System R Sheathing.

## 2.05 ACCESSORIES

- A. Fasteners and Anchors:
  - 1. Metal and Finish: Hot-dipped galvanized steel per ASTM A 153/A 153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.
  - 2. Drywall Screws: Bugle head, hardened steel, power driven type, length three times thickness of sheathing.
- B. Joist Hangers: Hot dipped galvanized steel, sized to suit framing conditions.
  - 1. For contact with preservative treated wood in exposed locations, provide minimum G185 galvanizing per ASTM A653/A653M.
- C. Sill Gasket on Top of Foundation Wall: 1/4 inch thick, plate width, closed cell plastic foam from continuous rolls.
- D. Sill Flashing: As specified in Section 07 6200.
- E. Subfloor Glue: Waterproof, water base, air cure type, cartridge dispensed.

## 2.06 FACTORY WOOD TREATMENT

- A. Treated Lumber and Plywood: Comply with requirements of AWPA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.
  - 1. Preservative-Treated Wood: Provide lumber and plywood marked or stamped by an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWPA standards.
- B. Preservative Treatment:
  - 1. Preservative Pressure Treatment of Lumber Above Grade: AWPA U1, Use Category UC3B, Commodity Specification A using waterborne preservative to 0.25 lb/cu ft retention.
    - a. Kiln dry lumber after treatment to maximum moisture content of 19 percent.
    - b. Treat lumber exposed to weather.
    - c. Treat lumber in contact with masonry or concrete.
    - d. Treat lumber less than 18 inches above grade.
  - 2. Termite Treatment:
    - a. Non-toxic borate spray Termite Treatment of wood products 3 ft minimum Above floor slab.

## PART 3 EXECUTION

### 3.01 PREPARATION

- A. Install sill gasket under sill plate of framed walls bearing on foundations; puncture gasket cleanly to fit tightly around protruding anchor bolts.

- B. Coordinate installation of rough carpentry members specified in other sections.

### **3.02 INSTALLATION - GENERAL**

- A. Select material sizes to minimize waste.
- B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.
- C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

### **3.03 FRAMING INSTALLATION**

- A. Set structural members level, plumb, and true to line. Discard pieces with defects that would lower required strength .
- B. Make provisions for temporary construction loads, and provide temporary bracing sufficient to maintain structure in true alignment and safe condition until completion of erection and installation of permanent bracing.
- C. Install structural members full length without splices .
- D. Comply with member sizes, spacing, and configurations indicated, and fastener size and spacing indicated, but not less than required by applicable codes and AFPA Wood Frame Construction Manual.
- E. Install horizontal spanning members with crown edge up and not less than 3 inches of bearing at each end.
- F. Construct double joist headers at floor and ceiling openings and under wall stud partitions that are parallel to floor joists; use metal joist hangers unless otherwise detailed.
- G. Provide bridging at joists in excess of 8 feet span per manufacturer's recommendations. Fit solid blocking at ends of members.
- H. Frame wall openings with two or more studs at each jamb; support headers on cripple studs.

### **3.04 BLOCKING, NAILERS, AND SUPPORTS**

- A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.

### **3.05 ROOF-RELATED CARPENTRY**

- A. Coordinate installation of roofing carpentry with deck construction, framing of roof openings, and roofing assembly installation.

### **3.06 INSTALLATION OF CONSTRUCTION PANELS**

- A. Subflooring/Underlayment Combination: Glue and nail to framing; staples are not permitted.
- B. Subflooring: Glue and nail to framing; staples are not permitted.
- C. Roof Sheathing: Secure panels with long dimension perpendicular to framing members, with ends staggered and over firm bearing.
  1. Nail panels to framing; staples are not permitted.
- D. Wall Sheathing: Secure with long dimension perpendicular to wall studs, with ends over firm bearing and staggered, using nails, screws, or staples.
  1. Support all edges of exterior sheathing with blocking between studs.

### **3.07 SITE APPLIED WOOD TREATMENT**

- A. Apply preservative treatment compatible with factory applied treatment at site-sawn cuts, complying with manufacturer's instructions.
- B. Allow preservative to dry prior to erecting members.

**END OF SECTION 06 1000**



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**SECTION 06 1500  
WOOD DECKING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Plywood structural wood decking.

**1.02 REFERENCE STANDARDS**

- A. AWPA U1 - Use Category System: User Specification for Treated Wood; American Wood-Preservers' Association; 2012.
- B. PS 1 - Structural Plywood; 2009.

**1.03 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience and certified by AITC.

**1.04 DELIVERY, STORAGE, AND HANDLING**

**PART 2 PRODUCTS**

**2.01 MANUFACTURERS**

- A. Plywood Decking:
  - 1. Georgia-Pacific Corporation: [www.buildgp.com](http://www.buildgp.com).
  - a. Basis of Design: Plytanium Plywood (Sturd-I-Floor).
  - 2. Substitutions: See Section 01 6000 - Product Requirements.

**2.02 WOOD MATERIALS**

- A. Wood fabricated from old growth timber is not permitted.
- B. Provide sustainably harvested wood; see Section 01 6000 for requirements.
- C. Provide wood harvested within a 500 mile radius of the project site.
- D. Plywood Decking: PS 1 veneer plywood; APA Rated Sheathing, Span Rating 2'; Exterior grade; 1A interior veneer appearance grade; sanded.

**2.03 WOOD TREATMENT**

- A. Factory-Treated Lumber and Plywood: Comply with requirements of AWPA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

- A. Verify that support framing is ready to receive decking.

**3.02 INSTALLATION - PLYWOOD DECKING**

- A. Install decking perpendicular to framing members, with ends staggered over firm bearing. On sloped surfaces, lay decking with tongue upward.
- B. Engage plywood tongue and groove edges.
- C. Allow expansion space at edges and ends.
- D. Attach decking with adhesive and screws.

**END OF SECTION 06 1500**

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## SECTION 06 1733 WOOD I-JOISTS

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Wood I-joists for floor framing.
- B. Bridging, bracing, and anchorage.
- C. Framing for openings.

#### 1.02 RELATED REQUIREMENTS

- A. Section 06 1000 - Rough Carpentry: Installation requirements for miscellaneous framing.
- B. Section 06 1000 - Rough Carpentry: Material requirements for blocking, plates, and miscellaneous framing.

#### 1.03 REFERENCE STANDARDS

- A. ASTM D5055 - Standard Specification for Establishing and Monitoring Structural Capacities of Prefabricated Wood I-Joists; 2013.
- B. PS 2 - Performance Standard for Wood-Based Structural-Use Panels; 2010.

#### 1.04 DESIGN REQUIREMENTS

- A. Design Floor Live Load: 50 lbs/sq ft with deflection limited to 1/360 of span.

#### 1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's literature describing materials, dimensions, allowable spans and spacings, bearing and anchor details, bridging and bracing requirements, and installation instructions; identify independent inspection agency.
- C. Sealed Shop Drawings: Indicate sizes and spacing of joists, bracing and bridging, bearing stiffeners, holes to be cut (if any), and framed openings between joists.
- D. Certificate: Certification by joist manufacturer that products delivered are of the same design and construction as those evaluated by the independent inspection agency.

#### 1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

#### 1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in manufacturer's original packaging with manufacturer's name and product identification intact and legible.
- B. Protect products from damage due to weather and breakage.
- C. Protect joists from warping or other distortion by stacking in upright position, braced to resist movement, with air circulation under coverings and around stacks.
- D. Handle individual joists in the upright position.

### PART 2 PRODUCTS

#### 2.01 MANUFACTURERS

- A. Wood I-Joists:
  1. Georgia-Pacific Corporation: [www.buildgp.com](http://www.buildgp.com).
  2. LP Building Products: [www.lpcorp.com](http://www.lpcorp.com).
  3. Weyerhaeuser: [www.woodbywy.com](http://www.woodbywy.com).
  4. Substitutions: See Section 01 6000 - Product Requirements.

## 2.02 MATERIALS

- A. Wood I-Joists: Solid lumber top and bottom flanges and oriented strand board (OSB) webs bonded together with structural adhesive, with published span rating to meet project requirements.
  - 1. Span Rating: Established and monitored in accordance with ASTM D5055 by independent inspection agency.
  - 2. Oriented Strand Board: Comply with PS 2.
  - 3. Adhesive: Tested for wet/exterior service in accordance with ASTM D2559.
  - 4. Depth: 14 inches.
  - 5. Fabrication Tolerances:
    - a. Flange Width: Plus/minus 1/32 inch.
    - b. Flange Thickness: Minus 1/16 inch.
    - c. Joist Depth: Plus 0, minus 1/8 inch.
  - 6. Marking: Mark each piece with depth, joist spacing, and allowable span for joist spacing.
- B. Wood-Based Components:
  - 1. Wood fabricated from old growth timber is not permitted.
- C. Joist Bridging: Type, size and spacing recommended by joist manufacturer.
- D. Fasteners: Electrogalvanized steel, type to suit application.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify that supports and openings are ready to receive joists.
- B. Verify that field measurements are as indicated on shop drawings.

### 3.02 PREPARATION

- A. Coordinate placement of bearing items.

### 3.03 ERECTION

- A. Install joists in accordance with manufacturer's instructions.
- B. Set structural 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.
- E. Install permanent bridging and bracing.
- F. Install headers and supports to frame openings required.
- G. Frame openings between joists with lumber in accordance with Section 06 1000.
- H. Coordinate installation of sheathing/decking with work of this section.

**END OF SECTION 06 1733**

**SECTION 06 1753**  
**SHOP-FABRICATED WOOD TRUSSES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Shop fabricated wood trusses for roof framing.
- B. Bridging, bracing, and anchorage.

**1.02 RELATED REQUIREMENTS**

- A. Section 06 1000 - Rough Carpentry: Installation requirements for miscellaneous framing.
- B. Section 06 1000 - Rough Carpentry: Material requirements for blocking, bridging, plates, and miscellaneous framing.

**1.03 REFERENCE STANDARDS**

- A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2013.
- B. TPI 1 - National Design Standard for Metal Plate Connected Wood Truss Construction; Truss Plate Institute; 2007 and errata (ANSI/TPI 1).
- C. TPI DSB-89 - Recommended Design Specification for Temporary Bracing of Metal Plate Connected Wood Trusses; Truss Plate Institute; 1989.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Show truss configurations, sizes, spacing, size and type of plate connectors, cambers, framed openings, bearing and anchor details, and bridging and bracing.
  - 1. Include identification of engineering software used for design.
  - 2. Provide shop drawings stamped or sealed by design engineer.
  - 3. Submit design calculations.

**1.05 QUALITY ASSURANCE**

- A. Designer Qualifications: Perform design by or under direct supervision of a Professional Engineer experienced in design of this Work and licensed in the State in which the Project is located.
- B. Fabricator Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

**1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Handle and erect trusses in accordance with TPI BCSI 1.
- B. Store trusses in vertical position resting on bearing ends.

**PART 2 PRODUCTS**

**2.01 TRUSSES**

- A. Wood Trusses: Designed and fabricated in accordance with TPI 1 and TPI DSB-89 to achieve structural requirements indicated.
  - 1. Connectors: Steel plate.
  - 2. Structural Design: Comply with applicable code for structural loading criteria.

**2.02 MATERIALS**

- A. Lumber:
  - 1. Moisture Content: Between 7 and 9 percent.
  - 2. Lumber fabricated from old growth timber is not permitted.
- B. Steel Connectors: Hot-dipped galvanized steel sheet, ASTM A653/A653M Structural Steel (SS) Grade 33/230, with G90/Z275 coating; die stamped with integral teeth; thickness as indicated.

C. Truss Bridging: Type, size and spacing recommended by truss manufacturer.

### **2.03 ACCESSORIES**

- A. Wood Blocking, Bridging, Plates, and Miscellaneous Framing: As specified in Section 06 1000.
- B. Fasteners: Electrogalvanized steel, type to suit application.

### **2.04 WOOD TREATMENT**

- A. Treated Lumber and Plywood: Comply with requirements of AWPA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that field measurements are as indicated.
- B. Verify that supports and openings are ready to receive trusses.

### **3.02 ERECTION**

- A. Install trusses in accordance with manufacturer's instructions and TPI DSB-89 and TPI BCSI 1; maintain a copy of each TPI document on site until installation is complete.
- B. Set members level and plumb, in correct position.
- C. Install permanent bridging and bracing.
- D. Frame openings between trusses with lumber in accordance with Section 06 1000.

**END OF SECTION 06 1753**

**SECTION 06 2000**  
**FINISH CARPENTRY**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Finish carpentry items.

**1.02 SUBMITTALS**

- A. Product Data:
- B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.

**1.03 QUALITY ASSURANCE**

- A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.

**1.04 DELIVERY, STORAGE, AND HANDLING**

- A. Protect work from moisture damage.

**PART 2 PRODUCTS**

**2.01 FINISH CARPENTRY ITEMS**

- A. Exterior Items:
  - 1. Porch post: PVC.
    - a. Size: As indicated on drawings.
    - b. Style: As indicated on drawings.
    - c. Colr: White.
  - 2. Guardrails: PVC.
    - a. Pickets: Colonial style at 4 inches on center.

**2.02 FABRICATION**

- A. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.

**PART 3 EXECUTION**

**3.01 INSTALLATION**

- A. Set and secure materials and components in place, plumb and level.

**3.02 TOLERANCES**

- A. Maximum Variation from True Position: 1/16 inch.
- B. Maximum Offset from True Alignment with Abutting Materials: 1/32 inch.

**END OF SECTION 06 2000**

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**SECTION 07 2100**  
**THERMAL INSULATION**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Board insulation at cavity wall construction, perimeter foundation wall, underside of floor slabs, and exterior wall behind fiber cement wall finish.
- B. Batt insulation in exterior wall construction.

**1.02 REFERENCE STANDARDS**

- A. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2014.
- B. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2012.
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2014.
- D. ASTM E136 - Standard Test Method for Behavior of Materials in a Vertical Tube Furnace At 750 Degrees C; 2012.

**1.03 SUBMITTALS**

- A. Product Data: Provide data on product characteristics, performance criteria, and product limitations.

**PART 2 PRODUCTS**

**2.01 APPLICATIONS**

- A. Insulation Under Concrete Slabs: Extruded polystyrene board.
- B. Insulation at Perimeter of Foundation: Expanded polystyrene board.
- C. Insulation in Wood Framed Walls: Batt insulation with no vapor retarder.

**2.02 FOAM BOARD INSULATION MATERIALS**

- A. Expanded Polystyrene (EPS) Board Insulation: ASTM C578, Type XI; with the following characteristics:
  1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
  2. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
- B. Extruded Polystyrene Board Insulation: Extruded polystyrene board; ASTM C578; with either natural skin or cut cell surfaces, and the following characteristics:
  1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
  2. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
  3. R-value; 1 inch of material at 72 degrees F: 5, minimum.

**2.03 BATT INSULATION MATERIALS**

- A. Where batt insulation is indicated, either glass fiber or mineral fiber batt insulation may be used, at Contractor's option.
- B. Glass Fiber Batt Insulation: Flexible preformed batt or blanket, complying with ASTM C665; friction fit.
  1. Combustibility: Non-combustible, when tested in accordance with ASTM E136.
  2. Formaldehyde Content: Zero.
  3. Manufacturers:
    - a. CertainTeed Corporation: [www.certainteed.com](http://www.certainteed.com).
    - b. Johns Manville: [www.jm.com](http://www.jm.com).
    - c. Owens Corning Corporation; EcoTouch PINK FIBERGLAS Insulation: [www.ocbuildingspec.com](http://www.ocbuildingspec.com).
- C. Mineral Fiber Batt Insulation: Flexible preformed batt or blanket, complying with ASTM C665; friction fit; unfaced flame spread index of 0 (zero) when tested in accordance with ASTM E84.

1. Smoke Developed Index: 0 (zero), when tested in accordance with ASTM E84.
2. Manufacturers:
  - a. Johns Manville; MinWool Sound Attenuation Fire Batts: [www.jm.com](http://www.jm.com).
  - b. Thermafiber, Inc.; SAFB: [www.thermafiber.com](http://www.thermafiber.com).
  - c. ROXUL, Inc; ComfortBatt: [www.roxul.com](http://www.roxul.com).

## PART 3 EXECUTION

### 3.01 BOARD INSTALLATION AT FOUNDATION PERIMETER

- A. Apply adhesive to back of boards:
- B. Install boards horizontally on foundation perimeter.
  1. Butt edges and ends tightly to adjacent boards and to protrusions.
- C. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

### 3.02 BOARD INSTALLATION UNDER CONCRETE SLABS

- A. Place insulation under slabs on grade after base for slab has been compacted.
- B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.
- C. Prevent insulation from being displaced or damaged while placing vapor retarder and placing slab.

### 3.03 BATT INSTALLATION

- A. Install insulation in accordance with manufacturer's instructions.
- B. Install in exterior wall spaces without gaps or voids. Do not compress insulation.
- C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
- D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.
- E. Retain insulation batts in place with spindle fasteners at 12 inches on center.

### 3.04 PROTECTION

- A. Do not permit installed insulation to be damaged prior to its concealment.

**END OF SECTION 07 2100**

**SECTION 07 2119**  
**FOAMED-IN-PLACE INSULATION**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Foamed-in-place insulation.
  - 1. In exterior framed walls.

**1.02 REFERENCE STANDARDS**

- A. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2010.
- B. ASTM D2842 - Standard Test Method for Water Absorption of Rigid Cellular Plastics; 2012.
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2014.
- D. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2014.
- E. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2004 (Reapproved 2012).
- F. ASTM E2178 - Standard Test Method for Air Permeance of Building Materials; 2013.

**1.03 SUBMITTALS**

- A. Product Data: Provide product description, insulation properties, and preparation requirements.
- B. Certificates: Certify that products of this section meet or exceed specified requirements.

**1.04 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with not less than three years of documented experience.

**1.05 FIELD CONDITIONS**

- A. Do not apply foam when temperature is below that specified by the manufacturer for ambient air and substrate.
- B. Do not apply foam when temperature is within 5 F of dew point.

**PART 2 PRODUCTS**

**2.01 MANUFACTURERS**

- A. Foamed-In-Place Insulation:

**2.02 MATERIALS**

- A. Foamed-In-Place Insulation: Medium-density, rigid or semi-rigid, closed cell polyurethane foam; foamed on-site, using blowing agent of non-ozone-depleting gas.
  - 1. Aged Thermal Resistance: R-value of 5.8 (deg F hr sq ft)/Btu, minimum, when tested at 1 inch thickness in accordance with ASTM C518 after aging for 90 days at 41 degrees F.
  - 2. Water Vapor Permeance: Vapor retarder; 1.51 perm, maximum, when tested at 1" thickness in accordance with ASTM E96/E96M, desiccant method.
  - 3. Water Absorption: Less than 2 percent by volume, maximum, when tested in accordance with ASTM D2842.
  - 4. Air Permeance: 0.004 cfm/sq ft, maximum, when tested at intended thickness in accordance with ASTM E2178 or ASTM E283 at 1.5 psf.
  - 5. Closed Cell Content: At least 88 percent.
  - 6. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/450, maximum, when tested in accordance with ASTM E84.
  - 7. Products:
    - a. Basis of Design: Certainteed; CertaSpray Closed Cell Foam

### **2.03 ACCESSORIES**

- A. Primer: As required by insulation manufacturer.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify work within construction spaces or crevices is complete prior to insulation application.
- B. Verify that surfaces are clean, dry, and free of matter that may inhibit insulation or overcoat adhesion.

### **3.02 PREPARATION**

- A. Mask and protect adjacent surfaces from over spray or dusting.
- B. Apply primer in accordance with manufacturer's instructions.

### **3.03 APPLICATION**

- A. Apply insulation in accordance with manufacturer's instructions.
- B. Apply insulation by spray method, to a uniform monolithic density without voids.
- C. Patch damaged areas.
- D. Trim excess away for applied trim or remove as required for continuous sealant bead.

### **3.04 PROTECTION**

- A. Do not permit subsequent construction work to disturb applied insulation.

**END OF SECTION 07 2119**

**SECTION 07 2126**  
**BLOWN INSULATION**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Ceiling: Loose insulation pneumatically placed through access holes.

**1.02 REFERENCE STANDARDS**

- A. ASTM C764 - Standard Specification for Mineral Fiber Loose-Fill Thermal Insulation; 2011.
- B. ASTM C1015 - Standard Practice for Installation of Cellulosic and Mineral Fiber Loose-Fill Thermal Insulation; 2006 (Reapproved 2011)e1.

**1.03 SUBMITTALS**

- A. Product Data: Provide data on product characteristics, performance criteria, limitations.
- B. Certificates: Certify that products of this section meet or exceed specified requirements.

**PART 2 PRODUCTS**

**2.01 MANUFACTURERS**

- A. Blown Insulation:
  - 1. CertainTeed Corporation: [www.certainteed.com](http://www.certainteed.com).
  - 2. GreenFiber: [www.greenfiber.com](http://www.greenfiber.com).
  - 3. Johns Manville: [www.jm.com](http://www.jm.com).

**2.02 MATERIALS**

- A. Loose Fill Insulation: ASTM C764, mineral wool fiber type, nodulated for pour and bulk for pneumatic placement.
  - 1. Thermal Conductivity: 0.27 BTU in/(hr sq ft deg F).
  - 2. Installed Thickness: As indicated on drawings.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

- A. Verify that substrate, adjacent materials, and insulation are dry and ready to receive insulation.
- B. Verify that light fixtures have thermal cut-out device to restrict over-heating in soffit or ceiling spaces.

**3.02 INSTALLATION**

- A. Install insulation and ventilation baffle in accordance with ASTM C1015 and manufacturer's instructions.
- B. Place insulation pneumatically to completely fill joist spaces.
- C. Place insulation against baffles. Do not impede natural attic ventilation to soffit.
- D. Completely fill intended spaces. Leave no gaps or voids.

**3.03 CLEANING**

- A. Remove loose insulation residue.

**END OF SECTION 07 2126**

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## SECTION 07 3113 ASPHALT SHINGLES

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Asphalt shingle roofing.
- B. Flexible sheet membranes for eave protection, underlayment, and valley protection.
- C. Associated metal flashings and accessories.

#### 1.02 REFERENCE STANDARDS

- A. ASTM D226/D226M - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing; 2009.
- B. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection; 2013.
- C. ASTM D3462/D3642M - Standard Specification for Asphalt Shingles Made From Glass Felt and Surfaced With Mineral Granules; 2010a.
- D. NRCA MS104 - The NRCA Steep Roofing Manual; National Roofing Contractors Association; 2001, Fifth Edition, with interim updates.

#### 1.03 SUBMITTALS

- A. Product Data: Provide data indicating material characteristics.
- B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

#### 1.04 QUALITY ASSURANCE

- A. Perform Work in accordance with the recommendations of NRCA Steep Roofing Manual.

#### 1.05 FIELD CONDITIONS

- A. Do not install shingles or eave protection membrane when surface temperatures are below 45 degrees F.

### PART 2 PRODUCTS

#### 2.01 SHINGLES

- A. Manufacturers:
  - 1. Owens Corning Corp; [www.owenscorning.com](http://www.owenscorning.com).
  - 2. GAF; Timberline Cool Series: [www.gaf.com](http://www.gaf.com).
  - 3. Certainteed: Landmark Solaris Gold; [www.certainteed.com](http://www.certainteed.com).
- B. Asphalt Shingles: Asphalt-coated glass felt, mineral granule surfaced, complying with ASTM D3462/D3642M; Class A fire resistance.
  - 1. Weight: 250 lb/100 sq ft.
  - 2. Self-sealing type.
  - 3. Basis of Design: Owens Corning Corp; Duration Premium Cool Shingles.

#### 2.02 SHEET MATERIALS

- A. Eave Protection Membrane (Ice Barrier): Asphalt-saturated organic roofing felt, unperforated, complying with ASTM D226/D226M, Type I ("No.15").
- B. Underlayment: Asphalt-saturated organic roofing felt, unperforated, complying with ASTM D226/D226M, Type II ("No.30").
- C. Flexible Flashing: Self-adhering polymer-modified asphalt sheet complying with ASTM D1970/D1970M; 40 mil total thickness; with strippable treated release paper and polyethylene sheet top surface.

## **2.03 ACCESSORIES**

- A. Nails: Standard round wire shingle type, of hot-dipped zinc coated steel, 10 wire gage, 0.1019 inch shank diameter, 3/8 inch head diameter, of sufficient length to penetrate through roof sheathing or 3/4 inch into roof sheathing or decking.
- B. Lap Cement: Fibrated cutback asphalt type, recommended for use in application of underlayment, free of toxic solvents.
- C. Ridge Vents: Plastic, roll formed with vent openings that do not permit direct water or weather entry; flanged to receive shingles.

## **2.04 METAL FLASHINGS**

- A. Metal Flashings: Provide sheet metal eave edge, gable edge, open valley flashing, and dormer flashing.
  - 1. Form sections square and accurate to profile, in maximum possible lengths, free from distortion or defects detrimental to appearance or performance.
  - 2. Hem exposed edges of flashings minimum 1/4 inch on underside.

## **PART 3 EXECUTION**

### **3.01 PREPARATION**

- A. Seal roof deck joints wider than 1/16 inch as recommended by shingle manufacturer.
- B. At areas where eave protection membrane is to be adhered to substrate, fill knot holes and surface cracks with latex filler.
- C. Broom clean deck surfaces before installing underlayment or eave protection.
- D. Install eave edge and gable edge flashings tight with fascia boards. Weather lap joints 2 inches and seal with plastic cement. Secure flange with nails spaced 12 inches on center.

### **3.02 INSTALLATION - EAVE PROTECTION MEMBRANE (ICE BARRIER)**

- A. Install eave protection membrane from eave edge to minimum 3 ft up-slope beyond interior face of exterior wall.
- B. Install eave protection membrane on low slope porch roofs and 3 ft up slope beyond intersections with adjacent roof slopes.
- C. Refer to drawings for locations.

### **3.03 INSTALLATION - UNDERLAYMENT**

- A. At Roof Slopes Greater Than 4:12 : Install underlayment perpendicular to slope of roof, with ends and edges weather lapped minimum 4 inches. Stagger end laps of each consecutive layer. Nail in place. Weather lap minimum 4 inches over eave protection.
- B. Items projecting through or mounted on roof: Weather lap and seal watertight with plastic cement.

### **3.04 INSTALLATION - VALLEY PROTECTION**

- A. Install flexible flashing in accordance with manufacturer's instructions.

### **3.05 INSTALLATION - METAL FLASHING AND ACCESSORIES**

- A. Weather lap joints minimum 2 inches and seal weather tight with plastic cement.
- B. Items Projecting Through or Mounted on Roofing: Flash and seal weather tight with plastic cement.

### **3.06 INSTALLATION - SHINGLES**

- A. Install shingles in accordance with manufacturer's instructions.
  - 1. Fasten individual shingles using 2 nails per shingle, or as required by code, whichever is greater.
  - 2. Fasten strip shingles using 4 nails per strip, or as required by code, whichever is greater.

- B. Place shingles in straight coursing pattern with 5 inch weather exposure to produce double thickness over full roof area. Provide double course of shingles at eaves.
- C. Project first course of shingles 3/4 inch beyond fascia boards.
- D. Extend shingles 1/2 inch beyond face of gable edge fascia boards.
- E. Coordinate installation of roof mounted components or work projecting through roof with weather tight placement of counterflashings.
- F. Complete installation to provide weather tight service.

### **3.07 PROTECTION**

- A. Do not permit traffic over finished roof surface.

**END OF SECTION 07 3113**

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**SECTION 07 4646**  
**FIBER CEMENT SIDING**

**PART 1 GENERAL**

**1.01 REFERENCE STANDARDS**

- A. ASTM C1186 - Standard Specification for Flat Fiber Cement Sheets; 2008 (Reapproved 2012).

**1.02 SUBMITTALS**

- A. Product Data: Manufacturer's data sheets on each product to be used, including:
1. Manufacturer's requirements for related materials to be installed by others.
  2. Preparation instructions and recommendations.
  3. Storage and handling requirements and recommendations.
  4. Installation methods, including nail patterns.
- B. Maintenance Instructions: Periodic inspection recommendations and maintenance procedures.
- C. Warranty: Submit copy of manufacturer's warranty, made out in Owner's name, showing that it has been registered with manufacturer.

**1.03 QUALITY ASSURANCE**

- A. Installer Qualifications: Company specializing in performing work of the type specified in this section with minimum 3 years of experience.

**1.04 DELIVERY, STORAGE, AND HANDLING**

- A. Store products under waterproof cover and elevated above grade, on a flat surface.

**PART 2 PRODUCTS**

**2.01 SIDING**

- A. Lap Siding: Individual horizontal boards made of cement and cellulose fiber formed under high pressure with integral surface texture, complying with ASTM C1186 Type A Grade II; with machined edges, for nail attachment.
1. Style: Standard lap style.
  2. Texture: Smooth.
  3. Length: 12 ft, nominal.
  4. Width (Height): 7-1/4 inches.
  5. Thickness: 5/16 inch, nominal.
  6. Finish: Factory applied topcoat.
  7. Color: As indicated on drawings.
  8. Warranty: 50 year limited; transferable.
  9. Lap Siding Manufacturers:
    - a. Allura, a division of Plycem USA, Inc : [www.allurausa.com](http://www.allurausa.com).
    - b. James Hardie Building Products, Inc : [www.jameshardie.com](http://www.jameshardie.com).
    - c. Nichiha USA, Inc : [www.nichiha.com](http://www.nichiha.com).
- B. Soffit Panels: Vented and Non-vented smooth panels of same material and finish.
- C. Soffit Panels: Vented and Non-vented panels made of cement and cellulose fiber formed under high pressure with integral surface texture, complying with ASTM C1186 Type A Grade II; with machined edges, for nail attachment.
1. Texture: Smooth.
  2. Length: 96 inches, nominal.
  3. Width: 48 inches.
  4. Thickness: 5/16 inch, nominal.
  5. Finish: Factory applied topcoat.
  6. Manufacturer: Same as siding.

**2.02 ACCESSORIES**

- A. Trim: Same material and texture as siding.

- B. Fasteners: Galvanized or corrosion resistant; length as required to penetrate minimum 1-1/4 inch.
- C. Sealant: Elastomeric, polyurethane or silyl-terminated polyether/polyurethane, and capable of being painted.

## PART 3 EXECUTION

### 3.01 PREPARATION

- A. Install sheet metal flashing:
  - 1. Above door and window trim and casings.
  - 2. Above horizontal trim in field of siding.

### 3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions and recommendations.
  - 1. Read warranty and comply with all terms necessary to maintain warranty coverage.
  - 2. Use trim details indicated on drawings.
  - 3. Touch up all field cut edges before installing.
  - 4. Pre-drill nail holes if necessary to prevent breakage.
- B. Over Wood and Wood-Composite Sheathing: Fasten siding through sheathing into studs.
- C. Allow space for thermal movement between both ends of siding panels that butt against trim; seal joint between panel and trim with specified sealant.
- D. Joints in Horizontal Siding: Avoid joints in lap siding except at corners; where joints are inevitable stagger joints between successive courses.
- E. Do not install siding less than 6 inches from surface of ground nor closer than 1 inch to roofs, patios, porches, and other surfaces where water may collect.
- F. After installation, seal all joints except lap joints of lap siding. Seal around all penetrations. Paint all exposed cut edges.

### 3.03 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

**END OF SECTION 07 4646**

**SECTION 07 6200**  
**SHEET METAL FLASHING AND TRIM**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Fabricated sheet metal items, including flashings, counterflashings, gutters, downspouts, and other items indicated in Schedule.
- B. Sealants for joints within sheet metal fabrications.

**1.02 REFERENCE STANDARDS**

- A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels; 2013.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2013.

**1.03 QUALITY ASSURANCE**

- A. Perform work in accordance with SMACNA (ASMM) and CDA A4050 requirements and standard details, except as otherwise indicated.

**PART 2 PRODUCTS**

**2.01 SHEET MATERIALS**

- A. Pre-Finished Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 24 gage (0.0239) inch thick base metal, shop pre-coated with PVDF coating.
  - 1. PVDF (Polyvinylidene Fluoride) Coating: Superior Performance Organic Finish, AAMA 2605; multiple coat, thermally cured fluoropolymer finish system.

**2.02 FABRICATION**

- A. Form sections true to shape, accurate in size, square, and free from distortion or defects.
- B. Form pieces in longest possible lengths.
- C. Hem exposed edges on underside 1/2 inch; miter and seam corners.
- D. Fabricate corners from one piece with minimum 18 inch long legs; seam for rigidity, seal with sealant.

**2.03 GUTTER AND DOWNSPOUT FABRICATION**

- A. Gutters: Profile as indicated.
- B. Downspouts: Rectangular profile.
- C. Gutters and Downspouts: Size indicated on drawings.
- D. Accessories: Profiled to suit gutters and downspouts.
  - 1. Anchorage Devices: In accordance with SMACNA requirements.
  - 2. Gutter Supports: Straps.
  - 3. Downspout Supports: Straps.
- E. Seal metal joints.

**PART 3 EXECUTION**

**3.01 INSTALLATION**

- A. Secure flashings in place using concealed fasteners. Use exposed fasteners only where permitted.
- B. Apply plastic cement compound between metal flashings and felt flashings.
- C. Fit flashings tight in place. Make corners square, surfaces true and straight in planes, and lines accurate to profiles.
- D. Seal metal joints watertight.

- E. Secure gutters and downspouts in place using fasteners.
- F. Slope gutters 1/4 inch per 10 feet, minimum.
- G. Connect downspouts to downspout boots. Seal connection watertight.

### **3.02 SCHEDULE**

- A. Gutters and Downspouts: Pre-Finished Galvanized Steel.
- B. Sill and Ledge Flashings: Galvanized Steel.
- C. Flashings Associated with Shingle Roofing, including Valley, Hip, Ridge, Eave, Gutter Edge, Gable Edge: Pre-Finished Galvanized Steel.
- D. Termite Shields: Galvanized Steel.

**END OF SECTION 07 6200**

**SECTION 07 7123**  
**MANUFACTURED GUTTERS AND DOWNSPOUTS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Pre-finished aluminum gutters and downspouts.

**1.02 RELATED REQUIREMENTS**

- A. Section 07 6200 - SHEET METAL FLASHING AND TRIM.

**1.03 REFERENCE STANDARDS**

- A. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
- B. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric]; 2014.

**1.04 SUBMITTALS**

- A. Shop Drawings: Indicate locations, configurations, jointing methods, fastening methods, locations, and installation details.

**PART 2 PRODUCTS**

**2.01 MANUFACTURERS**

- A. Gutters and Downspouts:

**2.02 MATERIALS**

- A. Pre-Finished Aluminum Sheet: ASTM B209 (ASTM B209M); 0.0201 inch thick; 24 gauge.
  - 1. Finish: Plain, shop pre-coated with modified silicone coating.
  - 2. Color: White.

**2.03 COMPONENTS**

- A. Gutters: Profile as indicated.
- B. Downspouts: Profile as indicated.
- C. Anchors and Supports: Profiled to suit gutters and downspouts.
  - 1. Gutter Supports: Straps.
  - 2. Downspout Supports: Straps.

**2.04 FABRICATION**

- A. Form gutters and downspouts of profiles and size indicated.
- B. Fabricate with required connection pieces.
- C. Form sections square, true, and accurate in size, in maximum possible lengths, free of distortion or defects detrimental to appearance or performance. Allow for expansion at joints.
- D. Hem exposed edges of metal.
- E. Fabricate gutter and downspout accessories; seal watertight.

**PART 3 EXECUTION**

**3.01 INSTALLATION**

- A. Install gutters, downspouts, and accessories in accordance with manufacturer's instructions.
- B. Connect downspouts to storm sewer system. Grout connection watertight.

**END OF SECTION 07 7123**

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**SECTION 07 8400**  
**FIRESTOPPING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Firestopping systems.

**1.02 REFERENCE STANDARDS**

- A. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a.
- B. ASTM E1966 - Standard Test Method for Fire Resistive Joint Systems; 2007 (Reapproved 2011).
- C. SCAQMD 1168 - South Coast Air Quality Management District Rule No.1168; current edition; [www.aqmd.gov](http://www.aqmd.gov).
- D. UL 2079 - Standard for Tests for Fire Resistance of Building Joint Systems; Underwriters Laboratories Inc.; 2004.

**1.03 SUBMITTALS**

- A. Product Data: Provide data on product characteristics, performance ratings, and limitations.
- B. Sustainable Design Submittal: Submit VOC content documentation for all non-preformed materials.

**1.04 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

**PART 2 PRODUCTS**

**2.01 FIRESTOPPING - GENERAL REQUIREMENTS**

- A. Manufacturers:
  1. A/D Fire Protection Systems Inc: [www.adfire.com](http://www.adfire.com).
  2. 3M Fire Protection Products: [www.3m.com/firestop](http://www.3m.com/firestop).
  3. Hilti, Inc: [www.us.hilti.com](http://www.us.hilti.com).
  4. Nelson FireStop Products: [www.nelsonfirestop.com](http://www.nelsonfirestop.com).
  5. Specified Technologies, Inc: [www.stifirestop.com](http://www.stifirestop.com).
- B. Firestopping Materials with Volatile Content: Provide only products having lower volatile organic compound (VOC) content than required by South Coast Air Quality Management District Rule No.1168.
- C. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Type required for tested assembly design.
- D. Fire Ratings: See Drawings for required systems and ratings.

**2.02 FIRESTOPPING ASSEMBLY REQUIREMENTS**

- A. Floor-to-Floor, Wall-to-Wall, and Wall-to-Floor Joints, Except Perimeter, Where Both Are Fire-Rated: Use any system that has been tested according to ASTM E1966 or UL 2079 to have fire resistance F Rating equal to required fire rating of the assembly in which the joint occurs.
  1. Listing by UL, FM, or Intertek in their certification directory will be considered evidence of successful testing.
- B. Through Penetration Firestopping: Use any system that has been tested according to ASTM E814 to have fire resistance F Rating equal to required fire rating of penetrated assembly.
  1. Listing by UL, FM, or Intertek in their certification directory will be considered evidence of successful testing.

## **2.03 FIRESTOPPING FOR FLOOR-TO-FLOOR, WALL-TO-FLOOR, AND WALL-TO-WALL JOINTS**

- A. Gypsum Board Walls:
  - 1. Wall to Wall Joints:
    - a. 1 Hour Construction: UL System WW-D-0067; Hilti CP 606 Flexible Firestop Sealant.

## **2.04 FIRESTOPPING PENETRATIONS THROUGH GYPSUM BOARD WALLS**

- A. Penetrations By:
  - 1. Uninsulated Non-Metallic Pipe, Conduit, and Tubing:
    - a. 1 Hour Construction: UL System W-L-2078; Hilti CP 643N/644 Firestop Collar.
    - b. 1 Hour Construction: UL System W-L-2128; Hilti FS-ONE MAX Intumescent Firestop Sealant.
  - 2. Cable Trays with Electrical Cables:
    - a. 1 Hour Construction: UL System W-L-4060; Hilti FS-ONE MAX Intumescent Firestop Sealant.
  - 3. Insulated Pipes:
    - a. 1 Hour Construction: UL System W-L-5029; Hilti FS-ONE Intumescent Firestop Sealant.

## **PART 3 EXECUTION**

### **3.01 PREPARATION**

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter that could adversely affect bond of firestopping material.
- B. Remove incompatible materials that could adversely affect bond.

### **3.02 INSTALLATION**

- A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.

### **3.03 CLEANING**

- A. Clean adjacent surfaces of firestopping materials.

### **3.04 PROTECTION**

- A. Protect adjacent surfaces from damage by material installation.

**END OF SECTION 07 8400**

**SECTION 07 9100**  
**PREFORMED JOINT SEALS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Precompressed foam seals.
- B. Preformed strip seals.

**1.02 SUBMITTALS**

- A. Product Data: Manufacturer's technical data sheets for each product, including chemical composition, movement capability, color availability, limitations on application, and installation instructions.

**PART 2 PRODUCTS**

**2.01 MANUFACTURERS**

- A. Precompressed Foam Seals:
- B. Preformed Strip Seals:
  - 1. Sika Corporation: [www.usa-sika.com](http://www.usa-sika.com).

**2.02 PRECOMPRESSED FOAM SEALS**

- A. Precompressed Foam Seal: Urethane foam impregnated with water-repellent, with self-adhesive faces protected prior to installation by release paper.
  - 1. Color: Black.
  - 2. Size as required to provide weathertight seal when installed.

**2.03 PREFORMED STRIP SEALS**

- A. Preformed Strip Seal: Factory formed silicone profile for adhered application to face of joint substrate.
- B. Adhesive: As recommended by seal manufacturer.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

- A. Verify that joints are ready to receive this work.
- B. Measure joint dimensions and verify that seal products are of the correct size to properly seal the joints.

**3.02 PREPARATION**

- A. Properly prepare construction components adjacent to the work of this section to prevent damage and disfigurement due to this work.

**3.03 INSTALLATION**

- A. Install in accordance with manufacturer's written instructions.
- B. Precompressed Foam Seals:
  - 1. Install only when ambient temperature is within recommended application temperature range of adhesive. Consult manufacturer when installing outside this temperature range.
  - 2. Prepare joints and install seals in accordance with manufacturer's written recommendations.
  - 3. Remove loose materials and foreign matter that could impair adhesion of sealant.
  - 4. Do not stretch precompressed seal; avoid joints except at corners, ends, and intersections; install with face 1/8 to 1/4 inch below adjoining surface.
- C. Preformed Strip Seals:
  - 1. Install only when ambient temperature is within recommended application temperature range of adhesive. Consult manufacturer when installing outside this temperature range.

2. Prepare joints and install seals in accordance with manufacturer's written recommendations.
3. Remove loose materials and foreign matter that could impair adhesion.
4. When installing over failed sealant, remove portions of failed installation that protrude beyond surface; install backing tape on surface of failed installation to prevent adhesion of strip seal.

**3.04 CLEANING**

- A. Clean adjacent soiled surfaces.

**3.05 PROTECTION**

- A. Protect joints from damage until adhesives have properly cured.

**END OF SECTION 07 9100**

**SECTION 07 9200  
JOINT SEALANTS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Nonsag gunnable joint sealants.
- B. Self-leveling pourable joint sealants.
- C. Joint backings and accessories.

**1.02 REFERENCE STANDARDS**

- A. ASTM C834 - Standard Specification for Latex Sealants; 2010.
- B. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications; 2012.
- C. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2014.
- D. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2013.
- E. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants; 2008 (Reapproved 2012).
- F. ASTM C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants; 2002 (Reapproved 2013).
- G. SCAQMD 1168 - South Coast Air Quality Management District Rule No.1168; current edition; [www.aqmd.gov](http://www.aqmd.gov).

**1.03 SUBMITTALS**

- A. Product Data for Sealants: Submit manufacturer's technical data sheets for each product to be used, that includes the following.
  - 1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
  - 2. List of backing materials approved for use with the specific product.
  - 3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
  - 4. Substrates the product should not be used on.

**1.04 QUALITY ASSURANCE**

**1.05 WARRANTY**

- A. Warranty: Include coverage for installed sealants and accessories that fail to achieve watertight seal , exhibit loss of adhesion or cohesion, or do not cure.

**PART 2 PRODUCTS**

**2.01 JOINT SEALANT APPLICATIONS**

- A. Scope:
  - 1. Exterior Joints: Seal open joints, whether or not the joint is indicated on the drawings, unless specifically indicated not to be sealed. Exterior joints to be sealed include, but are not limited to, the following items.
    - a. Wall expansion and control joints.
    - b. Joints between door, window, and other frames and adjacent construction.
    - c. Joints between different exposed materials.
    - d. Openings below ledge angles in masonry.
    - e. Other joints indicated below.
  - 2. Interior Joints: Do not seal interior joints unless specifically indicated to be sealed. Interior joints to be sealed include, but are not limited to, the following items.
    - a. Joints between door, window, and other frames and adjacent construction.
    - b. In sound-rated wall and ceiling assemblies, gaps at electrical outlets, wiring devices, piping, and other openings; between wall/ceiling and other construction; and other flanking sound paths.

- c. Other joints indicated below.
- 3. Do not seal the following types of joints.
  - a. Intentional weepholes in masonry.
  - b. Joints indicated to be treated with manufactured expansion joint cover or some other type of sealing device.
  - c. Joints where sealant is specified to be provided by manufacturer of product to be sealed.
  - d. Joints where installation of sealant is specified in another section.
- B. Exterior Joints: Use nonsag non-staining silicone sealant, unless otherwise indicated.
- C. Interior Joints: Use nonsag polyurethane sealant, unless otherwise indicated.
  - 1. Wall and Ceiling Joints in Non-Wet Areas: Acrylic emulsion latex sealant.
  - 2. In Sound-Rated Assemblies: Acrylic emulsion latex sealant.
  - 3. Other Floor Joints: Self-leveling polyurethane "traffic-grade" sealant.
- D. Interior Wet Areas: Bathrooms and kitchens; fixtures in wet areas include plumbing fixtures, countertops, cabinets, and other similar items.
- E. Sound-Rated Assemblies: Walls and ceilings identified as "STC-rated", "sound-rated", or "acoustical".

## **2.02 JOINT SEALANTS - GENERAL**

- A. Sealants and Primers: Provide products having lower volatile organic compound (VOC) content than indicated in South Coast Air Quality Management District (SCAQMD); Rule 1168.

## **2.03 NONSAG JOINT SEALANTS**

- A. Non-Staining Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.
  - 1. Movement Capability: Plus and minus 50 percent, minimum.
  - 2. Non-Staining To Porous Stone: Non-staining to light-colored natural stone when tested in accordance with ASTM C1248.
  - 3. Dirt Pick-Up: Reduced dirt pick-up compared to other silicone sealants.
  - 4. Color: Match adjacent finished surfaces.
  - 5. Products:
    - a. Dow Corning Corporation: [www.dowcorning.com/construction](http://www.dowcorning.com/construction).
    - b. Pecora Corporation: [www.pecora.com](http://www.pecora.com).
    - c. Sika Corporation: [www.usa-sika.com](http://www.usa-sika.com).
- B. Polyurethane Sealant: ASTM C920, Grade NS, Uses M and A; single component; not expected to withstand continuous water immersion or traffic.
  - 1. Movement Capability: Plus and minus 25 percent, minimum.
- C. Acrylic Emulsion Latex: Water-based; ASTM C834, single component, non-staining, non-bleeding, non-sagging; not intended for exterior use.

## **2.04 SELF-LEVELING SEALANTS**

- A. Self-Leveling Polyurethane Sealant for Continuous Water Immersion: Polyurethane; ASTM C920, Grade P, Uses M and A; single or multicomponent; explicitly approved by manufacturer for traffic exposure and continuous water immersion.
  - 1. Movement Capability: Plus and minus 25 percent, minimum.

## **2.05 ACCESSORIES**

- A. Backer Rod: Cylindrical cellular foam rod with surface that sealant will not adhere to, compatible with specific sealant used, and recommended by backing and sealant manufacturers for specific application.
  - 1. Type for Joints Not Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type C - Closed Cell Polyethylene.
  - 2. Closed Cell and Bi-Cellular: 25 to 33 percent larger in diameter than joint width.

- B. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.

### PART 3 EXECUTION

#### 3.01 EXAMINATION

- A. Verify that joints are ready to receive work.
- B. Verify that backing materials are compatible with sealants.
- C. Verify that backer rods are of the correct size.

#### 3.02 PREPARATION

- A. Remove loose materials and foreign matter that could impair adhesion of sealant.
- B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.
- C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.
- D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.

#### 3.03 INSTALLATION

- A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B. Perform installation in accordance with ASTM C1193.
- C. Perform acoustical sealant application work in accordance with ASTM C919.
- D. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer.
- E. Install bond breaker backing tape where backer rod cannot be used.
- F. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.
- G. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.
- H. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

#### 3.04 FIELD QUALITY CONTROL

- A. Remove and replace failed portions of sealants using same materials and procedures as indicated for original installation.

**END OF SECTION 07 9200**

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**SECTION 08 1416**  
**PRE-HUNG PANEL WOOD DOORS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Paneled hollow core wood doors; 6 panel configuration; non-rated.

**1.02 SUBMITTALS**

- A. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.

**1.03 QUALITY ASSURANCE**

**1.04 DELIVERY, STORAGE, AND HANDLING**

- A. Package, deliver and store doors in accordance with specified quality standard.
- B. Accept doors on site in manufacturer's packaging. Inspect for damage.
- C. Protect doors with resilient packaging sealed with heat shrunk plastic. Do not store in damp or wet areas; or in areas where sunlight might bleach veneer. Seal top and bottom edges with tinted sealer if stored more than one week. Break seal on site to permit ventilation.

**PART 2 PRODUCTS**

**2.01 DOORS AND PANELS**

- A. Interior Doors: 1-3/8 inches thick unless otherwise indicated; 6 panel construction.
  - 1. Provide hollow core doors at all interior locations within apartments .

**2.02 DOOR AND PANEL CORES**

- A. Non-Rated Hollow Core Doors: Construction: particleboard core (PC), Type Standard (SHC/FSHC); faces as indicated.

**2.03 DOOR CONSTRUCTION**

- A. Fabricate doors in accordance with door quality standard specified.
- B. Cores Constructed with stiles and rails:
- C. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.
- D. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.

**2.04 DOOR FRAMES**

- A. Wood jambs shall be fabricated as a flat jamb with 2-piece split jamb. Hinge jamb preparations 1-3/8" thick doors to be machined for standard weight radius mortise for 3-1/2" hinges. Strike jamb preparations are to be machined for full lip cylindrical strike plate.

**2.05 HINGES**

- A. (3) standard weight radius mortise hinges are required.
- B. Provide edge clearances in accordance with the quality standard specified.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

**3.02 INSTALLATION**

- A. Install doors in accordance with manufacturer's instructions and specified quality standard.

- B. Use machine tools to cut or drill for hardware.
- C. Coordinate installation of doors with installation of frames and hardware.

**3.03 ADJUSTING**

- A. Adjust doors for smooth and balanced door movement.
- B. Adjust closers for full closure.

**3.04 SCHEDULE - SEE DRAWINGS**

**END OF SECTION 08 1416**

## SECTION 08 14 23

### ENTRY DOORS

#### PART I GENERAL

##### I.1 SECTION INCLUDES

- A. Entry doors.

##### I.2 RELATED SECTIONS

- A. Section 07 27 00 – Air Barriers: Water-resistant barrier.
- B. Section 07 92 00 – Joint Sealants: Sealants and caulking.
- C. Section 08 71 00 – Door Hardware.

##### I.3 REFERENCES

- A. American Architectural Manufacturers Association (AAMA):
  1. AAMA 502 – Voluntary Specification for Field Testing of Windows and Sliding Doors.
  2. AAMA 2605 – Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.
- B. American Society for Testing and Materials (ASTM):
  1. ASTM B 368 – Copper-Accelerated Acetic Acid - Salt Spray (Fog) Testing (CASS Test).
  2. ASTM C 1036 – Flat Glass.
  3. ASTM C 1048 – Heat-Treated Flat Glass–Kind HS, Kind FT Coated and Uncoated Glass.
  4. ASTM D 1149 – Rubber Deterioration – Surface Ozone Cracking in a Chamber.
  5. ASTM D 2803 – Filiform Corrosion Resistance of Organic Coatings on Metal.
  6. ASTM D 4060 – Abrasion Resistance of Organic Coatings by the Taber Abraser.
  7. ASTM E 283 – Rate of Air Leakage Through Exterior Windows, Curtain Walls and Doors Under Specified Pressure Difference Across the Specimen.
  8. ASTM E 330 – Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.
  9. ASTM E 331 – Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.
  10. ASTM G 85 – Modified Salt Spray (Fog) Testing.
  11. ASTM E 1300 – Standard Practice for Determining Load Resistance of Glass in Buildings.
- C. Window and Door Manufacturers Association (WDMA):
  1. AAMA/WDMA/CSA 101/I.S.2/A440 – Windows, Doors and Unit Skylights.
  2. WDMA I.S.4 – Water Repellent Preservative Treatment for Millwork.
  3. CS2 Hallmark Program Procedural Guide for Side Hinged Exterior Door Systems

##### I.4 PERFORMANCE REQUIREMENTS

- B. Door Unit Air Leakage, ASTM E 283, 1.57 psf (25 mph): 0.30 cfm per square foot of frame or less.
- C. Door Unit Water Penetration: No water penetration through door unit when tested in accordance with ASTM E 331 with water applied at rate of 5 gallons per hour per square foot. Doors with standard sill shall have water resistance performance level up to 7.5 psf and low profile sill (ADA) shall have water resistance performance level of 0 psf.
- D. System Thermal Values:
  - Door assembly U value = 0.19
  - Glass in solid doors U factor = 0.37 and SHGC = 0.27

## **I.5 SUBMITTALS**

- A. Comply with Division I requirements.
- B. Product Data: Submit manufacturer's product data, including installation instructions.
- C. Shop Drawings: Submit manufacturer's shop drawings, indicating dimensions, construction, component connections and locations, anchorage methods and locations, hardware locations, and installation details.
- D. Samples: Submit full-size or partial full-size sample of door illustrating glazing system, quality of construction, and color of finish.
- E. Warranty: Submit manufacturer's standard warranty.

## **I.6 QUALITY ASSURANCE**

- A. Mockup:
  1. Provide sample installation for field testing door performance requirements and to determine acceptability of door installation methods.
  2. Approved mockup shall represent minimum quality required for the Work.
  3. Approved mockup shall not remain in place within the Work.

## **I.7 DELIVERY, STORAGE, AND HANDLING**

- A. Delivery: Deliver materials to site undamaged in manufacturer's or sales branch's original, unopened containers and packaging, with labels clearly identifying manufacturer and product name. Include installation instructions.
- B. Storage: Store materials in an upright position, off ground, under cover, and protected from weather, direct sunlight, and construction activities.
- C. Handling: Protect materials and finish during handling and installation to prevent damage.

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURER**

- A. Basis of Design: Pella Corporation, 102 Main Street, Pella, Iowa 50219. Toll Free (800) 54-PELLA. Phone (641) 621-1000. Website [www.pella.com](http://www.pella.com).

### **2.2 ENTRY DOORS**

- A. Entry Doors: Factory-assembled doors with outward-swing door panels installed in frames.
- B. Frames:
  1. Select hardwood Mahogany, water-repellent, preservative-treated with EnduraGuard® in accordance with WDMA I.S.-4. EnduraGuard includes water-repellency, three active fungicides and an insecticide applied to the head and jambs.
  2. Interior Exposed Surfaces: Primed ready for site finishing with no visible fastener holes.
  3. Exterior Surfaces: Aluminum Clad Wood .
  4. Sills: Extruded aluminum.
    - a. ADA Approved sills.
  5. Frame Dimensions:
    - a. Overall Frame Depth: 5-15/16 inches (150 mm).
    - b. Nail-fin or Brickmould Frame Depth: 4-9/16 inches (116 mm).

- c. Other Frame Conditions available by Jamb Extending on 1/8" increments up to 9-3/16" inches (233 mm).

C. Door Panels:

- I. Fiberglass Door Panels:
  - a. 0.072-inch minimum fiberglass skin on exterior and interior surfaces with CFC-free injected foam insulating core.
  - b. Rails and Stiles: Wood top rails and stiles and wood plastic composite bottom rails secured with structural adhesive between skins at perimeter.
  - c. Fiberglass Grain: Oak
  - d. Lock Block: 12-inches or greater, solid wood.
  - e. Panel Thickness: 1-11/16 inches (43 mm).
- 2. Hardware Preparation
  - a. Factory prepared for latch bore and deadbolt bore.
    - 2-1/8-inch bore diameter [2-3/8] [2-3/4]-inch backsets.
    - 5-1/2 inches on center.

D. Weather Strip:

- 1. Head: Dual-seal weatherstrip shall contact interior face and side of door panel and extruded leaf rain screen shall cover the exterior face of door panel.
- 2. Jambs: Dual-seal weatherstrip shall contact interior face and side of door panel.
- 3. Sill: Bristle rain screen at exterior face of door panel with bulb weatherstrip on threshold shall contact interior face of door panel.

A. Glazing:

- I. Float Glass: ASTM C 1036, Quality I.
  - a. Tempered Glass: ASTM C 1048.
  - b. ASTM E1300 compliant.
- 2. Type:
  - a. Tempered Insulating Glass: multi-layer Low-E coated with argon dual-seal insulating glass, installed into high-performance glazing frames.

## 2.4 GLAZING OPTIONS

- A. Grilles-Between-the-Glass
- 1. Profile: 3/4-inch contoured.
  - 2. Aluminum Grills: Permanently installed between 2 panes of glass.
  - 3. Pattern: Prairie.
  - 4. Finish: Factory pre-finished.
    - a. Interior Color: White
    - b. Exterior Color: White

## 2.5 HARDWARE

- A. Hinges: Three (3) per door panel on 6' 8" and 7' 0" panel heights
- I. Type: 4-inch by 4-inch by 0.100-inch thick cold-rolled steel with Ball bearings and non-removal pin.
  - 2. Finish: US15, satin nickel.
- B. Frames are prepared for hardware to match door panel boring.

## 2.6 TOLERANCES

- A. Doors shall accommodate the following opening tolerances:
  - 1. Vertical Dimensions Between High and Low Points: Plus 1/4 inch, minus 0 inch.
  - 2. Width Dimensions: Plus 1/4 inch, minus 0 inch.
  - 3. Building Columns or Masonry Openings: Plus or minus 1/4 inch from plumb.

## 2.7 FINISH

- A. Door Frame Exterior Finish System: Pella EnduraClad.
  - 1. Exterior aluminum door frame surfaces shall be finished with the following multi-stage system:
    - a. Clean and etch aluminum surface of oxides.
    - b. Pre-treat with chrome phosphate conversion coating.
    - c. Pre-treat with chromic acid sealer/rinse.
    - d. Prime with baked-on modified polyester primer.
    - e. Top coat with baked-on polyester enamel.
  - 2. Color: To be selected by Architect from manufacturer'.
  - 3. Performance Requirements: Exterior aluminum finishes shall meet or exceed the following performance requirements of AAMA 2605:
    - a. Dry Film Hardness: Eagle Turquoise Pencil, F minimum.
    - b. Film Adhesion: 1/16-inch crosshatch, dry, wet, boiling water.
    - c. Impact Resistance: 1/10-inch distortion, no film removal.
    - d. Abrasion Resistance: Falling sand coefficient value of 20 minimum.
    - e. Chemical Resistance: 10 percent Muriatic acid, 15 minutes. Mortar pat test, 24 hours.
    - f. Detergent Resistance: 3 percent at 100 degrees F, 72 hours.
    - g. Corrosion Resistance: Humidity, 3,000 hours. Salt spray exceeds 3,000 hours.
- B. Exterior Finish System Performance Requirements:
  - 1. Exterior aluminum finishes shall meet or exceed the following performance requirements:
    - a. Copper-Accelerated Acetic Acid Salt Spray (Fog) Testing (CASS Test), ASTM B 368.
    - b. Ozone Deterioration, ASTM D 1149, Modified: 5 ppm ozone, 160 degrees F, 60 percent relative humidity, 100 hours exposure, little or no loss of cure.
    - c. Filiform Corrosion Resistance of Organic Coatings on Metal, ASTM D 2803: No corrosion.
    - d. Taber Abrasion Resistance, ASTM D 4060: 500 g weight, CS-10 wheel, 500 cycles, less than 25 g weight loss.
    - e. Cyclic Acidified Salt Fog Test, ASTM G 85, Appendix A-2.
- C. Door Panel Exterior Finish:
  - I. Fiberglass Door Panels: Unfinished, ready for site finishing
- D. Door Frame Interior Finish: Factory-primed, 1 coat, ready for site finishing
- E. Door Panel Interior Finish:
  - I. Fiberglass Door Panels: Unfinished, ready for site finishing

## 2.8 INSTALLATION ACCESSORIES

- A. Flashing/Sealant Tape: Pella SmartFlash.
  - 1. Aluminum-foil-backed butyl window and door flashing tape.
  - 2. Maximum Total Thickness: 0.013 inch.
  - 3. UV resistant.
  - 4. Verify sealant compatibility with sealant manufacturer.

- B. Interior Insulating-Foam Sealant: Low-expansion, low-pressure polyurethane insulating window and door foam sealant.
- C. Exterior Perimeter Sealant: "Pella Window and Door Installation Sealant" or equivalent high quality, multi-purpose sealant as specified in the joints sealant section.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Examine areas to receive doors. Notify Architect of conditions that would adversely affect installation or subsequent use. Do not proceed with installation until unsatisfactory conditions are corrected.

### 3.2 INSTALLATION

- A. Install doors in accordance with manufacturer's instructions and approved shop drawings.
- B. Install doors to be weather-tight and freely operating.
- C. Maintain alignment with adjacent work.
- D. Secure assembly to framed openings, plumb and square, without distortion.
- E. Integrate door system installation with exterior weather-resistant barrier using flashing/sealant tape. Apply and integrate flashing/sealant tape with weather-resistant barrier using watershed principles in accordance with door manufacturer's instructions.
- F. Place interior seal around door perimeter to maintain continuity of building thermal and air barrier using insulating-foam sealant.
- G. Seal door to exterior wall cladding with sealant and related backing materials at perimeter of assembly.
- H. Leave doors closed.

### 3.4 CLEANING

- A. Clean door frames and glass in accordance with Division I requirements.
- B. Do not use harsh cleaning materials or methods that would damage finish.
- C. Remove manufacturer's proprietary labels and visible markings.

### 3.5 PROTECTION

- A. Protect installed doors to ensure that, except for normal weathering, doors will be without damage or deterioration at time of substantial completion.

## END OF SECTION

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**SECTION 08 1600.00**  
**MOLDED COMPOSITE DOORS**

**PART I - GENERAL**

**I.1 SECTION INCLUDES**

- A. Commercial Doors

**I.2 REFERENCES**

- A. American National Standards Institute (ANSI)

- I. ANSI Z97.1: Safety Glazing Materials Used in Buildings – Safety Performance Specifications and Methods of Test

- B. National Fire Protection Association (NFPA)

- I. NFPA 252: Standard Methods of Fire Tests of Door Assemblies.

- C. Underwriters Laboratories, Inc. (UL)

- I. UL10B: Standard for Fire Tests of Door Assemblies (Note: Neutral pressure testing standard)

- 2. UL 10C: Standard for Positive Pressure Fire Tests of Door Assemblies.

**I.3 DESIGN REQUIREMENTS**

- A. Fire-Rated Door Assemblies: Fire door assemblies shall meet or exceed fire-protection ratings indicated when tested in accordance with UL 10B.

**I.4 SUBMITTALS**

- A. Product Data: Submit door manufacturer current product literature, including installation instruction.

- B. Samples: Provide finish samples for all products.

- C. Quality Assurance Submittals

- I. Manufacturer Instructions: Provide manufacturer's written installation instructions.

- D. Closeout Submittals

- I. Refer to Section Closeout Submittals

**I.5 DELIVERY, STORAGE AND HANDLING**

- A. Deliver doors, materials and components in manufacturer's original, unopened, undamaged containers with identification labels intact.

- B. Store doors as recommended by manufacturer.

## 1.6 WARRANTY

A. Manufacturer standard warranty indicating that the door will be free from material and workmanship defects from the date of substantial completion for the time periods indicated below:

- I. Door Unit: 5 years

## PART 2 - PRODUCTS

### 2.1 MANUFACTURER

A. JELD-WEN® Interior Doors; 3305 Lakeport Blvd; Klamath Falls, OR 97601, USA; Phone 877.535.3462, fax 541.882.3455; website [www.jeld-wen.com](http://www.jeld-wen.com).

B. Basis of Design:

- I. Doors are based on JELD-WEN Molded Interior Door: Arlington

### 2.2 COMMERCIAL DOORS

A. Door Design

- I. Surface Finish: Smooth

2. Panels and Sticking Profile:

- a. Six panels, with beaded sticking.

B. Core and Frame

- I. Solid mineral core with all-wood frame.

- a. Thickness: 1-3/4 inch with 60-minute fire rating.

2. Jambs

- a. Jamb Width: 6 1/2 inch

- b. Jamb Type: fire-rated doors

- c. Jamb Species: Finger-Jointed Pine

C. Hardware

- I. Finish: Antique Nickel

D. Finish: Preprimed

## PART 3 - EXECUTION

### 3.1 GENERAL

A. Install doors in accordance with manufacturer's installation guidelines and recommendations.

### 3.2 EXAMINATION

- A. Inspect door prior to installation.
- B. Inspect rough opening for compliance with door manufacturer recommendations. Verify rough opening conditions are within recommended tolerances.

### 3.3 PREPARATION

- A. Prepare door for installation in accordance with manufacturer's recommendations.
- B. Trim bottom of jamb sides to achieve desired distance between door bottom and finished floor height.

### 3.4 COMMERCIAL DOOR INSTALLATION

- A. Place door unit into opening and level hinge side of jamb. Use shims fastened through jamb and stop to level and temporarily secure in place.
- B. Level latch side of jamb. Use shims fastened through jamb and stop to level and temporarily secure in place.
- C. Verify spacing between jamb and door is uniform on all sides. Adjust as necessary.
- D. Shim top of jamb in center of opening and fasten with nail.
- E. Re-check for square, level and even spacing around door. Nail securely in place through stop, jamb, shims and into studs every 12 inches.
- F. Set nails.
- G. Install trim on both sides using nails every 12 to 16 inches.

### 3.5 SCHEDULES

- A. Interior Apartment Entrance from Stair (60 minute fire rated)

1. Style:	Commercial
2. Door Design:	Arlington
3. Surface Finish:	Smooth
4. Panels:	Six
5. Sticking Profile:	Beaded
6. Core:	Solid mineral
7. Frame:	All-wood
8. Thickness:	1-3/4 inch
9. Fire Rating:	60-minute
10. Jamb Width:	6 1/2 inch
11. Jamb Type:	Fire rated
12. Jamb Species:	Paintable Pine
13. Hardware Finish:	Satin Nickel
14. Door Finish:	Factory Primed for field finish

END OF SECTION

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**SECTION 08 3100**  
**ACCESS DOORS AND PANELS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Ceiling access door and frame units.

**1.02 SUBMITTALS**

- A. Product Data: Provide sizes, types, finishes, and hardware.
- B. Project Record Documents: Record actual locations of all access units.

**PART 2 PRODUCTS**

**2.01 ACCESS DOOR AND PANEL APPLICATIONS**

- A. Ceilings, Unless Otherwise Indicated:
  - 1. Material: Steel.
  - 2. Size in Other Ceilings: 12 by 12 inch, unless otherwise indicated.
  - 3. Standard duty, hinged door.
  - 4. Tool-operated spring or cam lock; no handle.

**2.02 WALL AND CEILING UNITS**

- A. Access Doors: Factory fabricated door and frame units, fully assembled units with corner joints welded, filled, and ground flush; square and without rack or warp; coordinate requirements with assemblies that units are to be installed in.
  - 1. Door Style: Single thickness with rolled or turned in edges.
  - 2. Steel Finish: Primed.
  - 3. Primed and Factory Finish: Polyester powder coat; color to match ceiling color.
  - 4. Hardware:
    - a. Hinges for Non-Fire-Rated Units: Continuous piano hinge.
    - b. Latch/Lock: Tamperproof tool-operated cam latch.
    - c. Gasketing: Extruded neoprene, around the perimeter of the door panel.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

- A. Verify that rough openings are correctly sized and located.

**3.02 INSTALLATION**

- A. Install units in accordance with manufacturer's instructions.
- B. Install frames plumb and level in openings. Secure rigidly in place.
- C. Position units to provide convenient access to the concealed work requiring access.

**END OF SECTION 08 3100**

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**SECTION 08 5413**  
**FIBERGLASS WINDOWS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Factory fabricated fiberglass windows with fixed and operating sash.
- B. Factory glazed.
- C. Operating hardware.
- D. Insect screens.

**1.02 REFERENCE STANDARDS**

- A. AAMA/WDMA/CSA 101/I.S.2/A440 - North American Fenestration Standard/Specification for windows, doors, and skylights; American Architectural Manufacturers Association/Window and Door Manufacturers Association/Canadian Standards Association; 2011.
- B. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2004 (Reapproved 2012).
- C. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2009).

**1.03 SUBMITTALS**

- A. Product Data: Provide component dimensions, anchors and glass.
- B. Shop Drawings: Indicate opening dimensions, framed opening tolerances, affected related work, installation requirements.
- C. Manufacturer's Certificate: Certify that products of this section meet or exceed specified requirements.
- D. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

**1.04 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

**1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Protect finished surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond when exposed to sunlight or weather.

**1.06 FIELD CONDITIONS**

- A. Do not install sealants when ambient temperature is less than 40 degrees F.
- B. Maintain this minimum temperature during and after installation of sealants.

**1.07 WARRANTY**

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide ten year manufacturer warranty for insulated glass units from seal failure, interpane dusting or misting, and replacement of same. Include coverage for degradation of color finish.

**PART 2 PRODUCTS**

**2.01 MANUFACTURERS**

- A. Fiberglass Windows:
  - 1. Basis of Design: Pella Corporation; Pella Impervia: [www.pellacommercial.com](http://www.pellacommercial.com).
  - 2. Substitutions: See Section 01 6000 - Product Requirements.

## 2.02 WINDOW UNITS

- A. Fiberglass Windows: Hollow, tubular, multi-layer fiber reinforced material; factory fabricated; with vision glass, related flashings, anchorage and attachment devices.
  - 1. Configuration: As indicated on drawings.
  - 2. Product Type: FW - Fixed window and H - Hung window, vertically sliding.
  - 3. Color: White.
  - 4. Movement: Accommodate movement between window and perimeter framing and deflection of lintel, without damage to components or deterioration of seals.
  - 5. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
- B. Performance Requirements: Provide products that comply with the following:
  - 1. Grade: AAMA/WDMA/CSA 101/I.S.2/A440 requirements for specific window type:
    - a. Performance Class (PC): R.
  - 2. Design Pressure (DP): In accordance with applicable codes.
  - 3. Water Leakage: No uncontrolled leakage on interior face when tested in accordance with ASTM E331 at differential pressure of 12.11 pounds per square foot.
  - 4. Air Leakage: Maximum of 0.1 cu ft/min/sq ft at 6.27 pounds per square foot differential pressure, when tested in accordance with ASTM E283.
  - 5. Energy Star Certified.

## 2.03 COMPONENTS

- A. Grilles: Between-the-glass:
  - 1. Color: Match exterior sash.
- B. Insect Screen Frame: aluminum frame of rectangular sections; fit with adjustable hardware; nominal size similar to operable glazed unit.
- C. Insect Screens: 14/18 mesh, glass fiber strands.
- D. Operable Sash Weather Stripping: Resilient PVC; permanently resilient, profiled to effect weather seal.
- E. Sealant for Setting Sills and Sill Flashing: Non-curing butyl type.

## 2.04 GLASS AND GLAZING MATERIALS

- A. Glass and Glazing Materials. Pella InsulShield glass.
  - 1. 11/16" Advanced Low-E insulating double pane glass with Argon, 2.5mm glass.
    - a. U-Factor: Less than or equal to 0.31.
    - b. SHGC: Less than or equal to 0.27.

## 2.05 HARDWARE

- A. Single Hung Sash: with ADA compliant, locking mechanism mounted on lower sash at sill level.
- B. Finish For Exposed Hardware: Match window finish.

## 2.06 FABRICATION

### PART 3 EXECUTION

#### 3.01 EXAMINATION

- A. Verify wall openings and adjoining air and vapor seal materials are ready to receive work of this Section.

#### 3.02 INSTALLATION

- A. Install windows in accordance with manufacturer's instructions.
- B. Attach window frame and shims to perimeter opening to accommodate construction tolerances and other irregularities.

- C. Align window plumb and level, free of warp or twist. Maintain dimensional tolerances and alignment with adjacent work.
- D. Set sill members and sill flashing in continuous bead of sealant.
- E. Provide thermal isolation where components penetrate or disrupt building insulation. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.

**3.03 ADJUSTING**

- A. Adjust hardware for smooth operation and secure weathertight closure.

**3.04 CLEANING**

- A. Remove protective material from pre-finished surfaces.
- B. Wash surfaces by method recommended and acceptable to window manufacturer; rinse and wipe surfaces clean.
- C. Remove excess glazing sealant by moderate use of mineral spirits or other solvent acceptable to sealant manufacturer.

**END OF SECTION 08 5413**

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**SECTION 08 7120**  
**DOOR HARDWARE**

**PART I - GENERAL**

**I.1 RELATED DOCUMENTS**

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

**I.2 SUMMARY**

- A. Section includes:

- I. Mechanical door hardware for the following:

- a. Swinging doors.

- B. Related Sections:

- I. Division 8 Section "Steel Doors and Storm Doors".

**I.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated. Include construction and installation details, material descriptions, dimensions of individual components and profiles, and finishes.

- B. Other Action Submittals:

- I. Door Hardware Schedule: Prepared by or under the supervision of Installer, detailing fabrication and assembly of door hardware, as well as installation procedures and diagrams. Coordinate final door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

- a. Submittal Sequence: Submit door hardware schedule concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate the fabrication of other work that is critical in Project construction schedule.

- b. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule." Double space entries, and number and date each page.

- c. Format: Use same scheduling sequence and format and use same door numbers as in the Contract Documents.

- d. Content: Include the following information:

- 1) Identification number, location, hand, fire rating, size, and material of each door and frame.

- 2) Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.

- 3) Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.

- 4) Fastenings and other pertinent information.
- 5) Explanation of abbreviations, symbols, and codes contained in schedule.
- 6) Mounting locations for door hardware.
- 7) List of related door devices specified in other Sections for each door and frame.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Warranty: Special warranty specified in this Section.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of door hardware to include in maintenance manuals. Include final hardware schedule.

#### 1.6 MATERIALS MAINTENANCE SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
- I. Door Hardware: 1 each bored lockset and keys, 2 each deadbolts and keys, 2 pair of hinges, 1 threshold and 2 sets of weather-stripping.

#### 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and an Architectural Hardware Consultant who is available during the course of the Work to consult with Contractor, Architect, and Owner about door hardware and keying.
- I. Warehousing Facilities: In Project's vicinity.
  2. Scheduling Responsibility: Preparation of door hardware and keying schedules.
- B. Source Limitations: Obtain each type of door hardware from a single manufacturer.
- C. Means of Egress Doors: Latches do not require more than **15 lbf** to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.
- D. Accessibility Requirements: For door hardware on doors in an accessible route, comply with the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines, ICC/ANSI A117.1, and HUD's "Fair Housing Accessibility Guidelines".
- I. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than **5 lbf**.
  2. Comply with the following maximum opening-force requirements:
    - a. Interior, Non-Fire-Rated Hinged Doors: **5 lbf** applied perpendicular to door.
    3. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than **1/2 inch** high.
    4. Adjust door closer sweep periods so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point **3 inches** from the latch, measured to the leading edge of the door.

**I.8 DELIVERY, STORAGE, AND HANDLING**

- A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.
- B. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.

**I.9 COORDINATION**

- A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete. Concrete, reinforcement, and formwork requirements are specified in Division 3.
- B. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- C. Existing Openings: Where hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, field verify existing conditions and coordinate installation of door hardware to suit opening conditions and to provide proper door operation.

**I.10 WARRANTY**

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
  - I. Failures include, but are not limited to, the following:
    - a. Structural failures including excessive deflection, cracking, or breakage.
    - b. Faulty operation of doors and door hardware.
    - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
  - 2. Warranty Period: Three years from date of Substantial Completion, unless otherwise indicated.

**PART 2 - PRODUCTS**

**2.1 SCHEDULED DOOR HARDWARE**

- A. Provide door hardware for each door as scheduled in Part 3 "Door Hardware Schedule" Article to comply with requirements in this Section.
  - I. Door Hardware Sets: Provide quantity, item, size, finish or color indicated.
- B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in Part 3 "Door Hardware Schedule" Article. Products are identified by descriptive titles corresponding to requirements specified in Part 2.

## 2.2 HINGES

- A. Hinges: BHMA A156.1.
- B. Plain-Bearing Hinges: Grade 3 (standard weight).
  - I. Mounting: Full mortise (butts).
  - 2. Base and Pin Metal: Brass with stainless-steel pin body and brass protruding heads.
  - 3. Pins: Non-rising loose unless otherwise indicated.
  - 4. Tips: Flat button.
  - 5. Corners: Square.

## 2.3 MECHANICAL LOCKS AND LATCHES

- A. Lock Functions: As indicated in door hardware schedule.
- B. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:
  - I. Bored Locks: Minimum **1/2-inch** latchbolt throw.
  - 2. Deadbolts: Minimum **1-inch** bolt throw.
- C. Lock Backset: **2-3/4 inches**, unless otherwise indicated.
- D. Lock Trim:
  - I. Description: Lever.
  - 2. Levers: Cast.
  - 3. Escutcheons (Roses): Wrought.
- E. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.
  - I. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
  - 2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
- F. Bored Locks: BHMA A156.2; Grade 1; Series 4000.
  - I. Basis-of-Design Product: Subject to compliance with requirements, provide Corbin Russwin Architectural Hardware; an ASSA ABLOY Group Company product indicated on Door Hardware Schedule or comparable product by one of the following:
    - a. Best Access Systems; Div. of Stanley Security Solutions, Inc.
    - b. SARGENT Manufacturing Company; an ASSA ABLOY Group company.
    - c. Schlage Commercial Lock Division; an Ingersoll-Rand company.

## 2.4 AUXILIARY LOCKS

- A. Bored Auxiliary Locks (deadlock): BHMA A156.5: Grade 1; with strike that suits frame.

I. Basis-of-Design Product: Subject to compliance with requirements, provide Corbin Russwin Architectural Hardware; an ASSA ABLOY Group Company product indicated on Door Hardware Schedule or comparable product by one of the following:

- a. Best Access Systems; Div. of Stanley Security Solutions, Inc.
- b. SARGENT Manufacturing Company; an ASSA ABLOY Group company.
- c. Schlage Commercial Lock Division; an Ingersoll-Rand company.

## 2.5 LOCK CYLINDERS

- A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver.
  - I. Manufacturer: Same manufacturer as for locking devices.
- B. Standard Lock Cylinders: BHMA A156.5; Grade I; permanent cores that are interchangeable; face finished to match lockset.

## 2.6 KEYING

- A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, Appendix A.
  - I. Existing System:
    - a. Master key or grand master key locks to Owner's existing system.
- B. Keys: Nickel silver.
  - I. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:
    - a. Notation: Information to be furnished by Owner.
  - 2. Quantity: In addition to one extra key blank for each lock, provide the following:
    - a. Cylinder Change Keys: Three.
    - b. Master Keys: Five.

## 2.7 DOOR GASKETING

- A. Door Gasketing: BHMA A156.22; air leakage not to exceed **0.50 cfm per foot** of crack length for gasketing other than for smoke control, as tested according to ASTM E 283; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.
- B. Rigid, Housed, Perimeter Gasketing: Vinyl bulb gasket material held in place by stainless steel housing; fastened to frame stop with screws.
- C. Door Sweeps: Neoprene gasket material held in place by flat aluminum housing or flange; surface mounted to face of door with screws.

**2.8 THRESHOLDS**

- A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.
- B. Compressing-Top Thresholds: Metal member with compressible vinyl seal on top of threshold that seals against bottom of door; and base metal of aluminum.

**2.9 FABRICATION**

- A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rated labels and as otherwise approved by Architect.
  - I. Manufacturer's identification is permitted on rim of lock cylinders only.
- B. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18.
- C. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.
  - I. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
  - 2. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
  - 3. Fasteners for Wood Doors: Comply with requirements in DHI WDHS.2, "Recommended Fasteners for Wood Doors."
  - 4. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

**2.10 FINISHES**

- A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

- A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.

### 3.3 INSTALLATION

- A. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.
  - I. Standard Steel Doors and Frames: ANSI/SDI A250.8.
  - 2. Custom Steel Doors and Frames: HMMA 831.
- B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.
  - I. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
  - 2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- C. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than the number recommended by manufacturer for application indicated or one hinge for every **30 inches** of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.
- D. Intermediate Offset Pivots: Where offset pivots are indicated, provide intermediate offset pivots in quantities indicated in door hardware schedule but not fewer than one intermediate offset pivot per door and one additional intermediate offset pivot for every **30 inches** of door height greater than **90 inches**.
- E. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."
- F. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.
- G. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
- H. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- I. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.
- J. Lock Cylinders: Install construction cores to secure building and areas during construction period.

- I. Furnish permanent cores to Owner for installation.

### 3.4 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
- B. Occupancy Adjustment: Approximately six months after date of Substantial Completion, Installer's Architectural Hardware Consultant shall examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors and door hardware.

### 3.5 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items as necessary to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

### 3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain door hardware and door hardware finishes.

### 3.7 DOOR HARDWARE SCHEDULE

#### Door Hardware Set No. H1

Locations: Main Exterior Entrance Doors; each to have the following:

Qty.	Item	Finish
3 each	4 1/2" x 4 1/2" hinges – by entrance system manufacturer	619
1 each	Bored lever passage set: Corbin-Russwin CL3510-NZD-SF118 – CT6B	619
1 each	Threshold by entrance system manufacturer	
1 set	Weather-stripping by entrance system manufacturer	
1 each	Door sweep by entrance system manufacturer	
1 each	Closer	

#### Door Hardware Set No. H2

Locations: Interior Entrance Doors, 1 hour fire rating; each to have the following:

Qty.	Item	Finish
3 each	4 1/2" x 4 1/2" hinges – by entrance system manufacturer	619
1 each	Bored lever entrance set: Corbin-Russwin CL3551-NZD-SF118 – CT6B	619
1 each	Bored deadbolt: Corbin-Russwin DL3113-CT6	619
1 each	Threshold x 36"	Mill aluminum
1 set	Weather-stripping x 16'-4"	Stainless Steel
1 each	Door sweep x 36"	Mill aluminum

2 each	Door Viewers Ives U700 for fire rated doors	626
1 each	Closer – LCN 4030	Mill aluminum

#### Door Hardware Set No. **H3**

Locations: Rear Patio Doors; each to have the following:

Qty.	Item	Finish
3 each	4 1/2" x 4 1/2" hinges – by entrance system manufacturer	619
1 each	Bored lever entrance set: Corbin-Russwin CL3551-NZD-SF118 –CT6B	619
1 each	Bored deadbolt: Corbin-Russwin DL3113-CT6	619
1 each	Threshold by entrance system manufacturer	Mill aluminum
1 set	Weather-stripping by entrance system manufacturer	Stainless Steel
1 each	Door sweep by entrance system manufacturer	Mill aluminum

#### Door Hardware Set No. **H4**

Locations: Bathroom and Bedroom; each to have the following:

Qty.	Item	Finish
1 each	Hinges by pre-hung door / frame manufacturer	619
1 each	Bored lever privacy set: Corbin-Russwin CL3520-NZD	619
1 each	Wall stop- Ives WS402CCV (402-1/2) – concave rubber bumper	619

#### Door Hardware Set No. **H5**

Locations: Closet and Laundry; each to have the following:

Qty.	Item	Finish
1 each	Hinges by pre-hung door / frame manufacturer	619
1 each	Bored lever passage set: Corbin-Russwin CL3510-NZD	619
1 each	Wall stop- Ives WS402CCV (402-1/2) – concave rubber bumper	619

#### Door Hardware Set No. **H6**

Locations: Pair Closet Doors; each pair to have the following:

Qty.	Item	Finish
2 each	Hinges by pre-hung door / frame manufacturer	619
2 each	Bored lever dummy set: Corbin-Russwin CL3510-NZD	619
2 each	Top mounted ball catch – Ives #349	619

## END OF SECTION 08712

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**SECTION 09 0561**  
**COMMON WORK RESULTS FOR FLOORING PREPARATION**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. This section applies to all floors identified in the contract documents as to receive the following types of floor coverings:
  1. Resilient tile.
  2. Broadloom carpet.
  3. Thin-set ceramic tile.
- B. Preparation of new concrete floor slabs for installation of floor coverings.
- C. Testing of concrete floor slabs for moisture and alkalinity (pH).
- D. Remediation of concrete floor slabs due to unsatisfactory moisture or alkalinity (pH) conditions.
  1. Contractor shall perform all specified remediation of concrete floor slabs. If such remediation is indicated by testing agency's report and is due to a condition not under Contractor's control or could not have been predicted by examination prior to entering into the contract, a contract modification will be issued.
- E. Preparation of new wood-based floors and subfloors for installation of new floor coverings.

**1.02 REFERENCES**

- A. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens); 2013.
- B. ASTM C472 - Standard Test Methods for Physical Testing of Gypsum, Gypsum Plasters and Gypsum Concrete; 1999 (Reapproved 2014).
- C. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2011.

**1.03 SUBMITTALS**

- A. Floor Covering and Adhesive Manufacturers' Product Literature: For each specific combination of substrate, floor covering, and adhesive to be used; showing:
  1. Moisture and alkalinity (pH) limits and test methods.
  2. Manufacturer's required bond/compatibility test procedure.
- B. Testing Agency's Report:
  1. Description of areas tested; include floor plans and photographs if helpful.
  2. Summary of conditions encountered.
  3. Moisture and alkalinity (pH) test reports.
  4. Copies of specified test methods.
  5. Recommendations for remediation of unsatisfactory surfaces.
  6. Submit report to Architect.
  7. Submit report not more than 7 business days after conclusion of testing.
- C. Adhesive Bond and Compatibility Test Report.

**1.04 QUALITY ASSURANCE**

- A. Moisture and alkalinity (pH) testing shall be performed by an independent testing agency employed and paid by Contractor.
- B. Testing Agency Qualifications: Independent testing agency experienced in the types of testing specified.
  1. Submit evidence of experience consisting of at least 3 test reports of the type required, with project Owner's project contact information.
- C. Contractor's Responsibility Relating to Independent Agency Testing:
  1. Provide access for and cooperate with testing agency.
  2. Confirm date of start of testing at least 10 days prior to actual start.

3. Allow at least 4 business days on site for testing agency activities.
4. Achieve and maintain specified ambient conditions.
5. Notify Architect when specified ambient conditions have been achieved and when testing will start.

## 1.05 FIELD CONDITIONS

- A. Maintain ambient temperature in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 65 degrees F or more than 85 degrees F.
- B. Maintain relative humidity in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 40 percent and not more than 60 percent.

## PART 2 PRODUCTS

### 2.01 MATERIALS

- A. Patching Compound: Floor covering manufacturer's recommended product, suitable for conditions, and compatible with adhesive and floor covering. In the absence of any recommendation from flooring manufacturer, provide a product with the following characteristics:
  1. Cementitious moisture-, mildew-, and alkali-resistant compound, compatible with floor, floor covering, and floor covering adhesive, and capable of being feathered to nothing at edges.
  2. Compressive Strength: 3000 psi, minimum, after 28 days, when tested in accordance with ASTM C109/C109M or ASTM C472, whichever is appropriate.
- B. Alternate Flooring Adhesive: Floor covering manufacturer's recommended product, suitable for the moisture and pH conditions present; low-VOC. In the absence of any recommendation from flooring manufacturer, provide a product recommended by adhesive manufacturer as suitable for substrate and floor covering and for conditions present.
- C. Remedial Floor Coating: Single- or multi-layer coating or coating/overlay combination intended by its manufacturer to resist water vapor transmission to degree sufficient to meet flooring manufacturer's emission limits, resistant to the level of alkalinity (pH) found, and suitable for adhesion of flooring without further treatment.
  1. If testing agency recommends any particular products, use one of those.

## PART 3 EXECUTION

### 3.01 CONCRETE SLAB PREPARATION

- A. Perform following operations in the order indicated:
  1. Preliminary cleaning.
  2. Moisture vapor emission tests; 3 tests in the first 1000 square feet and one test in each additional 1000 square feet, unless otherwise indicated or required by flooring manufacturer.
  3. Internal relative humidity tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
  4. Alkalinity (pH) tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
  5. Specified remediation, if required.
  6. Patching, smoothing, and leveling, as required.
  7. Other preparation specified.
  8. Adhesive bond and compatibility test.
  9. Protection.
- B. Remediations:
  1. Active Water Leaks or Continuing Moisture Migration to Surface of Slab: Correct this condition before doing any other remediation; re-test after correction.
  2. Excessive Moisture Emission or Relative Humidity: If an adhesive that is resistant to the level of moisture present is available and acceptable to flooring manufacturer, use that

- adhesive for installation of the flooring; if not, apply remedial floor coating over entire suspect floor area.
3. Excessive Alkalinity (pH): If remedial floor coating is necessary to address excessive moisture, no additional remediation is required; if not, if an adhesive that is resistant to the level present is available and acceptable to the flooring manufacturer, use that adhesive for installation of the flooring; otherwise, apply a skim coat of specified patching compound over entire suspect floor area.

### **3.02 PRELIMINARY CLEANING**

- A. Clean floors of dust, solvents, paint, wax, oil, grease, asphalt, residual adhesive, adhesive removers, film-forming curing compounds, sealing compounds, alkaline salts, excessive laitance, mold, mildew, and other materials that might prevent adhesive bond.
- B. Do not use solvents or other chemicals for cleaning.

### **3.03 MOISTURE VAPOR EMISSION TESTING**

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.
- C. Test in accordance with ASTM F1869 and as follows.
- D. Plastic sheet test and mat bond test may not be substituted for the specified ASTM test method, as those methods do not quantify the moisture content sufficiently.
- E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if test values exceed 3 pounds per 1000 square feet per 24 hours.
- F. Report: Report the information required by the test method.

### **3.04 ALKALINITY TESTING**

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.

### **3.05 PREPARATION**

- A. See individual floor covering section(s) for additional requirements.
- B. Comply with requirements and recommendations of floor covering manufacturer.
- C. Fill and smooth surface cracks, grooves, depressions, control joints and other non-moving joints, and other irregularities with patching compound.
- D. Do not fill expansion joints, isolation joints, or other moving joints.

### **3.06 ADHESIVE BOND AND COMPATIBILITY TESTING**

- A. Comply with requirements and recommendations of floor covering manufacturer.

### **3.07 APPLICATION OF REMEDIAL FLOOR COATING**

- A. Comply with requirements and recommendations of coating manufacturer.

### **3.08 PROTECTION**

- A. Cover prepared floors with building paper or other durable covering.

**END OF SECTION 09 0561**

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**SECTION 09 2116**  
**GYPSUM BOARD ASSEMBLIES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Metal channel ceiling framing.
- B. Acoustic insulation.
- C. Cementitious backing board.
- D. Gypsum wallboard.
- E. Joint treatment and accessories.

**1.02 REFERENCE STANDARDS**

- A. ANSI A108.11 - American National Standard for Interior Installation of Cementitious Backer Units; 2013.1.
- B. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 2013.1.
- C. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2012.
- D. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2014.
- E. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2012.
- F. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2011.
- G. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2013.
- H. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness; 2011.
- I. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2014.
- J. ASTM C1325 - Standard Specification for Non-Asbestos Fiber-Mat Reinforced Cement Substrate Sheets; 2014.
- K. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2014.
- L. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2012.
- M. GA-216 - Application and Finishing of Gypsum Board; Gypsum Association; 2013.

**1.03 SUBMITTALS**

- A. Product Data: Provide data on metal framing, gypsum board, accessories, and joint finishing system.

**1.04 QUALITY ASSURANCE**

- A. Installer Qualifications: Company specializing in performing gypsum board application and finishing, with minimum 3 years of documented experience.

**PART 2 PRODUCTS**

**2.01 GYPSUM BOARD ASSEMBLIES**

- A. Provide completed assemblies complying with ASTM C840 and GA-216.

## 2.02 METAL FRAMING MATERIALS

- A. Non-Loadbearing Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/240 at 5 psf.
  - 1. Furring: Hat-shaped sections, minimum depth of 7/8 inch.

## 2.03 BOARD MATERIALS

- A. Manufacturers - Gypsum-Based Board:
  - 1. American Gypsum Company: [www.americangypsum.com](http://www.americangypsum.com).
  - 2. CertainTeed Corporation: [www.certainteed.com](http://www.certainteed.com).
  - 3. Continental Building Products: [www.continental-bp.com](http://www.continental-bp.com).
  - 4. Georgia-Pacific Gypsum: [www.gpgypsum.com](http://www.gpgypsum.com).
  - 5. National Gypsum Company: [www.nationalgypsum.com](http://www.nationalgypsum.com).
  - 6. USG Corporation: [www.usg.com](http://www.usg.com).
- B. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
  - 1. Application: Use for vertical surfaces, unless otherwise indicated.
  - 2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
    - a. Mold resistant board is required in bathrooms.
  - 3. Thickness:
    - a. Vertical Surfaces: 1/2 inch.
    - b. Ceilings: 1/2 inch.
- C. Backing Board For Wet Areas: One of the following products:
  - 1. Application: Surfaces behind tile in wet areas including showers.
  - 2. ANSI Cement-Based Board: Non-gypsum-based; aggregated Portland cement panels with glass fiber mesh embedded in front and back surfaces complying with ANSI A118.9 or ASTM C1325.
    - a. Thickness: 1/2 inch.
- D. Ceiling Board: Special sag resistant gypsum ceiling board as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
  - 1. Application: Ceilings, unless otherwise indicated.
  - 2. Thickness: 1/2 inch.
  - 3. Edges: Tapered.

## 2.04 ACCESSORIES

- A. Acoustic Insulation: ASTM C665; preformed glass fiber, friction fit type, unfaced.
- B. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.
- C. Joint Materials: ASTM C475 and as recommended by gypsum board manufacturer for project conditions.
- D. Screws for Attachment to Steel Members Less Than 0.033 inch In Thickness, to Wood Members, and to Gypsum Board: ASTM C1002; self-piercing tapping type; cadmium plated for exterior locations.
- E. Screws for Attachment to Steel Members From 0.033 to 0.112 inch in Thickness: ASTM C954; steel drill screws for application of gypsum board to loadbearing steel studs.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify that project conditions are appropriate for work of this section to commence.

### 3.02 FRAMING INSTALLATION

- A. Metal Framing: Install in accordance with ASTM C754 and manufacturer's instructions.

- B. Suspended Ceilings and Soffits: Space framing and furring members as indicated.

### **3.03 ACOUSTIC ACCESSORIES INSTALLATION**

- A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.
- B. Acoustic Sealant: Install in accordance with manufacturer's instructions.

### **3.04 BOARD INSTALLATION**

- A. Comply with ASTM C 840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.
- B. Fire-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.
- C. Cementitious Backing Board: Install over steel framing members and plywood substrate where indicated, in accordance with ANSI A108.11 and manufacturer's instructions.
- D. Installation on Wood Framing: For rated assemblies, comply with requirements of listing authority. For non-rated assemblies, install as follows:
  1. Single-Layer Applications: Screw attachment.

### **3.05 INSTALLATION OF TRIM AND ACCESSORIES**

- A. Corner Beads: Install at external corners, using longest practical lengths.

### **3.06 JOINT TREATMENT**

- A. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
  1. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
  2. Level 1: Fire rated wall areas above finished ceilings, whether or not accessible in the completed construction.
- B. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
  1. Feather coats of joint compound so that camber is maximum 1/32 inch.

**END OF SECTION 09 2116**

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**SECTION 09 3000**  
**TILING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Tile for floor applications.
- B. Tile for wall applications.
- C. Tile for shower receptors.
- D. Cementitious backer board as tile substrate.
- E. Stone thresholds.
- F. Ceramic accessories.
- G. Ceramic trim.

**1.02 REFERENCE STANDARDS**

- A. ANSI A108.1A - American National Standard Specifications for Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar; 2013.1.
- B. ANSI A108.1B - American National Standard Specifications for Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex-Portland Cement Mortar; 2013.1.
- C. ANSI A108.1C - Specifications for Contractors Option: Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar or Installation of Ceramic Tile on a Cured Portland Cement Mortar Bed with Dry-Set or Latex-Portland Cement Mortar; 2013.1.
- D. ANSI A108.4 - American National Standard Specifications for Installation of Ceramic Tile with Organic Adhesives or Water Cleanable Tile-Setting Epoxy Adhesive; 2013.1.
- E. ANSI A108.5 - American National Standard Specifications for Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar; 2013.1.
- F. ANSI A108.6 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy; 2013.1.
- G. ANSI A108.8 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant Furan Resin Mortar and Grout; 2013.1.
- H. ANSI A108.9 - American National Standard Specifications for Installation of Ceramic Tile with Modified Epoxy Emulsion Mortar/Grout; 2013.1.
- I. ANSI A108.10 - American National Standard Specifications for Installation of Grout in Tilework; 2013.1.
- J. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units; 2013.1.
- K. ANSI A108.12 - American National Standard Specifications for Installation of Ceramic Tile with EGP (Exterior Glue Plywood) Latex-Portland Cement Mortar; 2013.1.
- L. ANSI A108.13 - American National Standard Specifications for Installation of Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone; 2013.1.
- M. ANSI A118.4 - American National Standard Specifications for Modified Dry-Set Cement Mortar; 2013.1.
- N. ANSI A118.7 - American National Standard Specifications for High Performance Cement Grouts for Tile Installation; 2013.1.
- O. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 2013.1.
- P. ANSI A118.15 - American National Standard Specifications for Improved Modified Dry-Set Cement Mortar; 2013.1.

- Q. ANSI A137.1 - American National Standard Specifications for Ceramic Tile - Version; 2013.1.
- R. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation - Version; 2013.1.

#### **1.03 SUBMITTALS**

- A. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.
- B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- C. Maintenance Data: Include recommended cleaning methods, cleaning materials, stain removal methods, and polishes and waxes.

#### **1.04 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, with minimum 5 years of documented experience.
- B. Installer Qualifications: Company specializing in performing tile installation, with minimum of 5 years of documented experience.

#### **1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

#### **1.06 FIELD CONDITIONS**

- A. Maintain ambient and substrate temperature of 50 degrees F during installation of mortar materials.

### **PART 2 PRODUCTS**

#### **2.01 TILE**

- A. Manufacturers: All products by the same manufacturer.
- B. Basis of design: Florida Tile; Savannah; Porcelain Floor and Ceramic Wall Tile.  
[www.floridatile.com](http://www.floridatile.com)
- C. Paver and Wall Tile: ANSI A137.1, and as follows:
  1. Moisture Absorption: 0 to 0.5 percent.
  2. Size and Shape: 12 inch square.
  3. Thickness: 8 mm.
  4. Surface Finish: Non-slip.
  5. Color(s): To be selected by Architect from manufacturer's full range.
  6. Trim Units: Matching bullnose, double bullnose, cove base, and cove shapes in sizes coordinated with field tile.

#### **2.02 TRIM AND ACCESSORIES**

- A. Ceramic Accessories: Glazed finish, same color and finish as adjacent field tile; same manufacturer as tile.
- B. Ceramic Trim: Matching bullnose, double bullnose, cove base, and cove ceramic shapes in sizes coordinated with field tile.
  1. Applications:
    - a. Open Edges: Bullnose.
    - b. Inside Corners: Jointed.
    - c. Floor to Wall Joints: Cove base.
  2. Manufacturers: Same as for tile.
- C. Thresholds: Marble, white, honed finish; 2 inches wide by full width of wall or frame opening; 1/2 inch thick; beveled one long edge with radiused corners on top side; without holes, cracks, or open seams.
  1. Applications:
    - a. At doorways where tile terminates.

## 2.03 SETTING MATERIALS

- A. Latex-Portland Cement Mortar Bond Coat: ANSI A118.4 or ANSI A118.15.
  - 1. Products:
    - a. ARDEX Engineered Cements; ARDEX X 77 MICROTEC: [www.ardexamericas.com](http://www.ardexamericas.com).
    - b. Custom Building Products; Complete Contact-LFT Premium Rapid Setting Large Format Tile Mortar, with Multi-Surface Bonding Primer: [www.custombuildingproducts.com](http://www.custombuildingproducts.com).
    - c. LATICRETE International, Inc; LATICRETE 254 Platinum: [www.laticrete.com](http://www.laticrete.com).
    - d. Merkrete, by Parex USA, Inc; Merkrete 720 Marble Pro: [www.merkrete.com](http://www.merkrete.com).

## 2.04 GROUTS

- A. Manufacturers:
  - 1. Basis of Design: H.B. Fuller Construction Products Inc.; TEC; Power Grout (TA-550); [www.tecspeciality.com](http://www.tecspeciality.com)
- B. Polymer Modified Grout: ANSI A118.7 polymer modified cement grout.
  - 1. Applications: Use this type of grout where indicated and where no other type of grout is indicated.
  - 2. Use sanded grout for joints 1/8 inch wide and larger; use unsanded grout for joints less than 1/8 inch wide.
  - 3. Color(s): As selected by Architect from manufacturer's full line.
  - 4. Products:

## 2.05 MAINTENANCE MATERIALS

- A. Tile Sealant: Gunnable, silicone, siliconized acrylic, or urethane sealant; moisture and mildew resistant type.
  - 1. Applications: Between tile and plumbing fixtures.
  - 2. Color(s): Match plumbing fixture color.

## 2.06 ACCESSORY MATERIALS

- A. Underlayment at Floors: Specifically designed for bonding to thin-set setting mortar; not primarily a waterproofing material and having the following characteristics:
  - 1. Type: Thin-Set Mortar Adhered Sheet.
    - a. Products:
      - 1) LATICRETE International, Inc; LATICRETE 170 Sound and Crack Isolation Mat: [www.laticrete.com](http://www.laticrete.com).
- B. Backer Board: Cementitious type complying with ANSI A118.9; high density, glass fiber reinforced, 1/2 inch thick; 2 inch wide coated glass fiber tape for joints and corners.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of setting materials to sub-floor surfaces.
- B. Verify that concrete sub-floor surfaces are ready for tile installation by testing for moisture emission rate and alkalinity; obtain instructions if test results are not within limits recommended by tile manufacturer and setting materials manufacturer.

### 3.02 INSTALLATION - GENERAL

- A. Install tile and thresholds and grout in accordance with applicable requirements of ANSI A108.1A thru A108.13, manufacturer's instructions, and TCNA (HB) recommendations.
- B. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.
- C. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor joints.

- D. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.
- E. Form internal angles square and external angles bullnosed.
- F. Install ceramic accessories rigidly in prepared openings.
- G. Install thresholds where indicated.
- H. Sound tile after setting. Replace hollow sounding units.
- I. Keep control and expansion joints free of mortar, grout, and adhesive.
- J. Prior to grouting, allow installation to completely cure; minimum of 48 hours.
- K. Grout tile joints unless otherwise indicated. Use standard grout unless otherwise indicated.
- L. At changes in plane and tile-to-tile control joints, use tile sealant instead of grout, with either bond breaker tape or backer rod as appropriate to prevent three-sided bonding.

### **3.03 INSTALLATION - FLOORS - THIN-SET METHODS**

- A. Over interior concrete substrates, install in accordance with TCNA (HB) Method F113, dry-set or latex-Portland cement bond coat, with standard grout, unless otherwise indicated.

### **3.04 INSTALLATION - FLOORS - MORTAR BED METHODS**

- A. Over interior concrete substrates, install in accordance with TCNA (HB) Method F111, with cleavage membrane, unless otherwise indicated.
- B. Cleavage Membrane: Lap edges and ends.
- C. Mortar Bed Thickness: 5/8 inch, unless otherwise indicated.

### **3.05 INSTALLATION - SHOWERS AND BATHTUB WALLS**

- A. At tiled shower receptors install in accordance with TCNA (HB) Method B415, mortar bed floor, and W244, thin-set over cementitious backer unit walls.
- B. Grout with standard grout as specified above.

### **3.06 INSTALLATION - WALL TILE**

#### **3.07 CLEANING**

- A. Clean tile and grout surfaces.

#### **3.08 PROTECTION**

- A. Do not permit traffic over finished floor surface for 4 days after installation.

#### **3.09 SCHEUDLE**

#### **3.10 REFER TO FINISH SCHEUDLE ON DRAWINGS.**

**END OF SECTION 09 3000**

**SECTION 09 6500  
RESILIENT FLOORING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Resilient sheet flooring.
- B. Resilient base.
- C. Resilient stair accessories.
- D. Installation accessories.

**1.02 REFERENCE STANDARDS**

- A. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009.
- B. ASTM E492 - Standard Test Method for Laboratory Measurement of Impact Sound Transmission Through Floor-Ceiling Assemblies Using the Tapping Machine; 2009.
- C. ASTM F1861 - Standard Specification for Resilient Wall Base; 2008 (Reapproved 2012)e1.
- D. ASTM F2169 - Standard Specification for Resilient Stair Treads; 2012.

**1.03 SUBMITTALS**

- A. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
- B. Selection Samples: Submit manufacturer's complete set of color samples for Architect's initial selection.
- C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. Extra Wall Base: 50 linear feet of each type and color.
  - 2. Extra Stair Materials: Quantity equivalent to 5 percent of each type and color.

**1.04 DELIVERY, STORAGE, AND HANDLING**

- A. Store all materials off of the floor in an acclimatized, weather-tight space.
- B. Maintain temperature in storage area between 55 degrees F and 90 degrees F.
- C. Protect roll materials from damage by storing on end.

**PART 2 PRODUCTS**

**2.01 SHEET FLOORING**

**2.02 STAIR COVERING**

- A. Stair Treads: Rubber; full width and depth of stair tread in one piece; tapered thickness; nosing not less than 1-5/8 inch deep.
  - 1. Minimum Requirements: Comply with ASTM F2169, Type TS, rubber, vulcanized thermoset.
  - 2. Nominal Thickness: 0.1875 inch.
  - 3. Nosing: Round.
  - 4. Style: Contrasting color abrasive grit strips full width.
  - 5. Color: Solid.
  - 6. Manufacturers:
    - a. Burke Flooring: [www.burkemercer.com](http://www.burkemercer.com).
    - b. Johnsonite, a Tarkett Company: [www.johnsonite.com](http://www.johnsonite.com).
    - c. Roppe Corp: [www.roppe.com](http://www.roppe.com).
- B. Stair Risers: Full height and width of tread in one piece, matching treads in material and color.
  - 1. Thickness: 0.080 inch.
  - 2. Manufacturers:
    - a. Burke Flooring: [www.burkemercer.com](http://www.burkemercer.com).

- b. Johnsonite, a Tarkett Company: [www.johnsonite.com](http://www.johnsonite.com).
- c. Roppe Corp: [www.roppe.com](http://www.roppe.com).

## **2.03 RESILIENT BASE**

- A. Resilient Base: ASTM F1861, Type TP, rubber, thermoplastic; top set Style C, Butt-to.
  - 1. Height: 4.25 inch.
  - 2. Thickness: 0.375 inch thick.
  - 3. Finish: Satin.
  - 4. Length: Roll.
  - 5. Color: Color as selected from manufacturer's standards.
  - 6. Accessories: Premolded external corners, internal corners, and end stops.
  - 7. Manufacturers:
    - a. Basis of Design: Burke Flooring; Art Deco: [www.burkemercer.com](http://www.burkemercer.com).

## **2.04 ACCESSORIES**

- A. Subfloor Filler: White premix latex; type recommended by adhesive material manufacturer.
- B. Primers, Adhesives, and Seaming Materials: Waterproof; types recommended by flooring manufacturer.
  - 1. VOC Content: 250 g/L or less.
- C. Sound Control Underlayment: Membrane consisting of cork granules and ground ethylene vinyl acetate (EVA) with polyurethane binder.
  - 1. Thickness: 0.08 inch.
  - 2. Minimum of 55 dB transmission loss when tested in accordance with ASTM E90 or ASTM E492.
  - 3. Products:
    - a. Proflex Products, Inc.; LV-100 Sound Control Underlayment: [www.proflex.us](http://www.proflex.us).

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resilient base.

### **3.02 PREPARATION**

- A. Remove sub-floor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with sub-floor filler to achieve smooth, flat, hard surface.
- B. Prohibit traffic until filler is cured.
- C. Clean substrate.

### **3.03 INSTALLATION**

- A. Starting installation constitutes acceptance of sub-floor conditions.
- B. Install in accordance with manufacturer's instructions.
- C. Spread only enough adhesive to permit installation of materials before initial set.
- D. Fit joints tightly.
- E. Set flooring in place, press with heavy roller to attain full adhesion.
- F. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.
- G. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.

- H. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

#### **3.04 SHEET FLOORING**

- A. Lay flooring with joints and seams parallel to longer room dimensions, to produce minimum number of seams. Lay out seams to avoid widths less than 1/3 of roll width; match patterns carefully at seams.
- B. Double cut sheet at seams.
- C. Lay flooring with tightly butted seams, without any seam sealer unless otherwise indicated.

#### **3.05 RESILIENT BASE**

- A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.
- B. Install base on solid backing. Bond tightly to wall and floor surfaces.

#### **3.06 STAIR COVERINGS**

- A. Install stair coverings in one piece for full width and depth of tread.
- B. Adhere over entire surface. Fit accurately and securely.

#### **3.07 CLEANING**

- A. Remove excess adhesive from floor, base, and wall surfaces without damage.
- B. Clean in accordance with manufacturer's instructions.

#### **3.08 PROTECTION**

- A. Prohibit traffic on resilient flooring for 48 hours after installation.

**END OF SECTION 09 6500**

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**SECTION 09 6519**  
**RESILIENT TILE FLOORING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Resilient tile flooring.
- B. Installation accessories:
  - 1. Adhesives and adhesive encapsulators.
  - 2. Finishes and cleaners.

**1.02 REFERENCE STANDARDS**

- A. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens); 2013.
- B. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source; 2014c.
- C. ASTM E662 - Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials; 2013b.
- D. ASTM F137 - Standard Test Method for Flexibility of Resilient Flooring Materials with Cylindrical Mandrel Apparatus; 2008 (Reapproved 2013).
- E. ASTM F386 - Standard Test Method for Thickness of Resilient Flooring Materials Having Flat Surfaces; 2011.
- F. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2011.
- G. ASTM F925 - Standard Test Method for Resistance to Chemicals of Resilient Flooring; 2013.
- H. ASTM F1514 - Standard Test Method for Measuring Heat Stability of Resilient Flooring by Color Change; 2003 (Reapproved 2013).
- I. ASTM F1515 - Standard Test Method for Measuring Light Stability of Resilient Flooring by Color Change; 2003 (Reapproved 2008).
- J. ASTM F1700 - Standard Specification for Solid Vinyl Floor Tile; 2013a.
- K. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2011.
- L. ASTM F1914 - Standard Test Method for Short-Term Indentation and Residual Indentation of Resilient Floor Covering; 2007 (Reapproved 2011).
- M. ASTM F2055 - Standard Test Method for Size and Squareness of Resilient Floor Tile by Dial Gage Method; 2010.
- N. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2011.
- O. ASTM F2199 - Standard Test Method for Determining Dimensional Stability of Resilient Floor Tile after Exposure to Heat; 2009 (Reapproved 2014).
- P. ASTM F2421 - Standard Test Method for Measurement of Resilient Floor Plank by Dial Gage; 2005 (Reapproved 2011).
- Q. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source; 2011.

**1.03 SUBMITTALS**

- A. Shop Drawings.
- B. Manufacturer's documentation for flooring and accessories:
  - 1. Technical Data.
  - 2. Installation and Maintenance.

3. Warranty.
4. Material Safety Data Sheets (MSDS) for accessories.

#### **1.04 DELIVERY, STORAGE, AND HANDLING**

- A. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.
- B. Store all materials flat off of the floor in an acclimatized, weather-tight space between 65 to 85 degrees F.
- C. Do not double stack pallets.

#### **1.05 QUALITY ASSURANCE**

- A. Installer Qualifications: Installer having a minimum of 3 years documented experience installing Vinyl Planks.

#### **1.06 WARRANTY**

- A. Limited 10 Year Light Commercial

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Basis of Design: Mohawk Group; Grainic tiles: [www.mohawkgroup.com](http://www.mohawkgroup.com).

#### **2.02 RESILIENT TILE FLOORING**

- A. Luxury Vinyl Plank and Tile:
  1. Pattern: Half Lap.
  2. Color: As selected from manufacturer's full range.
  3. Physical Properties:
    - a. Wear Layer Thickness: 12 mil.
    - b. Total Thickness (Gauge): 2.5 mm.
    - c. Finish: Urethane coating with ceramic bead particles.
    - d. Size: 6"x48".
    - e. Texture: Wood Emboss.
    - f. Certification: FloorScore Certified.
  4. Manufacturing, Performance, and Safety Standards:
    - a. ASTM F1700, Classification: Class III.
    - b. ASTM F386, Thickness: Passed requirements.
    - c. ASTM F2421/F2055, Size and Squareness: Passed requirements.
    - d. ASTM F1914, Residual Indentation: Exceeds requirements.
    - e. ASTM F137, Flexibility: Exceeds requirements.
    - f. ASTM F2199, Dimensional Stability: Exceeds requirements.
    - g. ASTM F925, Chemical Resistance: Exceeds requirements.
    - h. ASTM F1514, Resistance to Heat: Exceeds requirements.
    - i. ASTM F1515, Resistance to Light: Exceeds requirements.
    - j. ASTM E648/NFPA 253, Critical Radiant Flux: Class I.
    - k. ASTM E662, Smoke Density (Flaming and Non-Flaming): Passed requirements.

#### **2.03 ACCESSORIES**

- A. Moldings, Transition and Edge Strips: Metal.
- B. Adhesive and Adhesive Encapsulators:
  1. VOC Content: 250 g/L or less.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION .**

- A. Install flooring and accessories after other operations (including painting) have been completed.

- B. Acceptance of Conditions: Carefully examine all installation areas with installer/applicator present, for compliance with requirements affecting work performance.
  - 1. Verify that field measurements, product, adhesives, substrates, surfaces, structural support, tolerances, levelness, temperature, humidity, moisture content level, pH, cleanliness and other conditions are as required by the manufacturer, and ready to receive work.
- C. Verify that substrate is contaminant-free, including old adhesives and abatement chemicals.
- D. Test substrates as required by manufacturer to verify proper conditions exist.
  - 1. Concrete:
    - a. Moisture testing: Perform either the In-Situ Relative Humidity (RH) test (ASTM F2170) or Moisture Vapor Emission Rate (MVER) test (ASTM F1869). Refer to the Manufacturer's Installation Guide/Manual for the maximum allowable substrate moisture content. Substrates above the maximum allowable moisture content will require a moisture mitigation system.
    - b. Perform alkalinity testing to verify pH level is between 7 to 10 per ASTM F710.
    - c. Check substrate for absorbency per manufacturer's recommendations.
    - d. Perform bond testing per ASTM F710 to determine compatibility of adhesive to concrete substrate.
  - 2. Wood:
    - a. Shall be dry, clean, structurally sound and installed per underlayment manufacturer's installation instructions.
    - b. Test wood subfloors and underlayment panels using a suitable wood moisture pin-meter. Readings between the subfloor and underlayment panels should be within 3 percent prior to installing the underlayment panels.
    - c. The maximum moisture content should be 14 percent.
    - d. Proceed with installation only after satisfactory conditions have been met.

### **3.02 PREPARATION**

- A. Flooring installation should not begin until all site conditions have been assessed, testing has been completed and subfloor conditions are approved.
- B. Prepare per manufacturer's written instructions and as follows:
  - 1. Prepare substrates to ensure proper adhesion of Luxury Vinyl Plank & Tile.
  - 2. Concrete Substrates: Prepare substrate per ASTM F710.
    - a. Verify that subfloor is clean, flat, smooth, free of dirt, rust, paint, oil, wax or any contaminant that will interfere with adhesive bonding.
    - b. Mechanically remove substrate coatings that are not compatible with adhesives, such as sealers, curing, hardening or parting compounds, soap, wax, oil, etc.
      - 1) Do not use solvents or adhesive removers.
    - c. Expansion joints, isolation joints, or other moving joints must be honored and not be filled with underlayment products or other materials, and floor coverings must not be laid over them. Expansion joint covering systems should be detailed by the architect or engineer based upon intended usage and aesthetic considerations.
    - d. Surface cracks, grooves, depressions, control joints or other non-moving joints, and other irregularities shall be filled or smoothed with high quality Portland cement or calcium aluminate based patching or underlayment compound for filling or smoothing, or both.
      - 1) Do not skim-coat large areas with patching compound, especially slick power-troweled surfaces.
      - 2) Sand smooth per manufacturer's instructions.
    - e. Slick surfaces such as power troweled concrete shall be profiled as needed to allow for a mechanical bond between the adhesive and subfloor.
    - f. Do not use gypsum-based underlayment products and do not skim coat concrete subfloors.

- g. Self-leveling underlays: Provide a dry and smoothly-sanded underlayment substrate ready for installation of Luxury Vinyl Plank & Tile. Underlayment compound shall be moisture-resistant, mildew-resistant, and alkali-resistant and must have a minimum of 3,000 psi compressive strength per ASTM C109/C109M.
- h. Lightweight concrete shall have a compressive strength greater than 90 pounds per cubic foot with minimum compression strength of 2,500 psi or greater.
- 3. Wood Substrates or Panel Type Underlayment:
  - a. Use minimum 0.25 inch thick APA rated underlayment grade plywood with a fully sanded face or other underlayment panel that is appropriate for the intended usage. Install and prepare panels and seams according to the manufacturer's instructions.

### 3.03 INSTALLATION

- A. Installation per manufacturer's written instructions and as follows:
  - 1. Layout shall be specified by Architect.
  - 2. Follow layout and ensure installation reference lines are square.
  - 3. Expansion joints: Locate expansion, isolation, and other moving joints prior to installation.
    - a. Do not fill expansion, isolation, and other moving joints with patching compound or cover with resilient flooring.
  - 4. Adhesives: Adhere flooring to substrate using the full spread method resulting in a completed installation without gaps, voids, raised edges, bubbles or any other surface imperfections.
    - a. Select appropriate adhesive, trowel and follow manufacturer's instructions.
    - b. Periodically spot-check transfer of adhesive to back of tile during installation.
    - c. Roll floor with a 100 pound roller to ensure proper transfer of adhesive and bonding.
    - d. Protect floor from traffic per manufacturer's instructions.
    - e. Do not wet mop floor until the adhesive has properly set per written instructions.

### 3.04 FIELD QUALITY CONTROL

- A. Site tests and inspections:
  - 1. Inspect flooring installation for non-conforming work including, but not limited to, the following:
    - a. Lack of adhesion.
    - b. Bubbles, loose tiles or raised edges.
    - c. Dirt and debris underneath flooring.
    - d. Excessive gaps.
    - e. Improper substrate preparation as indicated by telegraphing.
    - f. Damage to tiles, including: dents/indentations, cuts, cracks, burns or punctures.
- B. Non-conforming work per General Conditions and as follows:
  - 1. Repair or replace damaged material if not acceptable to the Architect.

### 3.05 CLEANING

- A. Provide progress cleaning per manufacturer's written instructions and as follows:
  - 1. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the work.
    - a. Clean and protect completed construction until Substantial Completion.
    - b. During installation, remove wet adhesive from surface of flooring per manufacturer's instructions.
  - 2. Site: Maintain project site free of waste materials and debris.
- B. Provide final cleaning immediately prior to Substantial Completion inspection per manufacturer's written instructions.
  - 1. Protection: Remove manufacturer's and other installed protection immediately prior to Substantial Completion inspection, unless required otherwise.
  - 2. Clean floor with a neutral 6-8 pH cleaner.

### **3.06 PROTECTION**

- A. Protect materials from construction operations until date of Final Completion or Owner occupancy, whichever occurs first.
  1. Protect finished floor from abuse and damage by using heavy non-staining kraft paper, drop cloths or equivalent. Use additional, non-damaging protective materials as needed.
  2. Light foot traffic on a newly installed floor can be permitted after 24 hours.
  3. Keep heavy traffic and rolling loads off the newly installed LVT flooring for 48 hours.
  4. Protect the floor from rolling traffic by covering with protective boards.

**END OF SECTION 09 6519**

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**SECTION 09 6800  
CARPETING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Carpet, stretched-in with cushion underlay.

**1.02 RELATED REQUIREMENTS**

- A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

**1.03 REFERENCE STANDARDS**

- A. ASTM D2859 - Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials; 2006 (Reapproved 2011).

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.
- C. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.

**1.05 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing specified carpet with minimum three years documented experience.

**PART 2 PRODUCTS**

**2.01 CARPET**

- A. Basis of Design: Mohawk Group; Bigelow; Ivy Garden.
- B. Carpet, Type Broadloom: polypropylene.
  - 1. Surface Flammability Ignition: Pass ASTM D2859 (the "pill test").
  - 2. VOC Content: Comply with Section 01 6116.
  - 3. Color: To be selected by Architect from Manufacturer's full range.
  - 4. Roll Width: 12 ft.
  - 5. Fiber Type: Polyester
  - 6. Pile Weight: 30 oz/sq yd.
  - 7. Primary Backing:
    - a. Material: Woven Polypropylene.

**2.02 CUSHION**

**2.03 BASIS OF DESIGN: MOHAWK GROUP; MOHAWK PAD; SMART STEP 24.**

- A. Cushion: 100% post industrial recycled content.
  - 1. Roll Width: 12 ft.
  - 2. Thickness: 0.275 inches.
  - 3. Density: 7.0 lb/cu ft.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

- A. Cementitious Sub-floor Surfaces: Verify that substrates are dry enough and ready for flooring installation by testing for moisture and alkalinity (pH).
  - 1. Obtain instructions if test results are not within limits recommended by flooring material manufacturer and adhesive materials manufacturer.

**3.02 PREPARATION**

- A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.

- B. Remove sub-floor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with sub-floor filler.
- C. Clean substrate.

### **3.03 INSTALLATION - GENERAL**

- A. Starting installation constitutes acceptance of sub-floor conditions.
- B. Install carpet and cushion in accordance with manufacturer's instructions.
- C. Verify carpet match before cutting to ensure minimal variation between dye lots.
- D. Install carpet tight and flat on subfloor, well fastened at edges, with a uniform appearance.

### **3.04 STRETCHED-IN CARPET**

- A. Install tackless strips with pins facing the wall around entire perimeter, except across door openings. Use edge strip where carpet terminates at other floor coverings.
- B. Space tackless strips slightly less than carpet thickness away from vertical surfaces, but not more than 3/8 inch.
- C. Install cushion in maximum size pieces using spot adhesive to adhere to sub-floor.
- D. Lay out cushion so that seams will be perpendicular to, or offset from, minimum 6 inches from carpet seams.
- E. Butt cushion edges together and tape seams.
- F. Trim cushion tight to edge of tackless strip and around projections and contours.
- G. Double cut carpet seams, with accurate pattern match. Make cuts straight, true, and unfrayed. Apply seam adhesive to all cut edges immediately.
- H. Join seams using hot adhesive tape. Form seams straight, not overlapped or peaked, and free of gaps.
- I. Following seaming, hook carpet onto tackless strip at one edge, power stretch, and hook firmly at other edges. Follow manufacturer's recommendations for method and amount of stretch.
- J. Trim carpet neatly at walls and around interruptions. Tuck edges into space between tackless strip and wall.

### **3.05 CLEANING**

- A. Clean and vacuum carpet surfaces.

**END OF SECTION 09 6800**

**SECTION 09 9113  
EXTERIOR PAINTING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Surface preparation.
- B. Field application of paints.
- C. Scope: Finish exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:
  1. Exposed surfaces of steel lintels and ledge angles.
- D. Do Not Paint or Finish the Following Items:
  1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
  2. Items indicated to receive other finishes.
  3. Items indicated to remain unfinished.
  4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
  5. Non-metallic roofing and flashing.
  6. Floors, unless specifically indicated.
  7. Ceramic and other types of tiles.
  8. Brick, glass unit masonry, architectural concrete, cast stone, integrally colored plaster and stucco.
  9. Glass.
  10. Concealed pipes, ducts, and conduits.

**1.02 REFERENCE STANDARDS**

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.
- B. MPI (APL) - Master Painters Institute Approved Products List; Master Painters and Decorators Association; current edition, [www.paintinfo.com](http://www.paintinfo.com).
- C. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; current edition, [www.paintinfo.com](http://www.paintinfo.com).
- D. SSPC-SP 1 - Solvent Cleaning; 2015.

**1.03 SUBMITTALS**

- A. Product Data: Provide complete list of products to be used, with the following information for each:
  1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
  2. MPI product number (e.g. MPI #47).
  3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.
- B. Certification: By manufacturer that paints and finishes comply with VOC limits specified.

**1.04 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum three years documented experience.

**1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

- C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

## 1.06 FIELD CONDITIONS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- C. Do not apply exterior paint and finishes during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.
- D. Minimum Application Temperatures for Latex Paints: 50 degrees F for exterior; unless required otherwise by manufacturer's instructions.

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

- A. Provide paints and finishes used in any individual system from the same manufacturer; no exceptions.
- B. Paints:
  1. Benjamin Moore & Co: [www.benjaminmoore.com](http://www.benjaminmoore.com).
  2. Glidden Professional, a product of PPG Architectural Coatings: [www.gliddenprofessional.com](http://www.gliddenprofessional.com).
  3. PPG Paints: [www.ppgpaints.com](http://www.ppgpaints.com).
  4. Pratt & Lambert Paints: [www.prattandlambert.com](http://www.prattandlambert.com).
  5. Sherwin-Williams Company: [www.sherwin-williams.com](http://www.sherwin-williams.com).

### 2.02 PAINTS AND FINISHES - GENERAL

- A. Paints and Finishes: Ready mixed, unless required to be a field-catalyzed paint.
  1. Where MPI paint numbers are specified, provide products listed in Master Painters Institute Approved Product List, current edition available at [www.paintinfo.com](http://www.paintinfo.com), for specified MPI categories, except as otherwise indicated.
  2. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
  3. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
  4. For opaque finishes, tint each coat including primer coat and intermediate coats, one-half shade lighter than succeeding coat, with final finish coat as base color.
  5. Supply each paint material in quantity required to complete entire project's work from a single production run.
  6. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.
- B. Volatile Organic Compound (VOC) Content:
  1. Provide paints and finishes that comply with the most stringent requirements specified in the following:
    - a. Ozone Transport Commission (OTC) Model Rule, Architectural, Industrial, and Maintenance Coatings; [www.otcair.org](http://www.otcair.org); specifically:
      - 1) Opaque, Flat: 50 g/L, maximum.
      - 2) Opaque, Nonflat: 150 g/L, maximum.
      - 3) Opaque, High Gloss: 250 g/L, maximum.
      - 4) Varnishes: 350 g/L, maximum.

2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.
- C. Colors: As indicated in Color Schedule.
  1. Selection to be made by Architect after award of contract.

## 2.03 PAINT SYSTEMS - EXTERIOR

- A. Paint E-OP - Exterior Surfaces to be Painted, Unless Otherwise Indicated: Including primed metal.
  1. Two top coats and one coat primer.
  2. Top Coat(s): Exterior Alkyd Enamel; MPI #94.
  3. Top Coat Sheen:
    - a. Semi-Gloss: MPI gloss level 5; use this sheen at all locations.

## 2.04 PRIMERS

- A. Primers: Provide the following unless other primer is required or recommended by manufacturer of top coats.
  1. Rust-Inhibitive Water Based Primer; MPI #107.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.
- C. Test shop-applied primer for compatibility with subsequent cover materials.

### 3.02 PREPARATION

- A. Clean surfaces thoroughly and correct defects prior to application.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces for finishing.
- D. Seal surfaces that might cause bleed through or staining of topcoat.
- E. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- F. Ferrous Metal:
  1. Solvent clean according to SSPC-SP1.
  2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.

### 3.03 APPLICATION

- A. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".
- B. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- C. Apply each coat to uniform appearance.
- D. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- E. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

**3.04 CLEANING**

- A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

**3.05 PROTECTION**

- A. Protect finishes until completion of project.
- B. Touch-up damaged finishes after Substantial Completion.

**3.06 COLOR SCHEDULE**

- A. Steel Lintels: #5555 Midnight Black.

**END OF SECTION 09 9113**

**SECTION 09 9123  
INTERIOR PAINTING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Surface preparation.
- B. Field application of paints and varnishes.
- C. Scope: Finish interior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.
  - 1. Mechanical and Electrical:
- D. Do Not Paint or Finish the Following Items:
  - 1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
  - 2. Items indicated to receive other finishes.
  - 3. Items indicated to remain unfinished.
  - 4. Fire rating labels, equipment serial number and capacity labels, bar code labels, and operating parts of equipment.
  - 5. Stainless steel, anodized aluminum, bronze, terne coated stainless steel, and lead items.
  - 6. Floors, unless specifically indicated.
  - 7. Ceramic and other tiles.
  - 8. Glass.
  - 9. Concealed pipes, ducts, and conduits.

**1.02 REFERENCE STANDARDS**

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.
- B. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Base Materials; 2007.
- C. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; current edition, [www.paintinfo.com](http://www.paintinfo.com).
- D. SSPC-SP 1 - Solvent Cleaning; 2015.
- E. SSPC-SP 6 - Commercial Blast Cleaning; Society for Protective Coatings; 2007.

**1.03 SUBMITTALS**

- A. Product Data: Provide complete list of products to be used, with the following information for each:
  - 1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
  - 2. MPI product number (e.g. MPI #47).
  - 3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.
- B. Certification: By manufacturer that paints and finishes comply with VOC limits specified.
- C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. Extra Paint and Finish Materials: 1 gallon of each color; from the same product run, store where directed.
  - 2. Label each container with color in addition to the manufacturer's label.

**1.04 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum three years documented experience.
- B. Applicator Qualifications: Company specializing in performing the type of work specified with minimum 3 years experience.

## **1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

## **1.06 FIELD CONDITIONS**

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- C. Do not apply materials when relative humidity exceeds 85 percent; at temperatures less than 5 degrees F above the dew point; or to damp or wet surfaces.
- D. Minimum Application Temperatures for Paints: 50 degrees F for interiors unless required otherwise by manufacturer's instructions.
- E. Minimum Application Temperature for Varnish Finishes: 65 degrees F for interior, unless required otherwise by manufacturer's instructions.
- F. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Provide paints and finishes used in any individual system from the same manufacturer; no exceptions.
- B. Paints:
  - 1. Behr Process Corporation: [www.behr.com](http://www.behr.com).
  - 2. Benjamin Moore & Co: [www.benjaminmoore.com](http://www.benjaminmoore.com).
  - 3. Glidden Professional, a product of PPG Architectural Coatings: [www.gliddenprofessional.com](http://www.gliddenprofessional.com).
  - 4. Sherwin-Williams Company: [www.sherwin-williams.com](http://www.sherwin-williams.com).
- C. Transparent Finishes:
  - 1. Behr Process Corporation: [www.behr.com](http://www.behr.com).
  - 2. Sherwin-Williams Company: [www.sherwin-williams.com](http://www.sherwin-williams.com).

### **2.02 PAINTS AND FINISHES - GENERAL**

- A. Paints and Finishes: Ready mixed, unless intended to be a field-catalyzed paint.
  - 1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
  - 2. For opaque finishes, tint each coat including primer coat and intermediate coats, one-half shade lighter than succeeding coat, with final finish coat as base color.
  - 3. Supply each paint material in quantity required to complete entire project's work from a single production run.
  - 4. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.
- B. Volatile Organic Compound (VOC) Content:
  - 1. Provide paints and finishes that comply with the most stringent requirements specified in the following:
    - a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.

- b. Ozone Transport Commission (OTC) Model Rule, Architectural, Industrial, and Maintenance Coatings; [www.otcair.org](http://www.otcair.org); specifically:
  - 1) Opaque, Flat: 50 g/L, maximum.
  - 2) Opaque, Nonflat: 150 g/L, maximum.
  - 3) Opaque, High Gloss: 250 g/L, maximum.
  - 4) Varnishes: 350 g/L, maximum.
2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.
- C. Colors: As indicated on drawings.
  1. Selection to be made by Architect after award of contract.
  2. Allow for minimum of six colors for each system, unless otherwise indicated, without additional cost to Owner.
  3. Extend colors to surface edges; colors may change at any edge as directed by Architect.

## 2.03 PAINT SYSTEMS - INTERIOR

- A. Paint I-OP - Interior Surfaces to be Painted, Unless Otherwise Indicated: Including gypsum board, wood, uncoated steel, and shop primed steel.
  1. Two top coats and one coat primer.
  2. Top Coat(s): Institutional Low Odor/VOC Interior Latex; MPI #143, 144, 145, 146, 147, or 148.
    - a. Products:
  3. Top Coat Sheen:
    - a. Flat: MPI gloss level 1; use this sheen for ceilings and other overhead surfaces.
    - b. Eggshell: MPI gloss level 3; use this sheen for walls.
  4. Primer: As recommended by top coat manufacturer for specific substrate.
- B. Paint I-OP-MD-DT - Medium Duty Door/Trim: For surfaces subject to frequent contact by occupants, including metals and wood:
  1. Medium duty applications include doors, door frames, handrails, guardrails, and balustrades.
  2. Two top coats and one coat primer.
  3. Top Coat(s): Interior Light Industrial Coating, Water Based; MPI #153 or 154.
  4. Top Coat Sheen:
    - a. Satin: MPI gloss level 4; use this sheen at all locations.
  5. Primer: As recommended by top coat manufacturer for specific substrate.
- C. Paint I-OP-MD-WC - Medium Duty Vertical: Including gypsum board.
  1. Two top coats and one coat primer.
  2. Top Coat(s): Interior Alkyd; MPI #47, 48, 49, or 51.
  3. Top Coat Sheen:
    - a. Eggshell: MPI gloss level 3; use this sheen at walls in wet locations.
  4. Primer: As recommended by top coat manufacturer for specific substrate.
- D. Paint I-TR -W - Transparent Finish on Wood.
  1. Stain: Semi-Transparent Stain for Wood; MPI #90.
    - a. Products:
  2. Top Coat(s): Alkyd Varnish; MPI #73 or 75
    - a. Products:
      - 1) Sherwin-Williams Wood Classics FastDry Varnish, Satin. (MPI #73)
  3. Top Coat Sheen:
    - a. Satin: MPI gloss level 4; use this sheen at all locations.

## 2.04 PRIMERS

- A. Primers: Provide the following unless other primer is required or recommended by manufacturer of top coats.

1. Interior Institutional Low Odor/VOC Primer Sealer; MPI #149.
2. Interior Drywall Primer Sealer.
3. Interior Rust-Inhibitive Water Based Primer; MPI #107.
4. Interior/Exterior Quick Dry Alkyd Primer for Metal; MPI #76.

### PART 3 EXECUTION

#### 3.01 EXAMINATION

- A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.
- C. Test shop-applied primer for compatibility with subsequent cover materials.
- D. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
  1. Gypsum Wallboard: 12 percent.
  2. Interior Wood: 15 percent, measured in accordance with ASTM D4442.

#### 3.02 PREPARATION

- A. Clean surfaces thoroughly and correct defects prior to application.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.
- D. Seal surfaces that might cause bleed through or staining of topcoat.
- E. Gypsum Board: Fill minor defects with filler compound. Spot prime defects after repair.
- F. Ferrous Metal:
  1. Solvent clean according to SSPC-SP1.
  2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
  3. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 "Commercial Blast Cleaning". Protect from corrosion until coated.
- G. Wood Surfaces to Receive Opaque Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats. Back prime concealed surfaces before installation.
- H. Wood Surfaces to Receive Transparent Finish: Wipe off dust and grit prior to sealing, seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after sealer has dried; sand lightly between coats. Prime concealed surfaces with gloss varnish reduced 25 percent with thinner.
- I. Wood Doors to be Field-Finished: Seal wood door top and bottom edge surfaces with tinted primer.

#### 3.03 APPLICATION

- A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
- B. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".
- C. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- D. Apply each coat to uniform appearance in thicknesses specified by manufacturer.
- E. Sand wood and metal surfaces lightly between coats to achieve required finish.

- F. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- G. Wood to Receive Transparent Finishes: Tint fillers to match wood. Work fillers into the grain before set. Wipe excess from surface.
- H. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

#### **3.04 CLEANING**

- A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

#### **3.05 PROTECTION**

- A. Protect finishes until completion of project.
- B. Touch-up damaged finishes after Substantial Completion.

#### **3.06 SCHEULE - PAINT SYSTEMS**

- A. Gypsum Board: Finish surfaces exposed to view.
  - 1. Interior Ceilings and Bulkheads: GI-OP-3L, flat.
  - 2. Interior Walls: GI-OP-3A, semi-gloss.
- B. Wood: Finish surfaces exposed to view.
  - 1. Interior trim and frames: WI-OP-3A, semi-gloss.
- C. Wood Doors: WI-TR-VS.
- D. Steel Doors and Frames: Finish surfaces exposed to view; MI-OP-3A, gloss.
- E. Shop-Primed Metal Items: Finish surfaces exposed to view.
  - 1. Interior: MI-OP-2A.

**END OF SECTION 09 9123**

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**SECTION 10 1400**  
**SIGNAGE**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Apartment Unit signs.
- B. Interior directional signs.
- C. Building identification signs.
- D. Traffic signs.
- E. Development sign.

**1.02 REFERENCE STANDARDS**

- A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.
- B. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- C. ICC A117.1 - Accessible and Usable Buildings and Facilities; International Code Council; 2009 (ANSI).

**1.03 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's printed product literature for each type of sign, indicating sign styles, font, foreground and background colors, locations, overall dimensions of each sign.
- C. Signage Schedule: Provide information sufficient to completely define each sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts, and colors.
  - 1. When room numbers to appear on signs differ from those on the drawings, include the drawing room number on schedule.
  - 2. When content of signs is indicated to be determined later, request such information from Owner through Architect at least 2 months prior to start of fabrication; upon request, submit preliminary schedule.
  - 3. Submit for approval by Owner through Architect prior to fabrication.
- D. Samples: Submit one sample of each type of sign, of size similar to that required for project, illustrating sign style, font, and method of attachment.

**1.04 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

**1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Package signs as required to prevent damage before installation.
- B. Package room and door signs in sequential order of installation, labeled by floor or building.

**1.06 FIELD CONDITIONS**

- A. Maintain this minimum temperature during and after installation of signs.

**PART 2 PRODUCTS**

**2.01 MANUFACTURERS**

- A. Flat Signs:
  - 1. Best Sign Systems, Inc: [www.bestsigns.com](http://www.bestsigns.com).
  - 2. Cosco Industries (ADA signs); ADA Series 1: [www.coscoarchitecturalsigns.com](http://www.coscoarchitecturalsigns.com).
  - 3. Mohawk Sign Systems, Inc: [www.mohawksign.com](http://www.mohawksign.com).

## 2.02 SIGNAGE APPLICATIONS

- A. Accessibility Compliance: Signs are required to comply with ADA Standards and ICC A117.1 and applicable building codes, unless otherwise indicated; in the event of conflicting requirements, comply with the most comprehensive and specific requirements.
- B. Apartment Unit Door Signs: Provide a sign for interior doors to each apartment unit.
  - 1. Sign Type: Flat signs with engraved panel media as specified.
  - 2. Provide "tactile" signage, with letters raised minimum 1/32 inch and Grade II braille.
  - 3. Character Height: 1-1/2 inch.
  - 4. Sign Size: 3 inches high by 8 inches wide
  - 5. Apartment Doors: Identify with Unit number; (UNIT-1, UNIT-2, UNIT-3, or UNIT-4.).
  - 6. Mounting Location: 60 inches from floor on latch side, 2 inches from frame.
  - 7. Allow for 48 apartment Unit signs.
- C. Interior Directional Signs:
  - 1. Sign Type: Same as room and door signs.
  - 2. Size: As required to list apartment units on second floor and indicate direction upstairs.
  - 3. Mounting Location: Lower level of stairwells.
  - 4. Allow for 17 signs.
  - 5. Wording of signs:
    - a. Line 1 for duplexes and Line 2 for quadplexes: List of apartment unit(s) upstairs.
    - b. Line 2 for duplexes or Line 3 for quadplexes: Upstairs.
    - c. Sign to include a directional arrow pointing upstairs.
- D. Building Identification Signs:
  - 1. Use individual metal letters mechanically attached to painted exterior grade plywood.
    - a. Plywood backerboard and letters to be of contrasting colors.
  - 2. Mount in a predominate location on outside of building, coordinate location with Owner and Building Official.
  - 3. Exterior: Allow for total of 6 character letters, 5 inches high, metal, per building identification sign.
  - 4. Allow for 24 building identification signs.
  - 5. The 7 buildings along Oakview Avenue shall have one building identification sign on the front and one building identification sign on the back of each building.
- E. Traffic and Parking Lot Signs: To match VDOT standards; locate where indicated on the drawings.
- F. Development Sign:
  - 1. Sign Type: High Density Urethane (HDU) sign foam. 18 lb density.
  - 2. Texture: Simulated wood grain.
  - 3. Font and Sign Colors: Match existing adjacent development signage at Sapling Grove.
  - 4. Size: 24.5 inches tall by 36 inches wide by 1.5 inches thick.
  - 5. Content:
    - a. Line 1: THE VILLAGE
    - b. Line 2: at OAKVIEW
    - c. Line 3: Bristol Redevelopment and
    - d. Line 4: Housing Authority
  - 6. Warranty: 10 years against deterioration, warping, cracking, and paint degradation.
  - 7. Mounting: Mount to two pieces of 4 inch by 4 inch painted pressure treated lumber embedded into the ground 24 inches below grade. Center of sign to be at 36 inches above grade.

## 2.03 SIGN TYPES

- A. Flat Signs: Signage media without frame.
  - 1. Edges: Square.
  - 2. Corners: Radiused.

3. Wall Mounting of One-Sided Signs: Concealed screws.
- B. Color and Font: Unless otherwise indicated:
  1. Character Font: Helvetica, Arial, or other sans serif font.
  2. Character Case: Upper case only.
  3. Background Color: To be selected from manufacturer's standard colors..
  4. Character Color: Contrasting color.

#### **2.04 TACTILE SIGNAGE MEDIA**

- A. Engraved Panels: Laminated colored plastic; engraved through face to expose core as background color:
  1. Total Thickness: 1/16 inch.

#### **2.05 DIMENSIONAL LETTERS**

- A. Metal Letters:
  1. Mounting: Tape adhesive.

#### **2.06 ACCESSORIES**

- A. Concealed Screws: Stainless steel, galvanized steel, chrome plated, or other non-corroding metal.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify that substrate surfaces are ready to receive work.

#### **3.02 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Install neatly, with horizontal edges level.
- C. Protect from damage until Substantial Completion; repair or replace damage items.

**END OF SECTION 10 1400**

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**SECTION 10 2800**  
**TOILET, BATH, AND LAUNDRY ACCESSORIES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Accessories for toilet rooms, showers, residential bathrooms, and utility rooms.
- B. Grab bars.

**1.02 REFERENCE STANDARDS**

- A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.
- B. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.

**1.03 SUBMITTALS**

- A. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.

**PART 2 PRODUCTS**

**2.01 MANUFACTURERS**

- A. Basis of Design: Refer to schedule on drawings..

**2.02 MATERIALS**

- A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
  - 1. Grind welded joints smooth.

**2.03 TOILET ROOM ACCESSORIES**

- A. Grab Bars: Stainless steel, nonslip grasping surface finish.
  - 1. Standard Duty Grab Bars:
    - a. Push/Pull Point Load: 250 pound-force, minimum.
    - b. Dimensions: 1-1/4 inch outside diameter, minimum 0.05 inch wall thickness, exposed flange mounting, 1-1/2 inch clearance between wall and inside of grab bar.
    - c. Length and Configuration: As indicated on drawings.

**2.04 SHOWER AND TUB ACCESSORIES**

- A. Shower Curtain Rod: Stainless steel tube, 1 inch outside diameter, 0.04 inch wall thickness, satin-finished, with 1 inch outside diameter, minimum 0.04 inch thick satin-finished stainless steel flanges, for concealed mounting.
- B. Shower Curtain:
  - 1. Material: Opaque vinyl, 0.008 inch thick, matte finish, with antibacterial treatment, flameproof and stain-resistant.
  - 2. Material: Polyester, machine washable, and mildew-resistant.
  - 3. Size: 72 by 72 inches, hemmed edges.
  - 4. Grommets: Stainless steel; pierced through top hem on 6 inch centers.
  - 5. Color: White.
- C. Folding Shower Seat: Wall-mounted surface; welded tubular seat frame, structural support members, hinges and mechanical fasteners of Type 304 stainless steel, refer to drawings for handing of seat.
  - 1. Seat: Phenolic or polymeric composite one-piece seat or seat slats, of white color.
  - 2. Size: ADA Standards compliant.

**2.05 RESIDENTIAL ACCESSORIES**

- A. Tumbler and Toothbrush Holder: Wall-mounted, stainless steel, 2-1/4 inch diameter tumbler hole, 2 toothbrush holes located on each side of tumbler hole, rectangular-shaped bracket and backplate for concealed attachment, satin finish.

## **2.06 UTILITY ROOM ACCESSORIES**

- A. Combination Utility Shelf/Mop and Broom Holder: 0.05 inch thick stainless steel, Type 304, with 1/2 inch returned edges, 0.06 inch steel wall brackets.
  - 1. Drying rod: Stainless steel, 1/4 inch diameter.
  - 2. Hooks: 3, 0.06 inch stainless steel rag hooks at shelf front.
  - 3. Mop/broom holders: 3 spring-loaded rubber cam holders at shelf front.
  - 4. Length: Manufacturer's standard length for number of holders/hooks.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify exact location of accessories for installation.

### **3.02 PREPARATION**

### **3.03 INSTALLATION**

- A. Install accessories in accordance with manufacturers' instructions in locations indicated on the drawings.
- B. Install plumb and level, securely and rigidly anchored to substrate.
- C. Mounting Heights: As required by accessibility regulations, unless otherwise indicated.
  - 1. Grab Bars: As indicated on the drawings.
  - 2. Other Accessories: As indicated on the drawings.

### **3.04 PROTECTION**

- A. Protect installed accessories from damage due to subsequent construction operations.

**END OF SECTION 10 2800**

**SECTION 10 5500  
POSTAL SPECIALTIES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Central mail delivery boxes.

**1.02 RELATED REQUIREMENTS**

- A. Section 03 3000 - Cast-in-Place Concrete: Concrete pedestal and anchor bolts for mail box.
- B. Section 05 5000 - Metal Fabrications: Fabricated metal pedestal and anchor bolts for mail box.

**1.03 REFERENCE STANDARDS**

- A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.
- B. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.

**1.04 SUBMITTALS**

- A. Product Data: Provide manufacturer's specifications and descriptive literature, installation instructions, maintenance information, and current USPS approval documentation.
- B. Shop Drawings: Indicate plans for each unit or groups of units, front elevations with compartment layout and model number, overall dimensions, rough-in opening sizes, construction and anchorage details.

**1.05 WARRANTY**

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide manufacturer's warranty against defects in materials or workmanship for a period of 5 years from Date of Substantial Completion.

**PART 2 PRODUCTS**

**2.01 CENTRAL MAIL DELIVERY BOXES**

- A. Central Mail Delivery Boxes: Provide products approved for United States Postal Service (USPS) delivery.
  - 1. Materials: Aluminum with stainless steel hardware.
  - 2. Finish: Powder coat in color selected by Architect from manufacturer's standard colors.
  - 3. Unit Types and Sizes: As specified.
  - 4. Configurations: See drawings for overall dimensions and layouts.
- B. Cluster Box Units (CBU): Pedestal-mounted, mail receptacle with weather-resistant cabinet for outdoor installation; front-loading, double-column design.
  - 1. Unit A: 12 customer compartments (3.125 inch high), 1 outgoing mail receptacle, and 1 parcel compartment.
    - a. Florence Manufacturing Company; Model 1570-12.
    - b. Postal Products Unlimited, Inc; Model N1029595.
    - c. Salsbury Industries; Model 3312.

**2.02 COMPONENTS**

- A. Locking - Front Loading Master Door: Three-point latching mechanism with USPS master lock furnished and installed by postmaster.
- B. Locking - Customer Compartment Doors: USPS approved cam lock, 3 keys each lock.
- C. Locking - Parcel Compartment Doors: Double-lock arrangement with USPS approved cam lock for customer access, and USPS master lock furnished and installed by postmaster.
- D. Pedestals: Standard aluminum pedestal with rubber mounting pad designed to meet USPS and height requirements of ADA Standards.

- E. Identification - Customer and Parcel Compartments: Sequential numerical or alphabetic characters, top to bottom, left to right; factory-installed.
  - 1. Customer Name Marking: Self-adhesive labels; attach below front of each compartment shelf.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify that concrete base and anchor bolts are ready to receive pedestal-mounted units.
- B. Do not begin installation until unacceptable conditions are corrected.

### 3.02 INSTALLATION

- A. Install postal specialties in accordance with approved shop drawings, manufacturer's instructions, and USPS requirements.
- B. Adjust and lubricate door hardware to operate properly.

**END OF SECTION 10 5500**

**SECTION 11 3100**  
**RESIDENTIAL APPLIANCES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Kitchen appliances.
- B. Laundry appliances.

**1.02 RELATED REQUIREMENTS**

- A. Section 26 2717 - Equipment Wiring: Electrical connections for appliances.

**1.03 REFERENCE STANDARDS**

- A. UL (EAUED) - Electrical Appliance and Utilization Equipment Directory; Underwriters Laboratories Inc.; current edition.

**1.04 SUBMITTALS**

- A. Product Data: Manufacturer's data indicating dimensions, capacity, and operating features of each piece of residential equipment specified.
- B. Copies of Warranties: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

**1.05 QUALITY ASSURANCE**

- A. Electric Appliances: Listed and labeled by UL and complying with NEMA standards.

**1.06 WARRANTY**

- A. Provide five (5) year manufacturer warranty on refrigeration system of refrigerators.
- B. Provide ten (10) year manufacturer warranty on tub and door liner of dishwashers.

**PART 2 PRODUCTS**

**2.01 KITCHEN APPLIANCES**

- A. Provide Equipment Eligible for Energy Star Rating: Energy Star Rated.
- B. Refrigerator: Free-standing, side-by-side, and frost-free.
  - 1. Basis of Design: Refer to schedule on drawings.
  - 2. Exterior Finish: Porcelain enameled steel, color white.
- C. Range: Electric, free-standing, with standard burners and removable drip pans.
  - 1. Basis of Design: Refer to schedule on drawings.
  - 2. Exterior Finish: Porcelain enameled steel, color white.
- D. Dishwasher: Undercounter.
  - 1. Basis of Design: Refer to schedule on drawings.
  - 2. Finish: Porcelain enameled steel, color white.

**2.02 LAUNDRY APPLIANCES**

- A. Provide Equipment Eligible for Energy Star Rating: Energy Star Rated.
- B. Clothes Washer: Front-loading.
  - 1. Basis of Design: Refer to schedule on drawings.
  - 2. Finish: Painted steel, color white.
- C. Clothes Dryer: Electric, stationary.
  - 1. Basis of Design: Refer to schedule on drawings.
  - 2. Finish: Painted steel, color white.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

- A. Verify utility rough-ins are provided and correctly located.

**3.02 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Anchor built-in equipment in place.

**3.03 ADJUSTING**

- A. Adjust equipment to provide efficient operation.

**3.04 CLEANING**

- A. Remove packing materials from equipment and properly discard.
- B. Wash and clean equipment.

**END OF SECTION 11 3100**

**SECTION 12 3530**  
**RESIDENTIAL CASEWORK**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Kitchen cabinets.
- B. Vanity cabinets.
- C. Casework hardware.

**1.02 RELATED REQUIREMENTS**

- A. Section 12 3600 - Countertops.

**1.03 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide component dimensions and construction details.
- C. Shop Drawings: Indicate casework locations, scaled plans, elevations, clearances required, rough-in and anchor placement dimensions and tolerances.

**1.04 QUALITY ASSURANCE**

- A. Manufacturer: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

**1.05 MOCK-UP**

- A. Provide full size mock-up of casework base unit, upper cabinet, and counter top.
- B. Mock-up may remain as part of the Work.

**PART 2 PRODUCTS**

**2.01 MANUFACTURERS**

- A. Residential Casework:
- B. Basis of Design:
  - 1. Leedo Cabinetry. [www.Leedo.com](http://www.Leedo.com)

**2.02 COMPONENTS**

- A. Cabinet Construction: The construction of all kitchen and bathroom vanity cabinets for this project shall meet or exceed the requirements of the American National Standard Institute (ANSI), the Kitchen Cabinet Manufacturers' Association (KCMA), and the following minimum cabinet requirements.
  - 1. FACE FRAMES: solid wood, minimum dimensions 0.75 inch by 1.5 inch.
  - 2. END PANELS, TOPS, and BOTTOMS: plywood, minimum thickness 0.5 inch. Tops and bottoms to be dadoed, glued, and stapled into sides and face frames.
  - 3. BACKS: plywood minimum thickness 0.25 inches, dadoed or rabbeted, glued and stapled into end panels.
  - 4. SHELVES: solid wood or plywood. Adjustable shelves, minimum thickness 0.625 inch. Fixed shelves, minimum thickness 0.5 inch. Edge banding is required on plywood.
  - 5. DOORS and DRAWER FRONTS: solid wood or plywood, minimum thickness 0.625 inch. Panels in "frame and panel" doors, minimum thickness 0.25 inch.
  - 6. DRAWER BOXES: solid wood or plywood, minimum thickness 0.5 inch. Sides dadoed, rabbeted, or dovetailed to receive the front and back members of the drawer box. No butt joints will be accepted.
  - 7. DRAWER BOTTOMS: plywood, minimum thickness 0.25 inch. Bottoms dadoed and glued into drawer box.
  - 8. DRAWER GUIDES: side mounted steel rails.
  - 9. Plastic laminate counter tops are to be post formed or have back splashes that are attached to the counter tops.

10. Sidewall splashes are required.
11. All cabinets to be factory / manufacturer assembled.
12. Before purchasing cabinets, submit VHDA's cabinet review form and manufacturer's specification sheets to VHDA's Architectural and Engineering Department for review. Written acceptance using VHDA's cabinet review form is required for each site. If requested, a cabinet
  - a. Sample is to be provided at the job site for physical inspection and acceptance. Provide two weeks for the review process.
13. Cabinet review forms are available at the VHDA web site at [www.vhda.com](http://www.vhda.com), or from Carol Hurdle: (804) 343-5738.
14. Compliance with above minimum requirements shall be necessary for VHDA's acceptance. However, VHDA reserves the right not to accept any cabinet that complies with such minimum requirements and to require compliance with such additional requirements and conditions as VHDA shall determine to be appropriate.

B. Countertops: As specified in Section 12 3600.

## **2.03 HARDWARE**

- A. Hardware: BHMA A156.9.
- B. Drawer and Door Pulls: Chrome wire pulls, 4 inches wide.
- C. Drawer Slides: Full Extension arms, steel construction.

## **2.04 FABRICATION**

- A. Shop assemble casework for delivery to site in units easily handled and to permit passage through building openings.
- B. Fabricate corners and joints without gaps or inaccessible spaces or areas where dirt or moisture could accumulate.

## **2.05 FINISHES**

### **PART 3 EXECUTION**

#### **3.01 INSTALLATION**

- A. Install casework, components and accessories in accordance with manufacturer's instructions.
- B. Set casework items plumb and square, securely anchored to building structure.

#### **3.02 ADJUSTING**

- A. Adjust doors, drawers, hardware, fixtures, and other moving or operating parts to function smoothly.

#### **3.03 CLEANING**

- A. Clean casework, countertops, shelves, and hardware.

#### **3.04 PROTECTION**

- A. Do not permit finished casework to be exposed to continued construction activity.

**END OF SECTION 12 3530**

## SECTION 12 3600 COUNTERTOPS

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

- A. Countertops for manufactured casework.
- B. Wall-hung counters and vanity tops.

#### 1.02 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2014.
- B. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

#### 1.03 SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product to be used, including:
  1. Preparation instructions and recommendations.
  2. Storage and handling requirements and recommendations.
  3. Specimen warranty.
- B. Shop Drawings: Complete details of materials and installation; combine with shop drawings of cabinets and casework specified in other sections.

#### 1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator.

### PART 2 PRODUCTS

#### 2.01 COUNTERTOP ASSEMBLIES

- A. Plastic Laminate Countertops: High pressure decorative laminate sheet bonded to substrate.
  1. Laminate Sheet, Unless Otherwise Indicated: NEMA LD 3, Grade HGP, for postforming, 0.039 inch nominal thickness.
    - a. Surface Burning Characteristics: Flame spread 25, maximum; smoke developed 450, maximum; when tested in accordance with ASTM E84.
    - b. Wear Resistance: In addition to specified grade, comply with NEMA LD 3 High Wear Grade requirements for wear resistance.
    - c. Finish: Matte or suede, gloss rating of 5 to 20.
    - d. Surface Color and Pattern: As selected by Architect from the manufacturer's full line.
    - e. Manufacturers:
      - 1) Formica Corporation: [www.formica.com](http://www.formica.com).
      - 2) Panolam Industries International, Inc\Nevamar: [www.nevamar.com](http://www.nevamar.com).
      - 3) Wilsonart, LLC: [www.wilsonart.com](http://www.wilsonart.com).
  2. Exposed Edge Treatment: Postformed laminate; front edge substrate built up to minimum 1-1/4 inch thick with raised radiused edge, integral coved backsplash with radiused top edge.
  3. Back and End Splashes: Same material, same construction.

#### 2.02 FABRICATION

- A. Fabricate tops and splashes in the largest sections practicable, with top surface of joints flush.
  1. Join lengths of tops using best method recommended by manufacturer.
  2. Fabricate to overhang fronts and ends of cabinets 1 inch except where top butts against cabinet or wall.
  3. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.
- B. Provide back/end splash wherever counter edge abuts vertical surface unless otherwise indicated.

1. Secure to countertop with concealed fasteners and with contact surfaces set in waterproof glue.
2. Height: 4 inches, unless otherwise indicated.
- C. Wall-Mounted Counters: Provide skirts, aprons, brackets, and braces as indicated on drawings, finished to match.

### **PART 3 EXECUTION**

#### **3.01 INSTALLATION**

- A. Securely attach countertops to cabinets using concealed fasteners. Make flat surfaces level; shim where required.
- B. Attach plastic laminate countertops using screws with minimum penetration into substrate board of 5/8 inch.
- C. Seal joint between back/end splashes and vertical surfaces.

#### **3.02 CLEANING**

- A. Clean countertops surfaces thoroughly.

#### **3.03 PROTECTION**

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

**END OF SECTION 12 3600**

## **SECTION 12 9313 BICYCLE RACKS**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Bicycle racks.

#### **1.02 SUBMITTALS**

- A. Product Data: Manufacturer's data sheets on each product to be used, including:
  1. Preparation instructions and recommendations.
  2. Installation methods.
- B. Shop Drawings: Indicate size, shape, and dimensions, including clearances from adjacent walls, doors, and obstructions.

#### **1.03 DELIVERY, STORAGE, AND HANDLING**

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Handle racks with sufficient care to prevent scratches and other damage to the finish.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Indoor Bicycle Racks:
  1. Bike Security Racks Co., Inc.: [www.bikeracks.com](http://www.bikeracks.com).
  2. Creative Pipe, Inc: [www.creativepipe.com](http://www.creativepipe.com).
  3. Highland Products Group, LLC: [www.indoorbikeracks.net](http://www.indoorbikeracks.net).

#### **2.02 BICYCLE RACKS**

- A. Interior Bicycle Racks: Device designed for indoor storage of bicycles; allows user provided lock to simultaneously secure one wheel and part of the frame on each bicycle parked or racked.
  1. Style: Indoor, floor mounted, single level, horizontal storage rack with fixed arms and locking loops.
  2. Capacity: 3 bicycles.
  3. Finish: Hot-dipped galvanized, maintenance-free and weather-resistant.
- B. Materials:

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Examine surfaces to receive bicycle racks.
- B. Do not begin installation until unsatisfactory substrates have been properly repaired.

#### **3.02 PREPARATION**

- A. Ensure surfaces to receive bicycle racks are clean, flat, and level.

#### **3.03 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Install bicycle racks level, plumb, square, and correctly located as indicated on the drawings.
- C. Surface Flange Installation: Anchor bicycle racks securely in place with 1/2 inch by 2 inch anchor bolts through flange holes.

#### **3.04 CLEANING**

- A. Clean installed work to like-new condition. Do not use cleaning materials or methods that could damage finish.

### **3.05 PROTECTION**

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

**END OF SECTION 12 9313**

**SECTION 21 0500**  
**COMMON WORK RESULTS FOR FIRE SUPPRESSION**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Pipe, fittings, sleeves, escutcheons, seals, and connections for sprinkler, standpipe and fire hose, and combination sprinkler and standpipe systems.

**1.02 REFERENCE STANDARDS**

- A. ASME A112.18.1 - Plumbing Supply Fittings; The American Society of Mechanical Engineers; 2012.
- B. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Welding, Brazing, and Fusing Qualifications; The American Society of Mechanical Engineers; 2013.
- C. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; The American Society of Mechanical Engineers; 2010.
- D. ASME B16.4 - Gray Iron Threaded Fittings; The American Society of Mechanical Engineers; 2011.
- E. ASME B16.5 - Pipe Flanges and Flanged Fittings; The American Society of Mechanical Engineers; 2013 (ANSI/ASME B16.5).
- F. ASME B16.9 - Factory-made Wrought Steel Butt-welding Fittings; The American Society of Mechanical Engineers; 2012.
- G. ASME B16.11 - Forged Steel Fittings, Socket-welding and Threaded; The American Society of Mechanical Engineers; 2011.
- H. ASME B16.25 - Butt-welding Ends; The American Society of Mechanical Engineers; 2012.
- I. ASME B36.10M - Welded and Seamless Wrought Steel Pipe; The American Society of Mechanical Engineers; 2004.
- J. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.
- K. ASTM A135/A135M - Standard Specification for Electric-Resistance-Welded Steel Pipe; 2009 (Reapproved 2014).
- L. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2013.
- M. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service; 2014e1.
- N. ASTM A536 - Standard Specification for Ductile Iron Castings; 1984 (Reapproved 2009).
- O. ASTM A795/A795M - Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use; 2013.
- P. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a.
- Q. AWS D1.1/D1.1M - Structural Welding Code - Steel; American Welding Society; 2011 w/Errata.
- R. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems; American Water Works Association; 2010 (ANSI/AWWA C105/A21.5).
- S. AWWA C110/A21.10 - Ductile-Iron and Gray-Iron Fittings; American Water Works Association; 2012 (ANSI/AWWA C110).
- T. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings; American Water Works Association; 2012 (ANSI/AWWA C111/A21.11).
- U. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast, for Water; American Water Works Association; 2009 (ANSI/AWWA C151/A21.51).

- V. AWWA C606 - Grooved and Shouldered Joints; American Water Works Association; 2011 (ANSI/AWWA C606).
- W. NFPA 13 - Standard for the Installation of Sprinkler Systems; National Fire Protection Association; 2013 (Errata 2014).
- X. NFPA 13R - Standard for the Installation of Sprinkler Systems in Low-rise Residential Occupancies; 2013.

### **1.03 SUBMITTALS**

- A. Product Data: Provide manufacturers catalogue information. Indicate valve data and ratings.
- B. Shop Drawings: Indicate pipe materials used, jointing methods, supports, floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections.

### **1.04 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

### **1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver and store valves in shipping containers, with labeling in place.
- B. Provide temporary protective coating on cast iron and steel valves.
- C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

## **PART 2 PRODUCTS**

### **2.01 FIRE PROTECTION SYSTEMS**

- A. Sprinkler Systems: Conform to NFPA 13R.
- B. Welding Materials and Procedures: Conform to ASME BPVC-IX.

### **2.02 BURIED PIPING**

- A. Steel Pipe: ASTM A53/A53M Schedule 40, ASTM A135/A135M Schedule 10, ASTM A795 Standard Weight, or ASME B36.10M Schedule 40, black, with AWWA C105/A21.5 polyethylene jacket, or double layer, half-lapped polyethylene tape.
  - 1. Steel Fittings: ASME B16.9, wrought steel, buttwelded, ASME B16.25, buttweld ends, ASTM A234/A234M, wrought carbon steel or alloy steel, ASME B16.5, steel flanges and fittings, or ASME B16.11, forged steel socket welded and threaded; with double layer, half-lapped polyethylene tape.
  - 2. Cast Iron Fittings: ASME B16.1, flanges and flanged fittings.
  - 3. Joints: Welded in accordance with AWS D1.1/D.1M.
  - 4. Casing: Closed glass cell insulation.
- B. Ductile Iron Pipe: AWWA C151/A21.51.
  - 1. Fittings: AWWA C110/A21.10, standard thickness.
  - 2. Joints: AWWA C111/A21.11, rubber gasket.
  - 3. Mechanical Couplings: Shaped composition sealing gasket, steel bolts, nuts, and washers.

### **2.03 ABOVE GROUND PIPING**

- A. Steel Pipe: ASTM A53 Schedule 40, black.
  - 1. Steel Fittings: ASME B16.9, wrought steel, buttwelded, ASME B16.25, buttweld ends, ASTM A234/A234M, wrought carbon steel or alloy steel, ASME B16.5, steel flanges and fittings, or ASME B16.11, forged steel socket welded and threaded.
  - 2. Cast Iron Fittings: ASME B16.1, flanges and flanged fittings and ASME B16.4, threaded fittings.
- B. Ductile Iron Pipe: AWWA C151/A21.51.

1. Fittings: AWWA C110/A21.10, standard thickness.
2. Joints: AWWA C111/A21.11, rubber gasket.
3. Mechanical Grooved Couplings: Malleable iron housing clamps to engage and lock, "C" shaped composition sealing gasket, steel bolts, nuts, and washers; galvanized for galvanized pipe.

## 2.04 PIPE SLEEVES

- A. Vertical Piping:
  1. Sleeve Length: 1 inch above finished floor.
  2. Provide sealant for watertight joint.
  3. Blocked Out Floor Openings: Provide 1-1/2 inch angle set in silicon adhesive around opening.
  4. Drilled Penetrations: Provide 1-1/2 inch angle ring or square set in silicone adhesive around penetration.
- B. Pipe Passing Through Below Grade Exterior Walls:
  1. Zinc coated or cast iron pipe.
  2. Provide watertight space with link rubber or modular seal between sleeve and pipe on both pipe ends.
- C. Clearances:
  1. Provide allowance for insulated piping.
  2. Wall, Floor, Floor, Partitions, and Beam Flanges: 1 inch greater than external; pipe diameter.
  3. All Rated Openings: Caulked tight with fire stopping material conforming to ASTM E814 in accordance with Section 07 8400 to prevent the spread of fire, smoke, and gases.

## 2.05 MANUFACTURED SLEEVE-SEAL SYSTEMS

- A. Modular/Mechanical Seal:
  1. Synthetic rubber interlocking links continuously fill annular space between pipe and wall/casing opening.
  2. Provide watertight seal between pipe and wall/casing opening.
  3. Elastomer element size and material in accordance with manufacturer's recommendations.
  4. Glass reinforced plastic pressure end plates.

## 2.06 ESCUTCHEONS

- A. Material:
  1. Fabricate from nonferrous metal.
  2. Chrome-plated except when 300 series, ASTM A269/A269M stainless steel is provided.
  3. Metals and Finish: Comply with ASME A112.18.
- B. Construction:
  1. One-piece for mounting on chrome-plated tubing or pipe and one-piece or split-pattern type elsewhere.
  2. Internal spring tension devices or setscrews to maintain a fixed position against a surface.

## 2.07 PIPE HANGERS AND SUPPORTS

- A. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron, adjustable swivel, split ring.
- B. Hangers for Pipe Sizes 2 inches and Over: Carbon steel, adjustable, clevis.
- C. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
- D. Wall Support for Pipe Sizes to 3 inches: Cast iron hook.
- E. Wall Support for Pipe Sizes 4 inches and Over: Welded steel bracket and wrought steel clamp.
- F. Vertical Support: Steel riser clamp.
- G. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

## 2.08 MECHANICAL COUPLINGS

- A. Rigid Mechanical Couplings for Grooved Joints:
  - 1. Dimensions and Testing: Comply with AWWA C606.
  - 2. Minimum Working Pressure: 300 psig.
  - 3. Housing Material: Fabricate of ductile iron conforming to ASTM A536.
  - 4. Housing Coating: Factory applied orange enamel.
  - 5. Gasket Material: EPDM suitable for operating temperature range from minus 30 degrees F to 230 degrees F.
  - 6. Bolts and Nuts: Hot dipped galvanized or zinc electroplated steel

## PART 3 EXECUTION

### 3.01 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and foreign material, from inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

### 3.02 INSTALLATION

- A. Install sprinkler system and service main piping, hangers, and supports in accordance with NFPA 13R.
- B. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.
- C. Install piping to conserve building space, to not interfere with use of space and other work.
- D. Group piping whenever practical at common elevations.
- E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- F. Pipe Hangers and Supports:
  - 1. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
  - 2. Place hangers within 12 inches of each horizontal elbow.
  - 3. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
  - 4. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
  - 5. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- G. Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.
- H. Prepare pipe, fittings, supports, and accessories for finish painting. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- I. Structural Considerations:
  - 1. Do not penetrate building structural members unless indicated.
- J. Provide sleeves when penetrating footings, floors, walls, and partitions and seal pipe and sleeve penetrations to achieve fire resistance equivalent to fire separation required.
- K. Manufactured Sleeve-Seal Systems:
  - 1. Install manufactured sleeve-seal systems in sleeves located in grade slabs and exterior concrete walls at piping entrances into building.
  - 2. Provide sealing elements of the size, quantity, and type required for the piping and sleeve inner diameter or penetration diameter.
  - 3. Locate piping in center of sleeve or penetration.

4. Install field assembled sleeve-seal system components in annular space between sleeve and piping.
  5. Tighten bolting for a water-tight seal.
  6. Install in accordance with manufacturer's recommendations.
- L. Escutcheons:
1. Install and firmly attach escutcheons at piping penetrations into finished spaces.
  2. Provide escutcheons on both sides of partitions separating finished areas through which piping passes.
  3. Use chrome plated escutcheons in occupied spaces and to conceal openings in construction.
- M. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

**END OF SECTION 21 0500**

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## SECTION 21 0523

### GENERAL-DUTY VALVES FOR WATER-BASED FIRE-SUPPRESSION PIPING

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Two-piece ball valves with indicators.
- B. Bronze butterfly valves with indicators.
- C. Iron butterfly valves with indicators.
- D. Check valves.
- E. Bronze OS&Y gate valves.
- F. Iron OS&Y gate valves.
- G. NRS gate valves.
- H. Indicator posts.
- I. Trim and drain valves.

##### 1.02 RELATED REQUIREMENTS

- A. Section 21 0500 - COMMON WORK RESULTS FOR FIRE SUPPRESSION: Pipe and fittings.

##### 1.03 REFERENCE STANDARDS

- A. FM P7825 - Approval Guide; Factory Mutual Research Corporation; current edition.
- B. NFPA 13 - Standard for the Installation of Sprinkler Systems; National Fire Protection Association; 2013 (Errata 2014).
- C. NFPA 13R - Standard for the Installation of Sprinkler Systems in Low-Rise Residential Occupancies; National Fire Protection Association; 2013.
- D. UL (DIR) - Online Certifications Directory; Underwriters Laboratories Inc.; current listings at database.ul.com.
- E. UL 262 - Gate Valves for Fire-Protection Service; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.
- F. UL 312 - Check Valves for Fire-Protection Service; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.
- G. UL 789 - Indicator Posts for Fire-Protection Service; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.
- H. UL 1091 - Butterfly Valves for Fire-Protection Service; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

##### 1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.

##### 1.05 QUALITY ASSURANCE

- A. Manufacturer:
  1. Obtain valves for each valve type from single manufacturer.
  2. Company must specialize in manufacturing products specified in this section, with not less than three years of documented experience.

##### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
  1. Protect internal parts against rust and corrosion.
  2. Protect threads and flange faces.

3. Set valves open to minimize exposure of functional surfaces.
- B. Use the following precautions during storage:
  1. Maintain valve end protection and protect flanges and specialties from dirt.
    - a. Provide temporary inlet and outlet caps.
    - b. Maintain caps in place until installation.
  2. Store valves in shipping containers and maintain in place until installation.
    - a. Store valves indoors and maintain at higher than ambient dew point temperature.
    - b. If outdoor storage is unavoidable, store valves off the ground in watertight enclosures.
- C. Use the following precautions for handling:
  1. Do not use operating handles or stems as lifting or rigging points.

## PART 2 PRODUCTS

### 2.01 GENERAL REQUIREMENTS

- A. UL Listed: Provide valves listed in UL's "Online Certifications Directory" under the following headings and bearing the UL mark:
  1. Main Level: HAMV - Fire Main Equipment.
    - a. Level 1: HCBZ - Indicator Posts, Gate Valve.
    - b. Level 1: HLOT - Valves.
- B. Comply with NFPA 13 and NFPA 13R for valves.
- C. Valve Pressure Ratings: Not less than minimum pressure rating indicated or higher as required.
- D. Valve Sizes: Same as upstream piping unless otherwise indicated.

### 2.02 TWO-PIECE BALL VALVES WITH INDICATORS

- A. UL 1091, except with ball instead of disc and FM Global standard for indicating valves (butterfly or ball type), Class Number 1112.
- B. Description:
  1. Minimum Pressure Rating: 175 psig.
  2. Body Design: Two piece.
  3. Body Material: Forged brass or bronze.
  4. Port Size: Full or standard.
  5. Seat: PTFE.
  6. Stem: Bronze or stainless steel.
  7. Ball: Chrome-plated brass.
  8. Actuator: Worm gear or traveling nut.

### 2.03 BRONZE BUTTERFLY VALVES WITH INDICATORS

- A. Minimum Pressure Rating: 175 psig.
- B. Body Material: Bronze.
- C. Seat: EPDM.
- D. Stem: Bronze or stainless steel.
- E. Disc: Bronze with EPDM coating.
- F. Actuator: Worm gear or traveling nut.
- G. Supervisory Switch: Internal or external.

### 2.04 IRON BUTTERFLY VALVES WITH INDICATORS

- A. Minimum Pressure Rating: 175 psig.
- B. Body Material: Cast or ductile iron with nylon, EPDM, epoxy, or polyamide coating.
- C. Seat: EPDM.
- D. Stem: Stainless steel.
- E. Disc: Ductile iron, nickel plated.

- F. Actuator: Worm gear or traveling nut.
- G. Supervisory Switch: Internal or external.
- H. Body Design: Grooved-end connections.

## 2.05 CHECK VALVES

- A. UL 312 and FM Global Approved for check valves, Class Number 1045.
- B. Minimum Pressure Rating: 175 psig.
- C. Type: Center guided check valve.
- D. Body Material: Cast iron, ductile iron.
- E. Center guided check with elastomeric seal.
- F. Hinge Spring: Stainless steel.
- G. End Connections: Flanged, grooved, or threaded.

## 2.06 BRONZE OS&Y GATE VALVES

- A. UL 262 and FM Global Approved for fire-service water control valves (OS&Y and NRS-type gate valves).
- B. Minimum Pressure Rating: 175 psig.
- C. Body and Bonnet Material: Bronze or brass.
- D. Wedge: One-piece bronze or brass.
- E. Wedge Seat: Bronze.
- F. Stem: Bronze or brass.
- G. Packing: Non-asbestos PTFE.
- H. Supervisory Switch: External.
- I. End Connections: Threaded.

## 2.07 IRON OS&Y GATE VALVES

- A. UL 262 and FM Global Approved for fire-service water control valves (OS&Y and NRS-type gate valves).
- B. Minimum Pressure Rating: 175 psig.
- C. Body and Bonnet Material: Cast or ductile iron.
- D. Wedge: Cast or ductile iron, or bronze with elastomeric coating.
- E. Wedge Seat: Cast or ductile iron, or bronze with elastomeric coating.
- F. Stem: Brass or bronze.
- G. Packing: Non-asbestos PTFE.
- H. Supervisory Switch: External.
- I. End Connections: Flanged.

## 2.08 NRS GATE VALVES

- A. Minimum Pressure Rating: 175 psig.
- B. Body and Bonnet Material: Cast or ductile iron.
- C. Wedge: Cast or ductile iron with elastomeric coating.
- D. Stem: Brass or bronze.
- E. Packing: Non-asbestos PTFE.
- F. Supervisory Switch: External.
- G. End Connections: Flanged.

## 2.09 INDICATOR POSTS

- A. UL 789 and FM Global Approved for indicator posts.
- B. Type: Wall.
- C. Base Barrel Material: Cast or ductile iron.
- D. Cap: Cast or ductile iron.
- E. Operation: Handwheel.

## 2.10 TRIM AND DRAIN VALVES

- A. Ball Valves:
  - 1. Description:
    - a. Pressure Rating: 175 psig.
    - b. Body Design: Two piece.
    - c. Body Material: Forged brass or bronze.
    - d. Port Size: Full or standard.
    - e. Seat: PTFE.
    - f. Stem: Bronze or stainless steel.
    - g. Ball: Chrome-plated brass.
    - h. Actuator: Hand-lever.
- B. Angle Valves:
  - 1. Description:
    - a. Pressure Rating: 175 psig.
    - b. Body Material: Brass or bronze.
    - c. Ends: Threaded.
    - d. Stem: Bronze.
    - e. Disc: Bronze.
    - f. Packing: Asbestos free.
    - g. Handwheel: Malleable iron, bronze, or aluminum.
- C. Globe Valves:
  - 1. Description:
    - a. Pressure Rating: 175 psig.
    - b. Body Material: Bronze with integral seat and screw-in bonnet.
    - c. Ends: Threaded.
    - d. Stem: Bronze.
    - e. Disc Holder and Nut: Bronze.
    - f. Disc Seat: Nitrile.
    - g. Packing: Asbestos free.
    - h. Handwheel: Malleable iron, bronze, or aluminum.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Confirm valve interior to be free of foreign matter and corrosion.
- B. Remove packing materials.
- C. Examine guides and seats by operating valves from the fully open position to the fully closed position.
- D. Examine valve threads and mating pipe for form and cleanliness.

### 3.02 INSTALLATION

- A. Install listed fire protection shutoff valves supervised-open, located to control sources of water supply except from fire department connections.
- B. Valves in horizontal piping installed with stem at or above the pipe center.

C. Position valves to allow full stem movement.

**END OF SECTION 21 0523**

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**SECTION 21 1300**  
**FIRE SUPPRESSION SPRINKLERS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Wet-pipe sprinkler system.
- B. System design, installation, and certification.
- C. Fire department connections.

**1.02 RELATED REQUIREMENTS**

- A. Section 21 0500 - COMMON WORK RESULTS FOR FIRE SUPPRESSION: Pipe, fittings, and valves.
- B. Section 21 0523 - General-Duty Valves for Water-Based Fire-Suppression Piping.

**1.03 REFERENCE STANDARDS**

- A. NFPA 13 - Standard for the Installation of Sprinkler Systems; National Fire Protection Association; 2013 (Errata 2014).
- B. NFPA 13R - Standard for the Installation of Sprinkler Systems in Low-Rise Residential Occupancies; National Fire Protection Association; 2013.
- C. NFPA 1963 - Standard for Fire Hose Connections; 2014.
- D. UL 405 - Fire Department Connection Devices; Current Edition, Including All Revisions.

**1.04 SUBMITTALS**

- A. Product Data: Provide data on sprinklers, valves, and specialties, including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
- B. Shop Drawings:
  1. Indicate hydraulic calculations, detailed pipe layout, hangers and supports, sprinklers, components and accessories. Indicate system controls.
  2. Submit shop drawings to authority having jurisdiction for approval. Submit proof of approval to Architect.
- C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  1. Extra Sprinklers: Type and size matching those installed, in quantity required by referenced NFPA design and installation standard.
  2. Sprinkler Wrenches: For each sprinkler type.

**PART 2 PRODUCTS**

**2.01 SPRINKLER SYSTEM**

- A. Sprinkler System: Provide coverage for entire building.
- B. Occupancy: Residential; comply with NFPA 13R.
- C. Water Supply: Determine volume and pressure from water flow test data.
- D. Provide fire department connections where indicated.
- E. Storage Cabinet for Spare Sprinklers and Tools: Steel, located adjacent to alarm valve.

**2.02 SPRINKLERS**

- A. Exposed Area Type: Upright type with guard.
  1. Response Type: Quick.
  2. Coverage Type: Standard.
  3. Fusible Link: Fusible solder link type temperature rated for specific area hazard.
- B. Sidewall Type: Semi-recessed horizontal sidewall type with matching push on escutcheon plate.

1. Response Type: Quick.
  2. Coverage Type: Standard.
  3. Fusible Link: Fusible solder link type temperature rated for specific area hazard.
- C. Residential Sprinklers: Concealed upright type with matching push on escutcheon plate.
1. Response Type: Quick.
  2. Fusible Link: Fusible solder link type temperature rated for specific area hazard.

## **2.03 PIPING SPECIALTIES**

- A. Fire Department Connections:
1. Type: Free standing made of corrosion resistant metal complying with UL 405.
    - a. Inlets: Two way, 2-1/2 inch swivel fittings, internal threaded. Thread size and inlets according to NFPA 1963 or Authority Having Jurisdiction. Brass caps with gaskets, chains, and lugs.
    - b. Outlet: Bottom with pipe threads, 4 NPS.
    - c. Sleeve: Brass, 18 inches height.
    - d. Signage: Raised or engraved lettering 1 inch minimum indicating system type.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Install in accordance with referenced NFPA design and installation standard.
- B. Install equipment in accordance with manufacturer's instructions.
- C. Place pipe runs to minimize obstruction to other work.
- D. Place piping in concealed spaces above finished ceilings.
- E. Apply masking tape or paper cover to ensure concealed sprinklers, cover plates, and sprinkler escutcheons do not receive field paint finish. Remove after painting. Replace painted sprinklers.
- F. Flush entire piping system of foreign matter.
- G. Hydrostatically test entire system.
- H. Require test be witnessed by Fire Marshal.

**END OF SECTION 21 1300**

**SECTION 22 0719**  
**PLUMBING PIPING INSULATION**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Piping insulation.
- B. Jackets and accessories.

**1.02 RELATED REQUIREMENTS**

- A. Section 07 8400 - Firestopping.
- B. Section 22 1005 - Plumbing Piping: Placement of hangers and hanger inserts.

**1.03 REFERENCE STANDARDS**

- A. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2010.
- B. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric]; 2010.
- C. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded Hot Plate Apparatus; 2013.
- D. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2013.
- E. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation; 2012.
- F. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation; 2013.
- G. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2014.
- H. ASTM C591 - Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation; 2013.
- I. ASTM C610 - Standard Specification for Molded Expanded Perlite Block and Pipe Thermal Insulation; 2011.
- J. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2013).
- K. ASTM D1056 - Standard Specification for Flexible Cellular Materials--Sponge or Expanded Rubber; 2014.
- L. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2014.
- M. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2013.
- N. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials; National Fire Protection Association; 2006.
- O. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

**1.05 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years of documented experience.

**1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

## PART 2 PRODUCTS

### 2.01 REQUIREMENTS FOR ALL PRODUCTS OF THIS SECTION

- A. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84, NFPA 255, or UL 723.

### 2.02 GLASS FIBER

- A. Manufacturers:
1. Johns Manville Corporation: [www.jm.com](http://www.jm.com).
  2. Owens Corning Corporation; Fiberglas Pipe Insulation ASJ: [www.ocbuildingspec.com](http://www.ocbuildingspec.com).
  3. Owens Corning Corporation; VaporWick Pipe Insulation: [www.ocbuildingspec.com](http://www.ocbuildingspec.com).
- B. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible.
1. 'K' value: ASTM C177, 0.24 at 75 degrees F.
  2. Maximum service temperature: 850 degrees F.
  3. Maximum moisture absorption: 0.2 percent by volume.
- C. Insulation: ASTM C547 and ASTM C795; semi-rigid, noncombustible, end grain adhered to jacket.
1. 'K' value: ASTM C177, 0.24 at 75 degrees F.
  2. Maximum service temperature: 650 degrees F.
  3. Maximum moisture absorption: 0.2 percent by volume.
- D. Vapor Barrier Jacket: White Kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm-inches.
- E. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.
- F. Fibrous Glass Fabric:
1. Cloth: Untreated; 9 oz/sq yd weight.
  2. Blanket: 1.0 lb/cu ft density.
  3. Weave: 10x10.
- G. Indoor Vapor Barrier Finish:
1. Cloth: Untreated; 9 oz/sq yd weight.
  2. Vinyl emulsion type acrylic, compatible with insulation, black color.
- H. Insulating Cement:
1. ASTM C449/C449M.

### 2.03 CELLULAR GLASS

- A. Insulation: ASTM C552, Type 1.
1. Apparent Thermal Conductivity; 'K' value: Grade 6, 0.33 at 100 degrees F.
  2. Service Temperature: Up to 800 degrees F.
  3. Water Vapor Permeability: 0.005 perm inch.
  4. Water Absorption: 0.5 percent by volume, maximum.

### 2.04 POLYETHYLENE

- A. Manufacturers:
1. Armacell LLC: [wwwarmacell.us](http://wwwarmacell.us).
- B. Insulation: Flexible closed-cell polyethylene tubing, slit lengthwise for installation, complying with applicable requirements of ASTM D1056.
1. 'K' value: ASTM C177; 0.25 at 75 degrees F.
  2. Maximum Service Temperature: 200 degrees F.
  3. Density: 2 lb/cu ft.
  4. Maximum Moisture Absorption: 1.0 percent by volume.
  5. Moisture Vapor Permeability: 0.05 perm inch, when tested in accordance with ASTM E96/E96M.
  6. Connection: Contact adhesive.

## 2.05 JACKETS

- A. Aluminum Jacket: ASTM B209 (ASTM B209M) formed aluminum sheet.
  - 1. Thickness: 0.016 inch sheet.
  - 2. Finish: Smooth.
  - 3. Joining: Longitudinal slip joints and 2 inch laps.
  - 4. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.
  - 5. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify that piping has been tested before applying insulation materials.
- B. Verify that surfaces are clean and dry, with foreign material removed.

### 3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with NAIMA National Insulation Standards.
- C. Exposed Piping: Locate insulation and cover seams in least visible locations.
- D. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, refer to Section 07 8400.
- E. Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping.
- F. Buried Piping: Provide factory fabricated assembly with inner all-purpose service jacket with self-sealing lap, and asphalt impregnated open mesh glass fabric, with one mil thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with a polyester film.

**END OF SECTION 22 0719**

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## **SECTION 22 1005**

### **PLUMBING PIPING**

#### **PART 1 GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Pipe, pipe fittings, valves, and connections for piping systems.
  - 1. Sanitary sewer.
  - 2. Domestic water.
  - 3. Pipe hangers and supports.
  - 4. Water pressure reducing valves.
  - 5. Relief valves.

##### **1.02 RELATED REQUIREMENTS**

- A. Section 07 8400 - Firestopping.
- B. Section 08 3100 - Access Doors and Panels.
- C. Section 22 0719 - Plumbing Piping Insulation.
- D. Section 33 1300 - Disinfecting of Water Utility Distribution.

##### **1.03 REFERENCE STANDARDS**

- A. ANSI Z21.22 - American National Standard for Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems; 1999, and addenda A&B (R2004).
- B. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; The American Society of Mechanical Engineers; 2012 (ANSI B16.18).
- C. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings; The American Society of Mechanical Engineers; 2013.
- D. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes; The American Society of Mechanical Engineers; 2013.
- E. ASME B31.9 - Building Services Piping; The American Society of Mechanical Engineers; 2014 (ANSI/ASME B31.9).
- F. ASSE 1003 - Water Pressure Reducing Valves for Domestic Water Distribution Systems; The American Society of Sanitary Engineering; 2009.
- G. ASTM B32 - Standard Specification for Solder Metal; 2008.
- H. ASTM B42 - Standard Specification for Seamless Copper Pipe, Standard Sizes; 2010.
- I. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2009.
- J. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2013.
- K. ASTM B813 - Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube; 2010.
- L. ASTM B828 - Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings; 2002 (Reapproved 2010).
- M. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120; 2012.
- N. ASTM D2235 - Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings; 2004 (Reapproved 2011).
- O. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40; 2013.
- P. ASTM D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems; 2012.
- Q. ASTM D2665 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings; 2014.

- R. ASTM D2729 - Standard Specification for Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2011.
- S. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings; 1996 (Reapproved 2010).
- T. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2014.
- U. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 2009.
- V. NSF 61 - Drinking Water System Components - Health Effects; 2012.
- W. NSF 372 - Drinking Water System Components - Lead Content; 2011.

#### **1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

#### **1.05 QUALITY ASSURANCE**

- A. Perform work in accordance with applicable codes.
- B. Identify pipe with marking including size, ASTM material classification, ASTM specification, potable water certification, water pressure rating.

#### **1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- B. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

#### **1.07 FIELD CONDITIONS**

- A. Do not install underground piping when bedding is wet or frozen.

### **PART 2 PRODUCTS**

#### **2.01 GENERAL REQUIREMENTS**

- A. Potable Water Supply Systems: Provide piping, pipe fittings, and solder and flux (if used), that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.

#### **2.02 SANITARY SEWER PIPING, BURIED WITHIN 5 FEET OF BUILDING**

- A. PVC Pipe: ASTM D2665 or ASTM D3034.
  - 1. Fittings: PVC.
  - 2. Joints: Solvent welded, with ASTM D2564 solvent cement.

#### **2.03 SANITARY SEWER PIPING, ABOVE GRADE**

- A. PVC Pipe: ASTM D2665.
  - 1. Fittings: PVC.
  - 2. Joints: Solvent welded, with ASTM D2564 solvent cement.

#### **2.04 WATER PIPING, BURIED WITHIN 5 FEET OF BUILDING**

- A. Copper Pipe: ASTM B42, annealed.
  - 1. Fittings: ASME B16.26, cast bronze.
  - 2. Joints: Flared.

#### **2.05 WATER PIPING, ABOVE GRADE**

- A. Copper Tube: ASTM B88 (ASTM B88M), Type K (A), Drawn (H).
  - 1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.

2. Joints: ASTM B32, alloy Sn95 solder.

## 2.06 PIPE HANGERS AND SUPPORTS

- A. Provide hangers and supports that comply with MSS SP-58.
  1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
  2. Overhead Supports: Individual steel rod hangers attached to structure or to trapeze hangers.
  3. Trapeze Hangers: Welded steel channel frames attached to structure.
  4. Vertical Pipe Support: Steel riser clamp.
- B. Plumbing Piping - Drain, Waste, and Vent:
  1. Hangers for Pipe Sizes 1/2 Inch to 1-1/2 Inches: Malleable iron, adjustable swivel, split ring.
  2. Hangers for Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
- C. Plumbing Piping - Water:
  1. Hangers for Pipe Sizes 1/2 Inch to 1-1/2 Inches: Malleable iron, adjustable swivel, split ring.

## 2.07 WATER PRESSURE REDUCING VALVES

- A. Manufacturers:
  1. Amtrol Inc: [www.amtrol.com](http://www.amtrol.com).
  2. Cla-Val Co: [www.cla-val.com](http://www.cla-val.com).
  3. Watts Regulator Company: [www.wattsregulator.com](http://www.wattsregulator.com).
- B. Up to 2 Inches:
  1. ASSE 1003, bronze body, stainless steel, and thermoplastic internal parts, fabric reinforced diaphragm, strainer, threaded single union ends.

## 2.08 RELIEF VALVES

- A. Pressure Relief:
  1. Manufacturers:
    - a. Cla-Val Co: [www.cla-val.com](http://www.cla-val.com).
    - b. Henry Technologies: [www.henrytech.com](http://www.henrytech.com).
    - c. Watts Regulator Company: [www.wattsregulator.com](http://www.wattsregulator.com).
  2. AGA Z21.22 certified, bronze body, teflon seat, steel stem and springs, automatic, direct pressure actuated.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify that excavations are to required grade, dry, and not over-excavated.

### 3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- D. Install piping to maintain headroom, conserve space, and not interfere with use of space.
- E. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 22 0719.
- F. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with Section 08 3100.
- G. Install water piping to ASME B31.9.

- H. Copper Pipe and Tube: Make soldered joints in accordance with ASTM B828, using specified solder, and flux meeting ASTM B813; in potable water systems use flux also complying with NSF 61 and NSF 372.
- I. PVC Pipe: Make solvent-welded joints in accordance with ASTM D2855.
- J. Sleeve pipes passing through partitions, walls and floors.
- K. Pipe Hangers and Supports:
  - 1. Install in accordance with ASME B31.9.
  - 2. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
  - 3. Place hangers within 12 inches of each horizontal elbow.
  - 4. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
  - 5. Provide copper plated hangers and supports for copper piping.

### **3.03 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM**

- A. Disinfect water distribution system in accordance with Section 33 1300.
- B. Prior to starting work, verify system is complete, flushed and clean.

### **3.04 SERVICE CONNECTIONS**

- A. Provide new sanitary sewer services. Before commencing work check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover to avoid freezing.
- B. Provide new water service complete with approved reduced pressure backflow preventer and water meter with by-pass valves, pressure reducing valve .
  - 1. Provide sleeve in wall for service main and support at wall with reinforced concrete bridge. Calk enlarged sleeve and make watertight with pliable material. Anchor service main inside to concrete wall.

**END OF SECTION 22 1005**

**SECTION 22 1006**  
**PLUMBING PIPING SPECIALTIES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Roof and floor drains.
- B. Cleanouts.
- C. Hydrants.
- D. Backflow preventers.
- E. Water hammer arrestors.

**1.02 RELATED REQUIREMENTS**

- A. Section 22 1005 - Plumbing Piping.
- B. Section 22 4000 - Plumbing Fixtures.

**1.03 REFERENCE STANDARDS**

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. ASME A112.6.3 - Floor and Trench Drains; The American Society of Mechanical Engineers; 2001 (R2007).
- C. ASSE 1011 - Hose Connection Vacuum Breakers; American Society of Sanitary Engineering; 2004 (ANSI/ASSE 1011).
- D. ASSE 1013 - Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Principle Backflow Preventers; American Society of Sanitary Engineering; 2011.
- E. ASSE 1019 - Vacuum Breaker Wall Hydrants, Freeze Resistant Automatic Draining Type; American Society of Sanitary Engineering; 2011 (ANSI/ASSE 1019).
- F. NSF 61 - Drinking Water System Components - Health Effects; 2012.
- G. NSF 372 - Drinking Water System Components - Lead Content; 2011.
- H. PDI-WH 201 - Water Hammer Arresters; Plumbing and Drainage Institute; 2010.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.
- C. Shop Drawings: Indicate dimensions, weights, and placement of openings and holes.
- D. Manufacturer's Instructions: Indicate Manufacturer's Installation Instructions: Indicate assembly and support requirements.

**PART 2 PRODUCTS**

**2.01 GENERAL REQUIREMENTS**

- A. Specialties in Potable Water Supply Systems: Provide products that comply with NSF 61 and NSF 372 for maximum lead content.

**2.02 DRAINS**

- A. Manufacturers:
  - 1. Jay R. Smith Manufacturing Company: [www.jayrsmith.com](http://www.jayrsmith.com).
  - 2. Josam Company: [www.josam.com](http://www.josam.com).
  - 3. Zurn Industries, Inc: [www.zurn.com](http://www.zurn.com).
- B. Floor Drain (FD-1):
  - 1. ASME A112.6.3; lacquered cast iron or stainless steel, two piece body with double drainage flange, weep holes, reversible clamping collar, and round, adjustable nickel-bronze strainer.

- C. Shower Channel Drain (SCD-1): Factory fabricated channel and grate with built in outlet pipe.  
1. Outlet Pipe: 2 inch diameter.

## 2.03 CLEANOUTS

- A. Manufacturers:  
1. Jay R. Smith Manufacturing Company: [www.jayrsmith.com](http://www.jayrsmith.com).  
2. Josam Company: [www.josam.com](http://www.josam.com).  
3. Zurn Industries, Inc: [www.zurn.com](http://www.zurn.com).
- B. Cleanouts at Exterior Surfaced Areas:  
1. Round cast nickel bronze access frame and non-skid cover.
- C. Cleanouts at Interior Finished Floor Areas :  
1. Lacquered cast iron body with anchor flange, reversible clamping collar, threaded top assembly, and round gasketed scored cover in service areas and round gasketed depressed cover to accept floor finish in finished floor areas.

## 2.04 HYDRANTS

- A. Manufacturers:  
1. Arrowhead Brass Company: [www.arrowheadbrass.com](http://www.arrowheadbrass.com).  
2. Jay R. Smith Manufacturing Company: [www.jayrsmith.com](http://www.jayrsmith.com).  
3. Zurn Industries, Inc: [www.zurn.com](http://www.zurn.com).
- B. Wall Hydrants:  
1. ASSE 1019; freeze resistant, self-draining type with chrome plated wall plate hose thread spout, handwheel, and integral vacuum breaker.

## 2.05 WASHING MACHINE BOXES AND VALVES

- A. Box Manufacturers:  
1. IPS Corporation/Water-Tite: [www.ipscorp.com](http://www.ipscorp.com).  
2. Oatey: [www.oatey.com](http://www.oatey.com).
- B. Valve Manufacturers:  
1. IPS Corporation/Water-Tite: [www.ipscorp.com](http://www.ipscorp.com).  
2. Zurn Industries, Inc: [www.zurn.com](http://www.zurn.com).
- C. Description: Plastic preformed rough-in box with brass long shank valves with wheel handles, socket for 2 inch waste, slip in finishing cover.

## 2.06 REFRIGERATOR VALVE AND RECESSED BOX

- A. Box Manufacturers:  
1. IPS Corporation/Water-Tite: [www.ipscorp.com](http://www.ipscorp.com).  
2. Oatey: [www.oatey.com](http://www.oatey.com).
- B. Valve Manufacturers:  
1. IPS Corporation/Water-Tite: [www.ipscorp.com](http://www.ipscorp.com).  
2. Zurn Industries, Inc: [www.zurn.com](http://www.zurn.com).
- C. Description: Plastic preformed rough-in box with brass valves with wheel handle, slip in finishing cover.

## 2.07 BACKFLOW PREVENTERS

- A. Manufacturers:  
1. Conbraco Industries: [www.apollovalves.com](http://www.apollovalves.com).  
2. Watts Regulator Company: [www.wattsregulator.com](http://www.wattsregulator.com).  
3. Zurn Industries, Inc: [www.zurn.com](http://www.zurn.com).
- B. Reduced Pressure Backflow Preventers:  
1. ASSE 1013; bronze body with bronze internal parts and stainless steel springs; two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve that opens under back

pressure in case of diaphragm failure; non-threaded vent outlet; assembled with two gate valves, strainer, and four test cocks.

## **2.08 WATER HAMMER ARRESTORS**

- A. Manufacturers:
  - 1. Jay R. Smith Manufacturing Company: [www.jayrsmith.com](http://www.jayrsmith.com).
  - 2. Watts Regulator Company: [www.wattsregulator.com](http://www.wattsregulator.com).
  - 3. Zurn Industries, Inc: [www.zurn.com](http://www.zurn.com).
- B. Water Hammer Arrestors:
  - 1. Stainless steel construction, bellows type sized in accordance with PDI-WH 201, precharged suitable for operation in temperature range -100 to 300 degrees F and maximum 150 psi working pressure.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.
- C. Install floor cleanouts at elevation to accommodate finished floor.
- D. Pipe relief from backflow preventer to nearest drain.
- E. Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping to washing machine outlets .

**END OF SECTION 22 1006**

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**SECTION 22 3000**  
**PLUMBING EQUIPMENT**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Water heaters.

**1.02 REFERENCE STANDARDS**

- A. ICC (IPC) - International Plumbing Code; 2012.
- B. UL 174 - Standard for Household Electric Storage Tank Water Heaters; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.
- C. UL 1453 - Standard for Electric Booster and Commercial Storage Tank Water Heaters; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

**1.03 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittals procedures.
- B. Product Data:
  - 1. Provide dimension drawings of water heaters indicating components and connections to other equipment and piping.
- C. Shop Drawings:
- D. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

**1.04 CERTIFICATIONS**

- A. Water Heaters: NSF approved.
- B. Electric Water Heaters: UL listed and labeled to UL 174 or UL 1453.
- C. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

**1.05 WARRANTY**

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year manufacturer warranty for domestic water heaters.

**PART 2 PRODUCTS**

**2.01 WATER HEATER MANUFACTURERS**

- A. A.O. Smith Water Products Co: [www.hotwater.com](http://www.hotwater.com).
- B. Rheem Manufacturing Company: [www.rheem.com](http://www.rheem.com).

**2.02 RESIDENTIAL ELECTRIC WATER HEATERS**

- A. Type: Automatic, electric, vertical storage.
- B. Performance:
  - 1. Energy Factor: GREATER THAN OR EQUAL TO 95 .
  - 2. Storage capacity: 40 gal.
  - 3. Heating element size: 4.5 kW.
  - 4. Maximum working pressure: 150 psig.
- C. Electrical Characteristics:
  - 1. 240 volts, single phase.
- D. Tank: Glass lined welded steel, thermally insulated with one inch thick glass fiber; encased in corrosion-resistant steel jacket; baked-on enamel finish.
- E. Controls: Automatic water thermostat with externally adjustable temperature range from 120 to 170 degrees F, flanged or screw-in nichrome elements, enclosed controls and electrical junction box and operating light. Wire double element units so elements do not operate simultaneously.

- F. Accessories: Provide:
1. Water Connections: Brass.
  2. Dip tube: Brass.
  3. Drain Valve.
  4. Anode: Magnesium
  5. Temperature and Pressure Relief Valve: ASME labelled.

### PART 3 EXECUTION

#### 3.01 INSTALLATION

- A. Install plumbing equipment in accordance with manufacturer's instructions, as required by code, and complying with conditions of certification, if any.
- B. Coordinate with plumbing piping and related electrical work to achieve operating system.

**END OF SECTION 22 3000**

**SECTION 22 4000**  
**PLUMBING FIXTURES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Dual flush water closets.
- B. Lavatories.
- C. Sinks.
- D. Bathtubs.
- E. Showers.

**1.02 RELATED REQUIREMENTS**

- A. Section 22 1005 - Plumbing Piping.
- B. Section 22 1006 - Plumbing Piping Specialties.
- C. Section 22 3000 - Plumbing Equipment.

**1.03 REFERENCE STANDARDS**

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. ANSI Z124.1.2 - American National Standard for Plastic Bathtub and Shower Units; 2005.
- C. ASME A112.6.1M - Supports for Off-the-Floor Plumbing Fixtures for Public Use; The American Society of Mechanical Engineers; 1997 (Reaffirmed 2002).
- D. ASME A112.18.1 - Plumbing Supply Fittings; The American Society of Mechanical Engineers; 2012.
- E. ASME A112.19.2 - Ceramic Plumbing Fixtures; The American Society of Mechanical Engineers; 2013.
- F. ASME A112.19.3 - Stainless Steel Plumbing Fixtures (Designed for Residential Use); The American Society of Mechanical Engineers; 2008 (R2013).
- G. ASME A112.19.14 - Six Liter Water Closets Equipped with Dual Flushing Device; 2013.
- H. NSF 61 - Drinking Water System Components - Health Effects; 2012.
- I. NSF 372 - Drinking Water System Components - Lead Content; 2011.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide catalog illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.
- C. Manufacturer's Instructions: Indicate installation methods and procedures.

**PART 2 PRODUCTS**

**2.01 GENERAL**

- A. Potable Water Systems: Provide plumbing fittings and faucets that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.
- B. Water Efficiency: EPA WaterSense label is required for all water closets, urinals, lavatory faucets, and showerheads.

**2.02 DUAL FLUSH WATER CLOSETS**

- A. Dual Flush Water Closet Manufacturers:
  - 1. American Standard, Inc: [www.americanstandard-us.com](http://www.americanstandard-us.com).
  - 2. Toto USA: [www.totousa.com](http://www.totousa.com).
  - 3. Zurn Industries, Inc: [www.zurn.com](http://www.zurn.com).

- B. Dual Flush Water Closets: ASME A112.19.14; high efficiency and low consumption, vitreous china, dual flush, tank type.
  - 1. Flush System: Pressure-assisted, wash down with a half-flush consumption of 1.1 GPF.
  - 2. Bowl: Elongated.
  - 3. Flush Actuator: Handle, chrome plated.
  - 4. Rough in: 12 inch.
  - 5. Seat: Manufacturer's standard or recommended elongated closed front seat with lid.
  - 6. Color: White.

## 2.03 LAVATORIES

- A. Lavatory Manufacturers:
  - 1. American Standard, Inc: [www.americanstandard-us.com](http://www.americanstandard-us.com).
  - 2. Kohler Company: [www.kohler.com](http://www.kohler.com).
  - 3. Zurn Industries, Inc: [www.zurn.com](http://www.zurn.com).
- B. Vitreous China Wall Hung Basin: ASME A112.19.2; vitreous china wall hung lavatory, 20 by 18 inch minimum, with 4 inch high back, rectangular basin with splash lip, front overflow, and soap depression.
  - 1. Drilling Centers: 4 inch.
- C. Vitreous China Counter Top Basin: ASME A112.19.2; vitreous china self-rimming counter top lavatory, varying sizes with drillings on 4 inch centers, front overflow, soap depression, seal of putty, calking, or concealed vinyl gasket.
- D. Supply Faucet Manufacturers:
  - 1. American Standard, Inc: [www.americanstandard-us.com](http://www.americanstandard-us.com).
  - 2. Kohler Company: [www.kohler.com](http://www.kohler.com).
  - 3. Zurn Industries, Inc: [www.zurn.com](http://www.zurn.com).
- E. Supply Faucet: ASME A112.18.1; chrome plated combination supply fitting with pop-up waste, water economy aerator with maximum flow of 0.5 gallon per minute (low-flow), indexed handles.
- F. Accessories:
  - 1. Offset waste with perforated open strainer.
  - 2. Wheel handle stops.
  - 3. Flexible supplies.
  - 4. Carrier:
    - a. Manufacturers:
      - 1) JOSAM Company: [www.josam.com](http://www.josam.com).
      - 2) Zurn Industries, Inc: [www.zurn.com](http://www.zurn.com).
    - b. ASME A112.6.1M; cast iron and steel frame with tubular legs, lugs for floor and wall attachment, concealed arm supports, bearing plate and studs.

## 2.04 SINKS

- A. Sink Manufacturers:
  - 1. American Standard, Inc: [www.americanstandard-us.com](http://www.americanstandard-us.com).
  - 2. Kohler Company: [www.kohler.com](http://www.kohler.com).
  - 3. Elkay: [www.elkayusa.com](http://www.elkayusa.com)
- B. Double Compartment Bowl: ASME A112.19.3; 33 by 22 by 9 inch outside dimensions 18 gage, .0478 inch thick, Type 302 stainless steel, self rimming and undercoated, with ledge back drilled for trim.
  - 1. Drain: 1-1/2 inch chromed brass drain.

## 2.05 BATHTUBS AND SHOWERS

- A. Bathtub Manufacturers:
  - 1. American Standard, Inc: [www.americanstandard-us.com](http://www.americanstandard-us.com).
  - 2. Kohler Company: [www.kohler.com](http://www.kohler.com).
  - 3. Aquarius: [www.aquariusproducts.com](http://www.aquariusproducts.com)

- B. Bathtub:
  - 1. ANSI Z124.1.2; molded glass fiber reinforced polyester, with slip-resistant bottom surface, contoured shape, white color.
  - 2. Length: 60 inches.
  - 3. Width: 30 inches.
- C. Bath and Shower Trim: ASME A112.18.1; concealed shower and over rim supply with diverter spout, indexed handles, bent shower arm with adjustable spray ball joint showerhead with maximum 1.5 gallon per minute (low-flow) flow and escutcheon, lever operated pop-up waste and overflow.

### PART 3 EXECUTION

#### 3.01 EXAMINATION

- A. Verify that walls and floor finishes are prepared and ready for installation of fixtures.
- B. Confirm that millwork is constructed with adequate provision for the installation of counter top lavatories and sinks.

#### 3.02 INSTALLATION

- A. Install each fixture with trap, easily removable for servicing and cleaning.
- B. Provide chrome plated rigid or flexible supplies to fixtures with loose key stops, reducers, and escutcheons.
- C. Install components level and plumb.
- D. Install and secure fixtures in place with wall carriers and bolts.
- E. Solidly attach water closets to floor with lag screws. Lead flashing is not intended hold fixture in place.

#### 3.03 INTERFACE WITH WORK OF OTHER SECTIONS

- A. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

#### 3.04 ADJUSTING

- A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

#### 3.05 CLEANING

- A. Clean plumbing fixtures and equipment.

**END OF SECTION 22 4000**

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**SECTION 23 0050**  
**SECTION 230050 – GENERAL HVAC REQUIREMENTS**

**PART 1 GENERAL**

**1.01 RELATED DOCUMENTS**

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

**1.02 SUMMARY**

- A. This section of the specifications shall be applicable to all phases of mechanical work covered by specifications and drawings issued for this project.

**1.03 INTENT OF CONTRACT DOCUMENTS**

- A. The Contract Documents are complementary, and what is called for in one place shall be as binding as if called for in all places. In case of conflict or variance among the contract documents, the more stringent shall take precedence. Figured dimensions shall be used in preference to scaling the drawings. In case of conflict between large and small scale drawings, the large scale drawings shall govern.
- B. The mechanical drawings show the general arrangement of all piping, equipment, and appurtenances and shall be followed as closely as actual building construction and the work of other trades will permit. The mechanical work shall conform to the requirements shown on all of the drawings. General and structural drawings shall take precedence over mechanical drawings. Because of the small scale of the mechanical drawings, it is not possible to indicate all offsets, fittings, and accessories, which may be required. The Contractor shall investigate the structural and finish conditions affecting the work and shall arrange his work accordingly, providing such fittings, valves, boxes, offsets, transitions, and other accessories as may be required to meet such conditions.

**1.04 CODES AND STANDARDS**

- A. All materials and workmanship shall comply with all applicable codes, state and federal laws, local ordinances, industry standards, utility company regulations, and all other criteria, which normally apply to work of this nature.
- B. In case of difference between building codes, state laws, federal laws, local ordinances, industry standards, utility company regulations, other criteria and the contract documents, the more stringent regulations will apply. The Contractor shall promptly notify the Architect/Engineer in writing of any such difference.
- C. If the Contractor performs any work that does not comply with these contract documents or the requirements of the applicable building codes, state laws, local ordinances, industry standards, utility company regulations, and other applicable criteria, he shall bear all costs arising in correcting the deficiencies.
- D. The standards referred to, except as modified in the specifications, shall have full force and effect as though printed in these specifications. These standards are not furnished to bidders for the reason that it is assumed that the manufacturer and trades involved are familiar with their requirements and are capable of obtaining a copy as they deem necessary.
- E. Applicable codes and standards shall include, but are not necessarily restricted to, the most recently published issues of the following:
  1. Building Codes:
    - a. International Building Code, International Plumbing Code, and International Mechanical Code and accumulative supplements.
      - 1) Industry Standards, Codes, and Specifications:
        - (a) ARI - Air Conditioning and Refrigeration Institute.
        - (b) AMCA - Air Moving and Conditioning Association.
        - (c) ANSI - American National Standards Institute.

- (d) ASHRAE - American Society of Heating, Refrigeration, and Air Conditioning Engineers.
- (e) ASME - American Society of Mechanical Engineers.
- (f) ASTM - American Society of Testing and Materials.
- (g) NEC - National Electrical Code.
- (h) NFPA - National Fire Protection Association.
- (i) UL - Underwriters' Laboratories, Inc.
- (j) SMACNA - Sheet Metal and Air Conditioning Contractors' National Association
- (k) MSS - Manufacturers Standardization Society of the Valve and Fittings Industry Inc.

#### **1.05 GOVERNMENTAL FEES, PERMITS, AND INSPECTIONS**

- A. Under each applicable section of the detailed mechanical specifications, the Contractor shall obtain and pay for all required licenses, permits, charges for connections to outside services, fees and inspections. Upon completion of the work under each section of the detailed mechanical specifications, the Contractor shall furnish a certificate of final inspection to the Architect/Engineer from the governmental inspection department having jurisdiction.

#### **1.06 VISITING THE SITE**

- A. Each Contractor shall be responsible for visiting the site before bidding the job to familiarize with all existing conditions to be met in the execution of the work under this contract. No additional compensation will be allowed for any changes he may be required to make because of site conditions.

#### **1.07 QUALITY ASSURANCE**

- A. Product Criteria:
  - 1. All materials shall be new and shall bear the manufacturer's name, trade name, and the UL label in every case where a standard has been established for this particular material. The equipment to be furnished shall be essentially the standard product of a manufacturer regularly engaged in the production of the required type of equipment, and shall be the manufacturer's latest approved design. All equipment shall bear a permanent and legible factory-applied nameplate to permit identification of manufacturer, model number and type of unit.
  - 2. Equipment Service: Products shall be supported by a service organization, which maintains an adequate inventory of repair parts and is located, in the opinion of the Architect/Engineer, reasonably close to the site.
  - 3. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer to provide for uniform appearance, operation, and maintenance.
  - 4. Assembled Units: Manufacturers of equipment assemblies, which use components made by others, assume complete responsibility for the final assembled product.
- B. Manufacturers' directions shall be followed in the delivery, storage, protection, and installation of all equipment and materials. The Contractor shall promptly notify the Architect/Engineer in writing of any conflict between any requirements of the contract documents and the written instructions before proceeding with the work. If the Contractor performs any work that does not comply with the manufacturers' directions or such written instructions from the Architect/Engineer, he shall bear all costs arising in correcting the deficiencies.

#### **1.08 EQUIPMENT AND MATERIALS REVIEW BY ARCHITECT/ENGINEER**

- A. Submission of Data: Comply with requirements of Division 01 "General Requirements". Equipment and materials which require Contractor submittal data are indicated in the respective detailed sections of the mechanical specifications. For all items so indicated, the Contractor shall submit shop drawings, diagrams, catalog data sheets, catalog numbers, and/or such other data necessary to fully describe and substantiate compliance with the contract requirements.

- B. Unless stated otherwise, trade names and catalog numbers shall be interpreted as establishing a general design and standard of quality and shall not be construed as limiting competition. The Contractor may use an article which, in his judgment and with written comment from the Architect/Engineer indicating no objection, is equal or superior to that specified. Drawings showing changes or revisions required by the substitution for specified items shall be submitted with the shop drawing data, and the costs of all such changes shall be borne by the Contractor. See Division 01 "General Requirements" for procedural requirements for substitutions.
- C. Review of equipment and materials submittals by the Architect/Engineer is only for general conformance with the design concept of the project and general compliance with the information given in the contract documents. Any comments made are subject to the requirements of the plans and specifications. The Contractor shall be responsible for quantities, dimensions which shall be confirmed and correlated at the job site, information that pertains solely to the fabrication processes or technique of construction, coordination among all the trades, and the satisfactory performance of the work.

**1.09 SUBMITTALS: IN ACCORDANCE WITH THIS SECTION OF THE SPECIFICATIONS, FURNISH THE FOLLOWING:**

- A. Manufacturer's Literature and Data: May be submitted under the pertinent section rather than under this section.
  1. Submit belt drive with the driven equipment.
  2. Submit electric motor data with the driven equipment.
  3. Hangers, inserts, supports and bracing.
  4. Wall, floor and ceiling plates (escutcheons).
- B. Maintenance Data and Operating Instructions: Under each applicable section of the detailed mechanical specifications, the Contractor shall provide in 3-ring binders, data on each manufactured item of equipment used and shall present this compilation to the Architect/Engineer for approval before being turned over to the Owner. Descriptive data, parts list, manufacturers' drawings and printed installation, operating and maintenance instructions for each item of equipment, shall be included. A complete index shall be provided listing the products alphabetically by name, together with the names and addresses of manufacturers whose products have been incorporated in the work and the names and addresses of the local sales and service representatives. The number of sets of descriptive data, O&M Manuals shall be as called for in Division 01 "General Requirements."

**1.10 EQUIPMENT DEVIATIONS**

- A. Equipment or Connections Different from Those Shown: Where equipment requiring different arrangements or connections from those shown is proposed by the Contractor and is not objected to by the Architect/Engineer, it shall be the responsibility of the Contractor to install the equipment to operate properly and in harmony with the intent of the drawings and specifications. The Contractor shall make all incidental changes in piping, ductwork, supports, insulation, wiring, heaters, controls, and other associated facilities. He shall provide all additional motors, controllers, valves, fittings, and other additional equipment required for proper operation of the system, including all required changes in affected trades. The Contractor shall be responsible for the proper location of roughing-in and connections. All such changes shall be made at no increase in the contract price to the Owner.
- B. Electric Equipment Ratings: The electrical design is based upon estimated load requirements and upon typical classes of equipment and component arrangement. Where the equipment actually provided requires circuits, wiring, controls or protective devices different from those indicated, all required modifications shall be made by the Contractor at no increase in contract price to the Owner.

**1.11 ELECTRICAL WORK**

- A. Furnish motors, controllers, contactors, motor starter, disconnects and devices indicated to control equipment with their respective pieces of equipment. Motors, controllers, contactors, and disconnects shall conform to and shall have electrical connections specified under

Electrical Division 16. Provide internal wiring for components of packaged equipment as an integral part of the equipment. Extended voltage range motors will not be permitted. Controllers and contactors shall have a maximum of 120 volt control circuits, and auxiliary contacts for use with the controls furnished. Electrical characteristics shall be as indicated. Each motor shall be of sufficient power to drive the equipment at the specified capacity without exceeding the nameplate rating of the motor. Manual or automatic control and protective or signal devices required for the operation specified or indicated and any control wiring required for controls and devices shall be provided under each applicable section of the detailed mechanical specifications.

## PART 2 PRODUCTS

### 2.01 DRIVE GUARDS

- A. For machinery and equipment, provide guards as shown in AMCA 410 for belts, chains, couplings, pulleys, sheaves, shafts, gears and other moving parts regardless of height above the floor. Drive guards may be excluded where motors and drives are inside factory fabricated unit casings.
- B. Materials: Sheet steel, cast iron, expanded metal or wire mesh rigidly secured so as to be removable without disassembling pipe, duct, or electrical connections to equipment.
- C. Access for Speed Measurement: One inch diameter hole at each shaft center.
- D. Lubrication: Guards shall not interfere with lubrication of equipment.

### 2.02 COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

- A. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections. Provide special energy efficient motors, unless otherwise specified for a particular application, use electric motors with the following requirements.
  1. Comply with NEMA MG 1 unless otherwise indicated.
  2. Comply with IEEE 841 for severe-duty motors.
- B. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
  1. Motor controllers.
  2. Torque, speed, and horsepower requirements of the load.
  3. Ratings and characteristics of supply circuit and required control sequence.
  4. Ambient and environmental conditions of installation location.
- C. Motor Characteristics: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level. Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.
- D. Single-Phase Motors: Capacitor-start type for hard starting applications. Motors for centrifugal fans and pumps may be split phase or permanent split capacitor (PSC). Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application: Permanent-split capacitor. Split phase. Capacitor start, inductor run, or Capacitor start, capacitor run.
  1. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
  2. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
  3. Motors 1/20 HP and Smaller: Shaded-pole type.
  4. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.
- E. Polyphase Motors: NEMA MG 1, Design B, squirrel cage, medium induction motor. Each two speed motor shall have two separate windings.

1. Insulation Resistance: Not less than one-half megohm between stator conductors and frame.
2. Service Factor: 1.15.
3. Multispeed Motors: Variable torque.
  - a. For motors with 2:1 speed ratio, consequent pole, single winding.
  - b. For motors with other than 2:1 speed ratio, separate winding for each speed.
    - 1) Rotor: Random-wound, squirrel cage. Enclosure Material: Rolled steel
    - 2) Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
    - 3) Temperature Rise: Class B temperature rise; Class F insulation.
    - 4) Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
    - 5) Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
    - 6) Inverter-Duty Motors: Class F temperature rise; Class H insulation.

## **2.03 EQUIPMENT AND MATERIALS IDENTIFICATION**

- A. Use symbols, nomenclature and equipment numbers as specified, or as shown on the drawings.
- B. Interior (Indoor) Equipment: Engraved nameplates, with letters not less than 3/16-inch high of brass with black-filled letters, or rigid black plastic with white letters permanently fastened to the equipment.
- C. Exterior (Outdoor) Equipment: Brass nameplates, with engraved black filled letters, not less than 3/16-inch high riveted or bolted to the equipment.

## **2.04 ACCESS PANELS**

- A. Under each applicable section of the detailed mechanical specifications, the Contractor shall provide access panels in all locations where required for access to concealed valves, traps, air cushions, controls, dampers, damper operators, junction boxes, and any other equipment or materials requiring inspection or maintenance. Access panels shall be of adequate size and properly located so that concealed items will be readily accessible for servicing or for removing and replacing if necessary, except as indicated or specified otherwise. Access panels are not required in ceilings formed of removable acoustical panels.
- B. Access panels that are not fire-rated shall be as follows: Prime-finished steel with screwdriver cam latch and concealed continuous piano hinge or natural anodized finish for toilets, showers, locker rooms, kitchen and other similar areas. Access panels in tile ceilings shall be in multiples of tile sizes. Tamper-proof access panels shall have latch style with tumbler lock.
- C. Where indicated and where access panels are installed in walls of shafts that are not sealed at each floor, access panels shall be fire-rated and shall bear the Underwriters' Laboratories, Inc. Class B, 1-1/2 hour label. Openings shall be framed in accordance with the access panel manufacturer's recommendations. Frames shall be not lighter than 16-gage steel. Panels shall be not lighter than 20-gage steel and shall be insulated sandwich type. Panels shall have a continuous hinge, self-lubricating lock, a direct action-knurled knob, and an interior latch release mechanism.

## **2.05 CHARTS, DIAGRAMS, AND SCHEMES**

- A. Charts, diagrams, and schemes listed below shall be provided under each applicable section of the detailed mechanical specifications by the Contractor, framed under glass, and installed where shown on the drawings or directed in the field. All charts, diagrams, and schemes shall be complete, neat, clear, legible, and permanent.
- B. Operating instructions for mechanical equipment.
- C. Electric sequence control diagrams of all mechanical system components.

## PART 3 EXECUTION

### 3.01 INSTALLATION

#### A. Coordination of Work:

1. The Contractor shall compare the mechanical drawings and specifications with the drawings and specifications of other trades, and shall report any discrepancies between them to the Architect/Engineer, and shall obtain from him written instructions for changes necessary in the mechanical work. The mechanical work shall be installed in cooperation with other trades installing interrelated work. Before installation, the Contractor shall make proper provision to avoid interferences in a manner approved by the Architect/Engineer. All changes required in the work of the Contractor caused by his neglect to do so shall be made by him at his own expense.
2. Anchor bolts, sleeves, inserts, and supports that may be required for the work shall be fully coordinated and compatible with the related equipment or materials. Locations shall be determined by the trade installing the related equipment or materials.
3. Slots, chases, openings, and recesses through floors, walls, ceilings, roofs, and partitions shall be located by the trades requiring them.
4. Locations of pipes, ducts, equipment, fixtures, etc., shall be adjusted to accommodate the work to interferences anticipated and encountered. The Contractor shall determine the exact route and location of each pipe and duct prior to fabrication. Pipes, ducts, etc., shall be concealed above ceilings, in walls, or in floors as applicable in all areas of the building except in equipment rooms, unfinished storage rooms, or other areas specifically noted to the contrary.
  - a. Right-of-Way: Lines which pitch shall have right-of-way over those which do not pitch. For example, plumbing drains shall normally have right-of-way. Lines whose elevations cannot be changed shall have the right-of-way over lines whose elevations can be changed.
  - b. Offsets, transitions, and changes in direction of pipes and ducts shall be made as required to maintain proper head room and pitch of sloping lines whether or not indicated on the drawings. The Contractor shall furnish and install all traps, drains, air vents, sanitary vents, etc., as required to affect these offsets, transitions, and changes in direction.
  - c. Exact locations of items such as diffusers, grilles, thermostats, hose bibs, wall hydrants, and other similar items in finished areas of the building and on the exterior of the building shall be coordinated with each other, the building structure, and architectural features thereof so as to be aligned with or centered on other items as applicable. Locations indicated on the drawings are approximate. Trades shall coordinate their work with door swings, block coursing, tile arrangement, and other similar features before establishing the location of any components. Before any related work has begun, the Architect/Engineer may direct reasonable minor changes in equipment locations with no increase in contract price to the Owner.
  - d. Installation and Arrangement: The Contractor shall install all mechanical work to permit removal (without damage to other parts) of coils, heat exchanger bundles, boiler tubes, fan shafts and wheels, filters, belt guards, sheaves and drives, and all other parts requiring periodic replacement or maintenance. The Contractor shall arrange pipes, ducts, and equipment to permit ready access to valves, cocks, traps, motors, control components, and to clear the openings of swinging and overhead doors and of access panels.
  - e. Ductwork: The Contractor shall change the cross-sectional dimensions of ductwork when required to meet job conditions but shall maintain at least the same equivalent cross-sectional area. The Contractor shall secure the approval of the Architect/Engineer prior to fabrication of ductwork requiring such changes. Ductwork shall not be fabricated until coordination with available space.
  - f. Drawings by Contractor: When directed by the Architect/Engineer, the Contractor shall submit for review by Architect/Engineer drawings clearly showing certain

- portions of the mechanical work and its relation to the work of other trades before beginning shop fabrication or erection in the field.
- g. Dimensions: The Contractor shall ensure that items to be furnished fit the space available. He shall make necessary field measurements to ascertain space requirements, including those for connections, and shall furnish and install such sizes and shapes of equipment that the final installation shall suite the true intent and meaning of the drawings and specifications. If he concludes that there is insufficient space for installation or specified materials, he shall immediately notify the Architect/Engineer of the conflict and shall stop affected work until he receives instructions as to how to proceed from the Architect/Engineer.
5. Protection and Cleaning:
- Equipment and materials shall be carefully handled, properly stored, and adequately protected to prevent damage before and during installation, in accordance with the manufacturer's recommendations. Damaged or defective items, in the opinion of the Architect/Engineer, shall be replaced.
  - All items subject to moisture damage (such as controls and electrical equipment) shall be stored in dry, heated spaces.
  - Protect all finished parts of equipment, such as shafts and bearings where accessible, from rust prior to operation by means of protective grease coating and wrapping. Close pipe openings with caps or plugs during installation. Tightly cover and protect fixtures and equipment against dirt, water, chemical or mechanical injury. At completion of all work, thoroughly clean fixtures, exposed materials and equipment.
6. Concrete and Grout: Use concrete and shrink compensating grout 3000 psi minimum.
7. Install gages, thermometers, valves and other devices with due regard for ease in reading or operating and maintaining said devices. Locate and position thermometers and gages to be easily read by operator standing on floor or walkway provided. Servicing shall not require dismantling adjacent equipment or pipe work.

### **3.02 MOTOR AND DRIVE ALIGNMENT**

- Belt Drive: Set driving and driven shafts parallel and align so that the corresponding grooves are in the same plane.
- Direct-Connect Drive: Securely mount motor in accurate alignment so that shafts are free from both angular and parallel misalignment when both motor and driven machine are operating at normal temperatures.

### **3.03 CUTTING AND PATCHING**

- The Contractor shall be responsible for all required digging, cutting, etc., incidental to the work, and shall thereafter make all required repairs necessary to restore the cut structure or material to the condition existing prior to the cutting. In no case shall the Contractor cut into any major structural element, beam, or column without the written approval of the Architect/Engineer. All cutting, patching, repairing, or replacing of work required because of fault, error, tardiness, or damage by any trade shall be performed with no increase in the contract price to the Owner.

### **3.04 LUBRICATION**

- Under each applicable section of the detailed mechanical specifications, the Contractor shall provide all oil and grease required for the operation of all equipment until acceptance by the Owner. The type and application of all lubricants shall conform to the recommendations of the manufacturer of the equipment involved. The Contractor shall be held responsible for all damage to bearings while the equipment is being operated by him up to the date of acceptance of the project. This Contractor shall be required to protect all bearings during installation and shall thoroughly grease or otherwise protect steel shafts and other bare ferrous parts to prevent corrosion. All equipment shall be provided with covers as necessary for proper protection against damage or deterioration during construction.

### **3.05 OPERATING AND PERFORMANCE TESTS**

- A. The Contractor and Building Control System Contractor shall provide qualified installation or startup personnel for the operation and adjustment of the mechanical and control systems to the TAB agency as required in Section 15950, "Testing, Adjusting, and Balancing". Should there be a deficiency in any tested system, or piece of equipment or component part thereof, occur during or as a result of tests, make proper corrections, repairs or replacements, and repeat tests at no additional cost to the Owner.
- B. When completion of certain work or system occurs at a time when final control settings and adjustments cannot be properly made to make performance tests, then make performance tests for heating systems and for cooling systems respectively during first actual seasonal use of respective systems following completion of the work.

### **3.06 INSTRUCTIONS TO OWNER'S PERSONNEL**

- A. Under each applicable section of the detailed mechanical specifications, the Contractor shall instruct the representative of the Owner in the proper operation and maintenance of all elements of the mechanical systems. A competent representative of the Contractor shall spend not less than two days in such formal instruction and shall spend such additional time as directed by the Architect/Engineer to fully prepare the Owner to operate and maintain the mechanical systems.

### **3.07 GUARANTEE**

- A. All mechanical equipment, materials, and labor required by the contract documents for this project shall be guaranteed to be free of defective materials or workmanship for a period of one year after final acceptance of the project. Extended warranty periods shall be provided as specified on the plans. Defects in equipment, materials, or workmanship occurring during this period shall be corrected with new equipment and materials or additional labor at no cost to the Owner.

**END OF SECTION 23 0050**

## SECTION 23 0553

### SECTION 230553 – IDENTIFICATION OF EQUIPMENT AND SYSTEMS

#### PART 1 GENERAL

##### 1.01 GENERAL REQUIREMENTS

- A. The work required under this Section shall conform to the requirements of "Division 1, General Requirements," "Conditions of the Contract" and "Supplementary Conditions."

##### 1.02 WORK INCLUDED

- A. All ductwork systems, piping systems, valves, controls and equipment on the Project shall be identified as specified herein. All marks of identification shall be easily visible from the floor or usual point of vision.

##### 1.03 REFERENCE STANDARDS

- A. All work and products in this Section shall be in accordance with the latest edition of ANSI 13.1 and the Local Code Authority.

#### PART 2 PRODUCTS

##### 2.01 MANUFACTURERS

- A. Pipe markers, nameplates, valve tags, "S" hooks, chains, ties, tapes and adhesives shall be manufactured by Seton Name Plate Corporation or approved equal.

##### 2.02 PAINTING

- A. General:
- B. Refer to the Architectural Documents for painting and finishing requirements. Division 15 shall cooperate with the Architectural Division regarding room finish requirements. The following requirements are in addition to the Architectural Division requirements.

##### 2.03 NAME PLATES

- A. Equipment nameplates shall be black surface, white core laminated bakelite with engraved letters. Plates shall be a minimum of 3 inches long by 1 inch wide with white letters 1 inch high.

#### PART 3 EXECUTION

##### 3.01 EQUIPMENT AND CONTROL PANEL NAMEPLATES

- A. Equipment and control panels shall be identified by means of nameplates permanently attached to the equipment. Nameplate designations shall correspond to the identification on the "Record/As-Built Drawings". Controls and instruments shall be identified by nameplates mounted under the control or instrument.

##### 3.02 TIME OF APPLICATION

- A. Equipment and system identification shall not be initiated until all painting required under the Architectural Section of these Specifications has been accomplished.

##### 3.03 EQUIPMENT IDENTIFICATION

- A. The Contractors shall coordinate the equipment tag designations and nameplates used to identify each piece of the Division 15 and Division 16 equipment so as to match and correspond to the equipment tag designations indicated on the contract documents. This includes, but is not limited to, the Contractor's shop drawings; submittals; record as-built drawings; wiring diagrams; testing and balancing reports; and Operating and Maintenance (O&M) manuals.

END OF SECTION 23 0553

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**SECTION 23 0593**  
**SECTION 230593 - TESTING, ADJUSTING, AND BALANCING**

**P1 GENERAL**

**SUMMARY**

**2.01 SECTION INCLUDES:**

- A. Testing adjusting, and balancing of air systems.
- B. Measurement of final operating condition of HVAC systems.
- C. REFERENCES
  - 1. Associated Air Balance Council:
    - a. AABC MN-1 - National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems.
  - 2. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
    - a. ASHRAE 111 - Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning and Refrigeration Systems.
  - 3. Natural Environmental Balancing Bureau:
    - a. NEBB - Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.
- D. SUBMITTALS
  - 1. Prior to commencing Work, submit proof of latest calibration date of each instrument.
  - 2. Test Reports: Indicate data on AABC MN-1 National Standards for Total System Balance forms or NEBB Report forms.
  - 3. Field Reports: Indicate deficiencies preventing proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
  - 4. Furnish reports in soft cover binder manuals, complete with table of contents page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.
- E. QUALITY ASSURANCE
  - 1. Perform Work in accordance with AABC MN-1 National Standards for Field Measurement and Instrumentation, Total System Balance or NEBB Procedural Standards for Testing, Balancing and Adjusting of Environmental Systems.
- F. QUALIFICATIONS
  - 1. Agency: Company specializing in testing, adjusting, and balancing of systems specified in this section with minimum three years documented experience certified by AABC or Certified by NEBB.
- G. SEQUENCING
  - 1. Sequence balancing between completion of systems tested and Date of Substantial Completion.
- H. SCHEDULING
  - 1. Schedule and provide assistance in final adjustment and test of life safety, smoke evacuation and/or smoke control system with Fire Authority.
- I. P2 PRODUCTS
- J. Not Used.
- K. P3 EXECUTION
- L. EXAMINATION
  - 1. Verify systems are complete and operable before commencing work. Verify the following:
    - a. Systems are started and operating in safe and normal condition.
    - b. Temperature control systems are installed complete and operable.

- c. Final filters are clean and in place. If required, install temporary media in addition to final filters.
  - d. Duct systems are clean of debris.
  - e. Fans are rotating correctly.
  - f. Fire and volume dampers are in place and open.
  - g. Air coil fins are cleaned and combed.
  - h. Access doors are closed and duct end caps are in place.
  - i. Air outlets are installed and connected.
  - j. Duct system leakage is minimized.
- M. INSTALLATION TOLERANCES
- 1. Air Handling Systems: Adjust to within plus or minus 10 percent of design.
  - 2. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.
- N. ADJUSTING
- 1. Verify recorded data represents actual measured or observed conditions.
  - 2. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
  - 3. After adjustment, take measurements to verify balance has not been disrupted. If disrupted, verify correcting adjustments have been made.
  - 4. Report defects and deficiencies noted during performance of services, preventing system balance.
  - 5. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
  - 6. Check and adjust systems approximately six months after final acceptance and submit report.
- O. AIR SYSTEM PROCEDURE
- 1. Adjust air handling and distribution systems to obtain required or design supply, return, and exhaust air quantities.
  - 2. Make air quantity measurements in main ducts by Pitot tube traverse of entire cross sectional area of duct.
  - 3. Measure air quantities at air inlets and outlets.
  - 4. Use volume control devices to regulate air quantities only to extent adjustments do not create objectionable air motion or sound levels. Effect volume control by using volume dampers located in ducts.
  - 5. Vary total system air quantities by adjustment of fan speeds. Provide sheave drive changes to vary fan speed. Vary branch air quantities by damper regulation.
  - 6. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across fan. Make allowances for 50 percent loading of filters.
  - 7. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
- P. SCHEDULES
- 1. Equipment Requiring Testing, Adjusting, and Balancing:
    - a. Air Cooled Refrigerant Condensers.
    - b. Air Handling Units.
    - c. Fans.
  - 2. Report Forms
    - a. Title Page:
      - 1) Name of Testing, Adjusting, and Balancing Agency
      - 2) Address of Testing, Adjusting, and Balancing Agency
      - 3) Telephone and facsimile numbers of Testing, Adjusting, and Balancing Agency
      - 4) Project name
      - 5) Project location
      - 6) Project Architect

- 7) Project Engineer
- 8) Project Contractor
- 9) Project altitude
- 10) Report date
- b. Summary Comments:
  - 1) Design versus final performance
  - 2) Notable characteristics of system
  - 3) Description of systems operation sequence
  - 4) Summary of outdoor and exhaust flows to indicate building pressurization
  - 5) Nomenclature used throughout report
  - 6) Test conditions
- c. Instrument List:
  - 1) Instrument
  - 2) Manufacturer
  - 3) Model number
  - 4) Serial number
  - 5) Range
  - 6) Calibration date
- d. Electric Motors:
  - 1) Manufacturer
  - 2) Model/Frame
  - 3) HP/BHP and kW
  - 4) Phase, voltage, amperage; nameplate, actual, no load
  - 5) RPM
  - 6) Service factor
  - 7) Starter size, rating, heater elements
  - 8) Sheave Make/Size/Bore
- e. V-Belt Drive:
  - 1) Identification/location
  - 2) Required driven RPM
  - 3) Driven sheave, diameter and RPM
  - 4) Belt, size and quantity
  - 5) Motor sheave diameter and RPM
  - 6) Center to center distance, maximum, minimum, and actual
- f. Air Moving Equipment:
  - 1) Location
  - 2) Manufacturer
  - 3) Model number
  - 4) Serial number
  - 5) Arrangement/Class/Discharge
  - 6) Air flow, specified and actual
  - 7) Return air flow, specified and actual
  - 8) Outside air flow, specified and actual
  - 9) Total static pressure (total external), specified and actual
  - 10) Inlet pressure
  - 11) Discharge pressure
  - 12) Sheave Make/Size/Bore
  - 13) Number of Belts/Make/Size
  - 14) Fan RPM
- g. Return Air/Outside Air Data:
  - 1) Identification/location
  - 2) Design air flow
  - 3) Actual air flow
  - 4) Design return air flow

- 5) Actual return air flow
- 6) Design outside air flow
- 7) Actual outside air flow
- 8) Return air temperature
- 9) Outside air temperature
- 10) Required mixed air temperature
- 11) Actual mixed air temperature
- 12) Design outside/return air ratio
- 13) Actual outside/return air ratio
- h. Exhaust Fan Data:
  - 1) Location
  - 2) Manufacturer
  - 3) Model number
  - 4) Serial number
  - 5) Air flow, specified and actual
  - 6) Total static pressure (total external), specified and actual
  - 7) Inlet pressure
  - 8) Discharge pressure
  - 9) Sheave Make/Size/Bore
  - 10) Number of Belts/Make/Size
  - 11) Fan RPM
- i. Duct Traverse:
  - 1) System zone/branch
  - 2) Duct size
  - 3) Area
  - 4) Design velocity
  - 5) Design air flow
  - 6) Test velocity
  - 7) Test air flow
  - 8) Duct static pressure
  - 9) Air temperature
  - 10) Air correction factor
- j. Terminal Unit Data:
  - 1) Manufacturer
  - 2) Type, constant, variable, single, dual duct
  - 3) Identification/number
  - 4) Location
  - 5) Model number
  - 6) Size
  - 7) Minimum static pressure
  - 8) Minimum design air flow
  - 9) Maximum design air flow
  - 10) Maximum actual air flow
  - 11) Inlet static pressure
- k. Air Distribution Test Sheet:
  - 1) Air terminal number
  - 2) Room number/location
  - 3) Terminal type
  - 4) Terminal size
  - 5) Area factor
  - 6) Design velocity
  - 7) Design air flow
  - 8) Test (final) velocity
  - 9) Test (final) air flow

- 10) Percent of design air flow
- I. Sound Level Report:
  - 1) Location
  - 2) Octave bands - equipment off
  - 3) Octave bands - equipment on
  - 4) RC level - equipment on
- m. Vibration Test:
  - 1) Location of points:
    - (a) Fan bearing, drive end
    - (b) Fan bearing, opposite end
    - (c) Motor bearing, center (when applicable)
    - (d) Motor bearing, drive end
    - (e) Motor bearing, opposite end
    - (f) Casing (bottom or top)
    - (g) Casing (side)
    - (h) Duct after flexible connection (discharge)
    - (i) Duct after flexible connection (suction)
  - 2) Test readings:
    - (a) Horizontal, velocity and displacement
    - (b) Vertical, velocity and displacement
    - (c) Axial, velocity and displacement
  - 3) Normally acceptable readings, velocity and acceleration
  - 4) Unusual conditions at time of test
  - 5) Vibration source (when non-complying)

**END OF SECTION 23 0593**

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**SECTION 23 0713**  
**SECTION 230713 - HVAC INSULATION**

**PART 1 GENERAL**

**1.01 SUMMARY**

- A. Section includes insulating the following services:
  - 1. Refrigerant piping, supply, return ductwork.

**1.02 SUBMITTALS**

- A. Submit product literature, which indicate complete material data, mastics, adhesives and list of materials proposed for this project; and indicate thickness of material for individual services.

**1.03 REGULATORY REQUIREMENTS**

- A. American Society for Testing and Materials, ASTM:
  - 1. Flame spread rating: 25 or less, ASTM E84.
  - 2. Smoke developed rating: 50 or less, ASTM E84.
- B. National Fire Protection Association, NFPA:
  - 1. Composite ductwork lining installation including lining, sealers, mastics and adhesives, NFPA 255 method as follows:
    - a. Flame spread rating: 25 or less.
    - b. Smoke developed rating: 50 or less.
  - 2. NFPA 90A: Air Conditioning and Ventilating Systems.
  - 3. NFPA 90B: Warm Air Heating and Air Conditioning Systems.
  - 4. NFPA 255: Test Methods Surface Burning - Building Materials.

**1.04 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver material to site in factory-fabricated containers with manufacturer's stamp or label affixed, showing fire hazard ratings of products.
- B. Store insulation in original wrappings; protect from weather and construction traffic.
  - 1. Protect insulation against dirt, water, chemical and mechanical damage.
  - 2. Do not install damaged insulation; remove from construction site.

**1.05 PROJECT CONDITIONS**

- A. Perform work at ambient and equipment temperatures recommended by adhesive manufacturer.

**1.06 SCHEDULING**

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

**PART 2 PRODUCTS**

**2.01 REFRIGERANT PIPING INSULATION**

- A. Refrigerant Piping Insulation (Indoors and Outdoors):
  - 1. Flexible Elastomeric Insulation: Closed-cell, materials. Comply with ASTM C 534, Type I for tubular materials.
  - 2. Manufacturer:
    - a. Aeroflex Aerocel.
    - b. Armacell AP Armaflex.
    - c. K-Flex Insul-Tube.
  - 3. Thermal conductivity factor:  $K=0.25 \text{ (BTU IN)/(HR FT}^2 \text{ }^{\circ}\text{F)}$  at  $75^{\circ}\text{F}$  mean temperature.
  - 4. Insulation shall have a thermal conductivity (K) of no more than  $0.27 \text{ (BTU-IN)/(HR-FT}^2\text{-}^{\circ}\text{F)}$  at  $75^{\circ}\text{F}$  mean temperature when tested by ASTM C177 and a water permeability of 0.20 perm-inch or less when tested by ASTM E96 Procedure B.

5. All outdoor refrigerant piping insulation shall be painted with minimum two coats of a UV protective paint to obtain complete coverage.
- B. Flexible Glass Fiber Duct Wrap:
  1. Insulation: K value of 0.22 @ 75 F. The insulation shall be  $\frac{3}{4}$  pound per cubic foot minimum density. Comply with ASTM C553. Insulation shall be capable of  $\pm 2$ " w.g. pressure, a maximum temperature of 250°F and 5000 fpm maximum velocity.
  2. Jacket:
    - a. Indoor: Factory applied, 0.002-inch foil-scrim-kraft vapor barrier.
  3. Manufacturers:
    - a. Certain-Teed Corp: Softtouch.
    - b. John Manville Corp: Microlite XG Type 75.
    - c. Owens Corning Fiberglas Corp: SoftR All service duct wrap.
- C. Rigid Glass Fiber Duct Board Insulation:
  1. Insulation: K value of 0.22 @ 75 F, Comply with ASTM C 612, Class 1. Insulation shall be capable of  $\pm 2$ " w.g. pressure, a maximum temperature of 250°F and 5000 fpm maximum velocity.
  2. Jacket:
    - a. Indoor: Factory applied, 0.002 inch foil-scrim-kraft vapor barrier.
  3. Manufacturers:
    - a. Certain-Teed Corp: ToughGard Duct Board.
    - b. John Manville Corp: Super Duct
    - c. Owens Corning Fiberglas Corp: QuietR Duct Board
- D. Flexible Glass Fiber Duct Wrap:
  1. Insulation: K value of 0.22 @ 75 F, Comply with ASTM C 612, Class 1. Insulation shall be capable of  $\pm 2$ " w.g. pressure, a maximum temperature of 250°F and 5000 fpm maximum velocity.
  2. Jacket:
    - a. Indoor: Factory applied, 0.002 inch foil-scrim-kraft vapor barrier.
  3. Manufacturers:
    - a. Certain-Teed Corp: ToughGard Duct Board.
    - b. John Manville Corp: Super Duct
    - c. Owens Corning Fiberglas Corp: QuietR Duct Board

## 2.02 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
  1. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
  1. Products  
<http://www.specagent.com/LookUp/?ulid=3071&mf=04&mf=95&src=wd&mf=04&src=wd> : Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82  
<http://www.specagent.com/LookUp/?uid=123456825874&mf=04&src=wd>.
    - b. Eagle Bridges - Marathon Industries; 225.  
<http://www.specagent.com/LookUp/?uid=123456825875&mf=04&src=wd>

- c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.  
<http://www.specagent.com/LookUp/?uid=123456825877&mf=04&src=wd>>Mon-Eco Industries, Inc.; 22-25  
<http://www.specagent.com/LookUp/?uid=123456825878&mf=04&src=wd>.
- 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## 2.03 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
  - 1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.
  - 1. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
  - 2. Service Temperature Range: Minus 20 to plus 180 deg F.
  - 3. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
  - 4. Color: White.
- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
  - 1. Products
    - <http://www.specagent.com/LookUp/?ulid=3076&mf=04&mf=95&src=wd&mf=04&src=wd> : Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.  
<http://www.specagent.com/LookUp/?uid=123456825892&mf=04&src=wd>
      - b. Eagle Bridges - Marathon Industries; 550  
<http://www.specagent.com/LookUp/?uid=123456825893&mf=04&src=wd>.
      - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50  
<http://www.specagent.com/LookUp/?uid=123456825894&mf=04&src=wd>.
      - d. Mon-Eco Industries, Inc.; 55-50  
<http://www.specagent.com/LookUp/?uid=123456825895&mf=04&src=wd>.
      - e. Vimasco Corporation; WC-1/WC-5  
<http://www.specagent.com/LookUp/?uid=123456825896&mf=04&src=wd>.
    - 2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
    - 3. Service Temperature Range: Minus 20 to plus 180 deg F.
    - 4. Solids Content: 60 percent by volume and 66 percent by weight.
    - 5. Color: White.

## 2.04 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
  - 1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
  - 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
  - 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
  - 4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
  - 5. Vinyl Jacket: White vinyl with a permeance of 1.3 perms when tested according to ASTM E 96/E 96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
  - 1. Verify that systems to be insulated have been tested and are free of defects.
  - 2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.02 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

### 3.03 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.
- B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Keep insulation materials dry during application and finishing.
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Install insulation with least number of joints practical.
- I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  - 1. Install insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
  - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. Install insulation with factory-applied jackets as follows:
  - 1. Draw jacket tight and smooth.
  - 2. Cover circumferential joints with 3-inch wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
  - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
    - a. For below ambient services, apply vapor-barrier mastic over staples.
  - 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
  - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.
- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

### **3.04 INSULATION SCHEDULE**

- A. Refrigerant piping: 1" thick on all pipe sizes.
- B. Duct blanket insulation in conditioned space: 1" for supply, return, outside air ductwork or a minimum of R-4.
- C. Duct board insulation in conditioned space: 1" for supply, return, outside air ductwork, or a minimum of R-4.
- D. Duct blanket insulation in unconditioned space: 2-1/2" for supply, return, outside air ductwork, or a minimum of R-8.
- E. Duct board insulation in unconditioned space: 2" for supply, return, outside air ductwork, or a minimum of R-8.
- F. Two layers of fire duct wrap shall be used on all kitchen hood exhaust ductwork.
- G. Duct blanket shall be utilized on ductwork in concealed locations. Duct board shall be utilized on duct exposed in mechanical rooms.
- H. No insulation required:
  1. Exhaust ductwork, except kitchen hood exhaust duct.
  2. Factory-insulated flexible ducts.
  3. Factory-insulated plenums and casings.
  4. Flexible connectors.
  5. Vibration-control devices.
  6. Factory-insulated access panels and doors.

**END OF SECTION 23 0713**

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**SECTION 23 2300**  
**SECTION 232300 - REFRIGERANT PIPING**

**PART 1 GENERAL**

**1.01 SUMMARY**

**1.02 THIS SECTION INCLUDES REFRIGERANT PIPING USED FOR AIR-CONDITIONING APPLICATIONS.**

**1.03 PERFORMANCE REQUIREMENTS**

- A. Line Test Pressure for Refrigerant R-410A:
  - 1. Suction Lines for Air-Conditioning Applications: 300 psig.
  - 2. Suction Lines for Heat-Pump Applications: 535 psig.
  - 3. Hot-Gas and Liquid Lines: 535 psig.
- 1.04 ACTION 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, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, 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 oil traps, double risers, 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.

**1.05 INFORMATIONAL SUBMITTALS**

- A. Welding certificates.
- B. Field quality-control test reports.

**1.06 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

**1.07 QUALITY ASSURANCE**

- A. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."
- B. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

**1.08 PRODUCT STORAGE AND HANDLING**

- A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

**PART 2 PRODUCTS**

**2.01 COPPER TUBE AND FITTINGS**

- A. Copper Tube: ASTM B 88, ACR Type L.
- B. Wrought-Copper Fittings: ASME B16.22.
- C. Wrought-Copper Unions: ASME B16.22.
- D. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.
- E. Brazing Filler Metals: AWS A5.8.
- F. Flexible Connectors:
  - 1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.

2. End Connections: Socket ends.
3. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch-long assembly.
4. Pressure Rating: Factory test at minimum 500 psig.
5. Maximum Operating Temperature: 250 deg F.

## 2.02 VALVES AND SPECIALTIES

- A. Service Valves:
  1. Body: Forged brass with brass cap including key end to remove core.
  2. Core: Removable ball-type check valve with stainless-steel spring.
  3. Seat: Polytetrafluoroethylene.
  4. End Connections: Copper spring.
  5. Working Pressure Rating: 500 psig.
- B. Safety Relief Valves: Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
  1. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
  2. Piston, Closing Spring, and Seat Insert: Stainless steel.
  3. Seat Disc: Polytetrafluoroethylene.
  4. End Connections: Threaded.
  5. Working Pressure Rating: 400 psig.
  6. Maximum Operating Temperature: 240 deg F.
- C. Thermostatic Expansion Valves: Comply with ARI 750.
  1. Body, Bonnet, and Seal Cap: Forged brass or steel.
  2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
  3. Packing and Gaskets: Non-asbestos.
  4. Capillary and Bulb: Copper tubing filled with refrigerant charge.
  5. Suction Temperature: 40 deg F.
  6. Reverse-flow option (for heat-pump applications).
  7. End Connections: Socket, flare, or threaded union.
- D. Straight-Type Strainers:
  1. Body: Welded steel with corrosion-resistant coating.
  2. Screen: 100-mesh stainless steel.
  3. End Connections: Socket or flare.
  4. Working Pressure Rating: 500 psig.
  5. Maximum Operating Temperature: 275 deg F.
- E. Angle-Type Strainers:
  1. Body: Forged brass or cast bronze.
  2. Drain Plug: Brass hex plug.
  3. Screen: 100-mesh monel.
  4. End Connections: Socket or flare.
  5. Working Pressure Rating: 500 psig.
  6. Maximum Operating Temperature: 275 deg F.
- F. Moisture/Liquid Indicators:
  1. Body: Forged brass.
  2. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
  3. Indicator: Color coded to show moisture content in ppm.
  4. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
  5. End Connections: Socket or flare.
  6. Working Pressure Rating: 500 psig.
  7. Maximum Operating Temperature: 240 deg F.
- G. Replaceable-Core Filter Dryers: Comply with ARI 730.

1. Body and Cover: Painted-steel shell with ductile-iron cover, stainless-steel screws, and neoprene gaskets.
  2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
  3. Desiccant Media: Activated alumina or charcoal.
  4. Designed for reverse flow (for heat-pump applications).
  5. End Connections: Socket.
  6. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
  7. Maximum Pressure Loss: 2 psig.
  8. Working Pressure Rating: 500 psig.
  9. Maximum Operating Temperature: 240 deg F.
- H. Permanent Filter Dryers: Comply with ARI 730.
1. Body and Cover: Painted-steel shell.
  2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
  3. Desiccant Media: Activated alumina or charcoal.
  4. Designed for reverse flow (for heat-pump applications).
  5. End Connections: Socket.
  6. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
  7. Maximum Pressure Loss: 2 psig.
  8. Working Pressure Rating: 500 psig.
  9. Maximum Operating Temperature: 240 deg F.
- I. Mufflers:
1. Body: Welded steel with corrosion-resistant coating.
  2. End Connections: Socket or flare.
  3. Working Pressure Rating: 500 psig.
  4. Maximum Operating Temperature: 275 deg F.
- J. Receivers: Comply with ARI 495.
1. Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
  2. Comply with UL 207; listed and labeled by an NRTL.
  3. Body: Welded steel with corrosion-resistant coating.
  4. Tappings: Inlet, outlet, liquid level indicator, and safety relief valve.
  5. End Connections: Socket or threaded.
  6. Working Pressure Rating: 500 psig.
  7. Maximum Operating Temperature: 275 deg F.
- K. Liquid Accumulators: Comply with ARI 495.
1. Body: Welded steel with corrosion-resistant coating.
  2. End Connections: Socket or threaded.
  3. Working Pressure Rating: 500 psig.
  4. Maximum Operating Temperature: 275 deg F.

## 2.03 REFRIGERANTS

- A. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.

## PART 3 EXECUTION

### 3.01 PIPING APPLICATIONS FOR REFRIGERANT R-410A

- A. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications: Copper, Type ACR, annealed- or drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.
- B. Safety-Relief-Valve Discharge Piping: Copper, Type ACR, annealed- or drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.

### 3.02 VALVE AND SPECIALTY APPLICATIONS

- A. Install diaphragm packless valves in suction and discharge lines of compressor.

- B. Install service valves for gage taps at inlet and outlet of hot-gas bypass valves and strainers if they are not an integral part of valves and strainers.
- C. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.
- D. Except as otherwise indicated, install diaphragm packless valves on inlet and outlet side of filter dryers.
- E. Install a full-sized, three-valve bypass around filter dryers.
- F. Install solenoid valves upstream from each expansion valve. Install solenoid valves in horizontal lines with coil at top.
- G. Install thermostatic expansion valves as close as possible to distributors on evaporators.
  - 1. Install valve so diaphragm case is warmer than bulb.
  - 2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
  - 3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.
- H. Install safety relief valves where required by ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.
- I. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.
- J. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for device being protected:
  - 1. Solenoid valves.
  - 2. Thermostatic expansion valves.
  - 3. Compressor.
- K. Install filter dryers in liquid line between compressor and thermostatic expansion valve, and in the suction line at the compressor.
- L. Install receivers sized to accommodate pump-down charge.
- M. Install flexible connectors at compressors.

### **3.03 PIPING INSTALLATION**

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, 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.
- C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- 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. Install fittings for changes in direction and branch connections.
- I. Select system components with pressure rating equal to or greater than system operating 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 refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.
- L. Slope refrigerant piping as follows:
  - 1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
  - 2. Install horizontal suction lines with a uniform slope downward to compressor.
  - 3. Install traps and double risers to entrain oil in vertical runs.
  - 4. Liquid lines may be installed level.
- M. When brazing or soldering, 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. Before installation of steel refrigerant piping, clean pipe and fittings using the following procedures:
  - 1. Shot blast the interior of piping.
  - 2. Remove coarse particles of dirt and dust by drawing a clean, lintless cloth through tubing by means of a wire or electrician's tape.
  - 3. Draw a clean, lintless cloth saturated with trichloroethylene through the tube or pipe. Continue this procedure until cloth is not discolored by dirt.
  - 4. Draw a clean, lintless cloth, saturated with compressor oil, squeezed dry, through the tube or pipe to remove remaining lint. Inspect tube or pipe visually for remaining dirt and lint.
  - 5. Finally, draw a clean, dry, lintless cloth through the tube or pipe.
  - 6. Safety-relief-valve discharge piping is not required to be cleaned but is required to be open to allow unrestricted flow.
- O. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.
- P. Identify refrigerant piping and valves according to Section 230553 "Identification for HVAC Piping and Equipment."
- Q. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- R. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

### **3.04 PIPE JOINT CONSTRUCTION**

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide), during brazing or welding, to prevent scale formation.
- D. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
  - 1. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.
  - 2. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.
- F. Threaded Joints: Thread steel pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads unless dry-seal threading is specified.

2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Steel pipe can be threaded, but threaded joints must be seal brazed or seal welded.
- H. Welded Joints: Construct joints according to AWS D10.12/D10.12M.
- I. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

### **3.05 HANGERS AND SUPPORTS**

- A. Install the following pipe attachments:
  1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet long.
  2. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
  3. Spring hangers to support vertical runs.
  4. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
- B. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:
  1. NPS 1/2: Maximum span, 60 inches; minimum rod size, 1/4 inch.
  2. NPS 5/8: Maximum span, 60 inches; minimum rod size, 1/4 inch.
  3. NPS 1: Maximum span, 72 inches; minimum rod size, 1/4 inch.
  4. NPS 1-1/4: Maximum span, 96 inches; minimum rod size, 3/8 inch.
  5. NPS 1-1/2: Maximum span, 96 inches; minimum rod size, 3/8 inch.
- C. Support multifloor vertical runs at least at each floor.

### **3.06 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. Pressure test system with dry nitrogen to 200 psi. Perform final test at 27 inches vacuum and psi using halide torch. Test to no leakage.

### **3.07 SYSTEM CHARGING**

- A. Charge system using the following procedures:
  1. Install core in filter dryers after leak test but before evacuation.
  2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
  3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
  4. Charge system with a new filter-dryer core in charging line.

### **3.08 ADJUSTING**

- A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.
- B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.
- C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.
- D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
  1. Open shutoff valves in condenser water circuit.
  2. Verify that compressor oil level is correct.
  3. Open compressor suction and discharge valves.
  4. Open refrigerant valves except bypass valves that are used for other purposes.
  5. Check open compressor-motor alignment and verify lubrication for motors and bearings.

- E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

**END OF SECTION 23 2300**

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**SECTION 23 3113**  
**SECTION 233113 - METAL DUCTS**

**PART 1 GENERAL**

**1.01 SUMMARY**

- A. Section Includes:
  - 1. Single-wall rectangular ducts and fittings.
  - 2. Single-wall round ducts and fittings.
  - 3. Sheet metal materials.
  - 4. Sealants and gaskets.
  - 5. Hangers and supports.
- B. Related Sections:
  - 1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
  - 2. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

**1.02 PERFORMANCE REQUIREMENTS**

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

**1.03 ACTION SUBMITTALS**

- A. Product Data: For each type of the following products:
  - 1. Liners and adhesives.
  - 2. Sealants and gaskets.
- B. Shop Drawings:
  - 1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
  - 2. Factory- and shop-fabricated ducts and fittings.
  - 3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
  - 4. Fittings.
  - 5. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
- C. Welding certificates.
- D. Field quality-control reports.

**1.04 QUALITY ASSURANCE**

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
  - 2. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."
- C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

## PART 2 PRODUCTS

### 2.01 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular 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."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular 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."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to 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."

### 2.02 SINGLE-WALL ROUND DUCTS AND FITTINGS

- A. 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.
  - 1. Manufacturers
    - <<http://www.specagent.com/LookUp/?ulid=3426&mf=04&mf=95&src=wd&mf=04&src=wd>> : Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      - a. Lindab Inc <<http://www.specagent.com/LookUp/?uid=123456812638&mf=04&src=wd>>.
      - b. McGill AirFlow LLC <<http://www.specagent.com/LookUp/?uid=123456812639&mf=04&src=wd>>.
      - c. SEMCO Incorporated <<http://www.specagent.com/LookUp/?uid=123456812640&mf=04&src=wd>>.
      - d. Sheet Metal Connectors, Inc <<http://www.specagent.com/LookUp/?uid=123456812641&mf=04&src=wd>>.
      - e. Spiral Manufacturing Co., Inc <<http://www.specagent.com/LookUp/?uid=123456812642&mf=04&src=wd>>.
- B. Transverse Joints: Select joint types and fabricate according to 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 60 Inches in Diameter: Flanged.
- C. Longitudinal Seams: Select seam types and fabricate according to 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.

- D. Tees and Laterals: Select types and fabricate according to 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."

## 2.03 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
  1. Galvanized Coating Designation: G90 shall be installed indoors and outdoors.
  2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Black steel ductwork
  1. For use with kitchen hood exhaust.
  2. Minimum thickness of steel shall be 16 gauge in thickness.

## 2.04 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Water-Based Joint and Seam Sealant:
  1. Application Method: Brush on.
  2. Solids Content: Minimum 65 percent.
  3. Shore A Hardness: Minimum 20.
  4. Water resistant.
  5. Mold and mildew resistant.
  6. VOC: Maximum 75 g/L (less water).
  7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
  8. Service: Indoor or outdoor.
  9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- C. Flanged Joint Sealant: Comply with ASTM C 920.
  1. General: Single-component, acid-curing, silicone, elastomeric.
  2. Type: S.
  3. Grade: NS.
  4. Class: 25.
  5. Use: O.
  6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  7. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
- E. Round Duct Joint O-Ring Seals:
  1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
  2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
  3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

## 2.05 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- H. Trapeze and Riser Supports:
  1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.

## PART 3 EXECUTION

### 3.01 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install round ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

### 3.02 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

### **3.03 DUCT SEALING**

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
  - 1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  - 2. Outdoor, Supply-Air Ducts: Seal Class A.
  - 3. Outdoor, Exhaust Ducts: Seal Class C.
  - 4. Outdoor, Return-Air Ducts: Seal Class C.
  - 5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
  - 6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
  - 7. Unconditioned Space, Exhaust Ducts: Seal Class C.
  - 8. Unconditioned Space, Return-Air Ducts: Seal Class B.
  - 9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
  - 10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.
  - 11. Conditioned Space, Exhaust Ducts: Seal Class B.
  - 12. Conditioned Space, Return-Air Ducts: Seal Class C.

### **3.04 HANGER AND SUPPORT INSTALLATION**

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
  - 1. Where practical, install concrete inserts before placing concrete.
  - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
  - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
  - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
  - 5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.

- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- G. Roof Supports for Ductwork: Horizontal ductwork on the roof shall be supported with equipment mounting supports that shall consist of a minimum of welded 18 gauge galvanized steel shell, base plate, and counter flashing, factory installed 2x4 or 2x6 wood nailing, and internal bulkhead reinforcement. Heights of the roof supports shall be coordinated in field with air handler discharge heights.
  - 1. Manufacturers  
<http://www.specagent.com/LookUp/?ulid=3426&mf=04&mf=95&src=wd&mf=04&src=wd> : Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Hranec Inc  
<http://www.specagent.com/LookUp/?uid=123456812638&mf=04&src=wd>.
    - b. The Pate Company.
    - c. Thycurb.

### **3.05 CONNECTIONS**

- A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

### **3.06 PAINTING**

- A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer.

### **3.07 FIELD QUALITY CONTROL**

- A. Perform tests and inspections.
- B. Leakage Tests:
  - 1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
  - 2. Test the following systems:
    - a. Ducts with a Pressure Class Higher Than 3-Inch wg: Test representative duct sections, selected by Architect from sections installed, totaling no less than 25 percent of total installed duct area for each designated pressure class.
    - b. Supply Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct sections, selected by Architect from sections installed, totaling no less than 50 percent of total installed duct area for each designated pressure class.
    - c. Return Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct sections, selected by Architect from sections installed, totaling no less than 50 percent of total installed duct area for each designated pressure class.
    - d. Exhaust Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct section totaling no less than 100 percent of total installed duct area for each designated pressure class.
  - 3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
  - 4. Test for leaks before applying external insulation.
  - 5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
  - 6. Give seven days' advance notice for testing.
  - 7. Duct System Cleanliness Tests:
  - 8. Visually inspect duct system to ensure that no visible contaminants are present.

9. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
  - a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.
- C. Duct system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.
- E. Exterior ductwork shall be sealed water tight with mastic.

### **3.08 DUCT CLEANING**

- A. Clean new duct systems before testing, adjusting, and balancing.
- B. Use service openings for entry and inspection.
  1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 233300 "Air Duct Accessories" for access panels and doors.
  2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
  3. Remove and reinstall ceiling to gain access during the cleaning process.
- C. Particulate Collection and Odor Control:
  1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
  2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.
- D. Clean the following components by removing surface contaminants and deposits:
  1. Air outlets and inlets (registers, grilles, and diffusers).
  2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
  3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
  4. Coils and related components.
  5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
  6. Supply-air ducts, dampers, actuators, and turning vanes.
  7. Dedicated exhaust components.
- E. Mechanical Cleaning Methodology:
  1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
  2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
  3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
  4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
  5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
  6. Provide drainage and cleanup for wash-down procedures.

7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

### **3.09 START UP**

- A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

### **3.10 DUCT SCHEDULE**

- A. Ductwork between Air-Handling Unit and terminal units:
  1. Pressure Class: Positive 4-inch wg.
  2. Minimum SMACNA Seal Class: A.
- B. Ductwork downstream of terminal units:
  1. Pressure Class: Positive or negative 2-inch wg.
  2. Minimum SMACNA Seal Class: A.
- C. Exhaust Ducts:
  1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
    - a. Pressure Class: Negative 2-inch wg
    - b. Minimum SMACNA Seal Class: A.
- D. Exterior Ductwork:
  1. Pressure Class: Positive 4-inch wg.
  2. Minimum SMACNA Seal Class: A.
- E. Kitchen hood exhaust: Black steel with a minimum thickness of 0.0575 inches. Seal ductwork water tight.
- F. Intermediate Reinforcement:
  1. Galvanized-Steel Ducts: Galvanized steel
- G. Elbow Configuration:
  1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
    - a. Velocity 1000 fpm or Lower:
      - 1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
      - 2) Mitered Type RE 4 without vanes.
    - b. Velocity 1000 to 1500 fpm:
      - 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
      - 2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
      - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
    - c. Velocity 1500 fpm or Higher:
      - 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
      - 2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
      - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
  2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
    - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
    - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
    - c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
  3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."

- a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
    - 1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
    - 2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
    - 3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
    - 4) Radius-to Diameter Ratio: 1.5.
  - b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
  - c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam or welded.
- H. Branch Configuration:
1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
    - a. Rectangular Main to Rectangular Branch: 45-degree entry.
    - b. Rectangular Main to Round Branch: Spin in.
  2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
    - a. Velocity 1000 fpm or Lower: 90-degree tap.
    - b. Velocity 1000 to 1500 fpm: Conical tap.
    - c. Velocity 1500 fpm or Higher: 45-degree lateral.

**END OF SECTION 23 3113**

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**SECTION 23 3300**  
**SECTION 233300 - AIR DUCT ACCESSORIES**

**PART 1 GENERAL**

**1.01 SUMMARY**

- A. Section Includes:
  - 1. Backdraft and pressure relief dampers.
  - 2. Manual volume dampers.
  - 3. Control dampers.
  - 4. Fire dampers.
  - 5. Flange connectors.
  - 6. Turning vanes.
  - 7. Duct-mounted access doors.
  - 8. Flexible connectors.
  - 9. Flexible ducts.
  - 10. Duct accessory hardware.

**1.02 ACTION SUBMITTALS**

- A. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.
  - 1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
    - a. Special fittings.
    - b. Manual volume damper installations.

**PART 2 PRODUCTS**

**2.01 ASSEMBLY DESCRIPTION**

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

**2.02 MATERIALS**

- A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
  - 1. Galvanized Coating Designation: G90.
  - 2. Exposed-Surface Finish: Mill phosphatized.

**2.03 BACKDRAFT DAMPERS**

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Greenheck Fan Corporation.
  - 2. Nailor Industries Inc.
  - 3. Ruskin Company.
- B. Description: Gravity balanced.
- C. Maximum Air Velocity: 1000 fpm.
- D. Maximum System Pressure: 4-inch wg.
- E. Blades: Multiple single-piece blades, extruded aluminum with sealed edges.
- F. Blade Action: Parallel.
- G. Blade Seals: Extruded vinyl, mechanically locked.

## 2.04 MANUAL VOLUME DAMPERS

- A. Standard, Steel, Manual Volume Dampers:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Air Balance Inc.; a division of Mestek, Inc .
    - b. Nailor Industries Inc .
    - c. Ruskin Company.
  - 2. Standard leakage rating, with linkage outside airstream.
  - 3. Suitable for horizontal or vertical applications.
  - 4. Frames:
    - a. Frame: Hat-shaped, 16 gauge minimum, galvanized sheet steel.
    - b. Mitered and welded corners.
    - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
  - 5. Blades:
    - a. Multiple or single blade.
    - b. Parallel- or opposed-blade design.
    - c. Stiffen damper blades for stability.
    - d. Galvanized-steel, 16 gauge minimum.
  - 6. Blade Axles: Plated steel.
  - 7. Bearings:
    - a. Synthetic.
    - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
  - 8. Tie Bars and Brackets: Galvanized steel.

## 2.05 CONTROL DAMPERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Greenheck Fan Corporation.
  - 2. Nailor Industries Inc <<http://>
  - 3. Ruskin Company.
  - 4. Young Regulator Company .
- B. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
- C. Frames:
  - 1. Hat shaped.
  - 2. 0.094-inch thick, galvanized sheet steel.
- D. Blades:
  - 1. Multiple blade with maximum blade width of 6 inches.
  - 2. Parallel- and opposed-blade design.
  - 3. Galvanized-steel.
  - 4. Blade thickness: 16 gauge
  - 5. Blade Edging: PVC.
  - 6. Blade Edging: Inflatable seal blade edging, or replaceable rubber seals.
- E. Blade Axles: 1/2-inch diameter; plated steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.
  - 1. Operating Temperature Range: From minus 40 to plus 200 deg F.
- F. Bearings:
  - 1. Molded synthetic.
  - 2. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

3. Thrust bearings at each end of every blade.

## 2.06 TURNING VANES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  1. Ductmate Industries, Inc.
  2. Duro Dyne Inc.
  3. Elgen Manufacturing.
  4. METALAIRE, Inc.
  5. SEMCO Incorporated.
  6. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
  1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.
- C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."
- D. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

## 2.07 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  1. Ductmate Industries, Inc.
  2. Duro Dyne Inc.
  3. Elgen Manufacturing.
  4. Ventfabrics, Inc .
  5. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Materials: Flame-retardant or noncombustible fabrics.
- C. Coatings and Adhesives: Comply with UL 181, Class 1.
- D. Metal-Edged Connectors: Factory fabricated with a fabric strip 5-3/4 inches wide attached to two strips of 2-3/4-inch wide, 0.028-inch thick, galvanized sheet steel.
- E. 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 200 deg F.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
  1. Install steel volume dampers in steel ducts.

- E. Set dampers to fully open position before testing, adjusting, and balancing.
- F. Install test holes at fan inlets and outlets and elsewhere as indicated.
- G. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
  - 1. On both sides of duct coils.
  - 2. Upstream and downstream from duct filters.
  - 3. At drain pans and seals.
  - 4. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
  - 5. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
  - 6. Retain first three subparagraphs below to provide access for duct cleaning. LEED Prerequisite IEQ 1 requires compliance with ASHRAE 62.1-2004, in which Section 7.2.4 - "Ventilation System Start-Up" requires that distribution systems be clean of dirt and debris.
  - 7. Upstream and downstream from turning vanes.
  - 8. Control devices requiring inspection.
  - 9. Elsewhere as indicated.
- H. Install access doors with swing against duct static pressure.
- I. Access Door Sizes:
  - 1. One-Hand or Inspection Access: 8 by 5 inches.
  - 2. Two-Hand Access: 12 by 6 inches.
- J. Label access doors according to Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- K. Install flexible connectors to connect ducts to equipment.
- L. Install duct test holes where required for testing and balancing purposes.

### **3.02 FIELD QUALITY CONTROL**

- A. Tests and Inspections:
  - 1. Operate dampers to verify full range of movement.
  - 2. Inspect locations of access doors and verify that purpose of access door can be performed.
  - 3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
  - 4. Inspect turning vanes for proper and secure installation.
  - 5. Operate remote damper operators to verify full range of movement of operator and damper.

**END OF SECTION 23 3300**

**SECTION 23 3416**  
**SECTION 233416 - HVAC FANS**

**PART 1 GENERAL**

**1.01 SUMMARY**

- A. Section Includes:
  - 1. Ceiling Mounted Centrifugal Exhaust Fans.
  - 2. Submittals:
    - a. Provide dimensional drawings and product data on each fan.
    - b. Provide fan curves for each fan at the specified operation point, with the flow, static pressure and horsepower clearly plotted.
    - c. Provide outlet velocity and fan's inlet sound power readings for the eight octave bands, decibels, and sones.
    - d. Strictly adhere to QUALITY ASSURANCE requirements as stated in section 1.04 of this specification.
    - e. Provide manufacturer's certification that exhaust fans are licensed to bear Air Movement and Control Association (AMCA), Certified Rating Seal for sound and air performance.
    - f. Installation, Operation, and Maintenance Manual (IOM): Provide manufacturer's installation, operations, and maintenance manual, including instructions on installation, operations, maintenance, pulley adjustment, receiving, handling, storage, safety information and cleaning. A troubleshooting guide, parts list, warranty and electrical wiring diagrams shall also be included.
  - 3. QUALITY ASSURANCE
    - a. Performance ratings: Conform to AMCA standard 211 and 311. Fans must be tested in accordance with ANSI/AMCA Standard 210-99 and AMCA Standard 300-96 in an AMCA accredited laboratory. Fans shall be certified to bear the AMCA label for air and sound performance seal.
    - b. Each fan shall be given a balancing analysis which is applied to wheels at the outside radius. The maximum allowable static and dynamic imbalance is 0.05 ounces (Balance grade of G6.3).
    - c. Comply with the National Electrical Manufacturers Association (NEMA), standards for motors and electrical accessories.
  - 4. DELIVERY, STORAGE AND HANDLING
    - a. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer, material, products included, and location of installation
    - b. Storage: Store materials in a dry area indoor, protected from damage, and in accordance with manufacturer's instructions. For long term storage follow manufacturer's Installation, Operations, and Maintenance Manual
    - c. Handling: Handle and lift fans in accordance with the manufacturer's instructions. Protect materials and finishes during handling and installation to prevent damage. Follow all safety warnings posted by the manufacturer
  - 5. WARRANTY
    - a. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.
      - 1) The warranty of this equipment is to be free from defects in material and workmanship for a period of one year from the purchase date. Any units or parts which prove defective during the warranty period will be replaced at the Manufacturers option when returned to Manufacturer, transportation prepaid.

- 2) Motor Warranty is warranted by the motor manufacturer for a period of one year. Should motors furnished by us prove defective during this period, they should be returned to the nearest authorized motor service station.
6. MAINTENANCE
- a. Refer to Manufacturer's Installation, Operation and Maintenance Manual (IOM), to find maintenance procedures.

## PART 2 PRODUCTS

### 2.01 FANS

- A. Ceiling mounted exhaust fan/light combination: Ceiling mounted exhaust fan/light combination shall be energy star compliant and shall have DC motors. The fan/light shall have two energy star qualified 18 watt light bulbs and a 4 watt C7 night light bulb. The fan shall have a 6" duct connection.
- B. Each fan shall bear a permanently affixed manufacturer's engraved nameplate constructed of aluminum and containing the model number and individual serial number for future identification.
- C. A disconnect shall be NEMA rated and factory installed with wiring included from the fan motor to a junction box installed within the motor compartment. A conduit chase shall be provided through the base to the motor compartment for ease of electrical wiring.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70 – 2005 Edition, by a qualified testing agency, and marked for intended location and application.
- E. Capacities and Characteristics: As shown on drawings.
- F. Accessories: Refer to Fan Schedule for required accessories for each fan:
  1. Disconnect Switch: Non-fused type, with thermal-overload protection mounted in the fan housing, factory wired through an internal aluminum conduit.
  2. Factory assembled sheet metal fan/light enclosure equal to Fire Rated Product Specialties Corp for mounting fan/light in rated ceiling. The enclosure shall be a one piece, formed and welded galvanized sheet steel box, open front face with integral fastening flanges for recessing and securing into framing to receive recessed fan/light. The enclosure shall be 12.2 inches wide, 20.2 inches long, and 9.5 inches tall. The enclosure shall be tested and approved by Intertec/Warnock Hersey Testing. Electrical knockouts, duct openings, and fasteners shall have clean knockouts. The enclosure shall have spot welded corners. The entire interior of the enclosure shall be covered with a 3/16" intumescent mat with 4 prepunched tabs on each face of the enclosure. The enclosure shall have 4 standard 7/8 inch diameter knock-outs in each unit. Enclosure shall have one 4-1/2" diameter opening for exiting of exhaust duct through enclosure wall.

## PART 3 EXECUTION

### 3.01 MANUFACTURER'S INSTRUCTIONS

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

### 3.02 EXAMINATION

- A. Examine areas to receive fans. Notify the Engineer of conditions that would adversely affect installation or subsequent utilization and maintenance of fans. Do not proceed with installation until unsatisfactory conditions are corrected.

### 3.03 PREPARATION

- A. Ensure roof openings are square, accurately aligned, correctly located, and in tolerance.
- B. Ensure duct is plumb, sized correctly, and to proper elevation above roof deck. Install duct as specified in Air Distribution (Division 23).

### **3.04 INSTALLATION**

- A. Enclosure installation: Check enclosure for distortions and defects. Use only the designed penetrations of the sheet metal enclosure assembly, do not use any additional ones. Penetrations of the sheet metal firestopping assembly is allowed for power wiring as described by in the manufacturer's installation information. Penetrations of the sheet metal fire stopping units shall be made only at factory designated knockout locations and in conformance with the manufacturers written installation instructions. A maximum of two standard 3C-12AWC "Romex" wires shall penetrate the enclosure as per the Manufacturer's instructions. Provide 4" PVC pipe sleeve extension from fan outlet through enclosure wall and firestop device at enclosure wall penetration. Fit fire stop device concentrically over the sleeve extension and attach to inside of enclosure in accordance with manufacturer's instructions. Install enclosure with testing agency approved firestop seal, 1/8 inch Fire Barrier ULTRA PPD plastic pipe device as manufactured by 3M with three layers of intumescent mat material, and 3/16 inch Intumsecent mat liner Model I-10 as manufactured by 3M. Install per manufacturer's recommendations.
- B. Install fan, motor and drive in accordance with manufacturer's instructions.
- C. Install fans level and plumb.
- D. Align fan and motor sheaves to allow belts to run true and straight.

### **3.05 CONNECTIONS**

- A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 15 Section "Air Duct Accessories."
- B. Install ducts adjacent to fans to allow service and maintenance.

### **3.06 PRE-OPERATION MAINTENANCE**

- A. Grease bearings.
- B. Rotate impeller by hand and check for shifting during shipment and check all bolts, collars, and other parts for tightness.

### **3.07 START-UP AND INSTRUCTIONS**

- A. Check vibration and correct as necessary for air balance work.

**END OF SECTION 23 3416**

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**SECTION 23 3713**  
**SECTION 233713 – DIFFUSERS, REGISTERS AND GRILLES**

**PART 1 GENERAL**

**1.01 SUMMARY**

- A. Section Includes:
  - 1. Air distribution diffusers, registers, and grilles.

**1.02 SUBMITTALS**

- A. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.

**PART 2 PRODUCTS**

**2.01 DIFFUSERS, REGISTERS & GRILLES**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. METALAIR, Inc.
  - 2. Nailor Industries Inc.
  - 3. Price Industries.
  - 4. Titus.
  - 5. Tuttle & Bailey.
- B. Sidewall Supply, SWS
  - 1. Registers shall be double deflection type with two sets of fully adjustable deflection blades spaced  $\frac{3}{4}$ " on center.
  - 2. The front set of blades shall run parallel to the short dimension.
  - 3. The integral volume control damper shall be of the opposed blade type and shall be constructed of aluminum. The damper shall be operable from the register face.
  - 4. The damper shall be mill finish.
  - 5. The grille shall be finished in white powder coat.
- C. Sidewall Return, SWR
  - 1. Grilles shall be 45 degree deflection fixed louver type with blades spaced  $\frac{3}{4}$ " on center.
  - 2. The blades shall run parallel to the short dimension of the grille.
  - 3. The grille shall be finished in white powder coat.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

- A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.02 INSTALLATION**

- A. Install grilles level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

### **3.03 ADJUSTING**

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

**END OF SECTION 23 3713**

**SECTION 23 8126**  
**SECTION 238126 - SPLIT-SYSTEM AIR-CONDITIONERS**

**PART 1 GENERAL**

**1.01 RELATED DOCUMENTS**

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

**1.02 SUMMARY**

- A. Section includes split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

**1.03 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.

**1.04 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

**1.05 QUALITY ASSURANCE**

- A. The units shall be listed by Electrical Laboratories (ETL), in accordance with UL-1995 certification and bear the cETL label.
- B. All wiring shall be in accordance with the National Electric Code (NEC).
- C. Each combination shall be rated in accordance with Air Conditioning Refrigeration Institute's (ARI) Standard 210/240 and bear the ARI label.
- D. System efficiency shall meet or exceed 16SEER and 10.0 HSPF

**1.06 DELIVERY, STORAGE AND HANDLING**

**1.07 WARRANTY**

- A. The units shall have a manufacturer's warranty for parts other than the compressor for a period of five (5) years from date of installation. The units shall have a limited labor warranty for a period of one (1) year from date of installation. The compressor shall have a warranty of five (5) years from date of installation. When warranties are required, verify with Owner's counsel that special warranties stated in this article are not less than remedies available to Owner under prevailing local laws.

**PART 2 – PRODUCTS**

**2.01 MANUFACTURERS**

- A. Subject to compliance with requirements, provide products by one of the following:
  1. Mitsubishi
  2. Daikin

**2.02 DUCTED VERTICAL INDOOR UNIT**

- A. General:
  1. The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, control circuit board, fan and fan motor. The system shall have reversing valve for heat pump cycle; the indoor unit shall include electric resistance heat for auxiliary heat source.
    - a. Unit Cabinet:
      - 1) The cabinet shall be galvanized steel construction, low profile, horizontal ducted fan coil not to exceed 7-7/8" in depth and equipped with four corner mounting brackets.

- (a) Fan:
  - (1) The indoor unit fan shall be an assembly with supply fans.
  - (2) The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings.
  - (3) The indoor fan shall consist of three (3) speeds, High, Mid, and Low plus Auto Fan Mode
  - (4) The indoor unit shall have a ducted air outlet system direct return air grille.
- (b) Filter:
  - (1) Return air shall have a filter of MERV 6 or greater.
- (c) Coil:
  - (1) The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing.
  - (2) The tubing shall have inner grooves for high efficiency heat exchange.
  - (3) All tube joints shall be brazed with phos-copper or silver alloy.
  - (4) The coils shall be pressure tested at the factory.
  - (5) A condensate pan and drain shall be provided under the coil.
  - (6) The unit shall be provided with an integral condensate lift mechanism able to raise drain water 21 – 11/16 inches above the condensate pan.
  - (7) A drain pan level switch, designed to connect to the control board, shall be provided, and installed on the condensate pan to prevent condensate from overflowing.
- (d) Electrical:
  - (1) The unit electrical power shall be 208/230 volts, 1 phase, 60 hertz.
- (e) Controls:
  - (1) Control by wall-mounted room thermostat to maintain room temperature setting.

## **2.03 DUCTED SPLIT HEAT PUMP OUTDOOR UNITS:**

### **2.04 UNIT CABINET:**

- A. The casing shall be fabricated of galvanized steel, bonderized, finished with an electro statically applied, thermally fused acrylic or polyester powder coating for corrosion protection. Assembly hardware shall be cadmium plated for weather resistance.
- B. Two (2) mild steel mounting feet, traverse mounted across the cabinet base pan, welded mount, providing four (4) slotted mounting holes shall be furnished. Assembly shall withstand lateral wind gust up to 155 MPH to meet applicable weather codes.
- 1. B. Fan:
  - a. The unit shall be furnished with a direct drive, high performance propeller type fan.
    - 1) Fan speed shall be switch automatically according to the number of operating indoor units and the compressor operating frequency.
      - (a) The fan motor shall be mounted with vibration isolation for quiet operation.
      - (b) The fan shall be provided with a raised guard to prevent contact with moving parts.
      - (c) The outdoor unit shall have horizontal discharge airflow.
  - 2) C. Coil:
    - (a) The outdoor unit coil shall be of nonferrous construction with lanced or corrugated plate fins on copper tubing.
  - 3) The coil shall be protected with an integral guard.
  - 4) Refrigerant flow from the outdoor unit to the indoor units shall be independently controlled by means of individual electronic linear expansion valves for each indoor unit.
- 5) D. Compressor:
- 6) The compressor shall be a high performance, hermetic, inverter driven, variable speed, dual rotary type.

- (a) The compressor motor shall be direct current (DC) type equipped with a factory supplied and installed inverter drive package.
- (b) The outdoor unit shall be equipped with a suction side refrigerant accumulator.
- 7) E. Electrical:
- 8) The unit electrical power shall be 208/230 volts, 1-phase, 60 hertz.

## PART 3- EXECUTION

### 3.01 INSTALLATION

- A. Install units level and plumb, following manufacturers written installation instructions.
- B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- C. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

### 3.02 CONNECTION

- A. Coordinate piping installations and specialty arrangements with schematics on Drawings and with requirements specified in piping systems. If Drawings are explicit enough, these requirements may be reduced or omitted.
- B. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- C. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.
- D. Duct Connections: Duct installation requirements are specified in Division 23 Section "Metal Ducts" Drawings indicate the general arrangement of ducts. Connect supply and return ducts to split-system air-conditioning units with flexible duct connectors. Flexible duct connectors are specified in Division 23 Section "Air Duct Accessories."

### 3.03 PIPING INSTALLATION

- A. Refer to Specification 232300 – Refrigerant Piping.

### 3.04 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:
  - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment. Remove and replace malfunctioning units and retest as specified above.
    - a. STARTUP SERVICE
      - 1) Engage a factory-authorized service representative to perform startup service.
        - (a) Complete installation and startup checks according to manufacturer's written instructions.

### 3.05 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

**END OF SECTION 23 8126**



**SECTION 260519  
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES**

**PART I - GENERAL**

**I.1 RELATED DOCUMENTS**

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

**I.2 SUMMARY**

- A. Section Includes:
1. Building wires and cables rated 600 V and less.
  2. Connectors, splices, and terminations rated 600 V and less.

**I.3 ACTION SUBMITTALS**

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

**I.4 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For testing agency.  
B. Field quality-control reports.

**I.5 QUALITY ASSURANCE**

- A. Testing Agency Qualifications: Member Company of NETA or an NRTL.  
  - I. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

**PART 2 - PRODUCTS**

**2.1 CONDUCTORS AND CABLES**

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Alcan Products Corporation; Alcan Cable Division.
  2. Alpha Wire.
  3. Belden Inc.
  4. Encore Wire Corporation.

5. General Cable Technologies Corporation.
  6. Southwire Incorporated.
- B. Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658.
- C. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type THHN-2-THWN-2.
- D. Multiconductor Cable: Comply with NEMA WC 70/ICEA S-95-658 for nonmetallic-sheathed cable, Type NM Type SO with ground wire.

## **2.2 CONNECTORS AND SPLICES**

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. AFC Cable Systems, Inc.
  2. Gardner Bender.
  3. Hubbell Power Systems, Inc.
  4. Ideal Industries, Inc.
  5. Ilasco; a branch of Bardes Corporation.
  6. O-Z/Gedney; a brand of the EGS Electrical Group.
  7. 3M; Electrical Markets Division.
  8. Tyco Electronics.
- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

## **2.3 SYSTEM DESCRIPTION**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.

## PART 3 - EXECUTION

### 3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger. Copper Type SER with equipment ground for above grade feeders from meter centers to apartment panels.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger. Romex type NM and NMC multiconductor cable for apartment and residential wiring methods.

### 3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type THHN-2-THWN-2, single conductors in raceway.
- B. Exposed Feeders and below grade applications: Type THHN-2-THWN-2, single conductors in raceway.
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN-2-THWN-2, single conductors in raceway and feeder cables concealed in wall, ceilings above grade: Type SE multiconductor cable with ground as copper conductor.
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-2-THWN-2, single conductors in raceway.
- E. Exposed Branch Circuits, in Crawlspaces: Type THHN-2-THWN-2, single conductors in raceway or Nonmetallic-sheathed cable, Type NM or NMC fastened per code requirements.
- F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-2-THWN-2, single conductors in raceway or Nonmetallic-sheathed cable, Type NM or NMC .
- G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-2-THWN-2, single conductors in raceway.
- H. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

### 3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

### **3.4 CONNECTIONS**

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

### **3.5 IDENTIFICATION**

- A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

### **3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS**

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

### **3.7 FIRESTOPPING**

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."

### **3.8 FIELD QUALITY CONTROL**

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform the following tests and inspections:

1. After installing conductors and cables, and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
  2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
- D. Test and Inspection Reports: Prepare a written report to record the following:
1. Procedures used.
  2. Results that comply with requirements.
  3. Results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- E. Cables will be considered defective if they do not pass tests and inspections.

**END OF SECTION**

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**SECTION 260526**  
**GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS**

**PART I - GENERAL**

**I.1 RELATED DOCUMENTS**

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

**I.2 SUMMARY**

- A. Section Includes: Grounding systems and equipment.
- B. Section includes grounding systems and equipment, plus the following special applications:
  - I. Underground distribution grounding.

**I.3 ACTION SUBMITTALS**

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

**I.4 INFORMATIONAL SUBMITTALS**

- A. Informational Submittals: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article, including the following:
  - I. Ground rods.
  - 2. Grounding for sensitive electronic equipment.
- B. Qualification Data: For qualified testing agency and testing agency's field supervisor.
- C. Field quality-control reports.

**I.5 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.

**I.6 QUALITY ASSURANCE**

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
  - I. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

- C. Comply with UL 467 for grounding and bonding materials and equipment.

## PART 2 - PRODUCTS

### 2.1 CONDUCTORS

- A. Insulated Conductors: Copper or tinned-copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction. All NMC, NM cable shall have an equipment grounds. All applied SE, SER cables shall include an equipment ground as integral to the cable assembly.
- B. Bare Copper Conductors:
  - I. Solid Conductors: ASTM B 3.
  - 2. Stranded Conductors: ASTM B 8.
  - 3. Tinned Conductors: ASTM B 33.
  - 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
  - 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
  - 6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
  - 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
- C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.

### 2.2 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, pressure type with at least two bolts.
  - I. Pipe Connectors: Clamp type, sized for pipe.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- D. Bus-bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

## 2.3 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel; 5/8 by 96 inches in diameter.

## PART 3 - EXECUTION

### 3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 2/0 AWG minimum.
  - I. Bury at least 24 inches below grade.
  - 2. Duct-Bank Grounding Conductor: Bury 12 inches above duct bank when indicated as part of duct-bank installation.
- C. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
  - I. Install bus on insulated spacers 2 inches minimum from wall, 6 inches above finished floor unless otherwise indicated.
  - 2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down to specified height above floor; connect to horizontal bus.
- D. Conductor Terminations and Connections:
  - I. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
  - 2. Underground Connections: Welded connectors except as otherwise indicated.
  - 3. Connections to Structural Steel: Welded connectors.

### 3.2 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements.
- B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.
- C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to

ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.

- D. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches from the foundation.

### **3.3 EQUIPMENT GROUNDING**

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
1. Feeders and branch circuits.
  2. Lighting circuits.
  3. Receptacle circuits.
  4. Single-phase motor and appliance branch circuits.
  5. Three-phase motor and appliance branch circuits.
  6. Flexible raceway runs.
  7. Armored and metal-clad cable runs.
  8. Computer and Rack-Mounted Electronic Equipment Circuits: Install insulated equipment grounding conductor in branch-circuit runs from equipment-area power panels and power-distribution units.
- C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
- D. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
- E. Signal and Communication Equipment: In addition to grounding and bonding required by NFPA 70, provide a separate grounding system complying with requirements in TIA/ATIS J-STD-607-A.

1. For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
2. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-4-by-12-inch grounding bus.
3. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

### **3.4 INSTALLATION**

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.
  1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
  2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
  1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
  2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
  3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- D. Grounding and Bonding for Piping:
  1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.

2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
  3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- E. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install tinned bonding jumper to bond across flexible duct connections to achieve continuity.
- F. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet apart.

### **3.5 LABELING**

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems" for instruction signs. The label or its text shall be green.
- B. Label each grounding conductor at the ground bar with equipment connected designation.
- C. Install labels at the telecommunications bonding conductor and grounding equalizer and at the grounding electrode conductor where exposed.
  - I. Label Text: "If this connector or cable is loose or if it must be removed for any reason, notify the facility manager."

### **3.6 FIELD QUALITY CONTROL**

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.
  - I. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- D. Tests and Inspections:
  - I. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
  2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.

3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at individual ground rods. Make tests at ground rods before any conductors are connected.
    - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    - b. Perform tests by fall-of-potential method according to IEEE 81.
  4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- E. Grounding system will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.
- G. Report measured ground resistances that exceed the following values:
- I. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
  2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
  3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
  4. Power Distribution Units or Panelboards Serving Electronic Equipment: 1 ohm(s).
  5. Substations and Pad-Mounted Equipment: 5 ohms.
  6. Manhole Grounds: 10 ohms.
- H. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

**END OF SECTION**

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**SECTION 260529**  
**HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS**

**PART I - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. This Section includes the following:
  1. Hangers and supports for electrical equipment and systems.
  2. Construction requirements for concrete bases.

**1.3 DEFINITIONS**

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. RMC: Rigid metal conduit.

**1.4 PERFORMANCE REQUIREMENTS**

- A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

**1.5 ACTION SUBMITTALS**

- A. Product Data: For the following:
  1. Steel slotted support systems.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:
  1. Trapeze hangers. Include Product Data for components.

2. Steel slotted channel systems. Include Product Data for components.
3. Equipment supports.

## **1.6 INFORMATIONAL SUBMITTALS**

- A. Welding certificates.

## **1.7 QUALITY ASSURANCE**

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Comply with NFPA 70.

## **1.8 COORDINATION**

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified together with concrete Specifications.

# **PART 2 - PRODUCTS**

## **2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS**

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
  1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Allied Tube & Conduit.
    - b. Cooper B-Line, Inc.; a division of Cooper Industries.
    - c. ERICO International Corporation.
    - d. GS Metals Corp.
    - e. Thomas & Betts Corporation.
    - f. Unistrut; Tyco International, Ltd.
    - g. Wesanco, Inc.
  2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
  3. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.

4. Channel Dimensions: Selected for applicable load criteria.
- B. Raceway and Cable Supports: As described in NECA I and NECA 101.
- C. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
  1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
    - a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      - 1) Hilti Inc.
      - 2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      - 3) MKT Fastening, LLC.
      - 4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
    2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
      - a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
        - 1) Cooper B-Line, Inc.; a division of Cooper Industries.
        - 2) Empire Tool and Manufacturing Co., Inc.
        - 3) Hilti Inc.
        - 4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.

- 5) MKT Fastening, LLC.
3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

## **2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES**

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

## **PART 3 - EXECUTION**

### **3.1 APPLICATION**

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
  1. Secure raceways and cables to these supports with two-bolt conduit clamps.
- D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

### **3.2 SUPPORT INSTALLATION**

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

- B. Raceway Support Methods: In addition to methods described in NECA I, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
  - D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
    - 1. To Wood: Fasten with lag screws or through bolts.
    - 2. To New Concrete: Bolt to concrete inserts.
    - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
    - 4. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
    - 5. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
    - 6. To Light Steel: Sheet metal screws.
    - 7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

### **3.3 INSTALLATION OF FABRICATED METAL SUPPORTS**

- A. Comply with installation requirements in Section 055000 "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

### **3.4 CONCRETE BASES**

- A. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

- B. Use 4000-psi 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 033000 "Cast-in-Place Concrete."
- C. Anchor equipment to concrete base.
  - 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
  - 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

### **3.5 PAINTING**

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Touchup: Comply with requirements in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

**END OF SECTION**

**SECTION 260533**  
**RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS**

**PART I - GENERAL**

**I.1 RELATED DOCUMENTS**

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

**I.2 SUMMARY**

- A. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Nonmetal boxes, conduits, tubing, and fittings.
3. Metal wireways and auxiliary gutters.
4. Boxes, enclosures, and cabinets.
5. Handholes and boxes for exterior underground cabling.

- B. Related Requirements:

- I. Section 270528 "Pathways for Communications Systems" for conduits, wireways, surface pathways, innerduct, boxes, faceplate adapters, enclosures, cabinets, and handholes serving communications systems.

**I.3 DEFINITIONS**

- A. GRC: Galvanized rigid steel conduit.
- B. IMC: Intermediate metal conduit.
- C. PVC: Polyvinyl Chloride plastic.

**I.4 ACTION SUBMITTALS**

- A. Product Data: For raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.
- C. Proof of UL testing and labeling.

## **I.5 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
  - 1. Structural members in paths of conduit groups with common supports.
  - 2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.
- B. Qualification Data: For professional engineer.
- C. Source quality-control reports.

## **PART 2 - PRODUCTS**

### **2.1 METAL CONDUITS, TUBING, AND FITTINGS**

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. AFC Cable Systems, Inc.
  - 2. Allied Tube & Conduit; a Tyco International Ltd. Co.
  - 3. Anamet Electrical, Inc.
  - 4. Electri-Flex Company.
  - 5. O-Z/Gedney; a brand of EGS Electrical Group.
  - 6. Picoma Industries, a subsidiary of Mueller Water Products, Inc.
  - 7. Republic Conduit.
  - 8. Robroy Industries.
  - 9. Southwire Company.
  - 10. Thomas & Betts Corporation.
  - 11. Western Tube and Conduit Corporation.
  - 12. Wheatland Tube Company; a division of John Maneely Company.
- B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. GRC: Comply with ANSI C80.1 and UL 6.
- D. IMC: Comply with ANSI C80.6 and UL 1242.
- E. EMT: Comply with ANSI C80.3 and UL 797.
- F. FMC: Comply with UL 1; zinc-coated steel.
- G. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- H. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

- I. Fittings for EMT:
  - a. Material: Steel.
  - b. Type: compression or set screw.
2. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
- I. Joint Compound for IMC or GRC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

## **2.2 NONMETALLIC CONDUITS, TUBING, AND FITTINGS**

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  1. AFC Cable Systems, Inc.
  2. Anamet Electrical, Inc.
  3. Arnco Corporation.
  4. Carlon
  5. CANTEX Inc.
  6. CertainTeed Corp.
  7. Condux International, Inc.
  8. Electri-Flex Company.
  9. Kraloy.
  10. Lamson & Sessions; Carlon Electrical Products.
  11. Niedax-Kleinhaus USA, Inc.
  12. RACO; a Hubbell company.
  13. Thomas & Betts Corporation.
- B. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. ENT: Comply with NEMA TC 13 and UL 1653.
- D. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
- E. LFNC: Comply with UL 1660.
- F. PVC: Outlet boxes for non-metallic sheathed cable shall be PVC plastic type boxes with associated cable clamp plastic restraints, and shall bear the UL label.
- G. RTRC: Comply with UL 1684A and NEMA TC 14.

- H. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
- I. Fittings for LFNC: Comply with UL 514B.

## **2.3 METAL WIREWAYS AND AUXILIARY GUTTERS**

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Cooper B-Line, Inc.
  - 2. Hoffman; a Pentair company.
  - 3. Mono-Systems, Inc.
  - 4. Square D; a brand of Schneider Electric.
- B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type I unless otherwise indicated, and sized according to NFPA 70.
  - I. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Wireway Covers: Hinged type unless otherwise indicated. Provisions for pad lock.
- E. Finish: Manufacturer's standard enamel finish.

## **2.4 BOXES, ENCLOSURES, AND CABINETS**

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Adalet.
  - 2. Cooper Technologies Company; Cooper Crouse-Hinds.
  - 3. EGS/Appleton Electric.
  - 4. Erickson Electrical Equipment Company.
  - 5. FSR Inc.
  - 6. Hoffman; a Pentair company.
  - 7. Hubbell Incorporated; Killark Division.
  - 8. Kraloy.
  - 9. Milbank Manufacturing Co.
  - 10. Mono-Systems, Inc.
  - 11. O-Z/Gedney; a brand of EGS Electrical Group.
  - 12. RACO; a Hubbell Company.

- 13. Robroy Industries.
  - 14. Spring City Electrical Manufacturing Company.
  - 15. Stahlin Non-Metallic Enclosures; a division of Robroy Industries.
  - 16. Thomas & Betts Corporation.
  - 17. Wiremold / Legrand.
- B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations. Outlet and device boxes shall be sealed to GWB walls and ceilings per energy conservation requirements of Earth Craft.
- C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS I and UL 514A.
- D. PVC Plastic Boxes : Comply with NEMA OS 2 –Non metallic outlet boxes. Boxes shall be UL listed and labeled.
- E. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB I, ferrous alloy, Type FD, with gasketed cover.
- F. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight. PVC outlet boxes may be used for residential fixtures. Boxes shall be UL listed and labeled.
- G. Small Sheet Metal Pull and Junction Boxes: NEMA OS I.
- H. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB I and UL 1773, galvanized, cast iron with gasketed cover.
- I. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- J. Device Box Dimensions: 4 inches square by 2-1/8 inches deep4 inches square by 3-1/2 inches deep.
- K. Gangable boxes are allowed.
- L. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type I with continuous-hinge cover with flush latch with padlock provision unless otherwise indicated.
  - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
  - 2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- M. Cabinets:
- 1. NEMA 250, Type I galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
  - 2. Hinged door in front cover with flush latch and concealed hinge.
  - 3. Key latch to match panelboards.
  - 4. Metal barriers to separate wiring of different systems and voltage.
  - 5. Accessory feet where required for freestanding equipment.

## **2.5 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING**

- A. General Requirements for Handholes and Boxes:
  - 1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
  - 2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Armorcast Products Company.
    - b. Carson Industries LLC.
    - c. CDR Systems Corporation; Hubbell Power Systems.
    - d. NewBasis.
    - e. Oldcastle Precast, Inc.; Christy Concrete Products.
    - f. Synertech Moulded Products; a division of Oldcastle Precast, Inc.
  - 2. Standard: Comply with SCTE 77.
  - 3. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
  - 4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
  - 5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
  - 6. Cover Legend: Molded lettering, "ELECTRIC".
  - 7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.

## **2.6 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES**

- A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
  - 1. Tests of materials shall be performed by an independent testing agency.
  - 2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
  - 3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012 and traceable to NIST standards.

## PART 3 - EXECUTION

### 3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
  - 1. Exposed Conduit: GRC.
  - 2. Concealed Conduit, Aboveground: GRC.
  - 3. Underground Conduit: RNC, Type EPC-40-PVC, concrete encased in areas subject to vehicle traffic and Type EPC-80-PVC, direct buried in non-vehicle traffic areas.
  - 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
  - 5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
- B. Indoors: Apply raceway or cabling products as specified below unless otherwise indicated:
  - 1. Exposed, Not Subject to Physical Damage: EMT or RNC.
  - 2. Exposed, Not Subject to Severe Physical Damage: EMT.
  - 3. Exposed and Subject to Severe Physical Damage: GRC.
  - 4. Concealed in Ceilings and Interior Walls and Partitions: EMT or residential cable NMC, NM type refer to Low Voltage Cable Section 260519 for application.
  - 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
  - 6. Damp or Wet Locations: GRC exposed, provide PVC RNC underground or undergrade.
  - 7. Boxes and Enclosures: NEMA 250, Type I, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations. Plastic outlet boxes may be applied with Non-metallic sheathed cable Type NM and NMC .
- C. Minimum Raceway Size: 3/4-inch trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
  - 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
  - 2. EMT: Use compression, steel or cast-metal fittings. Comply with NEMA FB 2.10.
  - 3. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
- E. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

### 3.2 INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

- B. 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.
- C. Complete raceway installation before starting conductor installation.
- D. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- E. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- F. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines. Cabling methods can be used concealed within finished walls, ceilings, and floors unless otherwise indicated or required by code.
- H. Support conduit within 12 inches of enclosures to which attached.
- I. Raceways Embedded in Slabs:
  - 1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot intervals.
  - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
  - 3. Arrange raceways to keep a minimum of 1 inch of concrete cover in all directions.
  - 4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
  - 5. Change from NC to GRC before rising above floor.
- J. Stub-ups to Above Recessed Ceilings:
  - 1. Use EMT, IMC, or RMC for raceways.
  - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
  - 3. NM or NMC non metallic sheathed cable may be applied above acoustical ceilings where supported per NEC requirements and in accordance with permitted use for residential application.
- K. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- L. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

- M. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- N. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- O. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- P. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- Q. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.
- R. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
  - I. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
  - 2. Where an underground service raceway enters a building or structure.
  - 3. Where otherwise required by NFPA 70.
- S. Comply with manufacturer's written instructions for solvent welding RNC and fittings.
- T. Expansion-Joint Fittings:
  - I. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
  - 2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
    - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
    - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
    - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
    - d. Attics: 135 deg F temperature change.
  - 3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install

- fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
  5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- U. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
1. Use LFMC in damp or wet locations subject to severe physical damage.
  2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
- V. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to bottom of box unless otherwise indicated. Coordinate outlet and switch box mounting heights with architectural cabinetry and built-in casework to avoid covering device locations with furniture. Advise A/E of any observed field interferences with device locations prior to rough in.
- W. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
- X. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel. Seal boxes to GWB to limit exterior air infiltration.
- Y. Locate boxes so that cover or plate will not span different building finishes.
- Z. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- AA. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

### **3.3 INSTALLATION OF UNDERGROUND CONDUIT**

- A. Direct-Buried Conduit:
- I. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.
    - a. For pipes and conduit less than 6 inches in nominal diameter, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.

2. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction.
3. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
  - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete for a minimum of 12 inches on each side of the coupling.
  - b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
4. Warning Planks: Bury warning planks approximately 12 inches above direct-buried conduits but a minimum of 6 inches below grade. Align planks along centerline of conduit.
5. Underground Warning Tape: Comply with requirements in Division 26 Section "Identification for Electrical Systems."
6. Earth Moving:
  - a. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth moving operations.
  - b. Protect and maintain erosion and sedimentation controls during earth moving operations.
  - c. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.
  - d. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.
    - I) If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

### **3.4 INSTALLATION OF UNDERGROUND HANHOLES AND BOXES**

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.
- D. Install handholes with bottom below frost line.
- E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables but short enough to preserve adequate working clearances in enclosure.
- F. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

### **3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS**

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

### **3.6 FIRESTOPPING**

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

### **3.7 PROTECTION**

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
  - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
  - 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

**END OF SECTION**

**SECTION 260544  
SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING**

**PART I - GENERAL**

**I.1 RELATED DOCUMENTS**

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

**I.2 SUMMARY**

- A. Section Includes:

1. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicone sealants.

- B. Related Requirements:

1. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

**I.3 ACTION SUBMITTALS**

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

**PART 2 - PRODUCTS**

**2.1 SLEEVES**

- A. Wall Sleeves:

1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

- B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board. Make seals airtight to GWB assemblies.
- C. Sleeves for Rectangular Openings:
  - 1. Material: Galvanized sheet steel.
  - 2. Minimum Metal Thickness:
    - a. For sleeve cross-section rectangle perimeter less than 50 inches and with no side larger than 16 inches, thickness shall be 0.052 inch.
    - b. For sleeve cross-section rectangle perimeter 50 inches or more and one or more sides larger than 16 inches, thickness shall be 0.138 inch.

## 2.2 SLEEVE-SEAL SYSTEMS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
  - I. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Advance Products & Systems, Inc.
    - b. CALPICO, Inc.
    - c. Metraflex Company (The).
    - d. Pipeline Seal and Insulator, Inc.
    - e. Proco Products, Inc.
  - 2. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
  - 3. Pressure Plates: Carbon steel.
  - 4. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

## 2.3 SLEEVE-SEAL FITTINGS

- A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.
  - I. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Presealed Systems.

## **2.4 GROUT**

- A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

## **2.5 SILICONE SEALANTS**

- A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
  - I. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
- B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

## **PART 3 - EXECUTION**

### **3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS**

- A. Comply with NECA 1.
- B. Comply with NEMA VE 2 for cable tray and cable penetrations.
- C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
  - I. Interior Penetrations of Non-Fire-Rated Walls and Floors:
    - a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
    - b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
  - 2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed.
  4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
  5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches above finished floor level. Install sleeves during erection of floors.
- D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
  2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.
- E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

### **3.2 SLEEVE-SEAL-SYSTEM INSTALLATION**

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.
- B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

### **3.3 SLEEVE-SEAL-FITTING INSTALLATION**

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeve-seal fittings.

#### **END OF SECTION**

**SECTION 260553  
IDENTIFICATION FOR ELECTRICAL SYSTEMS**

**PART I - GENERAL**

**I.1 RELATED DOCUMENTS**

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

**I.2 SUMMARY**

- A. Section Includes:

1. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Underground-line warning tape.
5. Warning labels and signs.
6. Instruction signs.
7. Equipment identification labels.
8. Miscellaneous identification products.

**I.3 ACTION SUBMITTALS**

- A. Product Data: For each electrical identification product indicated.

**I.4 QUALITY ASSURANCE**

- A. Comply with ANSI A13.1 and IEEE C2.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

**I.5 COORDINATION**

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those

required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

## PART 2 - PRODUCTS

### 2.1 POWER AND CONTROL RACEWAY IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.
- B. Colors for Raceways Carrying Circuits at 600 V or Less:
  - I. Black letters on an orange field.
  - 2. Legend: Indicate voltage and system or service type.
- C. Colors for Raceways Carrying Circuits at More Than 600 V:
  - I. Black letters on an orange field.
  - 2. Legend: "DANGER CONCEALED HIGH VOLTAGE WIRING."
- D. Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.
- E. Tape and Stencil for Raceways Carrying Circuits More Than 600 V: 4-inch- wide black stripes on 10-inch centers diagonally over orange background that extends full length of raceway or duct and is 12 inches wide. Stop stripes at legends.
- F. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.

### 2.2 ARMORED AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each cable size.
- B. Colors for Cables Carrying Circuits at 600 V and Less:
  - I. Black letters on an orange field.
  - 2. Legend: Indicate voltage and system or service type.

- C. Colors for Cables Carrying Circuits at More Than 600 V:
  - I. Black letters on an orange field.
  - 2. Legend: "DANGER HIGH VOLTAGE WIRING."
- D. Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.

## **2.3 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS**

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each cable size.
- B. Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.
- C. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.

## **2.4 CONDUCTOR IDENTIFICATION MATERIALS**

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.
- B. Self-Adhesive, Self-Laminating Polyester Labels: Preprinted, 3-mil- thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical-resistant, self-laminating, protective shield over the legend. Labels sized to fit the conductor diameter such that the clear shield overlaps the entire printed legend.
- C. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

## **2.5 UNDERGROUND-LINE WARNING TAPE**

- A. Tape:
  - I. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
  - 2. Printing on tape shall be permanent and shall not be damaged by burial operations.
  - 3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.
- B. Color and Printing:
  - I. Comply with ANSI Z535.1 through ANSI Z535.5.
  - 2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE.

3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE.

## **2.6 WARNING LABELS AND SIGNS**

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Baked-Enamel Warning Signs:
  1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
  2. 1/4-inch grommets in corners for mounting.
  3. Nominal size, 7 by 10 inches.
- C. Metal-Backed, Butyrate Warning Signs:
  1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for application.
  2. 1/4-inch grommets in corners for mounting.
  3. Nominal size, 10 by 14 inches.
- D. Warning label and sign shall include, but are not limited to, the following legends:
  1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
  2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

## **2.7 INSTRUCTION SIGNS**

- A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. inches and 1/8 inch thick for larger sizes.
  1. Engraved legend with black letters on white face.
  2. Punched or drilled for mechanical fasteners.
  3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

## **2.8 EQUIPMENT IDENTIFICATION LABELS**

- A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch.
- B. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch.

## **2.9 CABLE TIES**

- A. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, Type 6/6 nylon.
  - 1. Minimum Width: 3/16 inch.
  - 2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
  - 3. Temperature Range: Minus 40 to plus 185 deg F.
  - 4. Color: Black except where used for color-coding.
- B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self extinguishing, one piece, self locking, Type 6/6 nylon.
  - 1. Minimum Width: 3/16 inch.
  - 2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
  - 3. Temperature Range: Minus 40 to plus 185 deg F.
  - 4. Color: Black.
- C. Plenum-Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.
  - 1. Minimum Width: 3/16 inch.
  - 2. Tensile Strength at 73 deg F, According to ASTM D 638: 7000 psi.
  - 3. UL 94 Flame Rating: 94V-0.
  - 4. Temperature Range: Minus 50 to plus 284 deg F.
  - 5. Color: Black.

## **2.10 MISCELLANEOUS IDENTIFICATION PRODUCTS**

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.
- C. Provide Energy Code Certificate required by International Energy Conservation Code 2009 Edition paragraph 401.3. Coordinate with Owner and Architect on information required to complete certificate.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- F. Attach plastic raceway and cable labels that are not self-adhesive type with clear vinyl tape with adhesive appropriate to the location and substrate.
- G. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- H. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.
- I. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:
  - 1. Outdoors: UV-stabilized nylon.
  - 2. In Spaces Handling Environmental Air: Plenum rated.
- J. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.
- K. Painted Identification: Comply with requirements in painting Sections for surface preparation and paint application.

### **3.2 IDENTIFICATION SCHEDULE**

- A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A, and 120 V to ground: Identify with self-adhesive vinyl label. Install labels at 10-foot maximum intervals.
- B. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:
  - 1. Power.
  - 2. Communication.
  - 3. Fire Alarm System.

- C. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.
  - I. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.
    - a. Color shall be factory applied.
    - b. Colors for 208/120-V Circuits:
      - 1) Phase A: Black.
      - 2) Phase B: Red.
      - 3) Phase C: Blue.
- D. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.
- E. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive vinyl labels with the conductor or cable designation, origin, and destination.
- F. Control-Circuit Conductor Termination Identification: For identification at terminations provide self-adhesive vinyl labels with the conductor designation.
- G. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
  - I. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
  - 2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
  - 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.
- H. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
  - I. Limit use of underground-line warning tape to direct-buried cables.
  - 2. Install underground-line warning tape for both direct-buried cables and cables in raceway.
- I. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
- J. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Baked-enamel warning signs Metal-backed, butyrate warning signs.
  - I. Comply with 29 CFR 1910.145.

2. Identify system voltage with black letters on an orange background.
  3. Apply to exterior of door, cover, or other access.
  4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:
    - a. Power transfer switches.
    - b. Controls with external control power connections.
- K. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
- L. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
- I. Labeling Instructions:
    - a. Indoor Equipment: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1- 1/2-inch- high label; where two lines of text are required, use labels 2 inches high.
    - b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
    - c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
    - d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.
  2. Equipment to Be Labeled:
    - a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be engraved, laminated acrylic or melamine label.
    - b. Load Centers: Provide typewritten adhesive labels with circuit directories suitable for door installation in apartment panels.
    - c. Enclosures and electrical cabinets.
    - d. Access doors and panels for concealed electrical items.
    - e. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
    - f. Emergency system boxes and enclosures.
    - g. Enclosed switches.
    - h. Enclosed circuit breakers.
    - i. Enclosed controllers.
    - j. Push-button stations.
    - k. Power transfer equipment.
    - l. Contactors.

**END OF SECTION**

**SECTION 262416  
PANELBOARDS, LOAD CENTERS, AND METER CENTERS.**

**PART I - GENERAL**

**I.1 RELATED DOCUMENTS**

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

**I.2 SUMMARY**

- A. Section Includes:

1. Panelboards.
2. Apartment Load centers.
3. Meter centers.

**I.3 DEFINITIONS**

- A. SPD: Surge protective device.

**I.4 ACTION SUBMITTALS**

- A. Product Data: For each type of panelboard, load center, switching and overcurrent protective device, surge protective device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

**I.5 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For qualified testing agency.

- B. Field Quality-Control Reports:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

## **I.6 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For panelboards, load centers and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
  - 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
  - 2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

## **I.7 MAINTENANCE MATERIAL SUBMITTALS**

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Keys: Two spares for each type of panelboard cabinet lock.
  - 2. Circuit Breakers Including GFCI and Ground Fault Equipment Protection (GFEP) Types: Two spares for each panelboard minimum, unless otherwise indicated on schedules.

## **I.8 QUALITY ASSURANCE**

- A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA PB 1.
- D. Comply with NFPA 70.

## **I.9 DELIVERY, STORAGE, AND HANDLING**

- A. Handle and prepare panelboards, load centers, and meter centers for installation according to NEMA PB 1.

## **I.10 PROJECT CONDITIONS**

- A. Environmental Limitations:
  - I. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
  - a. Ambient Temperature: Not exceeding minus 22 deg F to plus 104 deg F.
  - b. Altitude: Not exceeding 6600 feet.
- B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
  1. Ambient temperatures within limits specified.
  2. Altitude not exceeding 6600 feet.

## I.II COORDINATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

## I.II WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.
  - I. Warranty Period: Five years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Enclosures: Flush- and surface-mounted cabinets.
  - I. Rated for environmental conditions at installed location.
    - a. Indoor Dry and Clean Locations: NEMA 250, Type I.
    - b. Outdoor Locations: NEMA 250, Type 3R.
    - c. Commercial Kitchen Areas: NEMA 250, Type 4X, stainless steel.
    - d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
    - e. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type I2.
  2. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
  3. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.

4. Finishes:
    - a. Panels and Trim: Steel and galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
    - b. Back Boxes: Same finish as panels and trim.
    - c. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components for exterior mounted equipment.
  5. Directory Card: Inside panelboard door, mounted in transparent card holder.
- B. Incoming Mains Location: Top and bottom.
- C. Phase, Neutral, and Ground Buses:
1. Material: Hard-drawn copper, 98 percent conductivity.
  2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
  3. Split Bus: Vertical buses divided into individual vertical sections.
- D. Conductor Connectors: Suitable for use with conductor material and sizes.
1. Material: Hard-drawn copper, 98 percent conductivity.
  2. Main and Neutral Lugs: Mechanical type.
  3. Ground Lugs and Bus-Configured Terminators: Mechanical type.
- E. Service Equipment Label: NRTL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.
- F. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- G. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.
- H. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
- I. Contactors in Main Bus: NEMA ICS 2, Class A, mechanically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.
  - I. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.

## 2.2 LOAD CENTERS FOR APARTMENT UNITS ONLY

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

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  3. Siemens Energy & Automation, Inc.
  4. Square D; a brand of Schneider Electric.
- B. Load Centers: Comply with UL 67.
- C. Mains: Circuit breaker main breakers.
- D. Branch Overcurrent Protective Devices: Plug-in circuit breakers, replaceable without disturbing adjacent units. Arc Flash or Arc Fault breakers, ground fault breakers, and switching duty breakers as scheduled on the plans. Residential overcurrent protection to match residential application.
- E. Conductor Connectors: Mechanical type for main, neutral, and ground lugs and buses.

### **2.3 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES**

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  3. Siemens Energy & Automation, Inc.
  4. Square D; a brand of Schneider Electric.
- B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
  2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
  3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:
    - a. Instantaneous trip.
    - b. Long- and short-time pickup levels.
    - c. Long- and short-time time adjustments.
    - d. Ground-fault pickup level, time delay, and  $I^2t$  response.
4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
  5. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
  6. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).

7. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
8. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
  - a. Standard frame sizes, trip ratings, and number of poles.
  - b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
  - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
  - d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
  - e. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
  - f. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-second time delay.
  - g. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts and "b" contacts operate in reverse of circuit-breaker contacts.
  - h. Alarm Switch: Single-pole, normally open contact that actuates only when circuit breaker trips.
  - i. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
  - j. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.
  - k. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in off position.
  - l. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.
  - m. No tandem breakers are allowed, nor ½ width breakers.

## **2.4 EQUIPMENT FOR ELECTRICITY METERING BY OWNER**

- A. Manufacturers:
  - I. Complete metering system shall be provided by same manufacturer.
    - a. Square D; Schneider Electric.
    - b. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
- B. Kilowatt-Hour/Demand Meter: Meters will be furnished by the power company.
- C. Multi-Meter Cabinet:
  - I. Listed or recommended by metering equipment manufacturer for use with multiple meters indicated. Provide meter cabinet configuration shown on the plans.

- D. Bussing and Cabinets: Meter center enclosures are NEMA 3R, U.L. listed as service entrance equipment with main devices and designed for wall mount, to meet NEC wire bending requirements. All unmetered conductor compartments may be sealed by utility company.
- E. Overcurrent Protection: Provide circuit breaker or fusible overcurrent protection size, type, and short circuit ratings as required by plans.

## **2.5 ACCESSORY COMPONENTS AND FEATURES**

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Receive, inspect, handle, and store panelboards according to NEMA PB I.I.
- B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION**

- A. Install panelboards, load centers and accessories according to NEMA PB I.I.
- B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
- C. Mount top of panel trim a maximum of 90 inches (2286 mm) above finished floor unless otherwise indicated. Mount load centers at heights required by ADA UDAG for maximum mounting height approved for handicapped units. Mount outdoor meter centers per manufacturers requirements and per local utility company metering requirements for the meter centers. All feeder breakers shall be accessible from ground level per NEC requirements.
- D. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- E. Install overcurrent protective devices and controllers not already factory installed.
  - I. Set field-adjustable, circuit-breaker trip ranges.

- F. Install filler plates in unused spaces.
- G. Stub four 1-inch (27-GRC) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future.
- H. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.
- I. Comply with NECA I.

### **3.3 IDENTIFICATION**

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 26 05 53 "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

### **3.4 FIELD QUALITY CONTROL**

- A. Perform tests and inspections.
- B. Tests and Inspections:
  - I. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- C. Panelboards , load centers, and meter centers will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

### **3.5 ADJUSTING**

- A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.
- B. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.
  - 1. Measure as directed during period of normal system loading.
  - 2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
  - 3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
  - 4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

**END OF SECTION**

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## **SECTION 262726 WIRING DEVICES**

### **PART I - GENERAL**

#### **I.1 RELATED DOCUMENTS**

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

#### **I.2 SUMMARY**

- A. Section Includes:

1. Receptacles, receptacles with integral GFCI, and associated device plates.
2. Weather-resistant receptacles.
3. Toggle switches
4. Cord and plug sets.
5. Residential Devices – Apartment Units Only.
6. Sight and Hearing Impaired Notification System.
7. Communications outlets.
8. Time Switch.

#### **I.3 DEFINITIONS**

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- D. RFI: Radio-frequency interference.
- E. TVSS: Transient voltage surge suppressor.
- F. UTP: Unshielded twisted pair.
- G. AFCI: Arc fault circuit interrupter.

#### **I.4 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:

1. Receptacles for Owner-Furnished Equipment: Match plug configurations.
2. Cord and Plug Sets: Match equipment requirements.

## **I.5 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

## **I.6 INFORMATIONAL SUBMITTALS**

- A. Field quality-control reports.

## **I.7 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

# **PART 2 - PRODUCTS**

## **2.1 MANUFACTURERS**

- A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
  1. Cooper Wiring Devices; Division of Cooper Industries, Inc. (Cooper).
  2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
  3. Leviton Mfg. Company Inc. (Leviton).
  4. Pass & Seymour/Legrand (Pass & Seymour).
- B. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

## **2.2 GENERAL WIRING-DEVICE REQUIREMENTS**

- A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. All receptacles and light switches shall be commercial specification grade.
- C. Comply with NFPA 70.
- D. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:
  1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
  2. Devices shall comply with the requirements in this Section.

### **2.3 STRAIGHT-BLADE RECEPTACLES**

- A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.
- I. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
- a. Cooper; 5351 (single), CR5362 (duplex).
  - b. Hubbell; HBL5351 (single), HBL5352 (duplex).
  - c. Leviton; 5891 (single), 5352 (duplex).
  - d. Pass & Seymour; 5361 (single), 5362 (duplex).

### **2.4 GFCI RECEPTACLES**

- A. General Description:
1. Straight blade, non-feed-through type.
  2. Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 943 Class A, and FS W-C-596.
  3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.
- B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:
- I. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
- a. Cooper; VGF20.
  - b. Hubbell; GFR5352L.
  - c. Pass & Seymour; 2095.
  - d. Leviton; 7590.

### **2.5 CORD AND PLUG SETS**

- A. Description:
1. Match voltage and current ratings and number of conductors to requirements of equipment being connected.
  2. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and ampacity of at least 130 percent of the equipment rating.
  3. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

### **2.6 TOGGLE SWITCHES**

- A. Comply with NEMA WD 1, UL 20, and FS W-S-896.

B. Switches, 120/277 V, 20 A:

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

a. Single Pole:

- 1) Cooper; AHI221.
- 2) Hubbell; HBL1221.
- 3) Leviton; 1221-2.
- 4) Pass & Seymour; CSB20AC1.

b. Two Pole:

- 1) Cooper; AHI222.
- 2) Hubbell; HBL1222.
- 3) Leviton; 1222-2.
- 4) Pass & Seymour; CSB20AC2.

c. Three Way:

- 1) Cooper; AHI223.
- 2) Hubbell; HBL1223.
- 3) Leviton; 1223-2.
- 4) Pass & Seymour; CSB20AC3.

d. Four Way:

- 1) Cooper; AHI224.
- 2) Hubbell; HBL1224.
- 3) Leviton; 1224-2.
- 4) Pass & Seymour; CSB20AC4.

C. Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches: 120/277 V, 20 A; for use with mechanically held lighting contactors.

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

- a. Cooper; 1995.
- b. Hubbell; HBL1557.
- c. Leviton; 1257.
- d. Pass & Seymour; 1251.

D. Vacancy Detectors for wall box and remote ceiling mounted devices, provide for manual on control with auto-off upon occupant leaving the space.

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

- a. Pass & Seymour
- b. Cooper
- c. Hubbell
- d. Leviton

## **2.7 RESIDENTIAL DEVICES APARTMENT UNITS ONLY**

- A. Residential-Grade, Tamper-Resistant Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, and UL 498.
  - I. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Cooper; TR270.
    - b. Hubbell; RR155TR.
    - c. Leviton; T5320.
    - d. Pass & Seymour; TR62.
  - 2. Description: Labeled to comply with NFPA 70, "Receptacles, Cord Connectors, and Attachment Plugs (Caps)" Article, "Tamper-Resistant Receptacles in Dwelling Units" Section.
- B. Bathroom Fan and Light Control:
  - I. Provide a three function control switch with the following functions: light and fan on/off control. Switch shall fit in a standard single gang box and be toggle type. Switch shall be residential grade. Coordinate switch with fan/heater/light provided.
- C. Telephone/data Outlet: Prewired CAT6 cable with outlet box and device plates. Demarc equipment and data switches and routers by service providers.
- D. TV Outlet: Prewire coaxial cable, outlet box and device plates. System CATV headend by Service provider.
- E. Building Alarm Outlet: Prewire with system cable see below.

## **2.8 SIGHT AND HEARING IMPAIRED NOTIFICATION SYSTEM**

- A. General
  - I. Complete system shall be provided by the same manufacturer.
  - 2. System components shall have multiple radio signal channel selections to allow changes to avoid other similar systems or interferences.
  - 3. Provide a complete system (other than those devices indicated as owner provided) to notify sight and hearing impaired tenants of the following devices/alarms through flashing notification lights and bed shaker:
    - a. Doorbell Activation.

- b. Smoke Detector Activation
- c. Building Alarm Device Activation.
- d. Alarm Clock Alarm.
- e. Phone Ringing.

B. Base Unit

- 1. AC power: Standard plug for 120 Volt NEMA 5-20R receptacle
- 2. Integral Battery Backup: Replaceable batteries for temporary power outages.
- 3. Wireless Connections to interface with the following devices:
  - a. Doorbell Device.
  - b. Up to 3 Audio Alarm Transmitters.
  - c. Up to 2 Remote Receivers.
- 4. Connect to standard phone outlet to provide interface output to phone/TDD device.
- 5. Hard wire connection to Bed shaker.
- 6. Standard 120 Volt NEMA 5-20R integral receptacle (300watt) for connection to notification lamp.
- 7. Base unit shall activate remote receiver(s), internal outlet, and bed shaker upon receiving signal from doorbell, audio alarm transmitters (smoke detector, building alarm, and intercom device), phone ringing, and alarm clock alarm. The remote receiver and internal outlet shall flash connected lamp source as a visual notification of the alarm. The bed shaker shall also be activated which will shake the bed upon the notification of the alarm.
- 8. Alarm Timed Out: The base unit will reset after 30 seconds of activation if not acknowledged. If the alarm devices continue to alarm/activate, the base unit will reactive until timed out again. Notification and timed out cycle will continue until the alarm is acknowledged or the alarm device is no longer activated.
- 9. Alarm Indicator Lights Integral to base unit shall be activated by respective alarm signal and reset when alarm is acknowledged or when alarm is timed out.
  - a. Phone.
  - b. Doorbell.
  - c. Clock Alarm.
  - d. Audio Alarm Transmitter (smoke detector, building alarm, and intercom device).
- 10. Alarm Reset Button shall acknowledge alarm and reset alarm notification.
- 11. Alarm Clock Function shall be integral to base unit and activate alarms bed shaker and remote receiver(s) and integral receptacle.

C. Bed Shaker:

- 1. Bed shaker shall be rated for the intended use of vibrating to shake the bed when placed under the pillow or on the bed frame to wake the tenant.
- 2. Shaker shall hard connect to the base unit. Minimum 10' cord connection.
- 3. Shaker shall be activated by the base unit upon alarm.

D. Door Bell:

- I. Integral Battery Powered: Replaceable batteries for extended use.
  2. Transmit wireless alarm signal to base unit when activated.
  3. Wireless range from base unit: 80-feet minimum.
- E. Audio Alarm Transmitter:
- I. Integral Battery Powered: Replaceable batteries for extended use.
  2. Unit shall detect audible alarm/activation of either of the smoke detector, building alarm, and intercom device that it is located adjacent to. Upon activation device shall transmit wireless alarm signal to base unit.
  3. Wireless range from base unit: 80-feet minimum.
- F. Remote Receiver
- I. AC power: Standard plug for 120 Volt NEMA 5-20R receptacle.
  2. Shall be activated by a wireless alarm signal from the base unit for alarm notification.
  3. Shall flash connected notification lamp for alarm notification until alarm is acknowledged at base unit.
  4. Wireless range from base unit: 80-feet minimum.
- G. Notification Lamp – Provided by owner.
- I. Notification Lamp that plugs into remote receiver for tenant visual notification.
- H. Phone/TDD Device – Provided by owner.
- I. Shall hard connect to base unit.
  2. Upon receiving a call the base unit will activate the notification devices indicating an incoming call.
  3. Answering the phone resets the alarm notification on the base unit.

## **2.9 WALL PLATES**

- A. Single and combination types shall match corresponding wiring devices.
- I. Plate-Securing Screws: Metal with head color to match plate finish.
  2. Material for Finished Spaces: Steel with white baked enamel, suitable for field painting.
  3. Material for Unfinished Spaces: Galvanized steel.
  4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant while in use cover, die-cast aluminum with lockable cover.

## **2.10 COMMUNICATION DEVICES**

- A. All phone, internet, and TV devices are to be installed in this contract with pre-wiring installed and grouped together end point terminations close to the buildings meter centers with 23 inches of wiring extending beyond the building exterior wall.

## **2.11 FINISHES**

- A. Device Color:
  - I. Wiring Devices shall be ivory in color with matching cover plates.

## **2.12 INSTALLATION**

- A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.
- B. Coordination with Other Trades:
  - I. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
  - 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
  - 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
  - 4. Install wiring devices after all wall preparation, including painting, is complete.
- C. Conductors:
  - I. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
  - 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
  - 3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
- D. Device Installation:
  - I. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
  - 2. Caulk around outlet box openings to make the opening air tight. This is an Earth Craft requirement.
  - 3. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
  - 4. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.

5. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
  6. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
  7. Use a torque screwdriver when a torque is recommended or required by manufacturer.
  8. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
  9. Tighten unused terminal screws on the device.
  10. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.
- E. Receptacle Orientation:
- I. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.
- F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.
- G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

## **2.13 GFCI RECEPTACLES**

- A. Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

## **2.14 FIELD QUALITY CONTROL**

- A. Perform the following tests and inspections:
- I. Test Instruments: Use instruments that comply with UL 1436.
  2. Test Instrument for Convenience Receptacles: Plug-in wiring analyzer with push to trip GFCI tester.
  3. Test complete sight and hearing impaired notification system works with all components including owner provided equipment.
- B. Tests for Convenience Receptacles:
- I. Line Voltage: Acceptable range is 105 to 132 V.
  2. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
  3. Using the test plug, verify that the device and its outlet box are securely mounted.
  4. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.
- C. Wiring device will be considered defective if it does not pass tests and inspections.

- D. Prepare test and inspection reports.

**END OF SECTION**

**SECTION 262813  
FUSES**

**PART I - GENERAL**

**I.1 RELATED DOCUMENTS**

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

**I.2 SUMMARY**

- A. Section Includes:

- I. Cartridge fuses rated 600-V ac and less for use in control circuits, enclosed switches, and enclosed controllers.

**I.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated. Include construction details, material, dimensions, descriptions of individual components, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:

- I. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
  - a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
  - b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.
2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.

**I.4 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

- I. Ambient temperature adjustment information.
2. Current-limitation curves for fuses with current-limiting characteristics.

## **I.5 MAINTENANCE MATERIAL SUBMITTALS**

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - I. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.

## **I.6 QUALITY ASSURANCE**

- A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA FU 1 for cartridge fuses.
- D. Comply with NFPA 70.

## **I.7 PROJECT CONDITIONS**

- A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F or more than 100 deg F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

## **I.8 COORDINATION**

- A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

# **PART 2 - PRODUCTS**

## **2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - I. Cooper Bussmann, Inc.
  - 2. Edison Fuse, Inc.
  - 3. Ferraz Shawmut, Inc.
  - 4. Littelfuse, Inc.

## **2.2 CARTRIDGE FUSES**

- A. Characteristics: NEMA FU I, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.
- B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.
- C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 FUSE APPLICATIONS**

- A. Cartridge Fuses:
  1. Feeders: Class RK1, fast acting.
  2. Motor Branch Circuits: Class RK5, time delay.
  3. Other Branch Circuits: Class RK1, time delay or Class RK5, time delay.
  4. Control Circuits: Class CC, time delay.

### **3.3 INSTALLATION**

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

### **3.4 IDENTIFICATION**

- A. Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder.

**END OF SECTION**

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**SECTION 262816  
ENCLOSED SWITCHES AND CIRCUIT BREAKERS**

**PART I - GENERAL**

**I.1 RELATED DOCUMENTS**

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

**I.2 SUMMARY**

- A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.
3. Molded-case circuit breakers (MCCBs).
4. Enclosures.

**I.3 DEFINITIONS**

- A. NC: Normally closed.  
B. NO: Normally open.  
C. SPDT: Single pole, double throw.

**I.4 ACTION SUBMITTALS**

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
1. Enclosure types and details for types other than NEMA 250, Type I.
  2. Current and voltage ratings.
  3. Short-circuit current ratings (interrupting and withstand, as appropriate).
  4. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
- B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.
- I. Wiring Diagrams: For power, signal, and control wiring.

## **I.5 INFORMATIONAL SUBMITTALS**

- A. Field quality-control reports.
  - 1. Test procedures used.
  - 2. Test results that comply with requirements.
  - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

## **I.6 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
  - I. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.

## **I.7 MAINTENANCE MATERIAL SUBMITTALS**

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - I. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
  - 2. Fuse Pullers: Two for each size and type.

## **I.8 QUALITY ASSURANCE**

- A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NFPA 70.

## **I.9 PROJECT CONDITIONS**

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
  - I. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
  - 2. Altitude: Not exceeding 6,600 feet.

## I.10 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

# PART 2 - PRODUCTS

## 2.1 FUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  3. Siemens Energy & Automation, Inc.
  4. Square D; a brand of Schneider Electric.
- B. Type GD, General Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS I, horsepower rated, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept padlock and interlocked with cover in closed position.
- C. Accessories:
1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
  2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
  3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
  4. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
  5. Lugs: Mechanical type, suitable for number, size, and conductor material.
  6. Service-Rated Switches: Labeled for use as service equipment.
  7. Accessory Control Power Voltage: Remote mounted and powered; 24-V ac.

## 2.2 NONFUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  3. Siemens Energy & Automation, Inc.
  4. Square D; a brand of Schneider Electric.

- B. Type GD, General Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS I, horsepower rated, lockable handle with capability to accept padlock and interlocked with cover in closed position.
- C. Accessories:
  - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
  - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
  - 3. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
  - 4. Lugs: Mechanical type, suitable for number, size, and conductor material.
  - 5. Accessory Control Power Voltage: Remote mounted and powered; 24-V ac.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION**

- A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- C. Install fuses in fusible devices.
- D. Comply with NECA I.

### **3.3 IDENTIFICATION**

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems."
  - I. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
  - 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

### **3.4 FIELD QUALITY CONTROL**

- A. Perform tests and inspections.
- B. Acceptance Testing Preparation:
  - I. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
  - 2. Test continuity of each circuit.
- C. Tests and Inspections:
  - I. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
  - 3. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

### **3.5 ADJUSTING**

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges

**END OF SECTION**

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**SECTION 265100  
INTERIOR LIGHTING**

**PART I - GENERAL**

**I.1 RELATED DOCUMENTS**

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

**I.2 SUMMARY**

- A. Section Includes:

1. Interior lighting fixtures and lamps.
2. Emergency lighting units.
3. Exit signs.
4. Lighting fixture supports.

- B. Related Sections:

1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including photoelectric switches and occupancy sensors.
2. Section 262726 "Wiring Devices" for manual wall-box switches.

**I.3 DEFINITIONS**

- A. CCT: Correlated color temperature.
- B. CRI: Color-rendering index.
- C. HID: High-intensity discharge.
- D. LER: Luminaire efficacy rating.
- E. Lumen: Measured output of lamp and luminaire, or both.
- F. Luminaire: Complete lighting fixture, including ballast housing if provided.

**I.4 ACTION SUBMITTALS**

- A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:
- I. Physical description of lighting fixture including dimensions.

2. Emergency lighting units including battery and charger.
3. Energy-efficiency data. (Energy Star Rating Required)
4. Life, output (lumens, CCT, and CRI), and energy-efficiency data for lamps.
5. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing & Calculation Guides, of each lighting fixture type. The adjustment factors shall be for lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.
  - a. Testing Agency Certified Data: For indicated fixtures, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining fixtures shall be certified by manufacturer.
  - b. Manufacturer Certified Data: Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Installation instructions.

## **I.5 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  1. Lighting fixtures.
  2. Partitions and millwork that penetrate the ceiling or extends to within 12 inches of the plane of the luminaires.
  3. Ceiling-mounted projectors.
  4. Structural members to which suspension systems for lighting fixtures will be attached.
  5. Other items in finished ceiling including the following:
    - a. Air outlets and inlets.
    - b. Smoke and fire detectors.
    - c. Occupancy sensors.
    - d. Access panels.
- B. Qualification Data: For qualified agencies providing photometric data for lighting fixtures.
- C. Field quality-control reports.
- D. Warranty: Sample of special warranty.

## **I.6 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.
  - I. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

## **I.7 MAINTENANCE MATERIAL SUBMITTALS**

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Lamps: 10 for every 100 of each type and rating installed. Furnish at least one of each type.
  - 2. Plastic Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
  - 3. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

## **I.8 QUALITY ASSURANCE**

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910, complying with the IESNA Lighting Measurements Testing & Calculation Guides.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NFPA 70.

## **I.9 COORDINATION**

- A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.
- B. Coordinate with other trades for space above ceilings.

## **I.10 WARRANTY**

- A. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period for Emergency Lighting Unit Batteries: 10 years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining nine years.
  - 2. Warranty Period for Emergency Fluorescent Ballast and Self-Powered Exit Sign Batteries: Seven years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining six years.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, product(s) indicated on Drawings.

### 2.2 GENERAL REQUIREMENTS FOR LIGHTING FIXTURES AND COMPONENTS

- A. All fixtures shall be Energy Star Rated unless otherwise indicated.
- B. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.
- C. Fluorescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.
- D. Metal Parts: Free of burrs and sharp corners and edges.
- E. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.
- F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- G. Diffusers and Globes:
- I. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
    - a. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
    - b. UV stabilized.
  2. Glass: Annealed crystal glass unless otherwise indicated.
- H. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
- I. Label shall include the following lamp and ballast characteristics:
    - a. "USE ONLY" and include specific lamp type.
    - b. Lamp diameter code (T-4, T-5, T-8, T-12, etc.), tube configuration (twin, quad, triple, etc.), base type, and nominal wattage for fluorescent and compact fluorescent luminaires.
    - c. Start type (preheat, rapid start, instant start, etc.) for fluorescent and compact fluorescent luminaires.

- d. CCT and CRI for all luminaires.

## **2.3 BALLASTS FOR LINEAR FLUORESCENT LAMPS**

- A. General Requirements for Electronic Ballasts:
  - 1. Comply with UL 935 and with ANSI C82.11.
  - 2. Designed for type and quantity of lamps served.
  - 3. Ballasts shall be designed for full light output unless another BF, dimmer, or bi-level control is indicated.
  - 4. Sound Rating: Class A.
  - 5. Total Harmonic Distortion Rating: Less than 10 percent.
  - 6. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
  - 7. Operating Frequency: 42 kHz or higher.
  - 8. Lamp Current Crest Factor: 1.7 or less.
  - 9. BF: 0.88 or higher.
  - 10. Power Factor: 0.98 or higher.
- B. Luminaires controlled by occupancy sensors shall have programmed-start ballasts.
- C. Electronic Programmed-Start Ballasts for T8 Lamps: Comply with ANSI C82.11 and the following:
  - 1. Lamp end-of-life detection and shutdown circuit for T5 diameter lamps.
  - 2. Automatic lamp starting after lamp replacement.
- D. Electromagnetic Ballasts: Comply with ANSI C82.1; energy saving, high-power factor, Class P, and having automatic-reset thermal protection.
  - I. Ballast Manufacturer Certification: Indicated by label.
- E. Ballasts for Low-Temperature Environments:
  - 1. Temperatures 0 Deg F and Higher: Electronic or electromagnetic type rated for 0 deg F starting and operating temperature with indicated lamp types.
  - 2. Temperatures Minus 20 Deg F and Higher: Electromagnetic type designed for use with indicated lamp types.
- F. Ballasts for Residential Applications: Fixtures designated as "Residential" may use low-power-factor electronic ballasts having a Class B sound rating and total harmonic distortion of approximately 30 percent.

## **2.4 BALLASTS FOR COMPACT FLUORESCENT LAMPS**

- A. Description: Electronic-programmed rapid-start type, complying with UL 935 and with ANSI C 82.11, designed for type and quantity of lamps indicated. Ballast shall be designed for full light output unless dimmer or bi-level control is indicated:

1. Lamp end-of-life detection and shutdown circuit.
2. Automatic lamp starting after lamp replacement.
3. Sound Rating: Class A.
4. Total Harmonic Distortion Rating: Less than 20 percent.
5. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
6. Operating Frequency: 20 kHz or higher.
7. Lamp Current Crest Factor: 1.7 or less.
8. BF: 0.95 or higher unless otherwise indicated.
9. Power Factor: 0.98, except fixtures designated as "Residential" may use low-power-factor electronic ballasts or higher.
10. Interference: Comply with 47 CFR 18, Ch. I, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.

## **2.5 BALLASTS FOR HID LAMPS**

- A. Electromagnetic Ballast for Metal-Halide Lamps: Comply with ANSI C82.4 and UL 1029. Include the following features unless otherwise indicated:
  1. Ballast Circuit: Constant-wattage autotransformer or regulating high-power-factor type.
  2. Minimum Starting Temperature: Minus 22 deg F for single-lamp ballasts.
  3. Rated Ambient Operating Temperature: 104 deg F.
  4. Open-circuit operation that will not reduce average life.
  5. Low-Noise Ballasts: Manufacturers' standard epoxy-encapsulated models designed to minimize audible fixture noise.
- B. Electronic Ballast for Metal-Halide Lamps: Include the following features unless otherwise indicated:
  1. Minimum Starting Temperature: Minus 20 deg F for single-lamp ballasts.
  2. Rated Ambient Operating Temperature: 130 deg F.
  3. Lamp end-of-life detection and shutdown circuit.
  4. Sound Rating: Class A.
  5. Total Harmonic Distortion Rating: Less than 20 percent.
  6. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
  7. Lamp Current Crest Factor: 1.5 or less.
  8. Power Factor: 0.90 or higher.
  9. Interference: Comply with 47 CFR 18, Ch. I, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.
  10. Protection: Class P thermal cutout.

## **2.6 EXIT SIGNS**

- A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
- B. Internally Lighted Signs:
  - I. Lamps for AC Operation: LEDs, 50,000 hours minimum rated lamp life.

2. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
  - a. Battery: Sealed, maintenance-free, lead calcium type.
  - b. Charger: Fully automatic, solid-state type with sealed transfer relay.
  - c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
  - d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
  - e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
  - f. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

## 2.7 EMERGENCY LIGHTING UNITS

- A. General Requirements for Emergency Lighting Units: Self-contained units complying with UL 924.
  1. Battery: Sealed, maintenance-free, lead-calcium type.
  2. Charger: Fully automatic, solid-state type with sealed transfer relay.
  3. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
  4. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
  5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
  6. Integral Time-Delay Relay: Holds unit on for fixed interval of 15 minutes when power is restored after an outage.
  7. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

## 2.8 FLUORESCENT LAMPS

- A. T8 rapid-start lamps, rated 32 W maximum, nominal length of 48 inches, 2800 initial lumens (minimum), CRI 75 (minimum), color temperature 3500 K, and average rated life 20,000 hours unless otherwise indicated.

- B. T8 rapid-start lamps, rated 17 W maximum, nominal length of 24 inches, 1300 initial lumens (minimum), CRI 75 (minimum), color temperature 3500 K, and average rated life of 20,000 hours unless otherwise indicated.
- C. Compact Fluorescent Lamps: 4-Pin, CRI 80 (minimum), color temperature 3500 K, average rated life of 10,000 hours at three hours operation per start unless otherwise indicated.
  - 1. 13 W: T4, double or triple tube, rated 900 initial lumens (minimum).
  - 2. 18 W: T4, double or triple tube, rated 1200 initial lumens (minimum).
  - 3. 26 W: T4, double or triple tube, rated 1800 initial lumens (minimum).
  - 4. 32 W: T4, triple tube, rated 2400 initial lumens (minimum).
  - 5. 42 W: T4, triple tube, rated 3200 initial lumens (minimum).
  - 6. 70 W: T4, triple tube, rated 5200 initial lumens (minimum).

## **2.9 LED LIGHTING FIXTURES**

- A. Components: UL 8750 recognized or listed as applicable.
- B. Tested in accordance with IES LM-79 and IES LM-80.
- C. LED estimated useful light: minimum of 50,000 hours at 70% lumen maintenance.
- D. LEDs controlled by vacancy sensor and manual switches.
- E. LEDs where dimmed levels are required by control and auto level sensors as indicated on plans.

## **2.10 LIGHTING FIXTURE SUPPORT COMPONENTS**

- A. Comply with Section 260529 "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.
- C. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.
- D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage.
- E. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gage.
- F. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
- G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Lighting fixtures:
  - 1. Set level, plumb, and square with ceilings and walls unless otherwise indicated.
  - 2. Install lamps in each luminaire.
- B. Temporary Lighting: If it is necessary, and approved by Architect, to use permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When construction is sufficiently complete, remove the temporary luminaires, disassemble, clean thoroughly, install new lamps, and reinstall.
- C. Lay-in Ceiling Lighting Fixtures Supports:
  - 1. Install ceiling support system rods or wires, independent of the ceiling suspension devices, for each fixture. Locate not more than 6 inches from lighting fixture corners.
  - 2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
  - 3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.
- D. Suspended Lighting Fixture Support:
  - 1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
  - 2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
  - 3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
  - 4. Do not use grid as support for pendant luminaires. Connect support wires or rods to building structure.
- E. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

### 3.2 IDENTIFICATION

- A. Install labels with panel and circuit numbers on concealed junction and outlet boxes. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

### 3.3 FIELD QUALITY CONTROL

- A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.

- B. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

#### **3.4     STARTUP SERVICE**

- A. Burn-in all lamps that require specific aging period to operate properly, prior to occupancy by Owner.

#### **3.5     ADJUSTING**

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting aimable luminaires to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose. Some of this work may be required after dark.

- I. Adjust aimable luminaires in the presence of Architect.

#### **END OF SECTION**

**SECTION 270544**  
**SLEEVES AND SLEEVE SEALS FOR COMMUNICATIONS PATHWAYS AND CABLING**

**PART I - GENERAL**

**I.1 RELATED DOCUMENTS**

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

**I.2 SUMMARY**

- A. Section Includes:

1. Sleeves for pathway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicone sealants.

- B. Related Requirements:

1. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

**I.3 ACTION SUBMITTALS**

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

**PART 2 - PRODUCTS**

**2.1 SLEEVES**

- A. Wall Sleeves:

1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

- B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.
- C. Sleeves for Rectangular Openings:
  - 1. Material: Galvanized-steel sheet.
  - 2. Minimum Metal Thickness:
    - a. For sleeve cross-section rectangle perimeter less than 50 inches and with no side larger than 16 inches, thickness shall be 0.052 inch.
    - b. For sleeve cross-section rectangle perimeter 50 inches or more and one or more sides larger than 16 inches, thickness shall be 0.138 inch.

## **2.2 SLEEVE-SEAL SYSTEMS**

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and pathway or cable.
  - I. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Advance Products & Systems, Inc.
    - b. CALPICO, Inc.
    - c. Metraflex Company (The).
    - d. Pipeline Seal and Insulator, Inc.
    - e. Proco Products, Inc.
  - 2. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
  - 3. Pressure Plates: Carbon steel.
  - 4. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

## **2.3 SLEEVE-SEAL FITTINGS**

- A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.
  - I. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Presealed Systems.

## **2.4 GROUT**

- A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

## **2.5 SILICONE SEALANTS**

- A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
  - I. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
- B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

## **PART 3 - EXECUTION**

### **3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS**

- A. Comply with NECA 1.
- B. Comply with NEMA VE 2 for cable tray and cable penetrations.
- C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
  - I. Interior Penetrations of Non-Fire-Rated Walls and Floors:
    - a. Seal annular space between sleeve and pathway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
    - b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
  - 2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and pathway or cable unless sleeve seal is to be installed.
  4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
  5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches above finished floor level. Install sleeves during erection of floors.
- D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
  2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.
- E. Roof-Penetration Sleeves: Seal penetration of individual pathways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between pathway or cable and sleeve for installing sleeve-seal system.

### **3.2 SLEEVE-SEAL-SYSTEM INSTALLATION**

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at pathway entries into building.
- B. Install type and number of sealing elements recommended by manufacturer for pathway or cable material and size. Position pathway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pathway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

### **3.3 SLEEVE-SEAL-FITTING INSTALLATION**

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeve-seal fittings.

### **END OF SECTION**

**SECTION 31 1000**  
**SITE CLEARING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Clearing and protection of vegetation.
- B. Removal of debris.

**1.02 RELATED REQUIREMENTS**

- A. Section 01 5000 - Temporary Facilities and Controls: Site fences, security, protective barriers, and waste removal.
- B. Section 01 7000 - Execution and Closeout Requirements: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products.
- C. Section 31 2200 - Grading: Topsoil removal.
- D. Section 31 2323 - Fill: Fill material for filling holes, pits, and excavations generated as a result of removal operations.

**PART 2 PRODUCTS**

**2.01 MATERIALS**

- A. Fill Material: As specified in Section 31 2200 - Grading.

**PART 3 EXECUTION**

**3.01 PREPARATION**

- A. Call Local Utility Line Information service at number shown on Drawings not less than three working days before performing Work.
  - 1. Request underground utilities to be located and marked within and surrounding construction areas.

**3.02 SITE CLEARING**

- A. Comply with other requirements specified in Section 01 7000.
- B. Minimize production of dust due to clearing operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.

**3.03 EXISTING UTILITIES AND BUILT ELEMENTS**

- A. Coordinate Work with utility companies; notify before starting Work and comply with their requirements; obtain required permits.
- B. Protect existing utilities to remain from damage.
- C. Do not disrupt public utilities without permit from authority having jurisdiction.
- D. Protect improvements on adjoining properties as well as those on the Owner's property.
- E. Restore any improvements damaged by this Work to their original condition, as acceptable to the Owner, other parties, or authorities having jurisdiction.

**3.04 VEGETATION**

- A. Scope: Remove trees, shrubs, brush, and stumps in areas to be covered by building structure, paving, playing fields, lawns, and planting beds.
- B. Do not remove or damage vegetation beyond the "Construction Limits" indicated on the Drawings.
  - 1. Trees and shrubs that are to remain within "Construction Limits" will be indicated on Drawings or conspicuously marked on site.
  - 2. Unless otherwise noted, trees within the "Construction Limits" shall become the property of the Contractor and shall be removed from the site.

3. Provide protection for roots and branches over 1-1/2 inches in diameter that are cut during construction operations. Coat the cut faces with an emulsified asphalt or other coating especially formulated for horticultural use on cut or damaged plant tissues. Temporarily cover all exposed roots with wet burlap to prevent roots from drying out. Provide earth cover as soon as possible.
- C. Install substantial, highly visible fences at least 3 feet high to prevent inadvertent damage to vegetation to remain:
  1. Around trees to remain within vegetation removal limits; locate no closer to tree than at the drip line.
- D. In areas where vegetation must be removed but no construction will occur other than pervious paving, remove vegetation with minimum disturbance of the subsoil.
- E. Vegetation Removed: Do not burn, bury, landfill, or leave on site, except as indicated.
  1. Chip, grind, crush, or shred vegetation for mulching, composting, or other purposes; preference should be given to on-site uses.
  2. Trees: Sell if marketable; if not, treat as specified for other vegetation removed; remove stumps and roots to depth of 18 inches.
  3. Sod: Re-use on site if possible; otherwise sell if marketable, and if not, treat as specified for other vegetation removed.
  4. Fill holes left by removal of stumps and roots, using suitable fill material, with top surface neat in appearance and smooth enough not to constitute a hazard to pedestrians.
- F. Remove above-grade improvements such as posts, poles, fences, and other Work as specifically indicated or necessary to permit new construction.
- G. Dead Wood: Remove all dead trees (standing or down), limbs, and dry brush on entire site; treat as specified for vegetation removed.
- H. Restoration: If vegetation outside removal limits or within specified protective fences is damaged or destroyed due to subsequent construction operations, replace at no cost to Owner.

### **3.05 DEBRIS**

- A. Continuously clean-up and remove waste materials from site. Do not allow materials to accumulate on site.
- B. Remove debris, rock, extracted plant life, junk, and trash from site.
- C. Remove paving, curbs, and slabs.
- D. Where indicated on Drawings, partially remove paving, curbs, and slabs. Neatly saw cut edges at right angle to surface.
- E. Do not burn or bury materials on site unless authorized in writing by authority having jurisdiction.
- F. Leave site in clean condition, ready for subsequent work.
- G. Clean up spillage and wind-blown debris from public and private lands.

**END OF SECTION 31 1000**

**SECTION 31 2200**  
**GRADING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Removal and storage of topsoil.
- B. Rough grading the site.
- C. Topsoil and finish grading .

**1.02 RELATED REQUIREMENTS**

- A. Section 31 1000 - Site Clearing.
- B. Section 31 2316 - Excavation.
- C. Section 31 2316.13 - Trenching: Trenching and backfilling for utilities.
- D. Section 31 2323 - Fill: Filling and compaction.
- E. Section 32 9219 - Seeding: Finish ground cover.

**PART 2 PRODUCTS**

**2.01 MATERIALS**

- A. Topsoil: See Section 31 2323.
- B. Other Fill Materials: See Section 31 2323.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

- A. Verify that survey bench mark and intended elevations for the Work are as indicated.

**3.02 PREPARATION**

- A. Identify required lines, levels, contours, and datum.
- B. Stake and flag locations of known utilities.
- C. Locate, identify, and protect from damage above- and below-grade utilities to remain.
- D. Protect site features to remain, including but not limited to bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs, from damage by grading equipment and vehicular traffic.
- E. Protect trees to remain by providing substantial fencing around entire tree at the outer tips of its branches; no grading is to be performed inside this line.

**3.03 ROUGH GRADING**

- A. Remove topsoil from areas to be further excavated, re-landscaped, or re-graded, without mixing with foreign materials.
- B. Do not remove topsoil when wet.
- C. Remove subsoil from areas to be further excavated, re-landscaped, or re-graded.
- D. Do not remove wet subsoil, unless it is subsequently processed to obtain optimum moisture content.
- E. When excavating through roots, perform work by hand and cut roots with sharp axe.
- F. See Section 31 2323 for filling procedures.
- G. Benching Slopes: Horizontally bench existing slopes greater than 3:1 to key fill material to slope for firm bearing.
- H. Stability: Replace damaged or displaced subsoil to same requirements as for specified fill.

**3.04 SOIL REMOVAL AND STOCKPILING**

- A. Stockpile topsoil to be re-used on site; remove remainder from site.

- B. Stockpile subsoil to be re-used on site; remove remainder from site.
- C. Stockpiles: Use areas designated on site; pile depth not to exceed 8 feet; protect from erosion.

### **3.05 FINISH GRADING**

- A. Before Finish Grading:
  - 1. Verify building and trench backfilling have been inspected.
  - 2. Verify subgrade has been contoured and compacted.
- B. Remove debris, roots, branches, stones, in excess of 1 inch in size. Remove soil contaminated with petroleum products.
- C. Where topsoil is to be placed, scarify surface to depth of 6 inches.
- D. In areas where vehicles or equipment have compacted soil, scarify surface to depth of 6 inches.
- E. Place topsoil in areas where seeding, sodding, and planting are required.
- F. Place topsoil to the following compacted thicknesses:
  - 1. Areas to be Seeded with Grass: 6 inches.
  - 2. Shrub Beds: 18 inches.
  - 3. Flower Beds: 12 inches.
  - 4. Planter Boxes: To within 3 inches of box rim.
- G. Place topsoil during dry weather.
- H. Remove roots, weeds, rocks, and foreign material while spreading.
- I. Near plants, buildings, and pavement, spread topsoil manually to prevent damage.
- J. Fine grade topsoil to eliminate uneven areas and low spots. Maintain profiles and contour of subgrade.
- K. Lightly compact placed topsoil.

### **3.06 TOLERANCES**

- A. Top Surface of Subgrade: Plus or minus 0.10 foot (1-3/16 inches) from required elevation.
- B. Top Surface of Finish Grade: Plus or minus 0.04 foot (1/2 inch).

### **3.07 REPAIR AND RESTORATION**

- A. Existing Facilities, Utilities, and Site Features to Remain: If damaged due to this work, repair or replace to original condition.
- B. Trees to Remain: If damaged due to this work, trim broken branches and repair bark wounds; if root damage has occurred, obtain instructions from Architect as to remedy.

### **3.08 FIELD QUALITY CONTROL**

- A. See Section 31 2323 for compaction density testing.

### **3.09 CLEANING**

- A. Remove unused stockpiled topsoil and subsoil. Grade stockpile area to prevent standing water.
- B. Leave site clean and raked, ready to receive landscaping.

**END OF SECTION 31 2200**

## **SECTION 31 2316**

### **EXCAVATION**

#### **PART 1 GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Excavating for building volume below grade, footings, slabs-on-grade, paving, site structures, utilities within the building, utilities, and site development.

##### **1.02 RELATED REQUIREMENTS**

- A. Document Bonham Circle Redevelopment: Geotechnical report; bore hole locations and findings of subsurface materials.
- B. Section 01 7000 - Execution and Closeout Requirements: General requirements for dewatering of excavations and water control.
- C. Section 31 1000 - Site Clearing.
- D. Section 31 2200 - Grading: Grading.
- E. Section 31 2316.13 - Trenching: Excavating for utility trenches outside the building to utility main connections.
- F. Section 31 2323 - Fill: Fill materials, filling, and compacting.
- G. Section 33 4600 - Subdrainage: Filter aggregate and filter fabric for foundation drainage systems.

##### **1.03 PROJECT CONDITIONS**

- A. Verify that survey bench mark and intended elevations for the Work are as indicated.

#### **PART 2 PRODUCTS - NOT USED**

#### **PART 3 EXECUTION**

##### **3.01 EXAMINATION**

- A. Verify that survey bench mark and intended elevations for the work are as indicated.

##### **3.02 PREPARATION**

- A. Call Local Utility Line Information service at number shown on Drawings not less than three working days before performing Work.
  - 1. Request underground utilities to be located and marked within and surrounding construction areas.
- B. Identify required lines, levels, contours, and datum locations.
- C. See Section 31 2200 for additional requirements.

##### **3.03 EXCAVATING**

- A. All excavation shall be unclassified regardless of material encountered.
- B. Excavate to accommodate building foundations, slabs-on-grade, paving, site structures, and construction operations.
- C. Notify Architect of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.
- D. Slope banks of excavations deeper than 4 feet to angle of repose or less until shored.
- E. Do not interfere with 45 degree bearing splay of foundations.
- F. Cut utility trenches wide enough to allow inspection of installed utilities.
- G. Hand trim excavations. Remove loose matter.
- H. Correct areas that are over-excavated and load-bearing surfaces that are disturbed; see Section 31 2323.
- I. Grade top perimeter of excavation to prevent surface water from draining into excavation.

- J. Remove excavated material that is unsuitable for re-use from site.
- K. Stockpile excavated material to be re-used in area designated on site in accordance with Section 31 2200.
- L. Remove excess excavated material from site.
- M. Repair or replace items indicated to remain that are damaged by excavation.
- N. Excavate subsoil from areas to be further excavated, re-landscaped, or regraded.
- O. Do not excavate wet subsoil or excavate and process wet material to obtain optimum moisture content.
- P. Benching Slopes: Horizontally bench existing slopes greater than 3:1 to key placed fill material into slope to provide firm bearing.
- Q. Stability: Replace damaged or displaced subsoil as specified for fill.
- R. Where unauthorized excavations have been carried below or beyond points required, restore these areas to the elevations and dimensions shown on the Drawings with material approved by Engineer and compact as specified. This Work shall be performed at no additional cost to the Owner.
- S. Excavate unsatisfactory soil materials encountered that extend below required elevations to the additional depth as directed by Engineer.
  - 1. Where removal of unsatisfactory material is due to fault or negligence of the Contractor, by inadequate shoring or bracing, dewatering, material storage or other failure to meet specified requirements, Work shall be performed at no additional cost to the Owner.
- T. Areas that receive seeding shall be graded below finished grades shown, leaving space for topsoiling.
- U. Stockpile excavated soil material satisfactory for backfill or fill until required. Place, grade, and shape stockpiles for proper drainage.
- V. Cut slopes shall be shaped and cleaned of loose rock as the work progresses in accordance with the following sequence:
  - 1. Slope whose vertical height is 20 feet or greater shall be shaped, cleaned, and seeded (where required) in three approximately equal increments of height. Slopes whose vertical height is 75 feet shall be shaped, cleaned, and seeded (where required) in approximately 25 foot increments of height.
  - 2. Slopes whose vertical height is less than 20 feet, but more than 5 feet, shall be shaped, cleaned, and seeded (where required) in two approximately equal increments of height.
  - 3. Slopes whose vertical height is less than 5 feet shall be shaped, cleaned, and seeded (where required) in one operation.

#### **3.04 EXCAVATION (FOR STRUCTURES)**

- A. Conform to elevations and dimensions shown on the drawings. Extend excavation sufficient distance from footings and foundations to permit placing and removal of concrete formwork, installation of services, and for other construction required. Foundation concrete shall not be placed until the bearing stratum has been examined and found satisfactory for the design bearing capacity.
- B. Where rock is encountered, notify Engineer. When the entire structure will bear on rock, it shall be used to support the foundation. Where only a part of the foundation will bear on rock, excavate 8 inches below subgrade of floor or footings and backfill with aggregate fill and thoroughly compact.

#### **3.05 SURFACE WATER CONTROL**

- A. Control and remove unanticipated water seepage into excavation.
- B. Provide ditches, berms, and other devices to divert and drain surface water from excavation area.

- C. Divert surface water and seepage water within excavation areas into sumps or settling basins prior to pumping water into drainage channels and storm drains.

### **3.06 DEWATERING**

- A. Design and provide dewatering system to permit Work to be completed on dry and stable subgrade.
- B. Operate dewatering system continuously until backfill is minimum 2 feet above normal ground water table elevation.
- C. When dewatering system cannot control water within excavation, notify Engineer and stop excavation work.
  - 1. Supplement or modify dewatering system and provide other remedial measures to control water within excavation.
  - 2. Demonstrate dewatering system operation complies with performance requirements before resuming excavation operations.
- D. Modify dewatering systems when operation causes or threatens to cause damage to new construction, existing site improvements, adjacent property, or adjacent water wells.
- E. Discharge groundwater and seepage water within excavation areas into sumps or settling basins prior to pumping water into drainage channels and storm drains.
- F. Remove dewatering and surface water control systems after dewatering operations are discontinued.

### **3.07 PROOFROLLING**

- A. Proofroll areas to receive fill, pavement, and building slabs to identify areas of soft yielding soils.
  - 1. Use loaded tandem-axle pneumatic tired dump truck or large smooth drum roller.
  - 2. Load equipment to maximum 50 tons gross weight and make a minimum of 4 passes with 2 passes perpendicular to the others.
- B. Undercut such areas to firm soil, backfill with granular fill, and compact to density equal or greater than requirements for subsequent fill material.
- C. Do not proofroll or undercut until soil has been dewatered.

### **3.08 FIELD QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements, for general requirements for field inspection and testing.
- B. Provide for visual inspection of load-bearing excavated surfaces before placement of foundations.

### **3.09 PROTECTION**

- A. Prevent displacement of banks and keep loose soil from falling into excavation; maintain soil stability.
- B. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.
- C. Protect structures, utilities and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth operations.

**END OF SECTION 31 2316**

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## SECTION 31 2316.13

### TRENCHING

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Backfilling and compacting for utilities outside the building.

##### 1.02 RELATED REQUIREMENTS

- A. Document Bonham Circle Redevelopment: Geotechnical report; bore hole locations and findings of subsurface materials.
- B. Section 31 2200 - Grading: Site grading.
- C. Section 31 2316 - Excavation: Building and foundation excavating.
- D. Section 31 2323 - Fill: Backfilling at building and foundations.
- E. Section 33 4600 - Subdrainage: Filter aggregate and filter fabric for foundation drainage systems.

##### 1.03 DEFINITIONS

- A. Utility: Any buried pipe, duct, conduit, or cable.
- B. Utility Structures: Manholes, catch basins, inlets, valve vaults, hand holes, and other utility access structures as indicated on Drawings.
- C. Trench Terminology:
  - 1. Trench Bottom: Area under bottom of trench supporting bedding.
  - 2. Bedding: Fill placed under utility pipe to 1/6 pipe diameter.
  - 3. Initial Backfill: Fill placed from 1/6 of outside pipe diameter to 12 inches above top of pipe.
  - 4. Final Backfill: Fill placed from initial backfill to subgrade

##### 1.04 REFERENCES

- A. AASHTO T 180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54 kg (10-lb) Rammer and a 457 mm (18 in.) Drop; American Association of State Highway and Transportation Officials; 2010.
- B. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates; 2014.
- C. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN·m/m<sup>3</sup>)); 2012.
- D. ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method; 2015.
- E. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup> (2,700 kN m/m<sup>3</sup>)); 2012.
- F. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method; 2008.
- G. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System); 2011.
- H. ASTM D4318 - Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils; 2010.
- I. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth); 2015.

##### 1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Materials Sources: Submit name of imported materials source.
- C. Compaction Density Test Reports.

## **1.06 FIELD MEASUREMENTS**

- A. All excavation shall be unclassified regardless of material encountered.
- B. Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or side dimensions, without specific approval of Engineer. Unauthorized excavation shall be replaced at Contractor's expense.

## **1.07 DELIVERY, STORAGE, AND HANDLING**

- A. When necessary, store materials on site in advance of need.
- B. When fill materials need to be stored on site, locate stockpiles where directed by the Engineer.
  - 1. Separate differing materials with dividers or stockpile separately to prevent intermixing.
  - 2. Prevent contamination.
  - 3. Protect stockpiles from erosion and deterioration of materials.

# **PART 2 PRODUCTS**

## **2.01 FILL MATERIALS**

- A. Aggregate fill shall meet VDOT requirements for No. 25 or No. 26 crusher run aggregate or No. 57 coarse aggregate.
- B. Clean earth fill shall be free of debris, roots, frozen materials, organic matter, rock or gravel larger than 1 inch in any dimension or other harmful matter.
- C. Native fill shall be 95 percent free of stones larger than 4 inches in any dimension or other harmful matter.
- D. Bedding Material: From trench bottom to 1/6 of outside pipe diameter.
  - 1. Pipe: Clean earth fill or aggregate fill.
  - 2. PVC Pipe: Aggregate fill.
- E. Bedding for Structures: Aggregate fill.
- F. Initial Backfill: From 1/6 of outside pipe diameter to 12 inches minimum above pipe.
  - 1. Pipe: Clean earth fill or aggregate fill.
  - 2. PVC Pipe: Aggregate fill.
- G. Final Backfill to Subgrade:
  - 1. Under Traveled Rights-of-Way: Aggregate fill.
  - 2. Under Landscape, Road Shoulders, and Existing or Future Paved Areas: Native fill or aggregate fill.

## **2.02 ACCESSORIES**

- A. Concrete: Class A3 concrete conforming to VDOT Road and Bridge Standards.
  - 1. Compressive strength of 3,000 psi at 28 days.
  - 2. Air entrained, content of 6% (plus or minus 2%).
  - 3. Water cement ratio of 0.49.
  - 4. Slump of 1-5 inches.
  - 5. Minimum cement content of 588 lbs. per cubic yard.

# **PART 3 EXECUTION**

## **3.01 EXAMINATION**

- A. Verify that survey bench marks and intended elevations for the work are as indicated.

## **3.02 PREPARATION**

- A. Call Local Utility Line Information service at number shown on Drawings not less than three working days before performing Work.
  - 1. Request underground utilities to be located and marked within and surrounding construction areas.
- B. Identify required lines, levels, contours, and datum locations.
- C. See Section 31 2200 for additional requirements.

### 3.03 TRENCHING

- A. Excavate subsoil required for utilities.
- B. Notify Architect of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.
- C. Slope banks of excavations deeper than 4 feet to angle of repose or less until shored.
- D. Do not interfere with 45 degree bearing splay of foundations.
- E. Cut trenches wide enough to allow inspection of installed utilities.
- F. Hand trim excavations. Remove loose matter.
- G. Remove large stones and other hard matter that could damage piping or impede consistent backfilling or compaction.
- H. Remove excavated material that is unsuitable for re-use from site.
- I. Stockpile excavated material to be re-used in area designated on site in accordance with Section 31 2200.
- J. Remove excess excavated material from site.
- K. Trench Width: Excavate bottom of trenches in accordance with the following schedule or as indicated on Drawings:
  - 1. 0 - 6' Trench Depth: Outside diameter of pipe bell, plus 12 inches.
  - 2. Greater than 6' Trench Depth: Outside diameter of pipe bell, plus 12 inches, plus 2 inches of width per foot for each foot of depth greater than 6 feet.
- L. Excavate trenches to depth indicated on Drawings. Provide uniform and continuous bearing and support for bedding material and pipe.
- M. Maintain vertical faces to an elevation equal to 12 inches above top of pipe.
  - 1. When Project conditions permit, side walls may be sloped or benched above this elevation.
  - 2. When side walls cannot be sloped, provide sheeting and shoring to protect excavation as specified in this Section.
- N. Support Utilities and Structures:
  - 1. Keep trench width at top of trench to practical minimum to protect adjacent or crossing utility lines.
  - 2. Support utilities crossing trench by means acceptable to utility company.
  - 3. Do not interfere with 45-degree bearing splay of foundations.
  - 4. Provide temporary support for structures above and below ground.
- O. When subsurface materials at bottom of trench are loose or soft, excavate to firm subgrade or to depth directed by Engineer.
  - 1. Cut out soft areas of subgrade not capable of compaction in place.
  - 2. Backfill with aggregate fill and compact to density equal to or greater than requirements of subsequent backfill material.
- P. When rock is encountered, excavate rock encountered 6 inches below the pipe for pipe bedding.
- Q. Where rock is encountered so that a manhole, vault, or other structure will bear on rock, it shall be used to support the foundation. Where only a part of the foundation will bear on rock, at least 8 inches of compacted granular material shall be provided below bottom of footings.
- R. Trim excavation. Hand trim for bell and spigot pipe joints where required. Shape trench bottom to afford circumferential support to the lower fourth of the pipe or excavate 6 inches below bottom of pipe for pipe bedding. Remove loose matter.
- S. Excavate trench bottom for PVC pipe to a depth 3 inches below the pipe and backfill overdepth with aggregate fill.
- T. Correct over excavated areas with compacted backfill as specified for authorized excavation or replace with flowable fill as directed by Engineer.

### **3.04 SHEETING AND SHORING**

- A. Sheet, shore, and brace excavations to prevent danger to persons, structures and adjacent properties and to prevent caving, erosion, and loss of surrounding subsoil.
- B. Support trenches more than 5 feet deep excavated through unstable, loose, or soft material. Provide sheeting, shoring, bracing, or other protection to maintain stability of excavation.
- C. Design sheeting and shoring to be removed at completion of excavation work.
- D. Repair damage caused by failure of the sheeting, shoring, or bracing and for settlement of filled excavations or adjacent soil.
- E. Repair damage to new and existing Work from settlement, water or earth pressure or other causes resulting from inadequate sheeting, shoring, or bracing.

### **3.05 SURFACE WATER CONTROL**

- A. Control and remove unanticipated water seepage into excavation.
- B. Provide ditches, berms, and other devices to divert and drain surface water from excavation area.
- C. Divert surface water and seepage water within excavation areas into sumps or settling basins prior to pumping water into drainage channels and storm drains.

### **3.06 DEWATERING**

- A. Design and provide dewatering system to permit Work to be completed on dry and stable subgrade.
- B. Operate dewatering system continuously until backfill is minimum 2 feet above normal ground water table elevation.
- C. When dewatering system cannot control water within excavation, notify Engineer and stop excavation work.
  - 1. Supplement or modify dewatering system and provide other remedial measures to control water within excavation.
  - 2. Demonstrate dewatering system operation complies with performance requirements before resuming excavation operations.
- D. Modify dewatering systems when operation causes or threatens to cause damage to new construction, existing site improvements, adjacent property, or adjacent water wells.
- E. Discharge ground water and seepage water within excavation areas into sumps or settling basins prior to pumping water into drainage channels and storm drains.
- F. Remove dewatering and surface water control systems after dewatering operations are discontinued.

### **3.07 BEDDING, HAUNCHING, AND INITIAL BACKFILL**

- A. Place bedding full width of trench to the depth indicated on Drawings and compact by tamping or rodding to prevent settlement. Perform in accordance with schedule at end of this Section.
- B. Install utility pipe and conduit in accordance with the respective utility section.
- C. Support pipe uniformly along entire length of pipe.
- D. Carefully place initial backfill to 12 inches above top of pipe or to depth indicated on Drawings. Compact in accordance with schedule at end of this Section.
- E. Backfill shall be placed by hand, uniformly on each side of the pipe and compacted in layers not exceeding 6 inches.

### **3.08 FINAL BACKFILLING TO SUBGRADE**

- A. Backfill to contours and elevations indicated using unfrozen materials.
- B. Fill up to finish grade elevations unless otherwise indicated.
- C. Employ a placement method that does not disturb or damage other work.

- D. Systematically fill to allow maximum time for natural settlement. Do not fill over porous, wet, frozen or spongy subgrade surfaces.
- E. Maintain optimum moisture content of fill materials to attain required compaction density.
- F. Place fill material in continuous layers and compact in accordance with schedule at end of this section.
- G. Layers shall not exceed 12 inches. Under road shoulders and under existing or future paved areas, layers shall not exceed 8 inches.
- H. Employ compaction equipment suitable for materials to be compacted and work area locations. Use power driven hand tampers for compacting materials adjacent to structures.

### **3.09 DISPOSAL OF EXCESS OR UNSATISFACTORY MATERIALS**

- A. Dispose of excess or unsatisfactory material offsite and legally.
- B. Furnish Engineer with certificate of disposal site or agreement from private property owner.

### **3.10 TOLERANCES**

- A. Top Surface of General Backfilling: Plus or minus 1 inch from required elevations.

### **3.11 FIELD QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements, for general requirements for field inspection and testing.
- B. Perform in place compaction tests in accordance with the following:
  1. Density Tests: ASTM D1556, ASTM D2167, ASTM D6938, or ASTM D698 (AASHTO T99).
  2. Moisture Tests: ASTM D6938.
- C. Frequency of Tests: One test per lift for every 1,000 feet of trench.
- D. Contractor shall employ an independent testing firm to assure compliance with these specifications for materials and compaction.
- E. If tests indicate Work does not meet specified requirements, remove Work, replace, compact, and retest.

### **3.12 PROTECTION OF FINISHED WORK**

- A. Section 01 7000 - Execution and Closeout Requirements: Protecting finished Work.
- B. Reshape and re-compact fills subjected to vehicular traffic during construction.

### **3.13 CLEANING**

- A. Leave unused materials in a neat, compact stockpile.
- B. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.
- C. Leave borrow areas in a clean and neat condition. Grade to prevent standing surface water.

### **3.14 SCHEDULE OF COMPACTION**

- A. Compact each layer of fill or backfill to not less than the following percentages of the maximum density at optimum moisture content as determined by ASTM D698 (AASHTO T99):
  1. 100 percent beneath and within 25 feet of buildings and structures, including those shown for future construction.
  2. 95 percent beneath pavements, walks, and road shoulders, including those shown for future construction.
  3. 90 percent in other unpaved areas.
  4. Minimum compaction in any area shall be to the density of the adjacent soil.

**END OF SECTION 31 2316.13**



## SECTION 31 2323

### FILL

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Filling, backfilling, and compacting for footings, slabs-on-grade, paving, site structures, and utilities.

##### 1.02 RELATED REQUIREMENTS

- A. Document Bonham Circle Redevelopment: Geotechnical report; bore hole locations and findings of subsurface materials.
- B. Section 03 3000 - Cast-in-Place Concrete.
- C. Section 31 2200 - Grading: Site grading.
- D. Section 31 2316 - Excavation: Removal and handling of soil to be re-used.
- E. Section 31 2316.13 - Trenching: Excavating for utility trenches outside the building to utility main connections.
- F. Section 32 1423 - Asphalt Unit Paving: Leveling bed placement under pavers.
- G. Section 33 4600 - Subdrainage: Filter aggregate and filter fabric for foundation drainage systems.

##### 1.03 REFERENCE STANDARDS

- A. AASHTO T 180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54 kg (10-lb) Rammer and a 457 mm (18 in.) Drop; American Association of State Highway and Transportation Officials; 2010.
- B. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates; 2014.
- C. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN·m/m<sup>3</sup>)); 2012.
- D. ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method; 2015.
- E. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup> (2,700 kN m/m<sup>3</sup>)); 2012.
- F. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method; 2008.
- G. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System); 2011.
- H. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth); 2005.
- I. ASTM D4318 - Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils; 2010.
- J. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth); 2015.

##### 1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Materials Sources: Submit name of imported materials source.
- C. Compaction Density Test Reports.

##### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. When necessary, store materials on site in advance of need.
- B. When fill materials need to be stored on site, locate stockpiles where indicated.

1. Separate differing materials with dividers or stockpile separately to prevent intermixing.
2. Prevent contamination.
3. Protect stockpiles from erosion and deterioration of materials.

## **1.06 COMPACTION TESTING**

- A. Contractor will provide compaction testing.
- B. Engage an independent, qualified testing laboratory to provide testing in this section. Results shall be submitted to the Engineer. Test locations shall be approved by Engineer.

## **1.07 EXCAVATION**

- A. See Section 31 2316 for excavation

## **PART 2 PRODUCTS**

### **2.01 FILL MATERIALS**

- A. Aggregate fill shall meet VDOT requirements for No. 57 coarse aggregate.
- B. Filtering material shall be a graded mixture of natural or crushed gravel, crushed stone, or natural sand with 100 percent passing a 1/2-inch sieve and none passing a No. 50 sieve, ASTM D 448, Size No. 8.
- C. Structural fill shall be free of debris, roots, frozen materials, organic matter, rock or gravel larger than 1 inch in any dimension, or other harmful matter.
- D. Native fill shall be 95% free from stones larger than 4 inches in any dimension or other harmful matter.
- E. Weathered shale fill: Weathered shale fill shall consist of weathered shale and soft rock, free of organic materials, clay soil, or other deleterious materials. Weathered shale fill material shall have no rock fragments over six inches (6") in greatest dimension.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that survey bench marks and intended elevations for the Work are as indicated.
- B. See Section 31 2200 for additional requirements.
- C. Verify subdrainage, dampproofing, or waterproofing installation has been inspected.
- D. Verify structural ability of unsupported walls to support imposed loads by the fill.

### **3.02 PREPARATION**

- A. Scarify subgrade surface to a depth of 6 inches to identify soft spots.
- B. Cut out soft areas of subgrade not capable of compaction in place. Backfill with structural fill.
- C. Compact subgrade to density equal to or greater than requirements for subsequent fill material.
- D. Until ready to fill, maintain excavations and prevent loose soil from falling into excavation.
- E. Proofroll to identify soft spots; fill and compact to density equal to or greater than requirements for subsequent fill material.

### **3.03 FILLING**

- A. Fill to contours and elevations indicated using unfrozen materials.
- B. Fill up to finish grade elevations unless otherwise indicated.
- C. Employ a placement method that does not disturb or damage other work.
- D. Systematically fill to allow maximum time for natural settlement. Do not fill over porous, wet, frozen or spongy subgrade surfaces.
- E. Maintain optimum moisture content of fill materials to attain required compaction density.
- F. Obtain fill from excavation or other approved sources. The material shall be such that it can be compacted in accordance with these specifications. Maximum rock size shall be 75 percent of compacted layer thickness or maximum of 6 inches diameter. Prevent nesting of large rocks

- and compact fill to prevent voids. Maximum rock size within 12 inches of footing elevations shall be 2-inch diameter.
- G. Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified percentage of maximum density.
  - H. Fill material that has been removed as too wet to permit compaction may be stockpiled or spread to dry. When moisture content is reduced to a satisfactory value, the material may be used as fill or backfill.
  - I. Place fill to obtain elevations shown on the Drawings. Do not place fill on muddy or frozen areas.
  - J. Excavate depressions caused by removal of stumps or other clearing operations to firm subgrade, fill with clean earthfill, and compact as specified.
  - K. When the existing ground surface has been disturbed and has a density of less than that specified for the particular area classification, scarify the ground surface, pulverize, adjust moisture condition to optimum moisture content, and compact to required depth and percentage of maximum density.
  - L. Weathered Shale Fill:
    - 1. If the weathered shale or soft rock is dry, the Contractor shall apply water to accelerate the slaking action and to facilitate compaction. The water shall be distributed uniformly over the layer by an approved method. The water shall be incorporated throughout the lift by a multiple gang disk with a disk wheel diameter of not less than 24 inches. The amount of water shall be that required to achieve optimum moisture content plus or minus 3 percent. Following the application of water and the disking operation, all shale fragments larger than 6 inches in greatest dimension shall be removed by appropriate methods.
    - 2. The compaction of the lifts shall be accomplished with an approved static tamping-foot roller in conjunction with an approved vibratory tamping-foot roller. The minimum weight of the static tamping-foot roller shall be 60,000 pounds. Each tamping foot on the static roller shall project from the drum a minimum of 6 inches. Each tamping foot on the vibratory roller shall project from the drum a minimum of 4 inches. The surface area of the end of each foot on both tamping-foot rollers shall be no less than 5-1/2 square inches. The minimum total compactive effort of the vibratory tamping-foot roller shall be 55,000 pounds. Total compactive effort is defined as that portion of the static weight acting on the unsprung compaction drum, added to the "centrifugal force" provided by that drum.
    - 3. Weathered shale, shale and soft rock mixtures, and soft rock shall be placed in 8-inch loose lifts and shall be compacted to at least 95 percent of the maximum dry density.
    - 4. Weathered shale and soft rock mixtures, and soft rock containing more than 20 percent clay and silt size fines shall not be placed beneath structures or within 10 feet of a retaining wall without approval of the Engineer.
  - M. Backfill footing drains as shown on Drawings.
  - N. Place backfill and fill materials evenly adjacent to structures. Prevent wedging action of the backfill against structures by carrying the material uniformly around the structure to approximately the same elevation in each lift.
  - O. Place aggregate fill material under all building slabs on grade. Compact to density required for fill under buildings.
  - P. Place fill material in continuous layers and compact in accordance with schedule at end of this Section.
  - Q. Backfill against supported foundation walls. Do not backfill against unsupported foundation walls.
  - R. Backfill simultaneously on each side of unsupported foundation walls until supports are in place.
  - S. Slope grade away from building minimum 2 percent slope for minimum distance of 10 ft., unless noted otherwise.
  - T. Make gradual grade changes. Blend slope into level areas.

- U. Remove surplus backfill materials from site.
- V. Leave fill material stockpile areas free of excess fill materials.
- W. Reshape and re-compact fills subjected to vehicular traffic.

#### **3.04 COMPACTION**

- A. Compact soil materials using equipment suitable for materials to be compacted and work area locations. Use power-driven hand tampers for compacting materials adjacent to structures.
- B. Provide equipment capable of adding moisture to the soil material as determined by moisture-density tests.
- C. Where required, uniformly apply water to the surface of subgrade or layer of soil material in such manner as to prevent free water appearing on the surface, either during or subsequent to compaction operations.

#### **3.05 TOLERANCES**

- A. See Section 31 2200 - Grading or Section 31 2316.13 - Trenching, as applicable.

#### **3.06 FIELD QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements, for general requirements for field inspection and testing.
- B. Perform in place compaction tests in accordance with the following:
  1. Density Tests: ASTM D1556, ASTM D2167, or ASTM D6938.
  2. Moisture Tests: ASTM D6938.
- C. If tests indicate Work does not meet specified requirements, remove Work, replace and retest.
- D. Frequency of Tests: Tests shall be performed on each lift of fill placed at the rates of one (1) test per 10,000 square feet of fill area, but not less than two (2) sets per lift, regardless of size of fill.

#### **3.07 PROTECTION OF FINISHED WORK**

- A. Section 01 7000 - Execution and Closeout Requirements: Protecting finished Work.
- B. Reshape and re-compact fills subjected to vehicular traffic and erosion.
- C. Where compacted areas are disturbed by subsequent construction or adverse weather, scarify the surface, reshape, and compact to the required density. Use hand tamper for recompaction over underground utilities and underfloor subdrains.
- D. Protect graded areas from the action of the elements. Settlement or other damage that occurs prior to acceptance of the Work shall be repaired and grades satisfactorily re-established.
- E. Repair after cleanup. Upon completion of construction work and after spoil and debris have been removed, regrade any areas disturbed by the operations.

#### **3.08 CLEANING**

- A. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.

#### **3.09 SCHEDULE**

- A. Fill Beneath and Within 25 Feet of Buildings and Structures, Including Those Shown for Future Construction
  1. Place structural fill and aggregate fill in layers not more than 8 inches in loose depth.
  2. Compact to minimum 100 percent of maximum density at optimum moisture content.
- B. Fill Beneath Pavements, Walk, and Road Shoulders, Including Those Shown for Future Construction:
  1. Place structural fill and aggregate fill in layers not more than 8 inches in loose depth.
  2. Compact to minimum 95 percent of maximum density at optimum moisture content.
- C. Fill Beneath Other Unpaved Areas:

1. Place structural fill and aggregate fill in layers not more than 8 inches in loose depth.
2. Compact to minimum 90 percent of maximum density at optimum moisture content.

**END OF SECTION 31 2323**

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## **SECTION 31 3116 TERMITE CONTROL**

### **PART I - GENERAL**

#### **I.1 SECTION INCLUDES**

- A. Termite treatment of structure.

#### **I.2 ACTION SUBMITTALS**

- A. Product Data: For each type of termite control product indicated. Include EPA-Registered Label for termite products.

#### **I.3 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For licensed installer.
- B. Test Reports: Provide 5-year product specific efficacy studies, concrete studies and application history.
- C. Product Certificates.
- D. Termite Treatment Report: Include the following:
  - 1. Date and time of application.
  - 2. Quantity of undiluted termite used.
  - 3. Dilutions, methods, volumes used, and rates of application.
  - 4. Areas of application.
  - 5. Areas not accessible.
- E. Warranties: Sample of special warranties.

#### **I.4 QUALITY ASSURANCE**

- A. Product shall comply with the following Earthcraft Virginia Multifamily V42014 Technical Guidelines:
  - I. DU I.13 Alternative termite treatment with no soil pretreatment:
    - a. Criteria
      - 1) Install an alternative termite treatment system with no soil pretreatment.
      - 2) Provide information on type of system, maintenance, and monitoring requirements in project-specific owner's manual.
  - 2. DU I.14 Non-toxic pest treatment
    - a. Criteria
      - I) All lumber in contact with foundation ( $\geq 36"$  above foundation)

- 2) Pre-treat all lumber in contact with the foundation with a non-toxic pest treatment such as borate. Lumber must be treated to a minimum height of 3' above the foundation.
- B. Installer Qualifications: A specialist who is licensed according to regulations of authorities having jurisdiction to apply termite control treatment and products in jurisdiction where Project is located and who employs workers trained and approved by manufacturer to install manufacturer's products.
- C. Regulatory Requirements: Formulate and apply termiticides according to the EPA-Registered Label.
- D. Source Limitations: Obtain termite control products from single source from single manufacturer.
- E. Pre-installation Conference: Conduct conference at Project site.

#### 1.5 PROJECT CONDITIONS

- A. Coordinate application of termiticide treatment of structure with access to all structural wood members and foundations. Install termiticide during the dried-in phase after all structural framing and sheathing is in place and prior to installation of drywall, insulation, mechanical systems and electrical wiring.

#### 1.6 WARRANTY

- A. Special Warranty: Standard form, signed by Applicator and Contractor, certifying that termite control work, consisting of applied termiticide treatment, will prevent infestation of subterranean and Formosan termites. Installer agrees to re-treat structure with termiticide treatments, and repair or replace damage where subterranean and Formosan termite activity is discovered during warranty period as directed by warranty.
- I. Warranty Period: Ten years from date of Substantial Completion.
    - a. Provide annual inspection of termite control work.

#### 1.7 GENERAL

- A. Provide a non-toxic pest control treatment equal to Bora-Care wood applied treatment for primary termite control, as herein specified.
- B. Limits of termite treatment are as follows:
- I. Pest control treatment product application will be provided to wood structural components in contact with foundations and application to bath traps, plumbing penetration and certain foundation areas.
- C. Pest control treatment product, when applied according to label instructions as a primary termite pretreatment, kills and prevents wood decay fungi, subterranean and Formosan

termites, carpenter ants, wood-boring beetles and many other insects. Pest control treatment product shall be a “green” borate-based, non-corrosive, product that uses a solution to penetrate wood and delivers years of long-term residual protection. Pest control treatment product shall be suitable for performance at above-ground, weather protected applications where termite protection or insect and decay resistance is required. Pest control treatment product intended to be used for framing and other areas where the wood is not in direct contact with the ground and is continuously protected from water during its service life. Normal exposure to water during ordinary construction shall not adversely affect the treatment.

## PART 2 - PRODUCTS

### 2.1 TERMITICIDE TREATMENT

- A. Provide an EPA-Registered termiticide, complying with requirements of authorities having jurisdiction, in an aqueous solution formulated to prevent termite infestation. Provide quantity required for application at the label volume and rate for the maximum termiticide concentration allowed for each specific use, according to product's EPA-Registered Label.
  - I. Basis-of-Design: Subject to compliance with requirements, provide BORA-CARE Commercial Termiticide Nisus Corporation; 100 Nisus Drive; Rockford, TN 37853; Phone 800.264.0870; website [www.nisuscorp.com](http://www.nisuscorp.com), or approved equal.
    - a. Active Ingredient: 40% Disodium Octaborate Tetrahydrate (DOT)
    - b. Penetrant: Patented Glycol mixture.

## PART 3 - EXECUTION

### 3.1 GENERAL

- A. Comply with the most stringent requirements of authorities having jurisdiction and with manufacturer's EPA-Registered Label for products.

### 3.2 TERMITICIDE TREATMENT TO STRUCTURE APPLICATION

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for interfaces with slab and foundation work, utility installation, and other conditions affecting performance of termite control.
- B. Proceed with application only after unsatisfactory conditions have been corrected.
- C. Termiticide Treatment Preparation: Remove foreign matter and impermeable materials that could decrease treatment effectiveness on areas to be treated.
- D. Application: Mix termiticide treatment solution to a uniform consistency. Provide quantity required for application at the label volume and rate for the maximum specified concentration of termiticide, according to manufacturer's EPA-Registered Label. Apply to the following so

that a continuous horizontal and vertical termiticide barrier or treated zone is established at the foundation of building construction. Distribute treatment evenly.

1. Structural Wood and Sill Plates: Treat all structural concrete, block, steel & wood and sill plates up 36 inches from contact with foundation as required by label.
2. Sheathing: Treat all cellulosic sheathing within 36 inches of the foundation.
3. Concrete Slab: Treat concrete slab a minimum of 2-8 inches out from all sill plates.
4. Bath Traps: Treat open bath traps and surrounding 12 inches of slab area.
5. Penetrations: Treat all pipe and plumbing penetrations to a height of 24 inches and a minimum of 6 inches surrounding penetration.
6. Expansion Joint and Abutting Connections: Treat abutting slab areas and expansion joints a minimum of 6 inches out on each side of joint or abutting slab connection.

**END OF SECTION 31 3116**

**SECTION 32 1123**  
**AGGREGATE BASE COURSES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Aggregate base course.
- B. Paving aggregates.

**1.02 RELATED REQUIREMENTS**

- A. Section 31 2200 - Grading: Preparation of site for base course.
- B. Section 31 2316.13 - Trenching: Compacted fill over utility trenches under base course.
- C. Section 31 2323 - Fill: Topsoil fill at areas adjacent to aggregate base course; compacted fill under base course.
- D. Section 32 1216 - Asphalt Paving: Binder and finish asphalt courses.
- E. Section 32 1713 - Parking Bumpers.
- F. Section 33 0513 - Manholes and Structures including frames.

**1.03 REFERENCE STANDARDS**

- A. AASHTO M 147 - Standard Specification for Materials for Aggregate and Soil-Aggregate Subbase, Base and Surface Courses; American Association of State Highway and Transportation Officials; 1965 (2004).
- B. AASHTO T 180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54 kg (10-lb) Rammer and a 457 mm (18 in.) Drop; American Association of State Highway and Transportation Officials; 2010.
- C. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates; 2014.
- D. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>)); 2012.
- E. ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method; 2015.
- F. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup> (2,700 kN m/m<sup>3</sup>)); 2012.
- G. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method; 2008.
- H. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System); 2011.
- I. ASTM D4318 - Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils; 2010.
- J. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth); 2010.
- K. Virginia Department of Transportation (VDOT): Road and Bridge Specifications; 2007.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Materials Sources: Submit name of imported materials source.
- C. Aggregate Composition Test Reports: Results of laboratory tests on materials used.
- D. Compaction Density Test Reports.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

## **1.05 DELIVERY, STORAGE, AND HANDLING**

- A. When necessary, store materials on site in advance of need.
- B. When aggregate materials need to be stored on site, locate where directed by Owner.
- C. Aggregate Storage, General:
  - 1. Separate differing materials with dividers or stockpile separately to prevent intermixing.
  - 2. Prevent contamination.
  - 3. Protect stockpiles from erosion and deterioration of materials.

## **PART 2 PRODUCTS**

### **2.01 MATERIALS**

- A. Subbase and Aggregate Base Material: Coarse aggregate type as indicated on Drawings conforming to Section 208 of the VDOT Road and Bridge Specifications.
- B. Fine Aggregate: Natural sand or stone sand type as indicated on Drawings conforming to Section 202 of the VDOT Road and Bridge Specifications.
- C. Coarse Aggregate: Coarse aggregate type as indicated on Drawings conforming to Section 203 of the VDOT Road and Bridge Specifications.
- D. Crusher Run Aggregate: Crusher run aggregate type as indicated on Drawings conforming to Section 205 of the VDOT Road and Bridge Specifications.
- E. Geotextile Fabric: Non-biodegradable, type as indicated on the Drawings conforming to Section 245 of the VDOT Road and Bridge Specifications.

### **2.02 SOURCE QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements, for general requirements for testing and analysis of aggregate materials.
- B. Where aggregate materials are specified using ASTM D2487 classification, test and analyze samples for compliance before delivery to site.
- C. If tests indicate materials do not meet specified requirements, change material and retest.
- D. Provide materials of each type from same source throughout the Work.
- E. Use sources approved by VDOT.
- F. Perform Work in accordance with VDOT Road and Bridge Specifications; maintain one copy of document on site.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that survey bench marks and intended elevations for the work are as indicated.
- B. Verify substrate has been inspected, gradients and elevations are correct, and is dry.

### **3.02 PREPARATION**

- A. Correct irregularities in substrate gradient and elevation by scarifying, reshaping, and re-compacting.
- B. Do not place aggregate on soft, muddy, or frozen surfaces.

### **3.03 INSTALLATION**

- A. Place aggregate in minimum 3-inch and maximum 6-inch layers and roller compact to specified density. When total thickness is 6 inches or less, place in one layer. When total thickness is greater than 6 inches, place in two equal layers.
- B. Have each layer of material compacted and approved prior to placing succeeding layers.
- C. Level and contour surfaces to elevations and gradients indicated on Drawings.
- D. Add small quantities of fine aggregate to coarse aggregate when required to assist compaction.
- E. Maintain optimum moisture content of fill materials to attain required compaction density.

- F. Use mechanical tamping equipment in areas inaccessible to compaction equipment.

### **3.04 TOLERANCES**

- A. Flatness: Maximum variation of 1/2-inch measured with 10 foot straight edge.
- B. Scheduled Compacted Thickness: Within 1/2-inch.
- C. Variation From Design Elevation: Within 1/2-inch.

### **3.05 FIELD QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements, for general requirements for field inspection and testing.
- B. Perform compaction density testing on compacted aggregate base course in accordance with ASTM D1556.
- C. Evaluate results in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D698 ("Standard Proctor").
- D. If tests indicate work does not meet specified requirements, remove work, replace and retest.
- E. Frequency of Tests: Two tests per layer for every 5,000 square feet.
- F. Proof roll compacted aggregate at surfaces that will be under slabs-on-grade, pavers, and paving.

### **3.06 CLEANING**

- A. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.

**END OF SECTION 32 1123**

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## **SECTION 32 1216** **ASPHALT PAVING**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Aggregate base course.
- B. Double course bituminous concrete paving.

#### **1.02 RELATED REQUIREMENTS**

- A. Section 31 2200 - Grading: Preparation of site for paving and base.
- B. Section 31 2323 - Fill: Compacted subgrade for paving.
- C. Section 32 1123 - Aggregate Base Courses: Aggregate base course.
- D. Section 32 1713 - Parking Bumpers.
- E. Section 32 1723.13 - Painted Pavement Markings: Pavement markings.
- F. Section 33 0513 - Manholes and Structures: Manholes, including frames; gutter drainage grilles, covers, and frames for placement by this section.

#### **1.03 REFERENCE STANDARDS**

- A. AI MS-2 - Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types; The Asphalt Institute; 1997.
- B. AI MS-19 - A Basic Asphalt Emulsion Manual; The Asphalt Institute; Fourth Edition.
- C. ASTM D946 - Standard Specification for Penetration-Graded Asphalt Cement for Use in Pavement Construction; 2009a.
- D. Virginia Department of Transportation (VDOT): Road and Bridge Specifications; 2007.

#### **1.04 SUBMITTALS**

- A. Product Data:
  - 1. Submit product information for asphalt and aggregate materials.
  - 2. Submit mix design with laboratory test results supporting design.
- B. Manufacturer's Certification: Certify products are produced at a plant approved by VDOT and meet or exceed specified requirements.

#### **1.05 QUALITY ASSURANCE**

- A. Perform Work in accordance with Section 315 of the VDOT Road and Bridge Specifications.
- B. Maintain one copy of document on site.
- C. Obtain materials from the same source throughout.
- D. Use sources and mixing plant approved by VDOT.

#### **1.06 FIELD CONDITIONS**

- A. Do not place asphalt base course or intermediate course when ambient air or road surface temperature is less than 40 degrees F for Mix Designation A; 50 degrees F for Mix Designations D, E, M, and S; or if surface is wet or frozen.
- B. Do not place asphalt surface course when ambient air or base surface temperature is less than 40 degrees F for Mix Designation A; 50 degrees F for Mix Designations D, E, M, and S; or if surface is wet or frozen.
- C. Place bitumen mixture when temperature is not more than 15 degrees F less than initial mixing temperature and not more than maximum specified temperature.

### **PART 2 PRODUCTS**

#### **2.01 MATERIALS**

- A. Asphalt Concrete Materials: Conform to Section 211 of VDOT Road and Bridge Specifications.

- B. Prime Coat and Tack Coat: Conform to Sections 310 and 311 of VDOT Road and Bridge Specifications.
- C. Sand: Fine aggregate, natural sand or stone sand conforming to Section 202 of VDOT Road and Bridge Specifications.
- D. Mineral Filler: Finely ground particles of limestone, hydrated lime or other mineral dust, free of foreign matter.

## **2.02 ASPHALT PAVING MIXES AND MIX DESIGN**

- A. Use dry material to avoid foaming. Mix uniformly.
- B. General: Use Superpave mix design conforming to Section 211 of the VDOT Road and Bridge Specifications.
- C. Wedging or Leveling Mix: Conform to intermediate course.
- D. Submit proposed mix design of each class of mix for review prior to beginning of Work.

## **2.03 SOURCE QUALITY CONTROL**

- A. Obtain materials from plant approved by VDOT.
- B. Test plant samples and mix design in accordance with Section 211 of the VDOT Road and Bridge Specifications.

# **PART 3 EXECUTION**

## **3.01 EXAMINATION**

- A. Verify utilities indicated under paving are installed with excavations and trenches backfilled and compacted.
- B. Verify compacted subgrade and aggregate base is dry and ready to support paving and imposed loads.
- C. Verify gradients and elevations of base are correct.
- D. Verify utility structure frames and lids are installed in correct position and elevation.

## **3.02 BASE COURSE**

- A. Place and compact base course.
- B. Section 32 1123 - Aggregate Base Courses.

## **3.03 PREPARATION - PRIMER**

- A. Apply primer in accordance with Section 311 of the VDOT Road and Bridge Specifications.
- B. Apply primer to contact surfaces of curbs and gutters.
- C. Use clean sand to blot excess primer.

## **3.04 PREPARATION - TACK COAT**

- A. Apply tack coat in accordance with Section 310 of the VDOT Road and Bridge Specifications.
- B. Apply tack coat on asphalt or concrete surfaces over subgrade surface at uniform rate of 0.05 to 0.10 gallon/sq. yd. (undiluted) and 0.10 to 0.15 gallon/sq. yd. (diluted).
- C. Apply tack coat to contact surfaces of curbs and gutters.
- D. Coat surfaces of manhole, catch basin, and utility structure frames with oil to prevent bond with asphalt pavement. Do not tack coat these surfaces.

## **3.05 PLACING ASPHALT PAVEMENT - DOUBLE COURSE**

- A. Place asphalt binder course within 24 hours of applying primer or tack coat.
- B. Place binder course to thickness identified on the Drawings.
- C. Place wearing course within two hours of placing and compacting binder course.
- D. Place wearing course to thickness identified on the Drawings.

- E. Install gutter drainage grilles and frames, manhole frames, and covers in correct position and elevation.
- F. Compact pavement by rolling to specified density. Do not displace or extrude pavement from position. Hand compact in areas inaccessible to rolling equipment.
- G. Perform rolling with consecutive passes to achieve even and smooth finish, without roller marks.

### **3.06 JOINTS**

- A. Transverse Joints
  1. When Work is suspended long enough to allow mixture to chill, construct transverse joint.
  2. Use butt joint when traffic will not pass over pavement.
  3. Use sloped wedge ahead of the end of pavement when traffic will pass over pavement. Place paper parting strip to removal of wedge.
  4. Tack coat edge of pavement prior to placing adjoining pavement.
- B. Longitudinal Joints
  1. Tack the edge of longitudinal joints prior to placing adjoining pavement.
  2. Pinch joint by rolling immediately behind the paver.
  3. Offset longitudinal joints in each layer by approximately 6 inches.

### **3.07 TOLERANCES**

- A. Flatness: Maximum variation of 1/4 inch measured with 10 foot straight edge.
- B. Compacted Thickness: Shall be in accordance with Section 315 of the VDOT Road and Bridge Specifications.
- C. Variation from True Elevation: Within 1/2 inch.

### **3.08 FIELD QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements, for general requirements for quality control.
- B. Perform Contractor Quality Control Program in accordance with Section 315 of VDOT Road and Bridge Specifications.
- C. When tests indicate Work does not meet specified requirements, remove Work, replace, and retest.

### **3.09 PROTECTION**

- A. Immediately after placement, protect pavement from mechanical injury for 7 days or until surface temperature is less than 140 degrees F.

**END OF SECTION 32 1216**

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**SECTION 32 1723.13**  
**PAINTED PAVEMENT MARKINGS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Parking lot markings, including parking bays, crosswalks, arrows, handicapped symbols, and curb markings.
- B. Roadway lane markings.

**1.02 RELATED REQUIREMENTS**

- A. Section 32 1216 - Asphalt Paving.
- B. Section 32 1726 - Tactile Warning Surfacing: Plastic tactile and detectable warning tiles for pedestrian walking surfaces.

**1.03 REFERENCE STANDARDS**

- A. AASHTO M247 - Standard Specification for Glass Beads Used in Traffic Paint.
- B. FS TT-B-1325 - Beads (Glass Spheres); Retro-Reflective; Rev. D, 2007.
- C. FS TT-P-1952 - Paint, Traffic Black, and Airfield Marking, Waterborne; Rev. E, 2007.
- D. MPI (APL) - Master Painters Institute Approved Products List; Master Painters and Decorators Association; current edition, [www.paintinfo.com](http://www.paintinfo.com).
- E. FHWA MUTCD - Manual on Uniform Traffic Control Devices for Streets and Highways; U.S. Department of Transportation, Federal Highway Administration; <http://mutcd.fhwa.dot.gov>; current edition.
- F. Virginia Department of Transportation (VDOT):
  - 1. Road and Bridge Specifications, 2007, published by VDOT.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
  - 1. Preparation instructions and recommendations.
  - 2. Storage and handling requirements and recommendations.
  - 3. Installation methods.
- C. Certificates: Submit for each batch of paint and glass beads stating compliance with specified requirements.

**1.05 QUALITY ASSURANCE**

- A. Perform Work in accordance with Section 704 of VDOT Road and Bridge Specifications.
- B. Maintain one copy of document on site.

**1.06 QUALIFICATIONS**

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum 5 years experience.
- B. Applicator: Company specializing in performing Work of this Section with minimum 5 years experience.

**1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver paint in containers of at least 5 gallons accompanied by batch certificate.
- B. Deliver glass beads in containers suitable for handling and strong enough to prevent loss during shipment accompanied by batch certificate.
- C. Store products in manufacturer's unopened packaging until ready for installation.
- D. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

## 1.08 FIELD CONDITIONS

- A. Do not install products under environmental conditions outside manufacturer's absolute limits.
- B. Do not apply materials when surface and ambient temperatures are outside temperature ranges required by paint product manufacturer or:
  1. Waterborne Paint: Apply when ambient air temperature and surface temperature is minimum 50 degrees F and rising and at a maximum of 160 degrees F.
  2. Thermoplastic: Do not apply until ambient air temperature and temperature of pavement is 50 degrees F or higher.
- C. Do not apply materials during rain or snow when relative humidity is outside humidity ranges, or moisture content of surfaces exceed those required by paint product manufacturer.
- D. Volatile Organic Content (VOC): Do not exceed State or Environmental Protection Agency maximum VOC on traffic paint.

## PART 2 PRODUCTS

### 2.01 MATERIALS

- A. Line and Zone Marking Paint and Preformed Thermoplastic Manufacturers:
  1. Accent Stripe, Inc.
  2. Crown Technology.
  3. Ennis Traffic Safety Solutions, Inc.
  4. Epoplex.
  5. Flint Trading.
  6. POLY-CARB, Inc.
  7. Sherwin Williams.
  8. SWARCO.
  9. Substitutions: See Section 01 6000 - Product Requirements.
  10. Furnish materials in accordance with Section 704 of VDOT Road and Bridge Specifications.
- B. Line and Zone Marking Paint:
  1. Roadway Markings: As required by authorities having jurisdiction.
  2. Waterborne Paint: Ready mixed, fast dry waterborne traffic paints, lead-free, non-toxic, suitable for roadway or parking lots.
  3. Thermoplastic: Alkyd based ready mixed, fast dry, lead free, non-toxic, for roadways.
  4. Glass Beads: AASHTO M247, Type 1, coated to enhance embedment and adherence with paint.
  5. Match existing line colors.
    - a. Parking Lot Lines: 4-inch, white.
    - b. Parking Lot Lane Lines: 4-inch yellow.
    - c. Stop Line: 24-inch white thermoplastic.
    - d. Roadway Center Lines: 4-inch yellow thermoplastic.
    - e. Roadway Edge Lines: 4-inch white thermoplastic.
    - f. Handicapped Symbols: Blue.

### 2.02 EQUIPMENT

- A. Roadway Application for Continuous Longitudinal Lines: Use application equipment with following capabilities:
  1. Dual nozzle paint gun to simultaneously apply parallel lines of indicated width in solid or broken patterns or various combinations of those patterns.
  2. Pressurized bead-gun to automatically dispense glass beads onto painted surface, at required application rate.
  3. Measuring device to automatically and continuously measure length of each line placed, to nearest foot (tenth of meter).
  4. Device to heat paint to manufacturer's temperature recommendation for fast dry and thermoplastic applications.

- B. Machine Calibration: Calibrate machines to meet specified tolerances.
- C. Temporary Marking Tape: Preformed, reflective, pressure sensitive adhesive tape in color(s) required; Contractor is responsible for selection of material of sufficient durability as to perform satisfactorily during period for which its use is required.
- D. For application of crosswalks, intersections, stop lines, legends, and other miscellaneous items by walk behind stripers, hand spray, or stencil trucks, apply with equipment meeting requirements of this Section. Do not use hand brushes or rollers. Optionally apply glass beads by hand.
- E. Tactile Warning Surfaces: See Section 32 1726.

### PART 3 EXECUTION

#### 3.01 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

#### 3.02 PREPARATION

- A. Maintenance and Protection of Traffic:
  1. Provide short-term traffic control in accordance with Section 01 5000 - Temporary Facilities and Controls.
  2. Prevent interference with marking operations and to prevent traffic on newly applied markings before markings dry.
- B. Allow new pavement surfaces to cure for a period of not less than 14 days before application of marking materials.
- C. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- D. Where oil or grease are present, scrub affected areas with several applications of trisodium phosphate solution or other approved detergent or degreaser, and rinse thoroughly after each application; after cleaning, seal oil-soaked areas with cut shellac to prevent bleeding through the new paint.
- E. Provide templates to control paint application by type and color at necessary intervals.

#### 3.03 INSTALLATION

- A. Begin pavement marking as soon as practicable after surface has been cleaned and dried.
- B. Do not apply paint if temperature of surface to be painted or the atmosphere is less than 50 degrees F or more than 95 degrees F.
- C. Apply in accordance with manufacturer's instructions using an experienced technician that is thoroughly familiar with equipment, materials, and marking layouts.
- D. Comply with FHWA MUTCD manual (<http://mutcd.fhwa.dot.gov>) for details not shown.
- E. Apply markings in locations determined by measurement from survey control points; preserve control points until after markings have been accepted.
- F. Apply uniformly painted markings of color(s), lengths, and widths as indicated on the drawings true, sharp edges and ends.
  1. Apply paint in one coat only.
  2. Wet Film Thickness: 0.015 inch.
  3. Length Tolerance: Plus or minus 3 inches.
  4. Width Tolerance: Plus or minus 1/8 inch.
- G. Parking Lots: Apply parking space lines, entrance and exit arrows, painted curbs, and other markings indicated on drawings.
  1. Mark the International Handicapped Symbol at indicated parking spaces.
  2. Hand application by pneumatic spray is acceptable.

- H. Symbols: Use a suitable template that will provide a pavement marking with true, sharp edges and ends, of the design and size indicated.

#### **3.04 APPLICATION TOLERANCES**

- A. Section 01 4000 - Quality Requirements: Tolerances.
- B. Maximum Variation from Wet Film Thickness: 1 mil.
- C. Maximum Variation from Wet Paint Line Width: Plus or minus 1/8-inch.
- D. Maximum Variation from Specified Application Temperature: Plus or minus 5 degrees F.

#### **3.05 DRYING, PROTECTION, AND REPLACEMENT**

- A. Protect newly painted markings so that paint is not picked up by tires, smeared, or tracked.
- B. Provide barricades, warning signs, and flags as necessary to prevent traffic crossing newly painted markings.
- C. Allow paint to dry at least the minimum time specified by the applicable paint standard and not less than that recommended by the manufacturer.
- D. Repair lines and markings, which after application and curing do not meet following criteria:
  1. Incorrect Location: Remove and replace incorrectly placed patterns.
  2. Insufficient Thickness, Line Width, Paint Coverage, or Glass Bead Coverage (where required): Prepare defective material by acceptably grinding or blast cleaning to remove substantial amount of beads and to roughen marking surface. Remove loose particles and debris. Apply new markings on cleaned surface in accordance with this Section.
  3. Uncured or Discolored Material, Insufficient Bonding: Remove defective markings in accordance with this Section and clean pavement surface one foot beyond affected area. Apply new markings on cleaned surface in accordance with this Section.
- E. Replace failed or defective markings in entire section of defective markings within 30 days after notification when any of the following exists during warranty period:
  1. Marking is discolored or exhibits pigment loss, and is determined to be unacceptable by visual comparison with beaded color plates.
  2. If glass beads are used, the average retro-reflectivity is less than 375 mcd/m<sup>2</sup>/lx for white pavement markings and 250 mcd/m<sup>2</sup>/lx for yellow pavement markings.
- F. Remove and replace markings that are applied at less than minimum material rates; deviate from true alignment; exceed length and width tolerances; or show light spots, smears, or other deficiencies or irregularities.
  1. Remove markings in manner to avoid damage to the surface to which the marking was applied, using carefully controlled sand blasting, approved grinding equipment, or other approved method.
  2. Replace removed markings at no additional cost to Owner.

**END OF SECTION 32 1723.13**

**SECTION 32 1726**  
**TACTILE WARNING SURFACING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Plastic tactile and detectable warning tiles for pedestrian walking surfaces.

**1.02 RELATED REQUIREMENTS**

- A. Section 03 3000 - Cast-in-Place Concrete: Concrete for sidewalks and platforms.
- B. Section 32 1723.13 - Painted Pavement Markings: Crosswalk and curb markings.

**1.03 REFERENCE STANDARDS**

- A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.
- B. 49 CFR 27, 37, and 38 - Standards for Accessible Transportation Facilities, Final Rule; Department of Transportation; current edition.
- C. AASHTO LRFD - Bridge Design Specifications, Customary U.S. Units (6th Edition); 2012.
- D. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- E. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
- F. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus; 2011.
- G. ASTM C501 - Standard Test Method for Relative Resistance to Wear of Unglazed Ceramic Tile by the Taber Abraser; 1984 (Reapproved 2009).
- H. ASTM C903 - Standard Practice for Preparing Refractory Castable Specimens by Cold Gunning; 2010.
- I. ASTM C1028 - Standard Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method; 2007e1.
- J. ASTM D543 - Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents; 2006.
- K. ASTM D570 - Standard Test Method for Water Absorption of Plastics; 1998 (Reapproved 2010)
- L. ASTM D638 - Standard Test Method for Tensile Properties of Plastics; 2010.
- M. ASTM D695 - Standard Test Method for Compressive Properties of Rigid Plastics; 2010.
- N. ASTM D790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials; 2010.
- O. ASTM D1308 - Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes; 2002 (Reapproved 2013).
- P. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2014.
- Q. ASTM G155 - Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Nonmetallic Materials; 2013.
- R. ATBCB PROWAG - Proposed Accessibility Guidelines for Pedestrian Facilities in the Public Right-of-Way; 2011.

**1.04 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years documented experience.
- B. Installer Qualifications: Company certified in writing by product manufacturer as having successfully completed work substantially similar to the work of this section.

## 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver to project site in manufacturer's protective wrapping and in manufacturer's unopened packaging.
- B. Store covered and elevated above grade and in manufacturer's unopened packaging until ready for installation. Maintain at ambient temperature between 40 and 90 degrees F.

## 1.06 WARRANTY

- A. Plastic Tiles: Provide manufacturer's standard five year warranty against manufacturing defects, breakage or deformation.

# PART 2 PRODUCTS

## 2.01 TACTILE AND DETECTABLE WARNING TILES

- A. Plastic Tactile and Detectable Warning Tiles: ADA Standards compliant, glass fiber and carbon fiber reinforced, exterior grade, matte finish polyester sheet with truncated dome pattern, solid color throughout, internal reinforcing of sheet and of truncated domes, integral radius cut lines on back face of tile; with factory applied removable protective sheeting.
  - 1. Material Properties:
    - a. Water Absorption: 0.20 percent, maximum, when tested in accordance with ASTM D570.
    - b. Slip Resistance: 0.80 minimum combined wet/dry static coefficient of friction, when tested in accordance with ASTM C1028.
    - c. Compressive Strength: 25,000 pounds per square inch, minimum, when tested in accordance with ASTM D695.
    - d. Tensile Strength: 10,000 pounds per square inch, minimum, when tested in accordance with ASTM D638.
    - e. Flexural Strength: 25,000 pounds per square inch minimum, when tested in accordance with ASTM D790.
    - f. Chemical Stain Resistance: No reaction to 1 percent hydrochloric acid, motor oil, calcium chloride, gum, soap solution, bleach, or antifreeze, when tested in accordance with ASTM D543.
    - g. Chemical Stain Resistance: No reaction to 1 percent hydrochloric acid, motor oil, calcium chloride, gum, soap solution, bleach, or antifreeze, when tested in accordance with ASTM D1308.
    - h. Abrasion Resistance: 300, minimum, when tested in accordance with ASTM C501.
    - i. Flame Spread: 25, maximum, when tested in accordance with ASTM E84.
    - j. Accelerated Weathering: Delta-E of less than 5.0 at 2,000 hours exposure, when tested in accordance with ASTM G155.
    - k. Adhesion: No delamination of tile prior to board failure in a temperature range of 20 to 180 degrees F, when tested in accordance with ASTM C903.
    - l. Loading: No damage when tested according to AASHTO LRFD test method HS20.
    - m. Salt and Spray Performance: No deterioration or other defect after 200 hours of exposure, when tested in accordance with ASTM B117.
  - 2. Installation Method: Cast in place.
  - 3. Shape: Rectangular.
  - 4. Dimensions: 24 inches by 48 inches.
  - 5. Pattern: In-line pattern of truncated domes complying with ADA Standards.
  - 6. Edge: Square.
  - 7. Joint: Butt.
  - 8. Color: As selected by Architect from manufacturer's standard range.
  - 9. Products:

## 2.02 ACCESSORIES

- A. Fasteners: ASTM A666, Type 304 stainless steel
  - 1. Type: Countersunk, color matched composite sleeve anchors

2. Size: 1/4 inch diameter and 1-1/2 inches long.
- B. Adhesive: Type recommended and approved by surfacing tile manufacturer.
- C. Sealant: Elastomeric sealant of color to match adjacent surfaces; approved by surfacing tile manufacturer.

### PART 3 EXECUTION

#### 3.01 EXAMINATION

- A. When installation location is near site boundary or property line, verify required location using property survey.
- B. Verify that work area is ready to receive work:
  1. Examine work area with installer present.
  2. If existing conditions are not as required to properly complete the work of this section, notify Architect.
  3. Do not proceed with installation until deficiencies in existing conditions have been corrected.
- C. Verify that dimensions, tolerances, and attachment methods for work in this section are properly coordinated with other work on site.

#### 3.02 INSTALLATION, GENERAL

- A. Install in accordance with manufacturer's written instructions.
  1. Do not install damaged, warped, bowed, dented, abraded, or otherwise defective units.
  2. Do not install when ambient or substrate temperature has been below 40 degrees F during the preceding 8 daylight hours.
- B. Field Adjustment:
  1. Locate relative to curb line in compliance with PROWAG, Sections 304 and 305.
  2. Orient so dome pattern is aligned with the direction of ramp.
  3. Align truncated dome pattern between adjacent units.
- C. Install units fully seated to substrate, square to straight edges and flat to required slope.
- D. Align units so that tops of adjacent units are flush and joints between units are uniform in width.

#### 3.03 INSTALLATION, CAST IN PLACE PLASTIC TILES

- A. Concrete:
  1. See Section 03 3000.
  2. Slump: 4 to 7 percent.
- B. When installing multiple adjacent units, leave a 3/16 inch gap between units to allow for expansion.
- C. Tamp and vibrate units as recommended by manufacturer.
- D. Place and position weights on units while concrete cures as recommended by manufacturer. Ensure no voids or air pockets exist between top surface of concrete and underside of units.

#### 3.04 CLEANING PLASTIC UNITS

- A. Remove protective plastic sheeting within 24 hours of installation.
- B. Remove excess sealant or adhesive from joints and edges.
- C. Clean four days prior to date of scheduled inspection.

#### 3.05 PROTECTION

- A. Protect installed units from traffic, subsequent construction operations or other imposed loads until concrete is fully cured.
- B. Touch-up, repair or replace damaged products prior to Date of Substantial Completion.

**END OF SECTION 32 1726**

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**SECTION 32 3113**  
**CHAIN LINK FENCES AND GATES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Fence framework, fabric, and accessories.
- B. Excavation for post bases; concrete foundation for posts.

**1.02 RELATED REQUIREMENTS**

- A. Section 03 3000 - Cast-in-Place Concrete: Concrete anchorage for posts.

**1.03 REFERENCE STANDARDS**

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2013.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.
- C. ASTM F567 - Standard Practice for Installation of Chain-Link Fence; 2011.
- D. CLFMI CLF 2445 - Product Manual; Chain Link Fence Manufacturers Institute; 1997.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on fabric, posts, accessories, fittings and hardware.

**1.05 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years of documented experience.

**PART 2 PRODUCTS**

**2.01 MANUFACTURERS**

- A. Chain Link Fences and Gates:
  - 1. Master-Halco, Inc.; \_\_\_\_\_: [www.masterhalco.com](http://www.masterhalco.com).
  - 2. Merchants Metals; \_\_\_\_\_: [www.merchantsmetals.com](http://www.merchantsmetals.com).
  - 3. Substitutions: See Section 01 6000 - Product Requirements.

**2.02 MATERIALS AND COMPONENTS**

- A. Materials and Components: Conform to CLFMI Product Manual.
- B. Nominal Fence Height Less than 6 Feet:
  - 1. Line Posts: 1.9-inch diameter.
  - 2. Corner and Terminal Posts: 2.88-inch.
  - 3. Top and Brace Rail: 1.66-inch diameter, plain end, sleeve coupled.
- C. Fabric: 2-inch diamond mesh interwoven wire, 9 gage copper bearing steel, 9 gage thick aluminum, top selvage knuckle end closed, bottom selvage knuckle end closed.
- D. Tension Wire: 7 gage thick steel, single strand.
- E. Tension Band: 3/16-inch thick by 3/4-inch wide steel.
- F. Tie Wire: Aluminum steel wire, 9 gage or 6 gage as indicated.

**2.03 ACCESSORIES**

- A. Caps: Cast steel galvanized sized to post diameter, set screw retainer.
- B. Fittings: Sleeves, bands, clips, rail ends, tension bars, fasteners and fittings; galvanized steel.

**2.04 FINISHES**

- A. Components (Other than Fabric): Galvanized in accordance with ASTM A123/A123M, at 2.0 oz/sq ft.

- B. Components and Fabric: Vinyl coated over coating of 2.0 oz/sq ft galvanizing.
- C. Hardware: Hot-dip galvanized to weight required by ASTM A153/A153M.
- D. Accessories: Same finish as framing.
- E. Color(s): To be selected by Architect or Owner from manufacturer's full range.

### PART 3 EXECUTION

#### 3.01 INSTALLATION

- A. Install framework, fabric, accessories in accordance with ASTM F567.
- B. Place fabric on outside of posts and rails.
- C. Set intermediate and terminal posts plumb in concrete footings with top of footing 2 inches above finish grade. Slope top of concrete for water runoff.
- D. Line Post Footing Depth Below Finish Grade: 2.25 feet (less than 6 ft fence height).
- E. Corner, Gate and Terminal Post Footing Depth Below Finish Grade: 3 feet.
- F. Provide top rail through line post tops and splice with 6 inch long rail sleeves.
- G. Do not stretch fabric until concrete foundation has cured 28 days.
- H. Stretch fabric between terminal posts or at intervals of 100 feet maximum, whichever is less.
- I. Position bottom of fabric 2 inches above finished grade.
- J. Fasten fabric to top rail, line posts, braces, and bottom tension wire with tie wire at maximum 15 inches on centers.
- K. Attach fabric to end, corner, and gate posts with tension bars and tension bar clips.
- L. Install bottom tension wire stretched taut between terminal posts.
- M. Excavate holes for posts to diameter and spacing as recommended by manufacturer.
- N. Center and align posts. Place concrete around posts, and vibrate or tamp for consolidation. Verify vertical and top alignment of posts and make necessary corrections.

#### 3.02 TOLERANCES

- A. Maximum Variation From Plumb: 1/4-inch.
- B. Maximum Offset From True Position: 1 inch.
- C. Components shall not infringe adjacent property lines.

**END OF SECTION 32 3113**

**SECTION 32 3119**  
**DECORATIVE METAL FENCES AND GATES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Decorative steel fences.

**1.02 REFERENCE STANDARDS**

- A. ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes; 2015.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- C. ASTM B117 - Practice for Operating Salt Spray (Fog) Apparatus; 2011.
- D. ASTM D523 - Standard Test Method for Specular Gloss; 2014.
- E. ASTM D714 - Test Method for Evaluating Degree of Blistering in Paint; 2002 (Reapproved 2009).
- F. ASTM D822/D822M - Standard Practice for Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings; 2013.
- G. ASTM D1654 - Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments; 2008.
- H. ASTM D2244 - Test Method for Calculations of Color Differences from Instrumentally Measured Color Coordinates; 2011.
- I. ASTM D2794 - Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact); 1993 (Reapproved 2010).
- J. ASTM D3359 - Standard Test Method for Measuring Adhesion by Tape Test; 2009e2.
- K. ASTM F2408 - Ornamental Fences Employing Galvanized Steel Tubular Pickets; 2011.

**1.03 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Submit manufacturer's data sheets on each product to be used, including:
  - 1. Preparation instructions and recommendations.
  - 2. Storage and handling requirements and recommendations.
  - 3. Installation methods.
- C. Shop Drawings:
  - 1. Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, gates, and schedule of components.
- D. Manufacturer's Warranty.

**1.04 DELIVERY, STORAGE AND HANDLING**

- A. Store materials in a manner to ensure proper ventilation and drainage. Protect against damage, weather, vandalism and theft.

**1.05 WARRANTY**

- A. Finish: 10 years.

**PART 2 PRODUCTS**

**2.01 FENCES**

- A. Fences: Complete factory-fabricated system of posts and panels, accessories, fittings, and fasteners; finished with electrodeposition coating, and having the following performance characteristics:
  - 1. Capable of resisting vertical load, horizontal load and infill performance requirements for fence categories defined in ASTM F2408.

- B. Electro-Deposition Coating: Multi-stage pretreatment/wash with zinc phosphate, followed by epoxy primer and acrylic topcoat.
  - 1. Total Coating Thickness: 2 mils, minimum.
  - 2. Color: Black.
  - 3. Coating Performance: Comply with general requirements of ASTM F2408.
    - a. Adhesion: ASTM D3359 (Method B); Class 3B with 90 percent or more of coating remaining in tested area.
    - b. Corrosion Resistance: ASTM B117, D 714 and D 1654; 1/8 inch coating loss or medium No.8 blisters after 1,500 hours.
    - c. Impact Resistance: ASTM D2794; 60 inch pounds.
    - d. Weathering Resistance: ASTM D523, D822/D822M and D2244; less than 60 percent loss of gloss.
- C. Steel: ASTM A653/A653M; tensile strength 45,000 psi, minimum.
  - 1. Hot-dip galvanized; A653/A653M, G60.
  - 2. 62 percent recycled steel, minimum.
- D. Fasteners: ASTM A276/A276M, Type 302 stainless steel; finished to match fence components.

## 2.02 WELDED STEEL FENCE

- A. Provide fence meeting requirements for Industrial class as defined by ASTM F2408.
- B. Fence Panels: Fusion welded; 3'-6" feet high by 8 feet long.
  - 1. Panel Style: Three rail.
  - 2. Attach panels to posts with manufacturer's standard panel brackets.
- C. Posts: Steel tube.
  - 1. Size: 2-1/2 inches square by 16 gage, 0.0625 inch, with manufacturer's standard cap.
- D. Rails: Manufacturer's standard, double-wall steel channel 1-1/2 inch square by 16 gage, 0.0625 inch with pre-punched picket holes.
  - 1. Picket Retaining Rods: 0.125 inch galvanized steel.
  - 2. Picket-to-Rail Intersection Seals: PVC grommets.
- E. Pickets: Steel tube.
  - 1. Spacing: 3-3/4 inch clear.
  - 2. Size: 3/4 inch square by 12 gage, 0.0625 inch.
  - 3. Style: Flush top rail.
- F. Flexibility: Capable of following variable slope of up to 1:2.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Set fence posts in accordance with the manufacturer recommended spacing.
- C. When cutting rails immediately seal the exposed surfaces by:
  - 1. Removing all metal shavings from cut area.
  - 2. Apply zinc-rich primer to thoroughly cover cut edge and drilled hole; allow to dry.
  - 3. Apply 2 coats of custom finish spray paint matching fence color.
  - 4. Failure to seal exposed surfaces in accordance with manufacturer's instructions will negate manufacturer's warranty.

### 3.02 ERECTION TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch.
- B. Maximum Offset From Indicated Position: 1 inch.

### 3.03 CLEANING

- A. Clean jobsite of excess materials; scatter excess material from post hole excavations uniformly away from posts. Remove excess material if required.

- B. Clean fence with mild household detergent and clean water rinse well. .
- C. Touch up scratched surfaces using materials recommended by manufacturer. Match touchup paint color to fence finish.

#### **3.04 PROTECTION**

- A. Protect installed products until completion of project.
- B. Touch-up, repair, or replace damaged products before Substantial Completion.

**END OF SECTION 32 3119**

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**SECTION 32 3223**  
**SEGMENTAL RETAINING WALLS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Segmental retaining walls made of modular concrete units with or without soil reinforcement.
- B. Engineering design.

**1.02 RELATED REQUIREMENTS**

- A. Section 31 1000 - Site Clearing: Removal of unwanted trees, bushes, and debris.
- B. Section 31 2200 - Grading: Rough and finish grading.
- C. Section 31 2316 - Excavation.
- D. Section 31 2323 - Fill.
- E. Section 33 4600 - Subdrainage.

**1.03 REFERENCE STANDARDS**

- A. AASHTO M 288 - Standard Specification for Geotextiles; American Association of State Highway and Transportation Officials; 2006.
- B. ASCE 7 - Minimum Design Loads for Buildings and Other Structures; American Society of Civil Engineers; 2011.
- C. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2014.
- D. ASTM C1262 - Standard Test Method for Evaluating the Freeze-Thaw Durability of Manufactured Concrete Masonry Units and Related Concrete Units; 2010.
- E. ASTM C1372 - Standard Specification for Dry-Cast Segmental Retaining Wall Units; 2011.
- F. ASTM D422 - Standard Test Method for Particle-Size Analysis of Soils; 1963 (Reapproved 2007).
- G. ASTM D448 - Standard Classification for Sizes of Aggregate for Road and Bridge Construction; 2012.
- H. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>)); 2012.
- I. ASTM D1241 - Standard Specification for Materials for Soil-Aggregate Subbase, Base, and Surface Courses; 2007.
- J. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lb/ft<sup>3</sup> (2,700 kN-m/m<sup>3</sup>)); 2012.
- K. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System); 2011.
- L. ASTM D4318 - Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils; 2010.
- M. ASTM D4355 - Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture, and Heat in a Xenon Arc Type Apparatus; 2007.
- N. ASTM D4491 - Standard Test Methods for Water Permeability of Geotextiles by Permittivity; 1999a (Reapproved 2014).
- O. ASTM D4632 - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles; 2008.
- P. ASTM D4751 - Standard Test Method for Determining Apparent Opening Size of a Geotextile; 2012.
- Q. ASTM D5321/D5321M - Standard Test Method for Determining the Shear Strength of Soil-Geosynthetic and Geosynthetic-Geosynthetic Interfaces by Direct Shear; 2014.

- R. ASTM D6706 - Standard Test Method for Measuring Geosynthetic Pullout Resistance in Soil; 2001 (Reapproved 2013).
- S. ASTM F405 - Standard Specification for Corrugated Polyethylene (PE) Pipe and Fittings; 2013.
- T. NCMA TR-127 - Design Manual for Segmental Retaining Walls; National Concrete Masonry Association; 2010, Third Edition.
- U. NCMA TR-160 - Seismic Design Manual for Segmental Retaining Walls; National Concrete Masonry Association; 1998.

#### **1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Concrete Units:
  - 1. Manufacturer's product data.
  - 2. ICC-ES evaluation report.
  - 3. Test data on freeze-thaw durability.
  - 4. Test data on unit strength and shear resistance between units.
  - 5. Test data on soil reinforcement connection.
  - 6. Manufacturer's certification that units meet requirements of specification.
  - 7. Storage and handling requirements and recommendations.
  - 8. Installation methods.
- C. Soil Reinforcement:
  - 1. Manufacturer's product data.
  - 2. ICC-ES evaluation report.
  - 3. Manufacturer's certification that product meets requirements of specification.
  - 4. Preparation instructions and recommendations.
  - 5. Storage and handling requirements and recommendations.
  - 6. Installation methods.
- D. Shop Drawings: Engineering drawings for installation, including elevations, large-scale details of elevations, typical sections, details, and connections, soil reinforcement, and drainage provisions.
  - 1. Include marked up contract drawings showing exact dimensions for blocks, required coping, and other minor revisions.
  - 2. Include design data: Detailed design calculations showing compliance with specified design criteria and material evaluations performed in accordance with specified design standard, signed and sealed by Design Engineer.
  - 3. Submit no less than 2 weeks prior to start of work.
  - 4. Obtain approval of Architect prior to start of work.
- E. Preconstruction Soil Test Reports.
- F. Unit Sample: One unit typical of size, color, and finish texture specified. Approved sample may be used in work.
- G. Soil Reinforcement Sample: Two pieces of each specified type, labeled, 12 by 12 inches square .
- H. Soil Reinforcement to Unit Connector: One connector.
- I. Design Engineer's Qualification Statement.
- J. Concrete Unit Manufacturer Qualification Statement.
- K. Installer Qualification Statement.

#### **1.05 QUALITY ASSURANCE**

- A. Design Engineer Qualifications: Provide design by or under direct supervision of Professional Engineer experienced in the work of this section and licensed in the State in which the Project is located and:

1. Having minimum of five years documented experience in design of reinforced soil structures.
  2. Employed by firm that has designed a minimum of 500,000 sq ft of segmental retaining walls.
  3. Having minimum of \$2,000,000 aggregate liability insurance.
- B. Preconstruction Soil Testing: Engage a qualified independent testing agency to test soil reinforcement and backfill materials for compliance with design criteria.
1. Testing Agency Qualifications: As specified in Section 01 4000.
- C. Product Testing: Performed by qualified independent testing agency or by manufacturer and witnessed by qualified independent testing agency.
- D. Manufacturer Qualifications -- Concrete Units: Firm specializing in manufacturing products specified in this section and:
1. With not less than 2 years documented experience.
  2. Whose products have been used on a minimum of five successfully completed projects similar in scope and size.
- E. Installer Qualifications: Firm specializing in design and installation of segmental retaining walls and:
1. With not less than 2 years documented experience.
  2. With a minimum of five previously constructed successful projects, similar in size and magnitude, using specified retaining wall system; provide contact names and numbers.
  3. Having site supervisor with verifiable qualified experience suitable for this project.
  4. Approved by retaining wall system manufacturer.

#### **1.06 MOCK-UP**

- A. Prior to erection of retaining walls, provide mock-up for evaluation of installation workmanship.
- B. Erect 4 by 4 ft sample wall using materials specified.
- C. Locate mock-up where directed by Architect.
- D. Do not start masonry work until mock-up has been approved by Architect.
- E. Retain mock-up during construction as standard for judging completed work. Do not alter or destroy mock-up until work is completed.

#### **1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Store products above ground on wood pallets or blocking, in manufacturer's unopened packaging, until ready for installation.
- B. Prevent excessive soil and mud from coming in contact with face of concrete units.
- C. Polymeric Materials: Store at temperatures above minus 20 degrees F; rolled materials may be laid flat or stood on end.
- D. Protect material from damage. Do not use damaged material. Remove damaged material from the site.
- E. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Segmental Concrete Units:
  1. Anchor Wall Systems, Inc: [www.anchorwall.com](http://www.anchorwall.com).
  2. Keystone Retaining Wall Systems, Inc: [www.keystonewalls.com](http://www.keystonewalls.com).
  3. Rockwood Retaining Walls: [www.rockwoodwalls.com](http://www.rockwoodwalls.com).
- B. Soil Reinforcement:
  1. Concrete unit licensor.

## 2.02 RETAINING WALLS

- A. Contractor is responsible for design of the retaining walls.
- B. Design Standard: Design retaining walls to be capable of withstanding the effects of gravity loads due to soil pressures resulting from grades indicated, determined in accordance with NCMA TR 127 Design Manual for Segmental Retaining Walls; perform all stability analyses specified in this standard.
  - 1. Include effects of sloped backfill as indicated on the drawings.
  - 2. Include effects of superimposed loads (surcharge) as indicated on the drawings.
  - 3. In addition, comply with applicable local, state, and federal codes and regulations.
  - 4. This design method considers potential failure modes categorized by external, internal, local, compound, and global stability.
  - 5. Seismic Stability: Perform analysis in accordance with ASCE 7.
  - 6. Provide engineering services as required for analysis for all modes of stability.
  - 7. Use of design software for calculations is permitted.
  - 8. Submit complete shop drawings showing all features of the design.
- C. Setback: 1/8 inch back from face per course.
- D. Shear Resistance: Design the wall not to exceed the capacity of materials and soils to resist shear:
  - 1. Shear Resistance Between Units: Determine in accordance with NCMA SRWU-2.
  - 2. Connection Between Units and Soil Reinforcement: Determine in accordance with NCMA SWRU-1.
  - 3. Coefficient for Direct Shear of Reinforcement on Soil: Determine in accordance with ASTM D5321/D5321M using soil similar in gradation and texture to that to be used for fill in the reinforced zone.
- E. Soil Reinforcement:
  - 1. Test reinforcement to be used in accordance with ASTM D6706 using soil taken from project site.
  - 2. Do not use more than one type of reinforcement attached to units within the same wall; do not use products made by different manufacturers in the same wall; minimize the number of different reinforcement and filter products to avoid confusion in placement.
  - 3. Walls Less Than 12 Feet (3.5 M) High: Use only one type of reinforcement of one grade and strength.
  - 4. Length Back from Wall: Not less than dimensions shown on the drawings.
  - 5. Long Term Design Strength of Reinforcement: Determine in accordance with NCMA TR 127: LTDS = Tult / (RFd + RFid + RFcr), where:
    - a. Tult = Ultimate (tensile) strength,
    - b. RFd = Reduction Factor for chemical and biological durability; minimum 1.1 for polyethylene and polypropylene, 1.15 for coated polyester geogrids, and 1.6 for polyester geotextiles;
    - c. RFid = Reduction Factor for Installation Damage;
    - d. RFcr = Reduction Factor for Creep; consistent with test procedure used for determining the ultimate strength.
  - 6. Lowest Layer of Reinforcement: Long term design strength as specified, minimum.
- F. Drainage: Design to prevent water accumulation in retained soil; use drainage fill and drainage pipe as required; provide outlets at 50 foot intervals along length of wall, minimum.

## 2.03 MATERIALS

- A. Retaining Wall Units: Machine-formed concrete blocks of shapes and sizes suitable for the retaining wall configuration required and complying with ASTM C1372 and the following:
  - 1. Face Color: Tan .
  - 2. Texture: Sculptured rock texture, on all exposed surfaces.
  - 3. Face Shape: Straight (flat) .

4. Curved Walls: Provide unit shapes that accommodate the required curves without cutting and with gaps between faces of adjacent units of not more than 1/8 inch.
  5. Acute Corners: Provide special shapes to form corners without cutting; exposed faces finished to match.
  6. Unit Face Area: 2/3 sq ft, minimum.
  7. Height: 6 inches, minimum.
  8. Length (Face Width): 12 inches, minimum.
  9. Width (Depth from Face): 11 inches, minimum, not including textured finish.
  10. Face Wall Thickness: 2 inches, minimum.
  11. Shear Resistance Mechanism: Manufacturer's standard.
  12. Moisture Absorption: 8 percent, maximum.
  13. Freeze-Thaw Resistance: Maximum of 1 percent or less weight loss after 100 cycles for each of 5 specimens or maximum of 1.5 percent or less weight loss after 150 cycles for 4 of 5 specimens, when tested in accordance with ASTM C1262
  14. Compressive Strength, 28 Day: 3000 psi, minimum.
  15. Concrete Density: 125 pounds per cubic ft, minimum, oven dry.
  16. Dimensional Tolerances: Plus/minus 1/16 inch from specified dimension.
  17. Appearance: No visible chips, cracks, or other imperfections when viewed from 10 feet under diffuse lighting.
- B. Cap Units: Portland cement concrete machine-formed solid blocks, matching segmental concrete units, complying with ASTM C1372, with abutting edges saw cut or formed to provide tight fitting, flush end-to-end joints.
1. Height: 4 inches, minimum.
  2. Width: Same as wall units.
  3. Depth: To fully cover wall units.
  4. Masonry Adhesive: To secure cap units as top course of wall.
    - a. Expected Life Span: 30 years.
    - b. Provide adhesive conforming to ASTM C920, Type S, Grade NS, Class 25, and as approved by unit manufacturer.
- C. Shear Connectors: Connection method to withstand design stresses and prevent movement of segmental units, and to hold soil reinforcement in proper design position during grid pre-tensioning and backfilling.
1. Flexural Strength: 128,000 psi, minimum.
  2. Short Beam Shear: 6,400 psi, minimum.
  3. Maintain strength over design temperature range of minus 10 degrees F to plus 100 degrees F.
- D. Soil Reinforcement: Polymeric geosynthetic specifically fabricated for use as soil reinforcement, dimensionally stable and able to retain geometry under manufacture, transport, and installation.
1. Polymeric Material: 100 percent virgin resin with maximum of 5 percent in-plant regrind material; polypropylene, polyethylene, or polyester.
    - a. Polyethylene and Polypropylene: Stabilized with long term antioxidants.
    - b. Polyester: Minimum molecular weight of 25,000 and carboxyl end group number less than 30.
  2. Permittivity: 0.5 per second, minimum, when tested in accordance with ASTM D4491.
  3. UV Resistance: 70 percent after 500 hours, when tested in accordance with ASTM D4355.
  4. Durability: Comply with minimum requirements of AASHTO M 288 Class 1; minimum mass of 8 oz/sq yard.
  5. Source Quality Control: Test each 40,000 sq ft of production, per lot or per day, for compliance with specified design properties.
- E. Drainage Filter: Geosynthetic textile.
1. Apparent Opening Size: 70 to 100 U.S. Sieve size, when tested in accordance with ASTM D4751.
  2. Permittivity: 0.5 per second, minimum, when tested in accordance with ASTM D4491.

3. Durability: Comply with minimum requirements of AASHTO M 288 Class 1; minimum mass of 8 oz/sq yard.
- F. Aggregate for Leveling Pad: Compacted sand, gravel, or crushed rock complying with one of the following:
  1. As specified in Section 31 2323.
  2. Meeting requirements of ASTM D1241, Gradation C.
  3. Do not use pea gravel.
- G. Concrete for Leveling Pad: Unreinforced concrete with compressive strength of 3,000 psi
- H. Drainage Fill: Clean, freely draining aggregate placed within, between, or immediately behind segmental units; do not use pea gravel; use one of the following:
  1. Aggregate as approved by Architect.
  2. Aggregate meeting requirements of ASTM D448, Size No. 57.
  3. Crushed stone or coarse gravel, 3/8 to; no more than 5 percent passing No. 200 sieve.
  4. Crushed stone or coarse gravel, meeting requirements of ASTM D422.
    - a. Sieve Size 1 inch: 100 percent passing.
    - b. Sieve Size 3/4 inch: 75 to 100 percent passing.
    - c. Sieve Size No. 4: 0 to 10 percent passing.
    - d. Sieve Size No. 50: 0 to 5 percent passing
- I. Backfill: Compacted soil placed behind drainage fill ; do not use heavy clay or organic soils; comply with one of the following:
  1. Use site-excavated or other soil approved by Architect.
  2. Granular soil with less than 5 percent passing No. 200 sieve.
  3. Inorganic ASTM D2487 soil types GP, GW, SP, or SM, free of debris.
    - a. Maximum Size: 3/4 inch, unless approved by Design Engineer, and design strength reduced to account for additional installation damage.
    - b. Plasticity of Fines: Less than 15. Liquid Limit: Less than 40, when tested in accordance with ASTM D4318.
    - c. Sieve Size 3/4 inch: 75 to 100 percent passing.
    - d. Sieve Size No. 40: 0 to 60 percent passing.
    - e. Sieve Size No. 200: 0 to 35 percent passing.
- J. Drainage Pipe: Perforated PVC, complying with ASTM D3034; or corrugated PE complying with ASTM F405; with geotextile filter wrap.

### PART 3 EXECUTION

#### 3.01 EXAMINATION

- A. Verify location of existing structures and utilities prior to excavation.
- B. Protect adjacent structures from the effects of excavation.
- C. Verify that layout dimensions are correct and substrate is in proper condition for installation.
- D. Notify Architect of unsatisfactory conditions.
- E. Do not proceed with installation until unsatisfactory conditions have been corrected.

#### 3.02 PREPARATION

- A. Excavation:
  1. Excavate to lines and grades shown on drawings.
  2. Do not disturb embankment or foundation beyond lines. Minimize over-excavation; fill over-excavated areas with compacted reinforced backfill or leveling pad material at Contractor's expense.
  3. After excavation, and prior to placement of leveling materials, Geotechnical Engineer will examine bearing soil surface to verify strength meets or exceeds design requirements and assumptions.
  4. Replace unsuitable bearing soil as directed by Geotechnical Engineer.

- B. Leveling Pad:
  - 1. Depth: 6 inches, minimum.
  - 2. Width: 6 inches minimum extension beyond front and back faces of units.
  - 3. In lieu of pad made solely of aggregate or concrete, pad may be 3 inches, minimum, of thick compacted sand or crushed rock, covered with 2 inches to 3 inches of unreinforced concrete.
  - 4. Location: Top of pad at 1 inch below grade for each 8 inches that wall extends above grade.
  - 5. Compact aggregate to lines and grades on drawings, in lifts 6 inches thick, maximum.
  - 6. Compact aggregate to a minimum of 95 percent standard Proctor density, when determined in accordance with ASTM D698 at moisture content within 2 percent of optimum.
  - 7. Use only hand-operated compaction equipment within 36 inches of back of wall.
- C. Verify level grade before proceeding.
- D. Install drainage collection pipe with a continuous fall in the direction of flow. Cap open ends as necessary to prevent soil and debris from entering.

### 3.03 INSTALLATION

- A. Install in accordance with drawings, manufacturer instructions, and applicable codes and regulations.
- B. Segmental Concrete Units:
  - 1. Place first course of units on leveling pad; check alignment and level. Check for full contact with base and for stability.
  - 2. Place units side by side for full length of wall, aligning back face of straight walls using string line or offset from base line and back face of curved walls using flexible pipe or other method recommended by manufacturer
  - 3. Do not leave gaps between units.
  - 4. Lay out corners and curves in accordance with manufacturer's instructions. Do not leave gaps to produce wall batter or curvature.
  - 5. Cut blocks with saw; do not split units.
  - 6. Sweep excess material from tops of units before laying succeeding courses.
  - 7. Place succeeding courses. Check for proper alignment and batter.
  - 8. Where top of wall changes elevation, step units to match grade or turn top course into embankment.
  - 9. Where bottom of wall changes elevation, step base leveling pad and extend lowest course a minimum of two units into slope.
- C. Soil Reinforcement: Install each layer on fully compacted fill.
  - 1. Orient soil reinforcement material with highest strength axis perpendicular to wall alignment.
  - 2. Attach to top of wall units and extend horizontally, full length, over compacted backfill.
  - 3. Install in one piece lengths with 100 percent coverage in each layer at each level. Do not splice or leave gaps between panels or ends of pieces.
- D. Drainage Fill: Place drainage fill in, between, and behind units.
  - 1. Compact to lines and grades on drawings, in lifts 6 inches thick, maximum; decrease lift thickness where necessary to achieve required density.
  - 2. Extend drainage fill 6 inches beyond back face of units.
- E. Backfill: Place, spread, and compact backfill from behind drainage fill to undisturbed soil.
  - 1. Use only lightweight hand-operated compaction equipment within 3 ft from back wall face, or one half of wall height, whichever is greater.
  - 2. Place backfill in lifts of maximum 6 inches to 8 inches loose thickness where hand compaction is used and 8 inches to 10 inches
  - 3. Compact backfill to 95 percent of maximum density, standard Proctor, as determined in accordance with ASTM D698, or as recommended by Geotechnical Engineer.

4. Moisture content of backfill prior to and during compaction to be within plus 1 or minus 3 percentage points dry of optimum and uniform throughout each layer.
  5. Do not operate tracked construction equipment directly upon soil reinforcement.
  6. At end of each day, slope top of backfill away from wall to direct runoff away from wall face. Prevent runoff from adjacent areas from entering wall site.
  7. At completion, if other work adjacent to wall is not to be done immediately (paving, landscaping, etc), grade top of backfill and provide temporary drainage to prevent water runoff toward the wall.
- F. Cap Units: Install and top two courses of units with masonry adhesive.
1. Clear cap units and top course of segmental concrete units of debris and standing water before applying adhesive.
  2. Apply masonry adhesive to top surface of top unit and place cap into position over projecting pins. Protect wall face from masonry adhesive.

#### **3.04 TOLERANCES**

- A. Top of Wall:
  1. Plan Location: Maximum of plus/minus 1 inch from plan location.
  2. Elevation: Maximum of plus/minus 1-1/2 inch from elevations shown on drawings.
- B. Face of Wall Flatness: Measured as deviation from a straight edge.
  1. In the Vertical Dimension: Plus/minus 1-1/2 inch per 10 foot section.
  2. In the Horizontal Dimension of Straight Walls: Plus/minus 1-1/2 inch per 10 foot section.
- C. Overall Wall Batter: Within 2 degrees of design, measured from the vertical.
- D. Gap Between Adjacent Units: 1/8 inch, maximum.

#### **3.05 FIELD QUALITY CONTROL**

- A. Owner will engage inspection and testing services, including independent laboratories, to provide quality assurance and testing services during construction. Contractor will secure necessary construction control testing during construction.
- B. Correct work found deficient and not in accordance with drawings and specifications.

#### **3.06 CLEANING**

- A. Clean wall face to remove debris and stains.
- B. Leave adjacent paved areas broom clean.

#### **3.07 PROTECTION**

- A. Prevent damage to wall and earthwork by subsequent construction and uncontrolled runoff until substantial completion; repair damage due to failure to protect wall or earthwork.
- B. Do not operate heavy paving or grading equipment within 36 inches from the back of the wall face.
- C. Do not operate equipment with wheel loads in excess of 150 psf live load within 10 feet from the wall face.
- D. Do not place temporary soil or fill stockpiles adjacent to wall.
- E. Replace damaged units prior to substantial completion.

**END OF SECTION 32 3223**

## SECTION 32 9300

### PLANTS

(Information and charts contained in these specifications are based on Landscape Specification Guidelines, 5<sup>th</sup> Edition, published by the Landscape Contractors Association of MD, DC, VA.)

#### PART 1 - GENERAL

##### 1.01 SECTION INCLUDES

- a. Trees, Shrubs, Perennials, & Groundcovers
- b. Soils and Soil Preparation

##### 1.02 SCOPE OF WORK

- A. The landscape contractor shall provide all materials, labor and equipment to complete all landscape work as shown on Quinn Craughwell Landscape Architect's (QCLA) plans and specifications.
- B. Total number of plants shall be drawn on QCLA's planting plan. The landscape contractor shall provide the total number specified of each plant with the contract price. The plant list submitted with the bid will automatically become part of the contract documents.

NOTE: If the contractor bids according to the Plant List, he/she should thoroughly check the plant list quantities with the symbols on the planting plan to be sure there are no discrepancies. Each plant grouping shall be labeled with the total number of plants per grouping by QCLA. If a discrepancy is found, the contractor shall immediately notify QCLA.

##### 1.03 REFERENCE STANDARDS

- A. All plant material will conform to the current issue of the American Standard for Nursery Stock published by the American Nursery & Landscape Association (ANLA).
- B. Plant material must be selected from nurseries that have been inspected and certified by state plant inspectors.
- C. Nomenclature will be in accordance with *Hortus III* by L. H. Bailey

##### 1.04 SUBMITTALS

- A. When requested by QCLA, owner, or owner's representative, samples of all materials other than plants shall be submitted to QCLA and the owner or the owner's representative for approval.

##### 1.05 SUBSTITUTIONS

- A. It is the landscape contractor's responsibility to make every reasonable effort to find the material specified by QCLA. The landscape contractor may offer substitutions to QCLA for consideration if plant availability presents a problem. The landscape contractor shall notify QCLA if there are known diseases or insect resistant species that can be substituted for a selected pest-prone plant. The contractor shall submit a base bid as per plan plus price clarifications for all recommended substitutions.

- B. It is the intent to eliminate post-bid substitutions. However, in the event that the contract material has become unavailable, an appropriate substitution must be approved by QCLA.

**1.06 UTILITIES AND UNDERGROUND FEATURES**

- A. The landscape contractor shall notify utility companies and/or the general contractor in advance of construction to locate utilities.
- B. Street lighting and other private utilities, including cable TV, communication lines, etc., shall be located by the owner, the owner's representative, or the general contractor. The landscape contractor shall notify QCLA of all such features if they impact any contracted work.
- C. If there is a conflict with the utilities and the planting, QCLA shall be responsible for directing the relocation of plants prior to the planting process. Any cost due to relocating after planting shall be borne by the owner.
- D. Underground features including—but not limited to—existing irrigation, septic systems, drain systems, invisible pet fence, landscape lighting, underground natural gas and security systems shall be located by the owner or general contractor. QCLA shall be notified of all such features by the landscape contractor.

**1.07 CONCEALED CONTINGENCIES**

- A. The correction of undisclosed subsurface conditions including but not limited to rock, roots, stumps, water, clay pan, solids contaminated with toxic substances or other obstacles encountered in excavation work, which are not apparent at the time of estimating, will result in additional costs to the owner. Upon discovery of undisclosed conditions, the landscape contractor shall notify QCLA and await QCLA's approval regarding any additional costs, before corrective measure are taken. When requested by QCLA or the owner, approval shall be in writing.

**1.08 DRAINAGE**

- A. If plants are to be installed in areas that show obvious poor drainage and the plants are inappropriate for that condition, the landscape contractor shall notify QCLA. If deemed necessary by QCLA, the plants shall be relocated, the contract shall be adjusted to allow for drainage correction at the owner's expense, or the plant selection modified by QCLA to accommodate the poor drainage situation.

**1.09 WORKMANSHIP**

- A. During delivery and installation, the landscape contractor shall perform in a professional manner, coordinating his/her activities so as not to interfere unduly with the work of other trades and leaving his/her work area(s) clean of litter and debris at the close of each workday.
- B. During planting, all areas shall be kept neat and clean by the landscape contractor, and precautions shall be taken to avoid damage to existing plants, large trees, turf and structures. Where existing trees are to be preserved, additional precautions shall be taken to avoid unnecessary accumulation of excavated materials, soil compaction, or root damage.
- C. Upon completion, all debris and waste material resulting from planting operations shall be removed from the project and the area cleaned up by the landscape contractor.

- D. Any damaged areas caused by the landscape contractor shall be restored to their original condition.

1.10 WATER

- A. The owner shall supply water on site at no cost. If the landscape contractor has to supply water to the site, it shall be at the owner's expense.

1.11 PLANTING SEASONS

- A. When requested by QCLA, a professional horticulturist, nursery professional, or arborist shall be consulted to determine the proper time, based on plant species and weather conditions, to move and install particular plant material to minimize stress to the plant. Plant material moved out of the normal planting season may require special treatment and may result in additional expense to the owner. The following guidelines should aid the landscape contractor in determining what and when to plant:

1. Stress Chart for B&B Deciduous Material

- |              |  |
|--------------|--|
| Lowest Risk  | a. Deciduous plants dug and planted while dormant in spring or fall except those listed in D. below.                 |
| ↓            | b. Deciduous plants dug during dormancy and planted after producing leaves providing they have been properly stored. |
| ↓            | c. Deciduous plants dug after leaves have fully expanded and hardened off.   |
| Highest Risk | d. Deciduous plants dug in the spring during newly expanding leaf production.  |

2. All woody plant material dug in full foliage between the months of May and September shall be handled in one of the following ways to harden-off:

- a. Properly harden-off in the field 7-10 days prior to digging by a gradual process of trenching and soaking, leaving the bottom surface of the ball attached to soil until shipping.
- b. Condition under irrigation in partial shade or sun for at least 4 days prior to shipping.
3. Container-grown and B&B deciduous material can be planted year round, provided it receives adequate irrigation for the first growing season.
4. Herbaceous perennials and summer flowering bulbs can be installed as soon as the ground is workable in spring until November 15. Plants installed after November 15 require a protective, supplemental mulch applied after December 15 and removed March 1.
5. Red, White, Willow and Scarlet oaks, Dogwood, Sweet Gum, Leyland Cypress, White Pine and all broadleaf evergreens should be planted between March 1 and October 30.

1.12 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: There should be a verification of performance for work by contract documents, to be conducted by QCLA or owner on-site and in the presence of the landscape contractor, for the purpose of acceptance. QCLA or owner shall prepare a list of plants that are lacking or in need of replacement, and a copy of this list shall be provided to the landscape contractor and to the owner or owner's representative.
- B. Initial Acceptance: There should be an approval of the work inspected. Acceptance can be on partially completed work under the contract, if approved by QCLA. If, for reasons beyond the landscape contractor's control, work has stopped, inspection shall be made on partially completed work. Warranty shall begin after landscape inspection and acceptance. Maintenance after initial inspection and acceptance shall be the responsibility of the owner, unless an optional maintenance contract has been specified. The landscape contractor should periodically inspect the site during the warranty period and notify QCLA if proper maintenance is not being performed.
- C. Final Inspection and Acceptance: The landscape contractor shall conduct a final inspection with QCLA, the owner or owner's representative at the end of the one year period.

#### 1.13 WARRANTY

- A. The landscape contractor's warranty for plant materials shall be for a minimum one (1) year period, excluding annuals, commencing on the date of initial acceptance. All plants shall be alive and in satisfactory growth at the end of the guarantee period.
- B. Any material that is 25% dead or more shall be considered dead and must be replaced by the landscape contractor at no charge. A tree shall be considered dead when the main leader has died back or 25% of the crown is dead.
- C. Warranty may be void if proper care, by owner or owner's maintenance contractor, is not maintained.
- D. Replacement shall be made by the landscape contractor during the next planting period.
- E. The landscape contractor shall be responsible for a one-time replacement only.
- F. Replacements shall be of the same type, size, and quality as original species unless otherwise specified by QCLA.
- G. The landscape contractor will not be responsible for plant material that has been damaged by vandalism, fire, removal, relocation, theft, or other activities beyond the landscape contractor's control. Plant losses due to abnormal weather conditions such as floods, excessive wind damage, drought, severe freezing, or abnormal rains will in no way be the responsibility of the landscape contractor.
- H. Existing plant material transplanted shall not be guaranteed unless otherwise stated by the landscape contractor.

### PART 2 - PRODUCTS

#### 2.01 SCOPE OF WORK

- A. The landscape contractor shall be responsible for furnishing and installing all plant material shown on QCLA's drawings and plant list, as submitted with the contract. For

calculation of quantities, the planting plan shall govern over the plant list. The landscape contractor shall have investigated the sources of supply and satisfied himself/herself that he/she can supply all the plants specified on the drawings in the size, variety and quality noted before submitting the bid. Failure to take this precaution will not relieve the successful bidder from the responsibility for furnishing and installing all the plant material in strict accordance with the contract requirements.

## 2.02 PLANT MATERIAL

- A. Plants will be nursery grown in accordance with the current ANLA's Standards and conform in general to representative species. Plants shall be grown under climatic conditions similar to those in the locality of the project for at least two years.
- B. Plants shall be freshly dug. No heeled-in plants or plants from cold storage will be accepted.
- C. Unless specifically noted otherwise, plants shall be of specimen quality, exceptionally heavy, symmetrical, tightly-knit plants, so trained or favored in their development and appearance as to be unquestionably and outstandingly superior in form, number of branches, compactness and symmetry.
- D. They shall be sound, healthy and vigorous, well-branched, and densely foliated when in leaf. They shall be free of disease, insect pests, eggs or larvae. They shall be free from physical damage or adverse conditions that would prevent thriving with the specified result.
- E. Plants shall be true species and variety and shall conform to measurements specified in the plant list, except that plants larger than specified may be used if acceptable to the Landscape Architect. Use of such plants shall not increase the Contract Sum.
- F. Trees shall have a single trunk unless a multistem is specifically called for in the plant list. No part of the trunk shall be conspicuously crooked as compared to normal trees of the same variety. The trunk shall be free of recent sunscald, frost cracks, or wounds from abrasions or other causes. Trees showing signs of such wounds shall be completely callused over, or they will be rejected. Trees with multiple leaders will be rejected. The main leader shall be intact and undamaged. Evergreen trees shall be of the specified height with spread in proportion to height, as designated in the ASNS standards, and shall be well branched to the ground.
- G. Balled and Burlapped (B&B) Material
  - 1. Balled and burlapped plants shall be dug with firm root balls free of noxious weeds. There should be no excess soil on top of the root ball or around the trunk.
  - 2. Caliper and Height Measurement and Ball sizes shall be in accordance with ANLA Standards.
- H. Container-Grown Stock
  - 1. The size of container-grown shrubs is measured by height and width of plant. Container-grown trees shall be in accordance with ANLA Standards.
  - 2. Herbaceous perennials shall be measured by pot size, not top growth. The root system of container-grown plants shall be well developed and well distributed throughout the container.

3. All container-grown trees and shrubs that have circling and matted roots shall be treated in the following manner prior to planting: using a knife or sharp blade, the landscape contractor shall make 4-5 cuts, 1" deep, the length of the root ball, to cut all circling roots.
4. All container-grown plants shall be grouped and watered daily by the landscape contractor or, if requested, the owner or the owner's representative until they are planted. Container material must have ample soil moisture and until the roots penetrate the soil, the soil must remain moist. The landscape contractor, the owner, or the owner's representative shall water twice weekly or at four-day intervals until the equivalent of one inch of rainfall or supplemental irrigation is received.
  - I. The landscape contractor shall cover all plant material in transit to keep material from drying out. The covering shall comply with state and local laws pertaining to the transport of materials.
  - J. Plant material labels shall be durable, legible labels stating the correct plant name and size in weather-resistant ink or embossed process. Attach securely to all plants, bundles, and containers of plant material delivered, being careful that those attached directly to plants will not restrict growth.

#### 2.02.1 INSPECTION

- A. When indicated by QCLA, plants may be subject to inspection and approval by QCLA at the place of growth or holding yard for conformity to specification requirements as to quality, size, and variety. It is the landscape contractor's responsibility to know his/her sources. The landscape contractor shall select plants ahead of inspection visits to prevent rejection of materials delivered to the site. Cost of inspection visits by QCLA shall be borne by the owner.
- B. Plants damaged in handling or transportation can be rejected by QCLA or the owner.
- C. Any plant material inspected at the place of growth, accepted, and tagged by QCLA, that has not been damaged in the time between selection by QCLA and delivery shall not be rejected at the site as long as the tag remains attached to the plant.
- D. State nursery inspection certificates shall be furnished to QCLA upon request.

#### 2.03 SOIL MATERIALS

##### 2.03.1 SOIL ANALYSIS

- A. Prior to developing recommendations for soil modifications, an analysis of existing soil conditions shall be performed by the landscape contractor. All Soil modifications shall be based on the results of the soil analysis.
- B. The soil analysis shall include the following:
  1. Sampling of existing soils as follows:
    - a. Identification and mapping of areas with different soil conditions.
    - b. For each area identified, one composite soil sample (1 cup) consisting of a minimum of eight (8) core samples.

- c. Soil testing shall be performed as per Section 3.01 Soil and Compaction Testing in this Section unless otherwise indicated on the landscape plan.
  - d. If the soil in the top 6-8" of soil indicates a pH level two or more units above or below the optimum pH level desired, additional testing of subsoil pH is recommended.
2. Compaction analysis:
    - a. Each of the soil conditions identified above shall be tested for compaction.
    - b. Compaction analysis shall be performed as per Section 3.01 Soil Testing in this Section.
  3. Drainage analysis:
    - a. Soils that exhibit the following characteristics shall be considered poorly drained:
      - Standing water
      - Anaerobic soils (may have objectionable odor)
      - Gray soils (hydric)
      - Presence of wetland species.
- C. Definitions of soils and planting mixes are as follows:
1. Existing soils are soils that are present on the site at the time of estimating.
  2. Imported soils are soils that are brought onto the site during the course of the job. On-site stockpiles of soil that may have been present at the time of estimating shall also be considered imported soils.
  3. Planting soils are prepared and often amended soils, whether they are existing, imported, or a blend of both existing and imported soils, that will be at the surface of the soil profile when planting begins.
  4. Subsoil is soil that, in an undisturbed soil profile, would be the B horizon.
- D. Based on the above analysis and definitions:
1. *Minimum* soil modification required including:
    - a. Nutrient and pH adjustments less than 2 pH units to existing soils
    - b. Addition of organic matter to the existing soils
    - c. Tilling of existing soils with the exception of rootzones of existing trees.
  2. *Significant* modification(s) required, including the following, in addition to the requirements of paragraph D.1:
    - a. Sub-soiling to reduce compaction below planting soils
    - b. Installing sub-surface drainage
    - c. Re-grading to improve surface drainage
    - d. Significant pH adjustment to existing soil or subsoil of more than 2 pH units
    - e. Adding imported soils or planting mixes
  3. *Significant modifications beyond the scope of these specifications*  
QCLA shall require consultation with a specialist in soils to determine appropriate action in the following circumstances:

- a. Soils containing quantities of man-made inert substances or objects considered harmful to plant growth
- b. Soils suspected of containing harmful chemical contaminants
- c. Soils suspected of containing naturally occurring compounds harmful to plant growth that are not easily remediated
- d. Subsoil conditions that require modifications beyond basic drainage and sub-soiling
- e. Soils not classified as a type of loam (i.e. clay, clay/silt, sand, sandy clay, etc.) using the USDA soils classification

#### 2.03.2 ORGANIC MATTER

- A. The following is a list of the types of organic matter that may be used as soil amendments.
  - 1. Yard debris mature compost – leaves, grass clippings and prunings screened through a 1/2" screen and containing less than 1% man-made inerts.
  - 2. Biosolids and yard debris compost – polymer or naturally dewatered bio-solids and yard debris that have been composted according to EPA standards, and screened through a 1/2" screen.
  - 3. Biosolids and woodchips compost – polymer or naturally dewatered bio-solids that have been composted with woodchips according to EPA standards, and screened through a 1/2" screen.
  - 4. Animal manure mature compost- made from poultry, swine, cattle or equine manures composted with bedding, wood waste or yard debris.
  - 5. Composted organic fines from wood waste – a product derived from the processing of wood mulch containing a minimum of 75% sawdust and dust size products.

#### 2.03.3 IMPORTED SOILS

- A. Imported soil shall meet acceptable soil test levels as specified in Soil Testing Section. When requested by QCLA, a certificate of soil test analysis, soil source location and crops grown in the soil over the past three years, if available, must be submitted to QCLA for approval before any soil is delivered to the project. Submit a one-pound sample of soil source of each soil to accompany soil test.
- B. Imported soils shall be loams of textural classification specified for each application. Unless otherwise indicated, imported soil installed on grade shall generally attempt to match existing soil texture. In extreme clay or sandy subsoil, follow recommendations of a soil specialist.
- C. Imported soil shall not contain toxic substances harmful to plant growth, pesticide residues, stones, lumps, plants, large roots and other debris over 1.5 inches. Imported soil shall also be free of Bermudagrass, quackgrass, Johnsongrass, mugwort, nutsedge, poison ivy, Canada thistle or other invasive weeds.
- D. Imported soil shall not be harvested, transported and/or graded when soil moisture exceeds field capacity or when material is frozen.
- E. The contractor shall protect imported soil stockpiles from erosion, saturation, or weed growth using plastic sheeting or tarps.

#### 2.03.4 PLANTING MIXES

- A. The recommendations of mix requirements is specific and based on results of soil test analysis.
- B. Planting mixes in quantities greater than 1 cubic yard shall be blended mechanically using commercial mixer or shredder. Ingredients shall be uniformly incorporated to obtain a consistent blend.
- C. The contractor shall protect plant mix stockpiles after mixing from erosion, saturation, or weed growth using plastic sheeting or tarps.
- D. When requested by QCLA, prior to mixing any planting mix, the contractor shall prepare sample mix ratios and submit to QCLA for approval along with test results. If the sample does not meet the mix criteria, the contractor shall resubmit alternative mix ration samples with test results.

#### 2.04 FERTILIZER

- A. Slow-release fertilizer should be the preferred type.
- B. For trees, shrubs, ground cover: The landscape contractor shall apply a fertilizer with a minimum analysis of 10% nitrogen, 6% phosphorus and 4% potassium.
- C. For perennials, annuals, bulbs: The landscape contractor shall apply a complete fertilizer that is slow released.
- D. Fertilizer shall be added by the landscape contractor, except when compost is used to amend soil, depending on the size of the plant and the manufacturer's recommendation. The following application rates should be used:
  1. Trees: 1 to 3 pounds of actual nitrogen contained in a complete fertilizer per 1000 square feet of treated area, i.e. if using 10-6-4 at the rate of 1 pound of actual nitrogen per 1000 square feet, apply at the rate of 10 pounds per 1000 square feet of treated area annually.
  2. Shrubs: 1/2 pound of actual nitrogen contained in a complete fertilizer per 100 square feet of bed area, (i.e. if using 10-6-4, this would be at the rate of 5 pounds per 100 square feet of bed area).
  3. Ground Cover: Use 1/4 pound of actual nitrogen per 100 square feet of bed area, (i.e. if using 10-6-4, apply approximately at the rate of 3 pounds per 100 square feet).
  4. Perennials, Annuals, Bulbs: If directed by QCLA, the landscape contractor shall run soil tests and determine fertilizer needs. If necessary, 3 pounds of time-released, high phosphate fertilizer per 100 square feet of bed area should be used.

#### 2.05 MULCH

- A. Organic material including shredded hardwood bark and ground wood waste, shall be composted and free of dyes.

- B. Organic material shall be uniform in size and free of foreign matter.
- C. Pine bark with less than 10% sapwood, pine needles, cypress bark, redwood bark, and cocoa shells does not need to be composted.

## 2.06 STAKES

- A. Stakes shall be 2" x 2" hardwood or approved equal. See Section 3.03 Tree Support Schedule of this section for proper stake length.

## 2.07 WIRE

- A. Wire shall be 12 or 14 gauge galvanized steel of approved equal, depending on size of tree. See Section 3.03 Tree Support Schedule of this section.

## 2.08 HOSE

- A. Hose shall be corded rubber, uniform in color, and either 1/2" or 3/4" depending on the size of the tree. Other methods such as straps or plastic chain locks may be used where approved by QCLA on the drawing planting details. See Section 3.03 Tree Support Schedule of this section.

## 2.09 TREE WRAP

- A. It is recommended that the landscape contractor wrap the trunks of smooth bark trees during dormant installation, and remove the tree wrap when the canopy is in leaf.

# PART 3 – EXECUTION

## 3.01 SOIL PREPARATION

### 3.01.1 SOIL TESTING

- A. Soil Testing Procedure:
  - 1. Each area should be sampled by mixing together a minimum of 8 soil samples from each area designated for testing by QCLA.
  - 2. A simple stainless steel soil auger should be used to obtain soil samples. A motorized auger is not recommended.
  - 3. Soils should always be assessed for the following:
    - a. Compaction: If the auger will not penetrate the soil to a depth of 8 - 10" without using excessive force, the soil is considered compacted to 85% or more.
    - b. pH value.
    - c. Minerals: Magnesium, Phosphorus, Potassium, and Calcium.
    - d. Organic content.
    - e. Mechanical analysis: % sand/silt/clay (when requested).
  - 4. The soil testing forms and supplies should be obtained at the Washington County branch of the Virginia Cooperative Extension located at 234 West Valley Street, Suite B in Abingdon Virginia.

5. All soil testing costs shall be included in the services supplied by the landscape contractor.
- B. Each soil test shall examine the following chemical and physical attributes. Any soil that falls within the indicated range of results shall be considered provisionally acceptable. Soil that falls outside of any of the indicated ranges may be amended, retested, and resubmitted for approval by the owner. Once a soil is considered provisionally acceptable, its pH level should be examined for suitability with the plants that are to be grown on the site. Special attention should be paid to the pH tolerances of plants that require acidic soil for healthy growth.

pH Range	4.5 – 7.0
Organic Matter	> 1.5%
Calcium	< 175 units or 3,000 lbs./A.
Magnesium	26-50 units or 71-124 lbs./A.
Phosphorus	26-50 units or 62-102 lbs./A.
Potassium	26-50 units or 85-160 lbs./A.

- C. In the event that the owner rejects the recommendations of the soil test and requires QCLA to approve planting in soils that otherwise require amendments, the landscape contractor may void the guarantee for plantings or lawns. In the event that the contractor voids the guarantee, the owner shall be notified in writing of such action prior to the installation of any plantings or lawns. No consideration of changes to the conditions of the guarantee will be allowed without written notification prior to planting.

### 3.01.2 MINIMUM MODIFICATIONS TO CREATE PLANTING SOILS

#### 3.01.2.1 GENERAL CONDITIONS

- A. Prior to amending soils, the landscape contractor shall clear the surface of all trash, debris and stones larger than 1" in diameter or length, brush, weeds, grass, wire, grade stakes and other objects that would interfere with soil preparation. Installation of all utilities and irrigation mainlines shall be completed prior to beginning soil work.
- B. Strategies for soil modifications shall be agreed upon by landscape contractor and landscape architect or owner based on soil testing analysis and observation prior to beginning work.
- C. All soils and drainage work within the critical root zone of any tree to remain shall be performed with strict attention tree preservation. Major roots shall be avoided and work shall be relocated as needed and approved by the landscape architect. No tilling shall be performed within the root zone of any existing trees. No additional soil will be laid on top of existing grade within critical root zone. Stockpiling of materials is prohibited within root zone.
- D. The soil shall not be tilled or amended when the soil's moisture level is above field capacity or when the soil is frozen.

- E. Grades after amendment, tilling and fine grading in the specified area shall conform to civil engineering drawings and/or other applicable specifications and shall be maintained true and even.

#### 3.01.2.2 MODIFICATIONS FOR NATIVE, UNDISTURBED LOAMY SOILS

- A. Unless deep tilling is indicated, amendments shall be applied uniformly based on the following recommendations and soil test results. The contractor shall thoroughly incorporate the amendments plus 1" of organic matter (or an amount as necessary to establish final grade) into the upper 6" of soil using a rear-tine ("sulky") rototiller. When requested by QCLA, the contractor shall retest planting soil at least one week after the incorporation of amendments to confirm that the soil has responded to meet the design criteria. The contractor shall submit the test results to QCLA for approval.
- B. All soils shall be tilled to a minimum depth of 6" prior to fine grading.
- C. Lightly firm tilled soils and establish finely graded soil surface free of divets and depressions. Ensure positive drainage away from buildings and other structures. Make changes in grade gradual. Blend slopes into level areas.

#### 3.01.2 SIGNIFICANT MODIFICATIONS TO CREATE PLANTING SOILS

##### 3.01.2.1 SUBSOILING TO REDUCE COMPACTION

- A. Sub-soiling will be necessary in all planting and sodding areas affected by construction, including those areas compacted by original construction of main building. The landscape contractor is to confirm that this work has been performed by the general contractor prior to the addition of any imported soils. If it was not, the landscape contractor will be responsible for sub-soiling at an additional cost to the owner, with approval by the owner.
- B. Sub-soiling shall be done by the landscape contractor using a chisel-type sub-soiler or chisel plow. In restricted areas, sub-soiling may be done with a mechanical ditch digger ("Ditchwitch"). A vibrating plow shall not be used.
- D. The sub-soiler shall penetrate the soil to a depth of 20" at 24" intervals with two passes in each area at 90 degrees to each other. In sloped areas, the first pass of sub-soiling equipment shall be across the slope and the second pass of sub-soiling equipment shall be up and down the slope.
- E. If the soil being sub-soiled is a loam, silt loam, or clay loam, spread 4 cubic yards of organic matter (from approved source and approved by landscape architect) per 1,000 sq. ft. for loam and silt loam soils OR 6 cubic yards for clay or clay loam soils, and rake or drag the organic matter across the sub-soiled area to fill the cavities created. If a ditch digger is used, fill the ditches with mature compost, and pack it firmly in the ditches created.
- F. In areas that are inaccessible by a chisel-type sub-soiler or chisel plow due to size, location, or construction, a post-hole digger may be used to penetrate soil to a depth of 20"-24", with holes spaced no more than 18"-24" apart.

##### 3.01.2.2 REGRADING TO IMPROVE SURFACE DRAINAGE

- A. All re-grading to improve surface drainage should be done to create positive drainage conditions throughout the planting areas. The civil engineering plan shall identify the

- location, slope and details of any areas that are to be regarded or swales to be created.
- B. The landscape contractor shall ensure appropriate slopes of the swales and final grades.
  - C. Unnecessary compaction of the soil shall be avoided during re-grading.
- 3.01.2.3 SIGNIFICANT pH ADJUSTMENT OF PLANTING SOILS AND/OR SUBSOILS
- A. If the pH of the subsoil is more than 2 pH units above or below the desired level, the landscape contractor shall amend with the recommended amount of lime or acidifying amendment and incorporate into the upper 4" to 6" of the subsoil prior to establishing the sub-grade. If the subsoil has a pH that is more than 2 units above the desired level, the landscape contractor shall incorporate 2 to 4 cubic yards of pine fines per 1,000 square feet in addition to the acidifying amendment.
  - B. If the pH of the existing soils is more than 2 pH units above or below the desired level, the landscape contractor shall amend with the recommended amount of lime or acidifying amendment and incorporate into the upper 4" to 6" of the existing soil prior to fine grading. If the subsoil has a pH that is more than 2 units above the desired level, the landscape contractor shall incorporate 2 to 4 cubic yards of pine fines per 1,000 square feet in addition to the acidifying amendment.
- 3.01.3 ADDING SOILS OR PLANTING MIXES
- A. Place 6" of organic matter (organic mature compost from approved source, as approved by landscape architect) to improve soil structure and establish final grade as directed by landscape architect.
    - a. Where the addition of 6" of organic matter creates higher than required grades, the removal of clay soils prior to the placement of organic matter or mounding of beds may be necessary. Confirm with landscape architect prior to beginning work.
    - b. Where more than 6" of earth is needed to establish final grade, clean fill can be brought in if contractor maintains 6" of organic matter at surface to be tilled to a depth of 12". This process is to be approved by landscape architect prior to commencing work.
  - B. Lightly firm tilled soils and establish finely graded soil surface free of divets and depressions. Ensure positive drainage away from buildings and other structures. Make changes in grade gradual. Blend slopes into level areas.
  - C. All soil depths are to be as measured after initial compaction and, when required by QCLA, after 12 months settlement.
  - D. All subsoil modification, installation of drain lines, planter drainage and rough grading shall be completed prior to adding soils. All sub-grades shall be inspected by QCLA or owner and approved prior to adding soils.
  - E. Add imported soil or planting mix in lifts not to exceed 12" in depth.
    - a. The landscape contractor shall compact each soil lift using a plate vibrator or light roller. Soil shall be compacted such that it still will show shallow heel

marks, or such that a standard 1" soil sampling tube meets at least 15 pounds of resistance when inserted into the soil.

- b. Soil that has been compacted should drain water at the rate of 1" per hour. Soils that drain less than 1" per hour are considered over-compacted and must be tilled and rolled again.

### 3.02 PLANTING PROCEDURE FOR TREES

#### 3.02.1 PREPARING THE TREE PIT

- A. The landscape contractor shall dig walls of tree pit so that they are vertical, or sloping outward in heavy soils, and scarified. Refer to QCLA drawing Planting Detail for Trees.
- B. The tree pit must be a minimum of 3 times the width of the ball of the tree.
- C. The tree pit shall be deep enough to allow 1/10 of the ball to be above the existing grade unless otherwise indicated on QCLA's drawing Planting Detail for Trees. Plants shall rest on undisturbed existing soil or well-compacted backfill.
- D. If poor drainage is suspected, the landscape contractor shall perform a percolation test. A twelve-inch wide by eighteen-inch deep hole must be filled with water and eight hours later, the hole should be empty. Sub-drainage may be needed if the hole does not drain properly in eight hours. QCLA shall be notified immediately by the landscape contractor where poor drainage is suspected.
- E. The landscape contractor shall follow QCLA's planting details drawing for all tree installations.

#### 3.02.2 PLACING TREE IN PIT

- A. The landscape contractor shall place the tree in the pit carrying the ball and then lower it into the pit. The landscape contractor shall not lift the tree by the trunk or branches.
- B. The landscape contractor shall set the tree straight and in the center of the pit with the most desirable side facing toward the prominent view or as directed by QCLA.
- C. The landscape contractor shall remove containers from all container-grown trees. The landscape contractor shall slash the edges of the root ball from top to bottom, at least 1" deep, as described in Section 2.02 Container Grown Stock.

#### 3.02.3 BACKFILLING TREE PIT

- A. Backfill mixture for trees and shrubs shall be 2/3 existing soil mixed with 1/3 organic material, plus granular fertilizer unless otherwise directed by QCLA on the drawing Tree Planting Details. If compost is used, granular fertilizer may be omitted.
- B. If any other additives are found to be needed at the time of planting, it shall be with the approval of QCLA at an additional cost to be paid by the owner.
- C. The landscape contractor shall backfill the tree pit with a soil mixture stated in the specifications, except where existing soil is suitable according to soil test results.

- D. The burlap, rope or wire must be cut and removed off the top 50% of the root ball by the landscape contractor. All plastic or synthetic film or twine must be removed completely from the root ball. The landscape contractor shall cut and remove all twine away from trunk.
- E. The tree must remain straight during backfilling procedure.
- F. Soil amendments as directed by results from soil testing, shall be thoroughly mixed by the landscape contractor either prior to filling the pit or as the pit is being filled.
- G. Sides of the tree pit shall be backfilled halfway with soil mixture and tamped as the pit is being filled by the landscape contractor. The landscape contractor shall not over compact top 2/3 of planting mixture.
- H. The landscape contractor shall finish backfilling sides of tree pit and tamp firmly.
- I. The landscape contractor shall never cover the top of the root ball with soil.
- J. The landscape contractor shall form a saucer above existing grade, around the outer rim of the tree pit, especially on slopes and in heavy soils.
- K. The landscape contractor shall mulch the top of the root ball and saucer to a maximum depth of 2". The landscape contractor shall not place mulch against the trunk.
- L. The landscape contractor shall water thoroughly on the interior of the tree saucer until it is filled, even if it is raining. A second watering may be necessary to insure saturation of the root ball and elimination of air pockets. An alternative watering method is to backfill half of the pit, flood the pit, and completely backfill afterwards. Slow release watering devices or automatic drip irrigation systems will improve survival.
- M. The landscape contractor shall remove all strings and wire from the tree, unless otherwise directed by QCLA. Tags and labels shall be removed unless otherwise directed by QCLA.

### 3.03 BRACING PROCEDURES

#### 3.03.1 TREE STAKING

- A. The decision to stake should be made on an individual tree basis and should not be required for all plantings (trees under 8' may not require staking). It is recommended that all container and root control bag trees be staked.
- B. The landscape contractor shall choose the correct size of tree staples, stakes, hose, and wire according to 3.2.5 Tree Support Schedule of this section. Staking shall be completed as soon as possible after planting the tree. Stakes shall be placed parallel to walks and buildings.
- C. The landscape contractor shall space stakes evenly and vertically on the outside of the tree ball and drive them firmly into the ground. The landscape contractor shall never drive a stake through the root ball, as it will damage the tree's root system.
- D. The landscape contractor shall cut pieces of hose long enough to loop around the trunk of the tree.

- E. The landscape contractor shall place the hose around the trunk at the height required to provide optimum support. Wire shall be threaded through the hose and both ends pulled horizontally 2' beyond the stake.
- F. The wire shall be twisted at the rubber hose to keep it in place. The landscape contractor shall wind both ends of the wire together around the stake twice and then twist wire back onto itself to secure. Excess wire shall be cut off. The wire shall be 2"-6" from the top of the stake.
- G. The above procedures shall be followed for each stake, keeping the tree straight at all times. For best establishment, there should be 1-3" sway in the tree.
- H. Stakes, wire and hose must be removed one year after planting by the landscape contractor, the owner, or the owner's representative, unless growing conditions warrant otherwise. The owner shall be advised by the landscape contractor that the supports shall be removed.
- I. Refer to QCLA drawing Tree Planting Detail.

### 3.03.2 TREE GUYING

- A. The decision to guy should be made on an individual tree basis and should not be required for all plantings.
- B. The landscape contractor shall choose the correct size of stakes, hose and wire according to 3.2.5 Tree Support Schedule of this section. Guying shall be completed as soon as possible after planting the tree.
- C. Lengths of staking hose shall be cut to extend 2" past tree trunk when wrapped around.
- D. Stakes shall be spaced evenly on outside of the tree saucer and each driven firmly into the ground. Stakes shall be driven at a 30° angle with the point of the stake toward the tree, with 4" or 5" remaining above ground.
- E. The hose shall be placed within bottom 1/3 of total plant height or at lowest branch height.
- F. The wire shall be threaded through the hose and pulled down the wire to extend 2" beyond the stake.
- G. Wire shall be twisted at the rubber hose to keep it in place. Both ends of the wire shall be wound together around the stake twice and then twisted back onto themselves to secure. Excess wire shall be cut. The wire shall be 2" from the top of the stake. If necessary, wires shall be twisted to tighten the guy.
- H. The landscape contractor shall follow the above procedures for each stake, keeping the tree straight at all times. For best establishment, there should be 1"-3" sway in the tree.
- I. The guy wires shall be flagged with surveyor's flagging tape or approved equal.
- J. The owner should be notified by the landscape contractor to remove stakes, wire, and hose one year after planting unless growing conditions warrant otherwise.

### 3.03.3 TREE SUPPORT SCHEDULE

NOTE: General guidelines are as follows. Evergreens are more likely to require stakes or guying. Flowering/shade trees not exceeding 8' shall be staked at the landscape architect's discretion. The landscape contractor shall be responsible for maintaining trees in a straight, upright condition throughout the warranty period.

<i>Tree Size Height</i>	<i>Tree Size Caliper</i>	<i>Stake</i>	<i>#</i>	<i>Wire or Cable</i>	<i>Turnbuckle</i>	<i>Hose</i>
6-8'	1-1 1/2"	5' upright	2	14 gauge wire	--	1/2"
8-10'	1 1/2"-2"	5' or 6' upright	2	14 gauge wire	--	1/2"
10-12'	2"-2 1/2"	7'-8' upright	2	14 gauge wire	--	1/2"
12-14'	2 1/2"-3"	2' guy	3	12 gauge wire	--	1/2"
14-16'	3"-4"	2' guy	3	12 gauge wire	--	3/4"
16-20'	4"-6"	30" guy	3	12 gauge wire	--	3/4"
20' & over	6" & over	Anchor	3	3/16" cable or as appropriate	3/8 x 6"	3/4"

### 3.04 PLANTING PROCEDURES FOR SHRUBS

#### 3.04.1 PLANTING SHRUBS

- A. For single shrubs the landscape contractor shall dig the pit one foot wider than the root ball diameter and deep enough to allow 1/10 of the root ball to set above existing grade.
- B. For shrub mass plantings, the landscape contractor shall prepare and amend entire planting bed. The landscape contractor shall observe soil preparation and amendment methods as outlined in Soil Specifications.
- C. The landscape contractor shall place the shrub in the pit by lifting and carrying it by the root ball or container. The landscape contractor shall remove containers from all container-grown shrubs and slash the edges of the root ball from top to bottom, at least 1" deep.
- D. The landscape contractor shall set the shrub straight and in the center of the pit with the most desirable side facing toward the prominent view.
- E. For individual shrub planting, the landscape contractor shall use a backfill mixture as stated in Section 3.02.3, except when existing soil is suitable as determined by soil test.
- F. The shrub must remain straight during the backfill procedure.
- G. The landscape contractor shall backfill sides of the pit halfway up with soil mixture and tamp as the pit is being filled.
- H. The landscape contractor shall cut and remove all rope, twine, or wire off the root ball and cut back and remove from the top half of the root ball. The landscape contractor shall remove as much burlap and woven products as possible. All plastic or synthetic film or twine must be completely removed from the root ball. All twine shall be cut back and removed from trunk and stems.

- I. The landscape contractor shall finish backfilling the sides of the shrub pit and tamp firmly.
- J. The landscape contractor shall form a saucer above the existing grade and completely around the planting pit.
- K. Mulch top of root ball and saucer a maximum depth of 2". Mulch shall be removed from around trunk and stems.
- L. The landscape contractor shall water shrub or shrub mass thoroughly even if it is raining. A second watering may be necessary to insure saturation of the root ball and elimination of air pockets. An alternative watering method is to backfill half of the pit, flood the pit and completely backfill afterwards. Slow-release watering devices or automatic drip irrigation systems may be used by the landscape contractor to improve plant survival.
- M. The landscape contractor shall prune out any dead or broken branches. The landscape contractor shall prune hedges, topiary, or other designated shrubs as directed by QCLA.
- N. The landscape contractor shall remove all strings, wire, etc. from the plant unless otherwise directed by QCLA. Tags and labels shall be removed unless otherwise directed by QCLA.

### 3.05 PLANTING PROCEDURES FOR ALL CONTAINER-GROWN TREES & SHRUBS

- A. The landscape contractor shall remove the plant either by cutting or inverting the container.
- B. For untreated plastic container-grown plants with circling roots, the landscape contractor shall make 4-5 1" cuts the length of the root ball, using a sharp knife.
- C. The landscape contractor shall plant shrub or trees 1/10 of the height of the root ball above existing grade unless otherwise specified in the drawing of planting details.
- D. The landscape contractor shall apply a 2" thick layer of approved mulch. The landscape contractor shall not place mulch against the trunk.

### 3.06 PLANTING PROCEDURES FOR GROUND COVER, PERENNIALS & ANNUALS

#### 3.06.1 PREPARING GROUND COVER, PERENNIAL & ANNUAL BEDS

- A. The landscape contractor shall observe soil preparation and amendment methods as outlined in Soil Specifications.
- B. The landscape contractor shall top dress fertilizer over bed area (except when compost is applied) based on soil test results. In the establishment stage, liquid fertilizer may be applied to annuals as directed by QCLA.
- C. The landscape contractor shall mulch the entire bed a minimum depth of 1", 2" maximum, with mulch approved by QCLA such as shredded hardwood mulch or unscreened compost.

#### 3.06.2 PLANTING GROUND COVER, PERENNIALS & ANNUALS

- A. The landscape contractor shall remove all biodegradable and non-biodegradable pots prior to planting. Root systems of all potted plants shall be split or crumbled.
- B. The landscape contractor shall install plants, either potted or bare root, so that the roots are surrounded by soil below the mulch. Potted plants shall be set so that the top of the pot is even with the existing grade. The roots of bare rooted plants shall be covered to the crown.
- C. The landscape contractor shall space and install plants as noted on the planting plan or contract.
- D. The landscape contractor shall thoroughly water the entire planting bed.
- E. Where indicated on the planting plan, beds are to be mulched to a depth no greater than 1" for perennials and groundcovers.
- F. The landscape contractor shall treat the mulched and planted bed with a pre-emergent, soil-applied herbicide if directed by QCLA and in accordance with manufacturer's specifications. The landscape contractor shall apply pre-emergent herbicide only when all foliage is dry to prevent foliar burn.

### 3.07 MAINTENANCE SERVICE

#### 3.07.1 MAINTENANCE OF TREES, SHRUBS, AND GROUNDCOVERS

- A. Maintenance shall begin immediately after each plant is planted. All planting and plant materials shall be maintained in satisfactory and acceptable condition until FINAL COMPLETION. Maintenance from the final completion to the FINAL ACCEPTANCE is the responsibility of the Owner. The Contractor shall inspect the Site periodically throughout the warranty period and notify the Owner if maintenance procedures are not satisfactory.
- A. Maintenance of planting shall consist of pruning, watering, cultivating, weeding, mulching, tightening and repairing of guys and stakes, resetting plants to proper grades in an upright position, furnishing and applying sprays as are necessary to keep the planting free from insects, diseases and plant replacement.
- B. Planting areas and plants shall be protected at all times against damage of any kind for the duration of the maintenance period. If any plants become damaged or injured, they shall be treated or replaced as directed by the Landscape Architect at no additional cost to the Owner. The Contractor shall not be responsible for acts of vandalism during the warranty and maintenance period.
- D. All stakes, guy wires, hoses, wrapping, and other materials used to stake, guy, and wrap plantings shall be removed at the Contractor's expense at the end of the warranty period.

#### END OF PLANTING SPECIFICATIONS

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**SECTION 33 0130**  
**CLEANING OF SEWERS**

**PART 1 GENERAL**

**1.01 SUMMARY**

- A. Provide all labor, materials, tools, equipment and incidentals as shown, specified, and required to clean the pipelines, laterals and manholes.
- B. The cleaning work to be performed by the Contractor includes:
  - 1. Field locating all manholes along the sewer reaches to be cleaned.
  - 2. Normal and heavy cleaning of existing sanitary sewers.
  - 3. Cutting of roots, grease, intruding sealing ring material and objects edged in pipe joints from existing sanitary sewers and laterals.
  - 4. Light cleaning immediately prior to performance of the pre-lining inspection.
  - 5. Removal of debris from the sewers.
  - 6. Pressure washing of manhole walls, rungs, channel and bench.
  - 7. Disposal of waste and sediment.
  - 8. Cleaning up as the work progresses and after the completion of all Work activities.

**1.02 RELATED SECTIONS**

- A. Section 33 0133 - TV Inspection of Sewer Pipelines.

**1.03 DEFINITIONS**

- A. Normal or Light Cleaning - Cleaning accomplished using water jets to scour and remove debris, grease, etc. from pipe and manhole in 1 to 3 complete passes of the nozzle.
- B. Root Cutting and Grease Cutting - Removal of roots larger than fine roots (as defined by PACP), hardened grease and intruding sealing ring material using cutting device.
- C. Heavy Cleaning - Cleaning accomplished by chain scraping, chain flailing, or other device approved by Engineer and using water jets to scour and remove encrustation, tuberculation, debris, grease, etc. from pipe.

**1.04 GENERAL PRECAUTIONS**

- A. This Contract requires Work in active sewers adhere to all Federal, State and local requirements for safety in confined spaces.
- B. Take precautions to protect sewer mains, laterals and manholes from damage that might be inflicted by the improper selection of the cleaning process or improper use of the equipment.
- C. When using hydraulically propelled devices, take precautions to ensure that the water pressure created does not cause damage or flooding to public or private property.
- D. Do not surcharge the sewer beyond the elevation that could cause overflow of sewage into area waterways, homes, buildings or onto the ground.
- E. Some of the manholes accessing sections of the sewer included in this work are on private property where either specific easements and/or trespass agreements with individual property owners have or have not been negotiated. Contact the Owner prior to accessing facilities situated on private property.
- F. Restore or repair any facility, public or private, which is damaged by Contractor actions at no cost to Owner.

**1.05 SUBMITTALS**

- A. Section 01 3000 - Administrative Requirements: Requirements for submittals.
- B. Specifications of the sewer cleaning equipment, including performance data on pump, hose diameter and length, tank capacity, and intended nozzles, chain cutters, scrapers, and root cutters to be used on the job.
- C. Specifications on the equipment to be used to remove sediment and debris at the downstream manhole of each reach to be cleaned.

- D. Valid waste disposal permit as issued by a licensed disposal facility and approved by the Engineer.
- E. Plan for disposal of debris and sediment removed from the sewer lines.

## 1.06 QUALIFICATIONS

- A. Contractor shall have experience in the cleaning of sewers. Documentation of experience shall be furnished to the Engineer upon request.

## PART 2 - PRODUCTS

### 2.01 MAINLINE SEWER CLEANING EQUIPMENT

- A. Sewer cleaning equipment shall consist of truck-mounted, high velocity hydrocleaning equipment. The equipment shall be provided with a minimum of 500 feet of one-inch inner diameter high-pressure hose with a selection of high velocity nozzles, as required for the cleaning operation. The nozzles shall produce a scouring action from 15 to 45 degrees in all size sewers to be cleaned. Use nozzles matched to the pumps and the site-specific cleaning requirements.
- B. The pumps shall be capable of delivering a minimum of 60 gpm at 2,000 psi at the nozzle head. A relief valve shall regulate pressure to the nozzle. The unit shall carry its own water tank, minimum of 1,000 gallons, auxiliary engines and pumps, and a hydraulically-driven hose reel.
- C. All controls shall be located so that the equipment can be operated above ground.

### 2.02 MANHOLE CLEANING EQUIPMENT

- A. Provide a high velocity washing hose for cleaning of the walls, rungs, channel and bench of the manhole. The hose shall have an adjustable nozzle capable of producing flow from a fine spray to a solid stream. All controls shall be located so that the equipment can be operated above ground.
- B. The equipment shall meet the requirements of Section 33 0110 - Manhole Rehabilitation when used for manhole preparation for rehabilitation work.

### 2.03 VACUUM EQUIPMENT

- A. Provide equipment capable of removing all sand, dirt, rocks, roots, and other debris from the sewer and manhole.
- B. Provide screens to prevent scoured debris from migrating downstream of the limits of the Work.

### 2.04 CUTTING EQUIPMENT

- A. Mainline Sewers: Provide equipment capable of mechanically removing encrustation, tuberculation, roots, grease, and intruding seal material. Devices shall include a root saw, spring blade root cutter chuck, chain scraper, chain cutter, or approved equal.

### 2.05 FLUSHING/CLEANING WATER

- A. Provide all flushing water required for the cleaning of sewers either by truck or by an agreement with the BVU Authority . Provide proof that all flushing water was acquired lawfully.

## PART 3 - EXECUTION

### 3.01 MAINLINE SEWER CLEANING

- A. Thoroughly clean all pipeline reaches in order to permit an unrestricted inspection by closed circuit television. Particular emphasis shall be afforded to the removal of accumulated encrustation, tuberculation, grease, roots, sand, rocks, sludge and other debris so that the video inspection will show clearly all portions of the pipe being inspected. Pressure shall be between 1,500 psi and 2,000 psi during normal cleaning operations in the sewer, unless otherwise approved by the Engineer.
- B. Clean upstream reaches of sewers before the downstream reaches.

- C. Insert cleaning equipment into the downstream manhole of a given reach and pull the debris downstream. Reverse setups may be used if all debris is removed (i.e., no material is passed to the adjacent pipe segment).
- D. Rig winching equipment so as not to damage the existing pipeline or manholes.
- E. During cleaning, restrict the flow level in the pipe to a maximum of 30 percent of the pipe diameter. Take particular care to avoid flooding house connections during cleaning operations.
- F. Remove any blockages of lateral building connections resulting from the cleaning or other items of work by cleaning of the building connection at no additional cost to the Owner.

### **3.02 MANHOLE CLEANING**

- A. Wash the wall, bench, channel and rungs of the manhole to remove accumulated debris, grease, sediment, and grit.

### **3.03 ROOT, GREASE AND INTRUDING SEAL MATERIAL REMOVAL**

- A. Remove all roots that could prevent the installation of a cured-in-place liner. Remove roots by suitable mechanical cutting devices or by hydraulic procedures such as with high-pressure jet cleaners. No roots of length greater than one and a half inches (1-1/2-inch) shall remain following root removal procedures.
- B. Remove all grease thicker than 1 inch or which could prevent the installation of a cured-in-place liner. Use suitable mechanical cutting devices to remove grease.
- C. Remove objects wedged in pipe joints and intruding sealing ring material that interferes with the rehabilitation of sewer lines.

### **3.04 DEBRIS REMOVAL**

- A. Remove all bricks, rocks, debris, sludge, dirt, sand, grease, roots, and other materials from the sewer and manhole and collect and remove the resulting debris from the downstream manholes of the sewer sections being cleaned. Utilize control measures in downstream manholes as necessary to prevent debris, sludge and other materials from passing through manholes to a downstream sewer section not scheduled for cleaning by Contractor that same day.
- B. When removing materials from manholes, return the discharge and drainage liquid stream to the downstream sewer and discharge downstream for disposal. Under no circumstances shall sewage or solids be dumped onto the ground surface, street, stream, ditches, catch basins, or storm drains. All solids and semi-solids shall be placed in a watertight container so that no spillage or leakage will occur, covered to minimize odors, and disposed by the Contractor. The Contractor is responsible for all operations and costs associated with removal, transportation, and disposal of debris collected during the cleaning operations.

### **3.05 DISPOSAL**

- A. Maintain and have available for inspection upon request a valid waste disposal permit as issued by a licensed disposal facility as approved by the Engineer.

### **3.06 FIELD QUALITY CONTROL**

- A. Acceptance of pipeline cleaning shall be made upon the successful completion of the television inspection documenting that all required debris, roots, and grease are removed to the satisfaction of the Engineer. If television inspection shows debris, solids, sand, grease, or grit remaining in the line, re-clean and re-inspect the pipeline at no additional compensation.

**END OF SECTION 33 0130**

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**SECTION 33 0132**  
**SEWER AND MANHOLE TESTING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Gravity Sewer Testing:
  - 1. Low-pressure Air Test.
  - 2. Exfiltration Test.
  - 3. Infiltration Test.
- B. Deflection Testing of Plastic Piping.
- C. Manhole Testing:
  - 1. Vacuum Test.
  - 2. Infiltration Test
  - 3. Exfiltration Test.

**1.02 RELATED REQUIREMENTS**

- A. Section 33 0513 - Manholes and Structures.
- B. Section 33 3111 - Sanitary Utility Sewerage Piping.

**1.03 REFERENCE STANDARDS**

- A. ASTM International:
  - 1. ASTM C828 - Standard Test Method for Low-Pressure Air Test of Vitrified Clay Pipe Lines; 2011.
  - 2. ASTM C924 - Standard Practice for Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method; 2009.
  - 3. ASTM C1244 - Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test; 2011.
  - 4. ASTM D2122 - Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings; 2015.
  - 5. ASTM F1417 - Standard Test Method for the Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air; 2011.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Submit the following prior to start of testing:
  - 1. Testing procedures.
  - 2. List of test equipment.
  - 3. Testing sequence schedule.
  - 4. Provisions for disposal of flushing and test water.
  - 5. Certification of test gauge calibration.
  - 6. Deflection mandrel drawings and calculations.
- C. Test Reports: Indicate results of manhole and piping tests.

**PART 2 PRODUCTS - NOT USED.**

**PART 3 EXECUTION**

**3.01 EXAMINATION**

- A. Verify that manholes and piping are ready for testing.
- B. Verify trenches are backfilled.
- C. Verify pressure piping concrete reaction support blocking or mechanical restraint system is installed.

**3.02 PIPING PREPARATION**

- A. Flush and clean piping.

- B. Assist Engineer in lamping gravity piping.
  1. Engineer will perform lamping operation by shining light at one end of each pipe section between manholes; observe light at other end; pipe shall exhibit a full circle of light; reject pipe not installed with uniform line and grade
  2. Remove and reinstall rejected pipe sections; re-clean and assist Engineer with re-lamping.
- C. Plug outlets, wye-branches, and laterals; brace plugs to resist test pressures.

### **3.03 FIELD QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Notify Engineer 72 hours in advance of tests. Engineer shall witness tests.
- C. Tests shall be conducted on short sections of sewer line, i.e., between manholes, or at the end of each day's Work. Installation of sewers will not be permitted at a point more than 2,000 feet ahead of any section of sewer which has not been given the final test and accepted. Provide all labor, materials, tools, and equipment necessary to make the tests. All equipment and methods used shall be acceptable to Engineer. All monitoring gages shall be subject to calibration, if deemed necessary. All sewer lines, regardless of size, that cross under streams shall be tested for and exhibit zero infiltration.

### **3.04 TESTING GRAVITY SEWER PIPING**

- A. Low-pressure Air Test:
  1. Perform test in accordance with applicable portions of ASTM C828, ASTM C924, and ASTM F1417.
  2. Test each section of gravity sewer piping between manholes.
  3. Introduce air pressure slowly to approximately 4 psig.
  4. Determine groundwater elevation above spring line of pipe. For every foot of groundwater above spring line of pipe, increase starting air test pressure by 0.43 psig; do not increase pressure above 10 psig.
  5. Allow pressure to stabilize for at least five minutes. Adjust pressure to 3.5 psig or increased test pressure as determined above when groundwater is present. Start test.
  6. Determine test duration for sewer section with single pipe size from the following table. Do not make allowance for laterals.

Nominal Pipe Size (inches)	Minimum Test Time (min/100 feet)
3	0.2
4	0.3
6	0.7
8	1.2
10	1.5
12	1.8
15	2.1
18	2.4
21	3.0
24	3.6
27	4.2
30	4.8
33	5.4
36	6.0

7. Record drop in pressure during test period; when air pressure has dropped more than 1.0 psig during test period, piping has failed; when 1.0 psig air pressure drop has not occurred during test period, discontinue test and piping is accepted.

8. When piping fails, determine source of air leakage, make corrections and retest; test section in incremental stages until leaks are isolated; after leaks are repaired, retest entire section between manholes.
- B. Exfiltration Test:
  1. Test pipe larger than 36 inch diameter with exfiltration test not exceeding 100 gallons for each inch of pipe diameter for each mile per day for each section under test. Perform test with minimum positive head of 4 feet.
- C. Infiltration Test
  1. Use only when gravity piping is submerged in groundwater minimum of 4 feet above crown of pipe for entire length being tested.
  2. Maximum Allowable Infiltration: 100 gallons per inch of pipe diameter for each mile per day for section under test; include allowances for leakage from manholes. Perform test with minimum positive head of 4 feet.

### **3.05 DEFLECTION TESTING OF PLASTIC PIPING**

- A. Perform vertical ring deflection testing on PVC sewer piping after backfilling has been in place for at least 30 days but not longer than 12 months.
- B. Allowable maximum deflection for installed plastic sewer pipe is limited to 5 percent of original vertical internal diameter.
- C. Furnish rigid ball or mandrel with diameter not less than 95 percent of base or average inside diameter of pipe as determined by ASTM standard to which pipe is manufactured. Measure pipe in compliance with ASTM D2122.
- D. Perform deflection testing using properly sized rigid ball or 'Go, No-Go' mandrel.
- E. Perform test without mechanical pulling devices.
- F. Locate, excavate, replace, and retest pipe exceeding allowable deflection.

### **3.06 TESTING MANHOLES**

- A. General: Test using air whenever possible prior to backfilling to assist in locating leaks. Make joint repairs on both outside and inside of joint to ensure permanent seal. Test manholes with manhole frame set in place.
- B. Vacuum test in accordance with ASTM C1244 and as follows:
  1. Plug pipe openings; securely brace plugs and pipe.
  2. Inflate compression band to affect seal between vacuum base and structure; connect vacuum pump to outlet port with valve open; draw vacuum to 10 inches of Hg; close valve; start test.
  3. Determine test duration for 4-foot diameter manhole from the following table:

Manhole Depth	Test Period
10 feet or less	60 seconds
>10 feet but <15 feet	75 seconds
>15 feet but <25 feet	90 seconds

4. For manholes 5 feet in diameter, add an additional 15 seconds and for manholes 6 feet in diameter, add an additional 30 seconds to the time requirements for 4-foot diameter manholes.
5. Record vacuum drop during test period; when vacuum drop is greater than 1 inch of Hg during test period, repair and retest manhole; when vacuum drop of 1 inch of Hg does not occur during test period, discontinue test and accept manhole.
6. When vacuum test fails to meet 1 inch Hg drop in specified time after repair, repair and retest manhole.
- C. Infiltration Test:
  1. Determine groundwater level.

2. Use infiltration test when groundwater is at least 4 feet above top of pipe for the entire length of line to be tested.
  3. Plug the pipe at the upper manhole.
  4. Install suitable measuring device at the next lowest manhole.
  5. Measure the amount of water flowing through the outlets over a 30-minute period. Maximum allowable leakage shall be limited to 1/2 gallon per hour per manhole plus maximum allowable sewer line leakage for the test section.
  6. Maximum allowable leakage for sewer lines shall be 2,400 gallons per day per mile or 100 gallons per day per inch pipe diameter per mile, whichever is less.
- D. Exfiltration Test:
1. Determine groundwater level.
  2. Use exfiltration test when groundwater is less than 4 feet above top of pipe.
  3. Plug pipes in manhole; remove water in manhole; observe plugs over period of not less than 2 hours to ensure there is no leakage into manhole.
  4. Fill manhole with water to within 4 inches of top of cover frame. Prior to test, allow manhole to soak for a maximum of 12 hours. The cover shall be on the manhole during the soaking period. After soak period, adjust water level inside manhole to within 4 inches of top of cover frame.
  5. Measure water level from top of manhole frame; at end of 30 minute test period, again measure water level from top of manhole frame; compute drop in water level during test period.
  6. Manhole exfiltration test shall not exceed 1/2 gallon per hour.
  7. When unsatisfactory test results are achieved, repair manhole and retest until result meets criteria; repair visible leaks regardless of quantity of leakage.
  8. Upon completion of the test, the water shall be removed from the manhole.

### **3.07 POST CONSTRUCTION TV INSPECTION OF SEWER PIPELINES**

- A. Perform after satisfactory completion of all required sewer and manhole testing.
- B. Comply with Section 33 0133 - TV Inspection of Sewer Pipelines, as applicable.

**END OF SECTION 33 0132**

**SECTION 33 0133**  
**TV INSPECTION OF SEWER PIPELINES**

**PART 1 GENERAL**

**1.01 SUMMARY**

- A. Section Includes:
  - 1. Pipeline flushing and cleaning.
  - 2. TV inspection of sewer pipelines.
  - 3. Audio-video taping of pipeline interior.
- B. Related Sections:
  - 1. Section 33 3111 - Sanitary Utility Sewerage Piping.

**1.02 REFERENCES**

- A. National Association of Sewer Service Companies (NASSCO).
- B. Pipeline Assessment Certification Program (PACP).

**1.03 SUBMITTALS**

- A. Section 01 3000 - Administrative Requirements: Requirements for submittals.
- B. CCTV equipment, including make, model, age of video systems and tractors, and documentation that CCTV software is PACP V4A4 -certified. PACP-compliant software will not be accepted.
- C. Copies of PACP certificate for inspectors completing the Work.
- D. Submit completed pre- and post-inspection compact discs or USBs, identified by file number, Contractor name, Project name, Contract number, Drawing number, Inspection Type: pre-/post-construction, date recorded, pipe segment, and asset identification number.
- E. Recordings become property of Owner/Engineer.
- F. Submit pre- and post-cleaning and television inspection logs for each section of sewer line to be rehabilitated and two copies of recordings for Work performed. Include the following as minimum information: stationing and location of lateral services, wyes or tees, clock references, pipe joints, infiltration/inflow defects, cracks, leaks, offset joints, and other information required to assess condition of sewer.

**1.04 QUALITY ASSURANCE/QUALIFICATIONS**

- A. Perform Work in accordance with local agency having jurisdiction.
- B. The Contractor shall be aware that these contracts require work in active sewers and shall follow all Federal, State and local requirements for safety in confined spaces.
  - 1. Inspection shall be performed by a National Association of Sewer Service Companies (NASSCO) Pipeline Assessment Certification Program (PACP) certified operator and shall meet the coding and reporting standards and guidelines as set by PACP. These same standards shall also be used for lateral inspections regardless of whether conducted using cleanout launched or mainline launched lateral camera. All report annotations, pipe conditions and pipe defects shall be identified properly using PACP codes as defined by PACP, and severity ratings shall be calculated according to PACP.

**PART 2 PRODUCTS**

**2.01 TELEVISION EQUIPMENT**

- A. Closed Circuit TV Equipment: Select and use closed-circuit television equipment that will produce a color recording. The camera and video system components shall have the following properties:
  - 1. Equipped with footage counter accurate to two tenths of a foot that displays on the TV monitor the exact distance of the camera from the starting point of the recording.
  - 2. Lighting system that allows the features and condition of the pipe to be clearly seen. Lighting shall not cause shadows or loss of color within the field of view of the camera.

3. Capable of operating in 100 percent humidity conditions.
4. Capable of producing a minimum 470 lines of vertical resolution color video picture. Picture quality and definition shall be to the satisfaction of the Engineer.
5. Pipe Inspection Camera: The pipe inspection camera and video components shall have the following additional properties:
  - a. Capable of producing a video recording using a pan-and-tilt, radial viewing, pipe inspection camera that pans +275 degrees and rotates 360 degrees.
  - b. Camera height adjustment so that the camera lens is always centered at one-half the inside diameter, or higher, in the pipe being televised.
  - c. Include a reflector in front of the camera if necessary to provide acceptable video image quality in large diameter pipe.
6. Recording: All recordings are to be in digital format.
  - a. Image Capture - Digitized picture images shall be stored and be exportable as JPEG formats.
  - b. Video Capture - Full time live video and audio files shall be captured for each pipe segment and lateral inspected. The files shall be stored in industry standard Windows Media or MPEG-4 format on a USB 2.0 external hard drive and viewable on a personal computer that utilizes Microsoft media player, Version 9.0. Alternate digital formats will not be accepted unless approved by the Engineer in advance of submittal. The video shall have a minimum resolution of 640 pixels (x) by 480 pixels (y) and an encoded frame rate of 29-97 frames per second. System shall perform an automatic disk image/file naming structure to allow saved video/data sections to be "burned" to digital format. It shall have the capability of "burning" a minimum of 120 minutes of recording to the DVDR media. The video recording shall be free of electrical interference and shall produce a clear and stable image. The audio recording shall be sufficiently free of background and electrical noise as to produce an oral report that is clear and discernable. The digital recordings and inspection data shall be cross-referenced to allow instant access to any point of interest within the digital recording.

### PART 3 EXECUTION

#### 3.01 PREPARATION

- A. Prior to TV inspection, clean sewer lines, laterals and manholes in accordance with Section 33 0130 - Cleaning of Sewers. Re-clean any sewer line or manhole found to be dirty during the TV inspection process.

#### 3.02 FIELD QUALITY CONTROL

- A. Section 01 4000 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Televise the sewer line to document the condition of the line. Notify the Engineer 48 hours in advance of any TV inspection so that the Engineer may observe inspection operations. Provide a color recording showing the completed Work.
- C. For mainline sewer inspections, inspection recording shall begin with the camera turned on and the header information entered on the above ground surface with the camera facing in the direction of the pipe to be inspected. With the camera recording, lower the camera into the manhole such that all pipe penetrations are shown and recorded, including all tap or outside drop connections.
- D. Center camera in manhole invert to the extent allowed by the channel geometry. For inspections from manholes, pan and record the entire circumference of the pipe penetration/manhole wall.
- E. With camera rolling, perform the distance counter preset if a preset point on the CCTV cable is used to set the counter, Contractor shall back up the camera after setting the preset and record the entry to the pipe.

- F. Pipeline inspection shall be from center of the starting manhole to the center of the ending manhole. Measure distances along the pipe from the inside of manhole wall of the starting manhole to inside of manhole wall of the downstream manhole.
- G. Prior to recording the location of defects, construction features and service connections, remove slack in the cable of the television inspection camera to ensure metering device is designating proper footage. Check accuracy of the measurement meters daily by use of a walking meter, roll-a-tape, or other suitable device.
- H. Center the camera in the middle of the pipe.
- I. Move the camera through the line (in the downstream direction whenever possible) at a uniform rate not to exceed 30 feet per minute.
- J. Stop at every joint for three seconds. When infiltration or other defects are evident, use pan and tilt to document pipe condition. Stop elsewhere when necessary to ensure proper documentation of the sewer's condition.
- K. Stop at every lateral connection. Center the camera so that the lighting and the pan and tilt view can be used to inspect as far into the lateral connection as possible. Pan the circumference of the tap, recording all defects found in the service connection. Where lateral flow is observed, observe flows from service connections for approximately two minutes to ascertain if the flow is sanitary or extraneous flow. The video recording may be paused during observation. Record results of the flow observed on video recording and inspection logs.
- L. Use manual winches, power winches, TV cable, and powered rewinds or other devices that do not obstruct the camera view or interfere with proper documentation of the sewer conditions to move the camera through the sewer line.
- M. TV inspection recordings shall be continuous for each pipe segment & adjust light levels, clean fouled or fogged lens, and allow vapor to dissipate from camera lights in order to produce acceptable recordings. All TV inspection recordings that do not meet the specified requirements shall be re-televised at no additional cost to the Owner.

### 3.03 FLOW CONTROL

- A. Adequately control the flow in the section being televised. Plugging or bypassing of the flows may be used to accomplish this. Recordings made where the depths of wastewater flow shown below are exceeded will be rejected:

Pipe Diameter (inches)	Depth of Flow (% of Pipe Diameter)
6-10	10
12-24	15

- 1. Whenever flows in a sewer line are blocked, plugged, pumped, or bypassed, take sufficient precautions to protect the sewer lines from damage that might be inflicted by excess sewer surcharging. Furthermore, take precautions to ensure that sewer flow control operations do not cause flooding or damage to public or private property being served by the sewers involved. No overflows are permitted. The Contractor is responsible for all damages.
- 2. Contractor is responsible for all damages to Contractor-owned and operated equipment, Owner facilities, and privately owned facilities caused by malfunction of plugs, pumps or other Contractor equipment. In the event of a failure or malfunction of Contractor equipment, contractor is responsible for all work necessary to restore facilities to pre-construction condition including but not limited to excavation and restoration of sewer lines and roadways required to retrieve malfunctioning or stuck cameras, plugs and hoses.
- 3. It is anticipated that portions of the sanitary sewer are bowed or bellied and as a result the camera will be submerged. Wherever the camera encounters a submerged condition, or where the wastewater flow depth exceeds the maximum allowable, reduce the flow depth to an acceptable level by performing the survey TV inspection during minimum flow hours,

or by pulling a camera with swab, high-velocity jet nozzle or other acceptable dewatering device. Recordings made while floating the camera are not acceptable unless approved by Engineer.

### **3.04 PASSAGE OF TV CAMERA**

- A. If during TV inspection of a pipe segment the camera is unable to pass an obstruction even though flow is unobstructed, televise the pipe segment from the opposite direction in order to obtain a complete recording of the line. Measure the distance between the manholes (centerline to centerline) with a tape or wheel to accurately determine the total length of the pipe segment.

**END OF SECTION 33 0133**

**SECTION 33 0513**  
**MANHOLES AND STRUCTURES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Monolithic concrete manholes with masonry transition to lid frame, covers, anchorage, and accessories.
- B. Modular precast concrete manhole sections with tongue-and-groove joints with masonry transition to lid frame, covers, anchorage, and accessories.

**1.02 RELATED REQUIREMENTS**

- A. Section 03 3000 - Cast-in-Place Concrete.

**1.03 REFERENCE STANDARDS**

- A. ASTM A48/A48M - Standard Specification for Gray Iron Castings; 2003 (Reapproved 2012).
- B. ASTM C478 - Standard Specification for Precast Reinforced Concrete Manhole Sections; 2013.
- C. ASTM C478M - Standard Specification for Precast Reinforced Concrete Manhole Sections [Metric]; 2014.
- D. ASTM C923 - Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals; 2008 (Reapproved 2013).
- E. ASTM C923M - Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals [Metric]; 2008b (Reapproved 2013).
- F. ASTM C990 - Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Section Using Preformed Flexible Joint Sealants; 2009.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manhole covers, component construction, features, configuration, and dimensions.
- C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- D. Manufacturer's Qualification Statement.

**1.05 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years documented experience and certified by NPCA Plant Certification program prior to and during Work of this Section.
- B. Obtain precast structures from a single source.

**1.06 DELIVERY, STORAGE AND HANDLING**

- A. Comply with precast concrete manufacturer's instructions and ASTM C913 for unloading, storing and moving precast manholes and drainage structures.
- B. Store precast concrete manholes and drainage structures to prevent damage to Owner's property or other public or private property. Repair property damaged from materials storage.
- C. Mark each precast structure by indentation or waterproof paint showing date of manufacture, manufacturer, and identifying symbols and numbers shown on Drawings to indicate its intended use.

**PART 2 PRODUCTS**

**2.01 MATERIALS**

- A. Manhole Sections: Reinforced precast concrete in accordance with ASTM C478 (ASTM C478M), with resilient connectors complying with ASTM C923 (ASTM C923M).
- B. Concrete: As specified in Section 03 3000.

- C. Joints for concrete pipe and manholes, using rubber gaskets in accordance with ASTM C443.
- D. Joints for concrete pipe, manholes, and box sections using preformed flexible joint sealants in accordance with ASTM C990.
- E. Concrete Reinforcement: As specified in Section 03 3000.

## **2.02 COMPONENTS**

- A. Standard Frames and Covers:
  - 1. Lid and Frame: ASTM A48/A48M, Class 30B Cast iron construction, machined flat bearing surface, removable lockable lid, closed lid design; live load rating of HS20 in paved/traffic areas; sealing gasket. Size, shape, and lettering as indicated on Drawings.
- B. Steps: Conform to ASTM C478 and current OSHA Regulations, minimum 12 inches wide spaced vertically 16 inches on center, made of copolymer polypropylene plastic encapsulating 1/2-inch grade 60 steel reinforcement. Vertical load resistance of 400 lbs. and minimum pull-out resistance of 1,000 lbs.

## **2.03 CONFIGURATION**

- A. Provide size and shape as indicated on Drawings.
- B. Foundation Slab: Cast-in-place or precast reinforced concrete integral with bottom section, level top surface.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify items provided by other sections of Work are properly sized and located.
- B. Verify that built-in items are in proper location, and ready for roughing into Work.
- C. Verify excavation for manholes is correct.

### **3.02 PREPARATION**

- A. Coordinate placement of inlet and outlet pipe or duct sleeves required by other sections.
- B. Excavate and place bedding. See Section 31 2316.13 for additional trenching requirements.

### **3.03 MANHOLES**

- A. Place concrete base pad, trowel top surface level.
- B. Place manhole sections plumb and level, trim to correct elevations, anchor to base pad.
- C. Form and place manhole cylinder plumb and level, to correct dimensions and elevations. As work progresses, build in fabricated metal items.
- D. Cut and fit for pipe.
- E. Grout base of shaft sections to achieve slope to exit piping. Trowel smooth. Contour as required.
- F. Set cover frames and covers level without tipping, to correct elevations.
- G. Coordinate with other sections of work to provide correct size, shape, and location.

**END OF SECTION 33 0513**

**SECTION 33 1116**  
**WATER UTILITY DISTRIBUTION PIPING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Pipe and fittings for water lines including domestic water lines and fire water lines.
- B. Tied Joint Restraint System.
- C. Valves, Fire hydrants, and Domestic water hydrants.

**1.02 RELATED REQUIREMENTS**

- A. Section 03 3000 - Cast-in-Place Concrete: Concrete for thrust restraints.
- B. Section 31 2316 - Excavation: Excavating of trenches.
- C. Section 31 2316.13 - Trenching: Excavating, bedding, and backfilling.
- D. Section 31 2323 - Fill: Bedding and backfilling.
- E. Section 33 0513 - Manholes and Structures.
- F. Section 33 1300 - Disinfecting of Water Utility Distribution: Disinfection of utility water piping.

**1.03 REFERENCES**

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.
- B. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2014.
- C. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength; 2014.
- D. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts; 2007a (Reapproved 2014).
- E. ASTM A588/A588M - Specification for High Strength Low-Alloy Structural Steel with 50 ksi (345 MPa) Minimum Yield Point to 4 in. (100 mm) Thick; 2015.
- F. ASTM B633 - Specification for Electrodeposited Coating of Zinc on Iron and Steel; 2013.
- G. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120; 2012.
- H. AWWA C502 - Dry Barrel Fire Hydrants; American Water Works Association (ANSI/AWWA C502/C502a); 2014.
- I. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service; American Water Works Association; 2009 (ANSI/AWWA C509).
- J. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Transmission and Distribution; American Water Works Association; 2007 (ANSI/AWWA C900/C900a).
- K. AWWA C901 - Polyethylene (PE) Pressure Pipe and Tubing, 1/2 In. (13 mm) Through 3 In. (76 mm), for Water Service; American Water Works Association; 2008.
- L. AWWA C905 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings 14 in. Through 48 in. (350 mm Through 1,200 mm) for Water Transmission and Distribution, American Water Works Association; 2010.
- M. UL 246 - Hydrants for Fire-Protection Service; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on pipe materials, pipe fittings, valves, hydrants and accessories.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

- D. Project Record Documents: Record actual locations of piping mains, valves, connections, thrust restraints, and invert elevations. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.
- E. Tied Joint Restraint System:
  - 1. Product Data: Submit catalog data for restrained joint details and installation instructions.
  - 2. Manufacturer's Installation Instructions: Submit installation instructions.
  - 3. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

## 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store valves in shipping containers with labeling in place including manufacturer's name and pressure rating.
- B. Stockpile pipe in locations agreed upon by Owner, Contractor, and Architect.

## PART 2 PRODUCTS

### 2.01 WATER PIPE

- A. PVC Pipe: ASTM D1785, Schedule 40; marked with NSF 61 designation for potable water use.
  - 1. Pipe Class: SDR 17, 250 psi; SDR 13.5 psi for 2" and 3".
  - 2. Fittings: AWWA C111, cast iron.
  - 3. Joints: ASTM D3139 compression gasket ring.
- B. PVC Pipe: AWWA C900 and AWWA C905; marked with NSF 61 designation for potable water use.
  - 1. Pipe Class: DR 17, 250 psi; SDR 13.5, 315 psi for 2".
  - 2. Pipe Class: DR 25, 165 psi; DR 18, 235 psi; and DR 14, 305 psi for 4" through 12".
  - 3. Fittings:
    - a. PVC, AWWA C900 and AWWA C905.
    - b. Ductile Iron, Mechanical Joint, AWWA C110.
  - 4. Joints:
    - a. PVC, ASTM D3139 with ASTM F477 PVC flexible elastomeric seals. Solvent-cement couplings are not permitted.
    - b. Ductile Iron, Mechanical Joint, AWWA C111.
    - c. Boltless Restrained Joints: Boltless, push on type, joint restraint independent of joint seal. Conform to pipe manufacturer's specifications.

### 2.02 VALVES

- A. Valves: Manufacturer's name and pressure rating marked on valve body.
- B. Resilient Wedge Gate Valves
  - 1. Manufacturers:
    - a. American Flow Control.
    - b. Clow Valve Company.
    - c. Mueller Co.
  - 2. Resilient Wedge Gate Valves: UL listed for 2", AWWA C509 for 3" through 36"; iron body, bronze or ductile iron.
    - a. Resilient seats.
    - b. Stem: Rising bronze stem (3" and smaller); non-rising bronze stem (4" and larger).
    - c. Operating Nut: Square; open counterclockwise unless otherwise indicated.
    - d. Ends: Flanged, mechanical joint or bell end connections.
    - e. Coating: AWWA C550; interior/exterior.
    - f. Sizes 12-Inch Diameter and Smaller: Equal to pressure of adjacent piping system.
- C. Valve Boxes:
  - 1. Valves 12-Inch Diameter and Smaller: Cast-iron, two-piece, as manufactured by Sigma, or approved equal.
  - 2. Cast iron lid marked "WATER".

## 2.03 TIED JOINT RESTRAINT SYSTEM

- A. Manufacturers:
  - 1. Dresser Piping Specialties.
  - 2. Ebaa Iron Sales, Inc.
  - 3. Star Pipe Products, Inc.
- B. Steel Types:
  - 1. High Strength Low-Alloy Steel, ASTM A588, heat-treated.
  - 2. High Strength Low-Alloy Steel, ASTM A588.
  - 3. Carbon Steel ASTM A36.
- C. Components:
  - 1. Tie Bolts:
    - a. 5/8-inch for 2-inch and 3-inch mechanical joints, 3/4 inch for 4 inch to 12 inch mechanical joints and flanged joints, ASTM A588, Grade B; ASTM A325, Type 3, except increase tensile strength of full-body threaded section to 40,000 pounds minimum for 5/8 inch and 60,000 pounds minimum for 3/4 inch by heat-treating (quenching and tempering) to manufacturer's reheat and hardness specifications.
  - 2. Tie Nut: Hex nut for each tie bolt and tie rods.
    - a. ASTM A563, Grade C3; plain, zinc plated, or galvanized.
  - 3. Tiepin: 3/4-inch round bar stock for use on bends and hydrants.
    - a. 6-inch hairpin shape, ASTM A588; ANSI B1.1; plain, zinc plated, or galvanized.
  - 4. Tie Coupling: Used to extend continuous threaded rods and provided with center stop to aid installation.
    - a. ASTM A588; plain, zinc plated, or galvanized.
  - 5. Tie Clamp: Retainer clamp for ductile iron, asbestos cement and polyvinyl chloride, push-on pipe in front of bell.
    - a. ASTM A36; ASTM A307 Grade A; ASTM A563, Grade A; plain, zinc plated, or galvanized.
  - 6. Tie Rod: Continuous threaded rod for cutting to desired lengths.
    - a. ASTM A588, Grade B; ASTM A325, Type 3; ANSI B1.1; plain zinc plated, or galvanized.
  - 7. Tie Bar: Steel bar used to restrain push-in plugs.
    - a. ASTM A36; plain, zinc plated, or galvanized.
  - 8. Tie Washer: Round flat washers.
    - a. ASTM A588, ASTM F436, Type 3; plain, zinc plated, or galvanized.
  - 9. Factory Applied Finishes: Zinc plated or galvanized to meet the following requirements:
    - a. ASTM B633 for electrodeposited coating of zinc on steel.
    - b. ASTM A153 for galvanizing iron and steel hardware.
    - c. Galvanizing for rolled, pressed, and forged steel shapes: ASTM A123; minimum 2.0 ounces per square foot coating thickness; galvanize after fabrication.

## 2.04 HYDRANTS

- A. Hydrants: Type as required by utility company.
- B. Manufacturers:
  - 1. American Darling.
- C. Dry-barrel Break-away Type: AWWA C502; cast-iron body, compression type valve.
  - 1. Bury Depth: As indicated on the Drawings.
  - 2. Inlet Connection: 6 inches.
  - 3. Valve Opening: 5-1/4 inch diameter.
  - 4. Ends: Mechanical Joint or Bell End.
  - 5. Bolts and Nuts: Corrosion resistant.
  - 6. Coating: AWWA C550; interior.
  - 7. Direction of Opening: Counterclockwise unless otherwise indicated.

- D. One pumper, two hose nozzles.
  - 1. Obtain thread type and size from local fire department.
  - 2. Attach nozzle caps by separate chains.
- E. Finish: Primer and two coats of enamel in color required by Owner.
- F. Extended Warranty: Provide manufacturer's warranty for one (1) year beyond the construction warranty. The warranty shall cover full replacement of any fire hydrant that fails, or any portion thereof, that causes poor performance of the hydrant.

## **2.05 BLOW-OFF VALVES**

- A. Blow-off valves shall be as indicated on the Drawings.

## **2.06 BEDDING AND COVER MATERIALS**

- A. Bedding: As specified in Section 31 2316.13.
- B. Cover: As specified in Section 31 2316.13.

## **2.07 ACCESSORIES**

- A. Concrete for Thrust Restraints: Concrete type specified in Section 03 3000.
- B. Manhole and Cover: Refer to Section 33 0513.
- C. Pipeline Markers:
  - 1. Underground Pipeline Markers
    - a. Description: Plastic Ribbon and Trace Wire Tape: Bright colored blue, continuously printed with "WATER SERVICE" in large letters, minimum 6 inches wide by 4 mil thick, with magnetic detectable conductor manufactured for direct burial service.
    - b. Underground pipe markers shall be required for non-metallic pipe only.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. See Section 01 7000 - Execution and Closeout Requirements for verification of existing conditions before starting Work.
- B. Verify that building service connection and municipal utility water main size, location, and invert are as indicated.

### **3.02 PREPARATION**

- A. Remove scale and dirt on inside and outside before assembly.
- B. Prepare pipe connections to equipment with flanges or unions.

### **3.03 TRENCHING**

- A. See the Section 31 2316 - Excavation and Section 31 2323 - Fill for additional requirements.
- B. Hand trim excavation for accurate placement of pipe to elevations indicated.
- C. Form and place concrete for pipe thrust restraints at each change of pipe direction. Place concrete to permit full access to pipe and pipe accessories. Provide thrust restraints as shown on Drawings.
- D. Backfill around sides and to top of pipe with cover fill, tamp in place and compact, then complete backfilling.

### **3.04 BACKFILLING**

- A. Backfill and compact around sides and to top of pipe in accordance with Section 31 2316.13.
- B. Maintain optimum moisture content of bedding material to attain required compaction density.

### **3.05 INSTALLATION - PIPE**

- A. Install ductile iron pipe and fittings in accordance with AWWA C600.
- B. Install PVC pipe in accordance with AWWA C605 and manufacturer's instructions.

- C. Handle and assemble pipe in accordance with manufacturer's instructions and as indicated on Drawings.
- D. Steel Rods, Bolt, Lugs, and Brackets: Coat buried steel with one coat of coal tar coating before backfilling.
- E. Normal Conditions: Maintain 10 ft. horizontal and 18-inch vertical separation of water main from sewer piping or as required by local code.
- F. Unusual Conditions: When local conditions prevent a horizontal separation of at least 10 feet, the water line may be laid closer to a sewer or sewer manhole provided that:
  - 1. The bottom of the water line is at least 18 inches above the top of the sewer.
  - 2. Where this vertical separation cannot be obtained, the sewer shall be constructed of AWWA-approved water pipe pressure-tested in place to 50 psi without leakage prior to backfilling. The sewer manhole shall be of watertight construction and tested in place.
- G. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, remove burrs. Use only equipment specifically designed for pipe cutting. The use of chisels or hand saws shall not be permitted. Grind edges smooth with beveled end for push-on connections.
- H. Flanged Joints: Not to be used in underground installations except within structures.
- I. Route pipe in straight line. Relay pipe that is out of alignment or grade.
- J. Sanitary and/or Combined Sewers or Sewer Manholes: No water pipes shall pass through or come in contact with any part of a sewer or sewer manhole.
- K. Install pipe with no high points. If unforeseen field conditions arise which necessitate high points, install air release valves as directed by Engineer.
- L. Install pipe to have bearing along entire length of pipe. Excavate bell holes to permit proper joint installation. Do not lay pipe in wet or frozen trench.
- M. Prevent foreign material from entering pipe during placement.
- N. Install pipe to allow for expansion and contraction without stressing pipe or joints.
- O. Close pipe openings with watertight plugs during work stoppages.
- P. Install access fittings to permit disinfection of water system performed under Section 33 1300.
- Q. Group piping with other site piping work whenever practical.
- R. Establish elevations of buried piping with not less than 3 ft. of cover. Measure depth of cover from final surface grade to top of pipe barrel.

### **3.06 INSTALLATION - VALVES AND HYDRANTS**

- A. Install valves in conjunction with pipe installation; set valves plumb.
- B. Provide buried valves with valve boxes installed flush with finished grade.
- C. Install hydrants; provide support blocking and drainage gravel; do not block drain hole.
- D. Set hydrants plumb with pumper nozzle facing roadway; set hydrants with centerline of pumper nozzle 18 inches above finished grade and safety flange not more than 6 inches or less than 2 inches above grade.
- E. Paint hydrants in accordance with local color scheme.
- F. After hydrostatic testing, flush hydrants and check for proper drainage.

### **3.07 PIPELINE MARKERS**

- A. Underground Pipeline Markers
  - 1. Install continuously over top of pipe buried 6 inches below subgrade, above pipe line.

### **3.08 CONCRETE THRUST RESTRAINT**

- A. Provide valves, tees, bends, caps, and plugs with concrete thrust blocks as indicated on Drawings.

- B. Pour concrete thrust blocks against undisturbed earth. Locate thrust blocks at each elbow or change of pipe direction to resist resultant force and so pipe and fitting joints will be accessible for repair.
- C. Do not encase fitting joints and flanges.

### **3.09 TIED JOINT RESTRAINT**

- A. Preparation
  1. Clean surfaces of pipe and fittings to receive tied joint restraint system.
- B. Installation
  1. Excavate and backfill in accordance with Section 31 2316.13 - Trenching.
  2. Install pipe and fittings in accordance with Section 33 3111 - Sanitary Utility Sewerage Piping.
  3. Install joint restraint system so joints are mechanically locked together to prevent joint separation.
- C. Erection Tolerances:
  1. Torque nuts on mating threaded fasteners to 45 foot pounds to 60 foot pounds for 5/8-inch nut or per manufacturer's recommendations.
  2. Torque 1 inch nuts to 100 foot pounds to 120 foot pounds or per manufacturer's recommendations.

### **3.10 DISINFECTION OF POTABLE WATER PIPING SYSTEM**

- A. Flush and disinfect system in accordance with Section 33 1300.

### **3.11 FIELD QUALITY CONTROL**

- A. Perform soil compaction tests in accordance with Section 31 2316.13.
- B. Perform pressure test on potable water distribution system in accordance with AWWA C600, AWWA C605, or as specified.
- C. Test Pressure:
  1. 1.5 x working pressure at test location elevation associated with the test section.
    - a. Do not exceed the rated pressure of pipe, fittings, valves, hydrants, and/or other related appurtenances.
- D. Pressure/Leakage Test Procedure:
  1. After completion of pipeline installation, including backfill, but prior to final connection to existing system, conduct concurrent pressure and leakage tests.
- E. Provide equipment required to perform leakage and pressure tests. The meter utilized for testing shall have a low flow registration less than or equal to 0.03 gpm. The pressure gauge utilized for testing shall have a 4-inch dial or larger and gradation of 2 psi increments.
- F. Conduct tests for at least two-hour duration.
- G. No pipeline installation will be approved when pressure varies by more than 5 psi. Water shall be added to the test section to maintain the test pressure. The amount of water used shall be recorded.
- H. Hydrostatic test boundaries shall be each valved section of water line. Each valve shall be subjected to test pressure on at least one side.
- I. Before applying test pressure, properly fill, flush, and expel air from section of piping under test.
- J. Slowly bring piping to test pressure and allow system to stabilize prior to conducting leakage test.
- K. Examine exposed piping, fittings, valves, hydrants, and joints carefully during pressure test. Repair or replace damage or defective pipe, fittings, valves, hydrants, or joints discovered, following pressure test.
- L. At the conclusion of the test, water shall be added to increase the pressure to the start test pressure. The amount of water added shall be recorded.

- M. No pipeline installation will be approved when leakage is greater than that determined by the following formula:

$L = (SD \sqrt{P}) / C$
L = testing allowance, in gallons per hour
S = length of pipe tested, in feet
D = nominal diameter of pipe, in inches
P = average test pressure during hydrostatic test, in psig
C = 148,000
When pipe under test contains sections of various diameters, calculate allowable leakage from sum of computed leakage for each size.

- N. When test of pipe indicates leakage greater than allowed, locate source of leakage, make corrections and retest until leakage is within allowable limits. Correct visible leaks regardless of quantity of leakage.

**END OF SECTION 33 1116**

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**SECTION 33 1300**  
**DISINFECTING OF WATER UTILITY DISTRIBUTION**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Disinfection of potable water transmission, distribution and service systems as specified in Section 33 1116.
- B. Testing and reporting results.

**1.02 RELATED REQUIREMENTS**

- A. Section 33 1116 - Water Utility Distribution Piping.

**1.03 REFERENCE STANDARDS**

- A. AWWA B300 - Hypochlorites; American Water Works Association; 2010 (ANSI/AWWA B300).
- B. AWWA B301 - Liquid Chlorine; American Water Works Association; 2010 (ANSI/AWWA B301).
- C. AWWA B302 - Ammonium Sulfate; American Water Works Association; 2010 (ANSI/AWWA B302).
- D. AWWA B303 - Sodium Chlorite; American Water Works Association; 2013.
- E. AWWA C651 - Disinfecting Water Mains; American Water Works Association; 2005 (ANSI/AWWA C651).

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittal procedures and Section 01 7000 - Execution and Closeout Requirements for submittal requirements.
- B. Test Reports: Indicate results comparative to specified requirements.
- C. Certificate: From authority having jurisdiction indicating approval of water system.
- D. Certificate: Certify that cleanliness of water distribution system meets or exceeds specified requirements.
- E. Disinfection report:
  1. Type and form of disinfectant used.
  2. Date and time of disinfectant injection start and time of completion.
  3. Test locations.
  4. Initial and 24 hour disinfectant residuals (quantity in treated water) in ppm for each outlet tested.
  5. Date and time of flushing start and completion.
  6. Disinfectant residual after flushing in ppm for each outlet tested.
- F. Bacteriological report:
  1. Date issued, project name, and testing laboratory name, address, and telephone number.
  2. Time and date of water sample collection.
  3. Name of person collecting samples.
  4. Test locations.
  5. Initial and 24 hour disinfectant residuals in ppm for each outlet tested.
  6. Coliform bacteria test results for each outlet tested.
  7. Certification that water conforms, or fails to conform, to bacterial standards of authority having jurisdiction, suitable for human consumption.

**1.05 QUALITY ASSURANCE**

- A. Perform Work in accordance with AWWA C651.
- B. Testing Firm: Company specializing in testing potable water systems, certified by governing authorities of the State in which the Project is located.
- C. Submit bacteriologist's signature and authority associated with testing.

## PART 2 PRODUCTS

### 2.01 DISINFECTION CHEMICALS

- A. Chemicals: AWWA B300, Hypochlorite, AWWA B301, Liquid Chlorine, AWWA B302, Ammonium Sulfate, and AWWA B303, Sodium Chlorite.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify that piping system has been cleaned, inspected, and pressure tested.
- B. Schedule disinfecting activity to coordinate with start-up, testing, adjusting and balancing, demonstration procedures, including related systems.

### 3.02 DISINFECTION

- A. Provide and attach equipment required to perform the Work.
- B. Perform disinfection of water distribution system.
- C. Introduce treatment into piping system.
- D. Maintain disinfectant in system for 24 hours minimum.
- E. Flush, circulate, and clean until required cleanliness is achieved; use municipal domestic water. The new system must be thoroughly flushed at a velocity of not less than 3.0 ft. per second until no trace of dirt or foreign matter is visible. Adequate provisions shall be made for drainage of flushing water. The sterilizing agent used must produce a solution of water and chlorine of not less than 25 mg/L available chlorine throughout the entire new piping system. Prior to flushing, the chlorine residual shall be measured. If it is less than 10 mg/L, the system shall be re-disinfected using 25 mg/L available chlorine in accordance with AWWA standards. After the chlorine solution has remained in the new piping system for at least 24 hours, the lines shall be thoroughly flushed until the normal residual chlorine in the system is measured.
- F. Replace permanent system devices removed for disinfection.

### 3.03 FIELD QUALITY CONTROL

- A. Disinfection, Flushing, and Sampling:
  1. Notify Engineer, Owner, and testing agency 72 hours in advance of test and have witness test.
  2. Disinfect pipeline installation in accordance with AWWA C651. Use of liquid chlorine is not permitted.
  3. Upon completion of retention period required for disinfection, the treated water shall contain no less than 10 mg/L chlorine through the entire length of the main. Flush pipeline until chlorine concentration in water leaving pipeline is no higher than that generally prevailing in existing system or is acceptable for domestic use.
  4. Legally dispose of chlorinated water. When chlorinated discharge may cause damage to environment, apply neutralizing chemical to chlorinated water to neutralize chlorine residual remaining in water.
  5. After final flushing and before pipeline is connected to existing system, or placed in service, employ a State Health Department-approved independent testing laboratory to sample, test and certify water quality suitable for human consumption. A minimum of two samples shall be collected from each sampling site for total coliform analysis. The number of sites depends on the amount of new construction but must include all dead end lines, be representative of the water in the newly constructed mains, and shall be collected a minimum of every 1,200 linear feet. These samples must be collected at least 24 hours apart and must show the water line to be absent of coliform bacteria.
  6. If the membrane filter method of analysis is used for the coliform analysis, non-coliform growth must also be reported.
  7. The chlorine residual must also be measured and reported.
  8. All samples must be analyzed by a State certified laboratory.
  9. Results of the bacterial examination shall be forwarded to the Engineer.

10. If laboratory results indicate the presence of coliform bacteria, the samples are unsatisfactory and disinfection shall be repeated until the samples are satisfactory. Cleaning, disinfection, and testing will be the responsibility of the Contractor. Water for these operations will be furnished by the Owner, but the Contractor shall include in the Bid the cost of loading, hauling, and discharging the water.
11. Testing and disinfection of the completed sections shall not relieve the Contractor of his responsibility to repair or replace any cracked or defective pipe. All work necessary to secure a tight line shall be performed at Contractor's expense.

**END OF SECTION 33 1300**

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**SECTION 33 3111**  
**SANITARY UTILITY SEWERAGE PIPING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Sanitary sewerage drainage piping, fittings, and accessories.
- B. Underground pipe markers.
- C. Connection of building sanitary drainage system to municipal sewers.
- D. Connection to existing manholes.
- E. Wye branches and tees.
- F. Sanitary laterals.

**1.02 RELATED REQUIREMENTS**

- A. Section 03 3000 - Cast-in-Place Concrete: Concrete for cleanout base pad construction.
- B. Section 31 2316 - Excavation: Excavating of trenches.
- C. Section 31 2316.13 - Trenching: Excavating, bedding, and backfilling.
- D. Section 31 2323 - Fill: Bedding and backfilling.
- E. Section 33 0132 - Sewer and Manhole Testing.
- F. Section 33 0513 - Manholes and Structures.

**1.03 REFERENCE STANDARDS**

- A. ASTM International:
  - 1. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120; 2012.
  - 2. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications; 2011.
  - 3. ASTM D2564 - Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems; 2012.ASTM D2729 - Standard Specification for Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2011.
  - 4. ASTM D2751 - Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings; 2005.
  - 5. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings; 1996 (Reapproved 2010).ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2014.
  - 6. ASTM D3350 - Standard Specification for Polyethylene Plastics Pipe and Fittings Material; 2012.
  - 7. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe; 2014.
- B. Virginia Department of Health (VDH):
  - 1. VDH Waterworks Regulations.
- C. Virginia Department of Environmental Quality (VDEQ):
  - 1. Sewage Collection and Treatment Regulations.
- D. Virginia Department of Transportation (VDOT):
  - 1. Road and Bridge Standards, 2008, published by VDOT.

**1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Section 01 3000 - Administrative Requirements: Requirements for coordination.
- B. Coordinate Work with local sewerage authority.
- C. Notify affected utility companies minimum of 72 hours prior to construction.
- D. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

E. Work in this Section includes all sanitary sewer work on this project.

#### **1.05 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittal procedures and Section 01 7000 - Execution and Closeout Requirements for submittal requirements.
- B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- C. Manufacturer's Installation Instructions: Indicate special procedures required to install Products specified.
- D. Field Quality Control Submittals: Document results of field quality control testing.
- E. Project Record Documents:
  - 1. Record location of pipe runs, connections, catch basins, cleanouts, and invert elevations.
  - 2. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

#### **1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Section 01 6000 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Do not place materials on private property without written permission of property owner.
- C. During loading, transporting and unloading, exercise care to prevent damage to materials.
- D. Do not drop pipe or fittings.
- E. Avoid shock or damage to pipe.
- F. Take measures to prevent damage to exterior surface or internal lining of pipe.
- G. Do not stack pipe higher than recommended by pipe manufacturer.
- H. Store gaskets for mechanical and push-on joints in cool, dry location out of direct sunlight and not in contact with petroleum products.
- I. Store polyvinyl chloride and polyethylene materials out of sunlight.

#### **1.07 EXISTING CONDITIONS**

- A. Verify field measurements and elevations are as indicated.

#### **1.08 QUALIFICATIONS**

- A. Manufacturer: Company specializing in manufacturing Products specified in this Section with minimum three years documented experience.
- B. Installer: Company specializing in performing Work of this Section with minimum 3 years documented experience.

### **PART 2 PRODUCTS**

#### **2.01 SEWER PIPE PIPE AND FITTINGS**

- A. Provide products that comply with applicable code(s).
- B. PVC Flexible Joint Plastic Pipe: ASTM D3034, Type PSM, Poly (Vinyl Chloride) (PVC) material; bell and spigot style rubber ring sealed gasket joint.
  - 1. Pipe Class: SDR 35.
  - 2. Minimum Pipe Stiffness: 46 psi.
  - 3. Fittings: PVC conforming to pipe specifications.
  - 4. Joints: ASTM D3212, elastomeric gaskets.
  - 5. Rubber Gaskets: Meet requirements of ASTM F477 or ASTM D1869.

#### **2.02 FLEXIBLE PIPE TO MANHOLE CONNECTION**

- A. Manufacturers:
  - 1. National Pollution Control Systems, Inc.
  - 2. Press-Seal Gasket Corporation.

3. Interpace Corporation.
- B. Pipe to manhole connection shall be sealed with a flexible boot, gasket, sleeve, or as detailed on Drawings.
  1. When the boot is used, the port shall be cored to the size, shape, surface finish, and location required and not cast in the manhole. The boot shall consist of a rubber gasket, an internal expansion sleeve, and one or more external compression take-up clamps.
  2. When gasket is used, the gasket shall be a rubber-pressed wedge gasket cast into the manhole.
  3. When sleeve is used, the sleeve shall be a flexible rubber sleeve cast into the manhole complete with stainless steel strap.
  4. All field penetrations into manholes shall be cast-in-place, cored, or saw cut to a sufficient size to accommodate the seals referenced above.
- C. Materials:
  1. Gaskets, Expansion Sleeves, and Connectors: Natural or synthetic rubber meeting ASTM C923.
  2. Clamps and Hardware: Series 300 non-magnetic stainless steel.

## **2.03 UNDERGROUND PIPE MARKERS**

- A. Plastic Ribbon Tape: Metallic core, brightly colored green continuously printed with "GRAVITY SEWER" in large letters, minimum 6 inches wide by 4 mils thick.

## **2.04 MANHOLES**

- A. Manholes: As specified in Section 33 0513 and indicated on Drawings; cover inscribed with "SANITARY SEWER".

## **2.05 BEDDING AND COVER MATERIALS**

- A. Pipe Bedding Material: As specified in Section 31 2323.
- B. Pipe Cover Material: As specified in Section 31 2323.

## **PART 3 EXECUTION**

### **3.01 GENERAL**

- A. Perform work in accordance with applicable code(s).

### **3.02 EXAMINATION**

- A. Section 01 7000 - Execution and Closeout Requirements: Verification of existing conditions before starting Work.
- B. Verify existing sanitary sewer utility main size, location, and invert are as indicated on Drawings.

### **3.03 EXCAVATION AND BEDDING**

- A. Excavate pipe trench in accordance with Section 31 2316.13.
- B. Excavate to lines and grades shown on Drawings or required to accommodate installation of encasement.
- C. Dewater excavations to maintain dry conditions and preserve final grades at bottom of excavation.
- D. Provide sheeting and shoring in accordance with Section 31 2316.13.
- E. Place bedding material and backfill trench per Section 31 2316.13.

### **3.04 INSTALLATION - PIPE**

- A. Install in accordance with manufacturers instructions and as indicated on Drawings.
- B. Install plastic pipe, fittings, and accessories in accordance with ASTM D2321.
- C. Seal joints watertight.

- D. Lay pipe to slope gradients indicated on Drawings. Begin at downstream end and progress upstream
- E. Ensure entire pipe is supported by bedding.
- F. Assemble and handle pipe in accordance with manufacturer's instructions except as modified on the Drawings or by Engineer.
- G. Keep pipe and fittings clean until work is completed and accepted by Engineer. Cap open ends during periods of work stoppage.
- H. Lay bell and spigot pipe with bells upstream.
- I. Pipe Joint. Preparatory to making pipe joints on gravity sewer lines, clean and dry all surfaces of joint pipe and jointing material. Use lubricants, primers, adhesives, and similar materials as recommended by the manufacturers. Place, fit, join, and adjust the jointing materials or factory fabricated joints as recommended by the manufacturer to obtain the degree of watertightness required. As soon as possible after the joint is made, place sufficient backfill material along each side of the pipe to resist forces that might tend to move the pipe off line and grade.
  - 1. Place backfill over the pipe immediately after the pipe has been laid.
- J. Service lateral connections and reconnection of existing connections to main sewers shall be made by using a saddle wye. All connections to sewers shall be made to prevent structural damage and infiltration to these facilities.
- K. Join Push-On Joint Pipe as Follows:
  - 1. Thoroughly clean inside of the bell and 8 inches of the outside of the spigot end of the joining pipe to remove oil, grit, excess coating, and other foreign matter. Flex rubber gasket and insert in the gasket recess of the bell socket. Apply a thin film of gasket lubricant supplied by pipe manufacturer to either the gasket or the spigot end of the joining pipe.
  - 2. Start spigot end of pipe into socket with care. The joint shall then be completed by forcing the plain end to the bottom of the socket with a forked tool or jack type device. Field-cut pipe shall have the end filed to match the manufactured spigot end.
  - 3. Permissible deflection of push-on joint pipe in force mains shall not be greater than listed in AWWA C600.
- L. Join polyvinyl chloride (PVC) pipe as recommended by the manufacturer using rubber ring gaskets in bell ends.
- M. Encase sewer pipe lines crossing under roads in a larger pipe or conduit called a casing pipe. The casing pipe shall be of the diameter and wall thickness as indicated in the chart below. Joining of steel casing pipe shall meet requirements of AWWA C206 "Standard for Field Welding of Steel Water Pipe Joints". Install casing pipe by open cutting, jacking or boring.
  - 1. The installation shall meet requirements of the Highway Department for installation under roadways. Brick up casing pipe ends to protect against foreign matter, but do not tightly seal. Prior to beginning Work, notify the Highway Department.
- N. Pipe Chart for Road Crossings:

CARRIER PIPE	MINIMUM CASING PIPE INSIDE DIAMETER	MINIMUM THICKNESS (D.O.T.)	MINIMUM THICKNESS (R.R.)
4-Inch PVC	12"	0.50"	N/A
4-Inch Ductile Iron	12"	0.50"	0.188"
6-Inch PVC	16"	0.50"	N/A
6-Inch Ductile Iron	16"	0.50"	0.188"
8-Inch PVC	20"	0.50"	N/A
8-Inch Ductile Iron	20"	0.50"	0.188"
10-Inch PVC	24"	0.50"	N/A
10-Inch Ductile Iron	24"	0.50"	0.188"

12-Inch PVC	24"	0.50"	N/A
12-Inch Ductile Iron	24"	0.50"	0.250"
16-Inch Ductile Iron	30"	0.50"	0.281"
18-Inch Ductile Iron	32"	0.50"	0.312"
20-Inch Ductile Iron	36"	0.50"	0.344"
24-Inch Ductile Iron	42"	0.50"	0.375"
30-Inch Ductile Iron	48"	0.50"	0.469"
36-Inch Ductile Iron	54"	0.50"	0.781"

- O. Skids shall be of structural steel with anti corrosion finish and shall be spaced at 9-foot maximum intervals. Skids shall be bolted around carrier pipe leaving a minimum of 2-inch clearance between skid and casing pipe. Lubrication shall be non-toxic and shall not support growth of bacteria. Skids shall be spider supports and spacers, or approved equal.
- P. Connect pipe to existing sewer system as indicated on Drawings at existing manhole or using doghouse manhole connection per Section 33 0513.
- Q. Place haunching material, rod, and tamp per Section 31 2316.13 to eliminate voids.
- R. Install underground marking tape continuously 18 inches above pipeline.
- S. Parallel Installation:
  - 1. Normal Conditions: Sewer lines and manholes shall be constructed at least 10 feet horizontally from a water line whenever possible. The distance shall be measured edge to edge.
  - 2. Unusual Conditions: When local conditions prevent a horizontal separation of at least 10 feet, the water line may be laid closer to a sewer or sewer manhole provided that:
    - a. The bottom of the water line is at least 18 inches above the top of the sewer.
    - b. Where this vertical separation cannot be obtained, the sewer shall be constructed of AWWA-approved water pipe pressure-tested in place to 50 psi without leakage prior to backfilling. The sewer manhole shall be of watertight construction and tested in place.
- T. Crossing:
  - 1. Normal Conditions: Sewers crossing under water lines shall be laid to provide a separation of at least 18 inches between the bottom of the water line and the top of the sewer whenever possible.
  - 2. Unusual Conditions: When local conditions prevent a vertical separation described in the paragraph above, the following construction shall be used:
    - a. Sewers passing over or under water lines shall be constructed as described in Parallel Installation, Unusual Conditions above.
    - b. Sewer passing over water lines shall be laid to provide:
      - 1) Vertical separation of at least 18 inches between bottom of sewer and top of water line.
      - 2) Adequate structural supports for the sewers to prevent excessive deflection of the joints and settling on and breaking water line.
      - 3) Maximum separation of water and sewer line joints.

### 3.05 CONNECTION TO EXISTING MANHOLE

- A. Core drill or saw cut existing manhole to clean opening. Use of pneumatic hammers, chipping guns, and sledge hammers is not permitted.
- B. Install flexible pipe to manhole connector and seal with non-shrink concrete grout.
- C. Concrete encase new sewer pipe minimum of 24 inches to nearest pipe joint. Use epoxy binder between new and existing concrete.
- D. Prevent construction debris from entering existing sewer line when making connection.

### **3.06 INSTALLATION - MANHOLE**

- A. Install manholes in accordance with Section 33 0513.

### **3.07 INSTALLATION - WYE BRANCHES AND TEES**

- A. Install wye branches or pipe tees at locations indicated on Drawings concurrent with pipe laying operations. Use standard fittings of same material and joint type as sewer main.
- B. Maintain minimum 5 feet separation distance between wye connection and manhole.
- C. Use saddle wye or tee with stainless steel clamps for taps into existing piping. Mount saddles with solvent cement or gasket and secure with metal bands. Layout holes with template and cut holes with mechanical cutter.

### **3.08 INSTALLATION - SANITARY LATERALS**

- A. Construct laterals from wye branch to terminal point at right-of-way or as indicated on Drawings.
- B. Where depth of main pipeline warrants, construct riser type laterals from wye branch.
- C. Maintain 3-foot minimum depth of cover over pipe.
- D. Maintain minimum 5-foot separation distance between laterals.
- E. Install watertight plug, braced to withstand pipeline test pressure thrust, at termination of lateral. Install temporary marker stake extending from end of lateral to 24 inches above finished grade. Paint top 6 inches of stake with fluorescent orange paint.

### **3.09 BACKFILLING**

- A. Backfill around sides and to top of pipe in accordance with Section 31 2316.13.
- B. Maintain optimum moisture content of backfill material to attain required compaction density.

### **3.10 FIELD QUALITY CONTROL**

- A. Section 01 4000 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Perform test on sanitary sewage system in accordance with Section 33 0132 and local code.
- C. Compaction Testing: In accordance with Section 31 2316.13.
- D. When tests indicate Work does not meet specified requirements, remove Work, replace, and retest.

### **3.11 PROTECTION OF FINISHED WORK**

- A. Section 01 7000 - Execution and Closeout Requirements: Requirements for protecting finished Work.
- B. Protect pipe and aggregate cover from damage or displacement until backfilling operation is in progress.
- C. Place backfill over the pipe immediately after the pipe has been laid.

**END OF SECTION 33 3111**

**SECTION 33 4111**  
**STORM UTILITY DRAINAGE PIPING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Storm drainage piping, fittings, and accessories.
- B. Connection of drainage system to municipal sewers.
- C. Catch basins, Plant area drains, Paved area drainage, and Site surface drainage.

**1.02 RELATED REQUIREMENTS**

- A. Section 03 3000 - Cast-in-Place Concrete: Concrete for cleanout base pad construction.
- B. Section 31 2316 - Excavation: Excavating of trenches.
- C. Section 31 2316.13 - Trenching: Excavating, bedding, and backfilling.
- D. Section 31 2323 - Fill: Bedding and backfilling.
- E. Section 33 0513 - Manholes and Structures.

**1.03 REFERENCE STANDARDS**

- A. AASHTO M 252 - Standard Specification for Corrugated Polyethylene Drainage Pipe; 2009.
- B. AASHTO M 294 - Standard Specification for Corrugated Polyethylene Pipe, 300- to 1500 MM (12- to 60- in.) Diameter; 2013.
- C. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications; 2011.
- D. ASTM D3350 - Standard Specification for Polyethylene Plastics Pipe and Fittings Material; 2012.
- E. Virginia Department of Transportation (VDOT):
  - 1. Road and Bridge Specifications, 2007, published by VDOT.
  - 2. Road and Bridge Standards, 2008, published by VDOT.

**1.04 ADMINISTRATIVE REQUIREMENTS**

- A. See Section 01 7000 - Execution and Closeout Requirements, for coordination and project conditions.
- B. Notify affected utility companies a minimum of 72 hours prior to construction.
- C. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

**1.05 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittal procedures and Section 01 7000 - Execution and Closeout Requirements for submittal requirements.
- B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- C. Manufacturer's Installation Instructions: Indicate special procedures required to install Products specified.
- D. Field Quality Control Submittals: Document results of field quality control testing.
- E. Project Record Documents:
  - 1. Record location of pipe runs, connections, catch basins, cleanouts, and invert elevations.
  - 2. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

**1.06 QUALITY ASSURANCE**

- A. Perform Work in accordance with VDOT Road and Bridge Specifications.
- B. Maintain one copy of document on site.

## 1.07 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum 5 years of documented experience.
- B. Installer: Company specializing in performing Work of this Section with minimum 5 years documented experience.

## 1.08 DELIVERY, STORAGE, AND HANDLING

- A. See Section 01 6000 - Product Requirements for requirements for transporting, handling, storing, and protecting products.
- B. Block individual and stockpiled pipe lengths to prevent moving.
- C. Do not place pipe or pipe materials on private property or in areas obstructing pedestrian or vehicle traffic.
- D. Do not place pipe flat on ground. Cradle to prevent point stress.
- E. Store UV sensitive materials out of direct sunlight.

## PART 2 PRODUCTS

### 2.01 SEWER PIPE MATERIALS

- A. Provide products that comply with applicable code(s).
- B. Plastic Pipe: ASTM D3350, High Density Polyethylene (HDPE) corrugated wall pipe with integrally formed smooth liner; inside nominal diameter of see drainage schedule inch, meeting the requirements of AASHTO M 252, Type S, for diameters between 3 inches and 10 inches and AASHTO M 294, Type S, for diameters between 12 inches and 60 inches, soil-tight, bell and spigot joints with rubber gaskets, with pipe and fittings manufactured from virgin PE compounds with cell classification 3254420C.

### 2.02 PIPE ACCESSORIES

- A. Fittings: Same material as pipe molded or formed to suit pipe size and end design, in required tee, bends, elbows, cleanouts, reducers, traps and other configurations required.
- B. Trace Wire: Magnetic detectable conductor, clear plastic covering, imprinted with "Storm Sewer Service" in large letters.

### 2.03 MANHOLES AND STRUCTURES

- A. Manholes: As specified in Section 33 0513 and as indicated on Drawings; covers inscribed "STORM SEWER".
- B. Catch Basin, Inlets, and Junction Boxes: Conform to VDOT Road and Bridge Standards and Specifications as indicated on Drawings.

### 2.04 BEDDING AND COVER MATERIALS

- A. General: Conform to Section 31 2316.13 - Trenching and Section 31 2323 - Fill for bedding and backfill around and on top of pipe.
- B. Bedding for Flexible Pipe (HDPE and CMP): Aggregate fill; shall meet VDOT requirements for No. 25 or No. 26 crusher run aggregate or No. 57 coarse aggregate.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. See Section 01 7000 - Execution and Closeout Requirements for verification of existing conditions before starting work.
- B. Verify trench cut is ready to receive work and excavations, dimensions, and elevations are as indicated on Drawings.

### 3.02 TRENCHING

- A. See Section 31 2316.13 - Trenching for additional requirements.

- B. Hand trim excavation for accurate placement of pipe to elevations indicated.
- C. Excavate to lines and grades shown on Drawings or to accommodate installation of encasement.
- D. Dewater excavations to maintain dry conditions and preserve final grades at bottom of excavation.
- E. Provide sheeting and shoring in accordance with Section 31 2316.13.
- F. Place bedding material at trench bottom, level continuous layer not exceeding 8 inches compacted depth; compact to 95 percent per Section 31 2316.13.
- G. Maintain optimum moisture content of bedding material to attain required compaction density.
- H. Backfill around sides and to top of pipe with cover fill, tamp in place and compact, then complete backfilling.

### **3.03 INSTALLATION - PIPE**

- A. Verify that trench cut is ready to receive work and excavations, dimensions, and elevations are as indicated on layout drawings.
- B. Install pipe, fittings, and accessories in accordance with manufacturer's instructions and as indicated on Drawings. Seal watertight.
  - 1. Plastic Pipe: Also comply with ASTM D2321.
- C. Lay pipe to slope gradients noted on layout drawings; with maximum variation from true slope of 1/8 inch in 10 feet. Begin at downstream end and progress upstream.
- D. Connect to building storm drainage system, foundation drainage system, and utility/municipal sewer system.
- E. Make connections through walls through sleeved openings, where provided.
- F. Seal joints watertight.
- G. Keep pipe and fittings clean until Work is completed and accepted by Engineer. Cap open ends during period of work stoppage.
- H. Lay bell and spigot pipe with bells upstream.
- I. Connect pipe to existing sewer system as indicated on Drawings at existing manhole or doghouse manhole connection per Section 33 0513.
- J. Install continuous trace wire 6 inches above top of pipe; coordinate with Section 31 2323.

### **3.04 INSTALLATION - MANHOLES, CATCH BASINS, TRENCH DRAINS AND CLEANOUTS**

- A. Install manholes in accordance with Section 33 0513.
- B. Form bottom of excavation clean and smooth to correct elevation.
- C. Form and place cast-in-place concrete base pad, with provision for sanitary sewer pipe end sections.
- D. Establish elevations and pipe inverts for inlets and outlets as indicated.
- E. Mount lid and frame level in grout, secured to top cone section to elevation indicated.

### **3.05 INSTALLATION - CONNECTION TO EXISTING STRUCTURES**

- A. Core drill existing manhole to clean opening. Do not use pneumatic hammers, chipping guns, or sledge hammers.
- B. Install watertight neoprene gasket and seal with non-shrink concrete grout.
- C. Concrete encase new sewer pipe minimum of 24 inches to nearest pipe joint. Use epoxy binder between new and existing concrete.
- D. Prevent construction debris from entering existing sewer line when making connection.

### **3.06 FIELD QUALITY CONTROL**

- A. Perform field inspection and testing in accordance with Section 01 4000.

- B. Soil Compaction Testing: In accordance with 31 2316.13.
- C. When tests indicate work does not meet specified requirements, remove work, replace and retest.

### **3.07 PROTECTION**

- A. Section 01 7000 - Execution and Closeout Requirements: Protecting finished Work.
- B. Protect pipe and aggregate cover from damage or displacement until backfilling operation is in progress.
  - 1. Take care not to damage or displace installed pipe and joints during construction of pipe supports, backfilling, testing, and other operations.
  - 2. Repair or replace pipe that is damaged or displaced from construction operations.

**END OF SECTION 33 4111**

**SECTION 33 4600**  
**SUBDRAINAGE**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Building Perimeter, Retaining Wall, and Under-Slab Drainage Systems.
- B. Filter aggregate and fabric and bedding.

**1.02 RELATED REQUIREMENTS**

- A. Section 31 2316 - Excavation: Excavating for subdrainage system piping and surrounding filter aggregate.
- B. Section 31 2316.13 - Trenching: Excavating and backfilling for site subdrainage systems.
- C. Section 31 2323 - Fill: Backfilling over filter aggregate, up to subgrade elevation.

**1.03 REFERENCE STANDARDS**

- A. ASTM D2729 - Standard Specification for Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2011.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- C. Project Record Documents: Record location of pipe runs, connections, cleanouts and principal invert elevations.

**1.05 REGULATORY REQUIREMENTS**

- A. Conform to applicable code for materials and installation of the work of this section.

**PART 2 PRODUCTS**

**2.01 PIPE MATERIALS**

- A. Manufacturers:
  1. Hancor.
  2. ADS.
  3. JM Eagle.
- B. Polyvinyl Chloride Pipe: ASTM D2729; plain end, 4 inch inside diameter; with required fittings.
- C. Corrugated Plastic Tubing: Flexible type; 4 inch diameter, with required fittings.
- D. Use perforated pipe at subdrainage system; unperforated through sleeved walls.

**2.02 AGGREGATE AND BEDDING**

- A. Filter Aggregate and Bedding Material: Granular fill as specified in Section 31 2323.
- B. Filter Sand and Bedding Material: Sand as specified in Section 31 2323.

**2.03 ACCESSORIES**

- A. Pipe Couplings: Solid plastic.
- B. Joint Covers: No. 15 asphalt saturated roofing felt.
- C. Filter Fabric: Water pervious type, black Mirafi 140 NL. \_\_\_\_\_.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

- A. Verify that trench cut is ready to receive work and excavations, dimensions, and elevations are as indicated on layout Drawings.

### **3.02 PREPARATION**

- A. Hand trim excavations to required elevations. Correct over-excavation with Type No. 57 aggregate.
- B. Remove large stones or other hard matter that could damage drainage piping or impede consistent backfilling or compaction.

### **3.03 INSTALLATION**

- A. Install and join pipe and pipe fittings in accordance with pipe manufacturer's instructions.
- B. Place drainage pipe on clean cut subsoil.
- C. Lay pipe to slope gradients noted on Drawings; with maximum variation from true slope of 1/8 inch in 10 feet.
- D. Loosely butt pipe ends. Place joint cover strip 12 inches wide, around pipe diameter centered over joint.
- E. Place pipe with perforations facing down. Mechanically join pipe ends.
- F. Install pipe couplings.
- G. Install filter aggregate at sides, over joint covers and top of pipe. Provide top cover compacted thickness of 12 inches.
- H. Place filter fabric over levelled top surface of aggregate cover prior to subsequent backfilling operations.
- I. Place aggregate in maximum 4 inch lifts, consolidating each lift.
- J. Refer to Section 31 2323 for compaction requirements. Do not displace or damage pipe when compacting.
- K. Place impervious fill over drainage pipe aggregate cover and compact.
- L. Connect to storm sewer system with unperforated pipe, through installed sleeves.
- M. Coordinate the Work with connection to municipal sewer utility service, and trenching.

### **3.04 FIELD QUALITY CONTROL**

- A. Section 01 4000 - Quality Requirements: Field inspection and testing.
- B. Request inspection prior to and immediately after placing aggregate cover over pipe.

### **3.05 PROTECTION**

- A. Protect pipe and aggregate cover from damage or displacement until backfilling operation begins.

**END OF SECTION 33 4600**

## **PROJECT MANUAL APPENDIX ONE**

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# **EarthCraft Virginia Multifamily V4**

## **2014 Technical Guidelines**

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# Introduction

## About EarthCraft

EarthCraft™ green building programs, which were first developed in 1999 as a partnership between the Greater Atlanta Home Builders Association and Southface Energy Institute, are designed to specifically address the challenging energy, water and climate conditions of the Southeast.

EarthCraft certification helps ensure that buildings and communities in the region meet strict criteria for saving energy and water, ensuring high indoor air quality, and protecting our land and natural resources. To achieve an EarthCraft certification, a building is required to undergo independent third-party verification by a qualified EarthCraft Technical Advisor who confirms the building meets all program requirements.

The family of EarthCraft green building programs includes:

### **EarthCraft House**



The EarthCraft House™ program is designed to certify new construction single-family detached homes, townhomes and duplexes. Any size or type of home can be certified because builders are able to select which program measures are best suited for the project while meeting minimum thresholds for performance.

### **EarthCraft Renovation**



EarthCraft Renovation™ offers remodelers and contractors the unique opportunity to certify projects of various size and complexity in renovation, remodeling and expansion. Renovation projects receive an assessment and recommendations for specific renovation techniques to address environmental performance areas.

### **EarthCraft Multifamily**



The EarthCraft Multifamily™ program is designed to certify new or renovated low-rise, mid-rise and high-rise residential buildings. Multifamily projects are designed to address environmental performance, livability and affordability for each unit as well as the structure as a whole.

### **EarthCraft Communities**



The EarthCraft Communities™ program is designed to certify sustainably planned and developed communities in urban, suburban or rural areas. The program offers a holistic approach to sustainable development projects.

### **EarthCraft Light Commercial**



The EarthCraft Light Commercial™ program is designed to certify new or renovated small-scale commercial buildings of 15,000 square feet or less. Projects receive hands-on support during the design and construction process that focuses on energy- and water-efficient design strategies.

## About the EarthCraft Multifamily 2014 Technical Guidelines

The EarthCraft Multifamily 2014 Technical Guidelines apply to all new construction and gut rehab projects in the EarthCraft Multifamily program permitted on or after January 1, 2014. The Technical Guidelines must be used in conjunction with the EarthCraft Multifamily Version 4 Worksheet and are intended to provide explanations for each line item on the Worksheet.

Projects seeking additional clarity beyond what is provided in the Technical Guidelines should consult the EarthCraft Virginia staff and/or an EarthCraft Technical Advisor for additional information.

All local building codes must be met. When local building codes are more stringent than the Technical Guidelines and Worksheet, the local code must be followed. Should the EarthCraft Technical Guidelines and Worksheet conflict with local code, the local code must be followed. The EarthCraft Builder must notify the EarthCraft Technical Advisor of any changes required for the project to meet local codes.

Additions and updates are made by EarthCraft to the Technical Guidelines as needed and requested. Technical Guidelines versions may be determined by the version date in the lower left corner of the document. The latest Technical Guidelines are available for free download from the EarthCraft website at [www.earthcraftvirginia.org](http://www.earthcraftvirginia.org). To make recommendations for improvements and updates to the Technical Guidelines, please contact EarthCraft Virginia or an EarthCraft Technical Advisor.

## **Legend**

The Technical Guidelines are organized by category. Each line item on the EarthCraft 2014 Worksheet is listed in the Technical Guidelines with the following supplemental information. To determine which line items are required by the program and the point values associated with line items, the EarthCraft 2014 Worksheet must be reviewed.

### **Criteria**

Criteria cover the requirements for the specified measure detailing any specific information necessary for meeting the line item. All criteria must be implemented to qualify for the line item on the EarthCraft Multifamily 2014 Worksheet.

Materials and methods described are representative of typical strategies that meet the intent of the criteria, but do not represent all strategies that may be used. The builder may request permission from EarthCraft, through the EarthCraft Technical Advisor, to meet the intent of the credit using a different approach; approval must be requested and approved prior to implementation.

Line items with multiple options will be identified through the use of numbers or letters in italics with specific criteria associated with each number or letter. Numbered items indicate criteria that may be added together on the EarthCraft Multifamily 2014 Worksheet for cumulative points; Lettered items indicate criteria that may not be added together (the project may only receive credit for one of the options listed). For example, under SP1.0: Type of Site, all three measures (1, 2 and/or 3) may be met or only one measure may be met as a site can be a brownfield, previously developed and an infill site, or it may only be one of those. Under SP 1.1: Ratio of Lot Size to Conditioned Floor Area, only one item, either A, B, C or D, may be counted towards EarthCraft certification.

### **Clarifications**

Clarifications provide case-specific clarifications of criteria implementation, such as trade-offs allowed within the program.

### **Exemptions**

Exemptions list specific exemptions to credit requirements.

### **Examples**

Examples provide examples of criteria implementation and are often used to demonstrate calculations.

### **Additional Resources**

Additional Resources are intended to provide a quick reference for applicable resources that may be used for additional information pertaining to criteria. Additional Resources are not intended to be an exhaustive list of references and products that may be used to meet criteria.

## Confirmation

When verifying line items on an EarthCraft project, EarthCraft Builders and EarthCraft Technical Advisors should reference the guidelines to ensure all requirements have been met. The Confirmation language articulates when the official confirmation activity should take place and how, and whether any documentation is required. All criteria must be confirmed before points are awarded on the EarthCraft Multifamily 2014 Worksheet.

Confirmation occurs primarily at either the pre-drywall inspection, the final inspection, or at both the pre-drywall inspection and final inspection. Each confirmation type confirms compliance of criteria as listed in the criteria and clarifications sections of each line item. The type(s) of confirmation is listed based on a set of standard options as follows:

- Visual
  - Indicates confirmation of criteria via direct visual inspection by the EarthCraft Technical Advisor.
  - The type of visual confirmation required is dependent on the criteria and should at a minimum include a direct visual inspection by the EarthCraft Technical Advisor to confirm criteria were met. For example, if the project is pursuing credit for recycling waste, in addition to reviewing the documented waste management plan provided by the builder, the EarthCraft Technical Advisor will visually confirm that materials are being recycled on site by seeing recycling signage and separation piles and confirming no materials meant for recycling are in the trash (e.g., no contractor beverage containers are in the dumpster).
  - If unable to confirm compliance of criteria through this option, the EarthCraft Technical Advisor may require documentation or photo confirmation.
- Verbal
  - Indicates confirmation of criteria via direct conversation between the builder and EarthCraft Technical Advisor
  - The type of verbal confirmation required is dependent on the criteria and should at a minimum include a reasonable explanation by the builder of how the criteria were met.
  - If unable to confirm compliance of criteria through this option, the EarthCraft Technical Advisor may require documentation or photo confirmation.
  - If the EarthCraft Technical Advisor identifies any discrepancy between the verbal description provided and visual inspections performed on the project, the visual confirmation rules. For example, if the builder verbally confirms all waste was disposed of in a state approved landfill, but the EarthCraft Technical Advisor sees a burry-pit on site, the project will not be eligible for certification.
- Documentation
  - Indicates confirmation of criteria via documentation provided by the builder and reviewed by the EarthCraft Technical Advisor
  - The type of documentation required is dependent on the criteria. For example, criteria dependent on calculations should be demonstrated through the documentation of those calculations. Other common forms of documentation include: site plans, house plans, product specifications, product warranties, test results, etc. The documentation must provide sufficient information for the EarthCraft Technical Advisor to confirm the criteria were met and should not require the EarthCraft Technical Advisor to conduct further research or calculations.
  - Documentation, as specified in the confirmation area for each line item, may either be:

- Presented at or before the applicable inspection and kept on file by the builder for a minimum of three years.
- Submitted to the EarthCraft Technical Advisor at or before the applicable inspection and kept on file by the EarthCraft Technical Advisor for a minimum of three years.
- Documentation applicable to multiple projects may be presented and/or submitted once and kept on file by the appropriate party. Updates to documentation are required whenever methods or materials used are changed. EarthCraft Technical Advisors are required to verbally reconfirm documentation accuracy at each inspection.
- When criteria are clearly met through visual inspection the EarthCraft Technical Advisor may waive documentation. For example, if the EarthCraft Technical Advisor visually confirms cork flooring has been installed on 30% of the floor area, s/he may waive documentation.
- Photo
  - Indicates confirmation of criteria via photo documentation provided by the builder and reviewed by the EarthCraft Technical Advisor.
  - Photos must be submitted by the builder to the EarthCraft Technical Advisor at or before the applicable inspection and kept on file by the EarthCraft Technical Advisor for a minimum of three years.
  - Photos must clearly illustrate criteria being confirmed as well as location in the project. At a minimum, photo documentation must:
    - Provide evidence of each measure outlined in the criteria.
    - Show both the general location and the specific strategy.
    - Be date stamped.
- Testing
  - Indicates confirmation of criteria via diagnostic testing performed primarily by the EarthCraft Technical Advisor. Tests not performed by the EarthCraft Technical Advisor, must be performed by a third-party approved by the EarthCraft Technical Advisor and not having a direct conflict of interest. For example, HVAC flow testing must be performed by a third-party not associated with the HVAC contractor. The EarthCraft Technical Advisor must review test results for reasonableness.
  - Proper industry-accepted training and testing protocol must be followed in addition to the specific measures outlined in the following guidelines, including properly calibrated and maintained equipment. Specific examples of industry-accepted testing protocols that must be followed in addition to the guidelines include:
    - Flow testing: the third-party must use a properly calibrated flow hood, flow grid or anemometer in accordance with relevant AABC, NEBB or ASHRAE procedures.
    - Blower door and duct leakage testing: the third-party must follow RESNET standards.

## About the EarthCraft Multifamily 2014 Worksheet and Manual

### **Objective**

The EarthCraft Multifamily Worksheet and the EarthCraft Manual provide project teams with detailed information and guidance on program implementation. The worksheet is the primary tool used to show compliance for an EarthCraft Multifamily project. The most recent worksheet should be downloaded from the EarthCraft website before each design review or new project seeks program compliance. This excel workbook includes a cover sheet indicating the projects score, an instructions tab for how to properly fill out and track the worksheet, the worksheet which illustrates which strategies the project has incorporated, a test sheet that provides blower door and duct leakage diagnostic testing results as well as an inspection notes tab. The EarthCraft Manual outlines roles and responsibilities for all project participants as well as a detailed process for certifying a project.

### **Instructions**

The EarthCraft Builder or project team representative must complete an EarthCraft worksheet to show that the project will qualify for certification. The EarthCraft Multifamily Worksheet is an Excel spreadsheet that can be downloaded from [www.earthcraftvirginia.org](http://www.earthcraftvirginia.org). Each project seeking certification must complete a worksheet unique to the project. The EarthCraft project team analyzes the project prior to construction and selects the credits that they plan to achieve by placing the appropriate score next to each point value. EarthCraft Virginia reviews the worksheet at the Design Review, Pre-Drywall Inspection, and Final Inspection to clarify any questions that may arise during implementation, collects the required documentation (varies per line item), and verifies specific measures (varies per line item).

### **Disclaimer and Notices**

EarthCraft Virginia provides the EarthCraft Multifamily 2014 Technical Guidelines for your individual use and to copy as-is, or in part as needed. No content may be altered. In exchange for this authorization, you agree to retain all copyright and other proprietary notices contained in the Technical Guidelines. You also agree not to sell or modify the Technical Guidelines.

Also, please note that none of the parties involved in the funding or creation of the Technical Guidelines, including Southface, EarthCraft Virginia, the Greater Atlanta Home Builders Association and all associated members, make any warranty (express or implied) or assume any liability or responsibility, to you or any third parties for the accuracy, completeness, or use of, or reliance on, any information contained in the Technical Guidelines, or for any injuries, losses or damages (including, without limitation, equitable relief) arising out of such use or reliance.

As a condition of use, you covenant not to sue, and agree to waive and release EarthCraft, Southface, EarthCraft Virginia, the Greater Atlanta Home Builders Association and all associated members from any and all claims, demands and causes of action for any injuries, losses or damages (including, without limitation, equitable relief) that you may now or hereafter have a right to assert against such parties as a result of your use of, or reliance on, the Technical Guidelines.

Please note that the builder, architect, or primary project manager is solely responsible for choosing the EarthCraft Multifamily criteria that are appropriate for the project and for their proper installation. EarthCraft and its representatives are responsible only for verifying the completion of EarthCraft requirements as set forth in the Technical Guidelines; such verification in no way constitutes a warranty as to the appropriateness of the selected EarthCraft criteria or the quality of implementation.

## Acknowledgements

EarthCraft would like to thank the support of our many government, industry and private sponsors and partners that help with the development and continued refinement of the EarthCraft Technical Guidelines:

- U.S. Department of Energy
- U.S. Environmental Protection Agency
- Georgia Environmental Facilities Authority
- EarthCraft Sponsors
- EarthCraft Technical Committee Members
- EarthCraft Technical Advisors
- EarthCraft Builders
- The countless other individuals that have provided feedback and shared information with EarthCraft.

For a current list of EarthCraft Sponsors, EarthCraft Technical Advisors, and EarthCraft Builders, please visit: [www.earthcraftvirginia.org](http://www.earthcraftvirginia.org).

If you would like to offer recommendations for refinement or improvement, please send comments to [admin@earthcraftvirginia.org](mailto:admin@earthcraftvirginia.org).

## EarthCraft Contact Information

 Website.....	www.earthcraftvirginia.org
 Email.....	admin@earthcraftvirginia.org
 General inquiries: EarthCraft Hotline.....	804.225.9843
 Fax.....	804.562.4159
 Mailing Address.....	1431 West Main Street Richmond, VA 23220

## Site Planning

The location of a project and the plan for the area around that project can have a significant impact on both the resident's quality of life and on the environment. Selecting an appropriate site for a project is essential to creating more walkable, livable communities with efficient transportation. One can also improve the air quality in a neighborhood, help manage storm water, lower energy bills and increase property values simply by protecting and restoring trees on a site. Planning for construction on a site can prevent soil loss and water pollution by reducing erosion and properly controlling for storm water.

The Site Planning category of the EarthCraft program focuses on actions that a project team can take to minimize the direct impact of a building site on the environment. These actions range from protecting excavated topsoil from erosion to reducing lot size. Projects may also implement additional site planning measures to promote accessibility to public amenities such as mass transit and parks or using degraded sites such as brownfields.

### Site Selection

#### SP 1.0 Type of site

##### Criteria

###### *1. Brownfield site*

Build project on a brownfield site. A brownfield site is where expansion or re-development is complicated by the real or perceived presence of a hazardous substance, pollutant or contaminant. Brownfield sites are typically located at abandoned, idle or under used industrial or commercial facility.

###### *2. Previously developed site*

Build project on lot that has preexisting paving or construction on ≥75% of site.

###### *3. Infill development site*

Build project on lot that is served by existing public sewer infrastructure and ensure that 50% or 75% of lot boundary is adjacent to parcels of land previously developed for ≥5 years' time. Natural areas or corridors are not considered previously developed. If the property borders a road, the land use on the opposite side of the road from the property should be used.

##### Additional Resources

Technical assistance for building on brownfield sites may be obtained by contacting the Environmental Protection Agency's (EPA) Division of Waste Management:  
<http://www.epa.gov/brownfields/tools/index.htm>.

##### Confirmation

- The EarthCraft Technical Advisor will visually confirm criteria compliance at pre-drywall inspection.

## SP 1.1 Average density – dwelling units per acre

### Criteria

Achieve dwelling unit per acre calculation of  $\geq 15$  dwelling units/acre,  $\geq 20$  dwelling units/acre, or  $\geq 25$  dwelling units/acre. This calculation will include all buildable land area within the project boundary, but may exclude permanently protected greenspace, floodplains, or tree-save areas. The acreage will be gross density of site including all parking lots, sidewalks, and other hardscape areas.

### Example

One hundred dwelling units on a 5-acre lot with 1-acre preserved as a permanently protected tree save area.  $100 \text{ units} / (5 \text{ acres} - 1 \text{ acre tree save}) = 25 \text{ dwelling units per acre}$ .

### Confirmation

- The builder must submit documentation demonstrating compliance to the EarthCraft Technical Advisor at the pre-drywall inspection.
- The EarthCraft Technical Advisor will review documentation provided by the builder at the pre-drywall inspection.

## Site Design

## SP 2.0 Connectivity

### Criteria

#### **1. Walking distance to bus line ( $\leq 1/4$ mile)**

Locate the primary entrance of the project within  $1/4$  mile of an existing bus line. Measure distance by following a walkable route comprised of sidewalks, public trails and pedestrian crosswalks.

#### **2. Walking distance to rail/rapid transit ( $\leq 1/2$ mile)**

Locate the primary entrance of the project within  $1/2$  mile of an existing light rail/heavy rail rapid transit station. Measure distance by following walkable route comprised of sidewalks, public trails and pedestrian crosswalks.

#### **3. Biking distance to bike path ( $\leq 1/2$ mile)**

Locate the primary entrance of the project within  $1/2$  mile of an existing or new bike path. Measure distance by following bikeable route.

#### **4. Walking distance to public openspace or greenspace $\geq 3/4$ acre in size ( $\leq 1/4$ mile)**

Locate the primary entrance of the project within  $1/4$  mile of a park that is available for occupant use and greater than  $3/4$  acre in size. Measure distance by following a walkable route comprised of sidewalks, public trails and pedestrian crosswalks. Two smaller parks equivalent in size to one large,  $3/4$  acre park, are accepted as meeting the intent.

#### **5. Walking distance to 4 or more mixed uses ( $\leq 1/4$ mile)**

Locate the primary entrance of the project within  $1/4$  mile of an existing business district. Measure distance by following walkable route comprised of sidewalks and pedestrian crosswalks. Business district must have at least 4 or more distinct community resources (e.g., one library, one school, one grocery store and one restaurant).

- A. Business district must have at least 6 or more distinct community resources. (e.g., one library, one school, one grocery store and one restaurant).**
- B. Business district must have at least 4 or more distinct community resources. (e.g., one library, one school, one grocery store and one restaurant).**

**Confirmation**

- The builder must present documentation demonstrating compliance of criteria to the EarthCraft Technical Advisor at the pre-drywall inspection.
- The EarthCraft Technical Advisor will review documentation provided by the builder for compliance of criteria.

**SP 2.1 Shade ≥50% of hardscapes within 30' of building****Criteria**

To reduce local heat island effects, shade at least 50% of hardscapes (paved area including walkways, driveways, patios and tennis courts) within 30' of the building. Shaded area should be calculated based on tree canopy coverage when the sun is directly overhead based on 5 years growth. Public walkways and roads should not be included in the hardscape calculation.

**Clarifications**

It is advantageous for durability to install plants that maintain ≥2' clearance from buildings at maturity.

Sites that provide 40% shade of hardscapes at completion also qualify.

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at final inspection.

**SP 2.2 Reduce light pollution – all exterior lights full cutoff****Criteria**

Reduce light pollution by minimizing light trespass on site for the purpose of reducing sky-glow, increasing nighttime visibility and minimizing negative effects on nocturnal environments and human health and functioning.

**Clarifications**

All exterior lighting will have full cutoff ability to reduce outdoor light pollution.

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at final inspection.

**SP 2.3 Permanent stormwater control****Criteria**

Control disturbed site area by integrating Low Impact Development Best Management Practices (LID BMP) into the project. All BMPs should be properly located to drain away from building foundation to protect building from moisture damage.

1. Direct impervious surface runoff to appropriately sized rain gardens, swales, drywells or bioretention areas. Receiving area soils should be amended to increase infiltration to the level required for maintaining storm water. Keep area protected from heavy machinery and parking during construction or mitigate soil compaction post construction.
2. Design and install rooftop gardens and green roofs.
3. Direct roof or site runoff into rain barrels and cisterns. Size barrels and cisterns appropriately and enable use of water for building reuse or landscape irrigation.

Use the LID manual for designing rain gardens, swales or bioretention areas (if applicable to the project). Provide the permanent stormwater management plan with scale clearly indicating: area of disturbed site, permeable and impermeable surfaces, and type and location of LID BMPs used. This plan can be integrated into the site plan, landscape plan or erosion control plan.

#### **A. *≥25% of onsite impervious surface areas***

Projects must disconnect at least 25% of onsite impervious surface areas from storm drains by implementing some or all of the LID BMPs from the list above.

#### **B. *≥50% of onsite impervious surface areas***

Projects must disconnect at least 50% of onsite impervious surface areas from storm drains by implementing some or all of the LID BMPs from the list above.

#### **C. *≥75% of onsite impervious surface areas***

Projects must disconnect at least 75% of onsite impervious surface areas from storm drains by implementing some or all of the LID BMPs from the list above.

### **Clarifications**

Landscape installation plan must be consistent with the LID BMPs selected for the project. Alternative LID BMPs may be approved by EarthCraft prior to use.

### **Example**

1,100 sq ft roof

150 sq ft pervious drive way

1,100 sq ft impervious surface total

530 sq ft of the roof drains to rain barrels sized appropriately

300 sq ft of the roof drains into a downspout and into a rain garden

In total, 880 sq ft (80%) of the 1,100 sq ft of impervious surface area drains to an LID BMP.

### **Additional Resources:**

- <http://www.lid-stormwater.net>
- <http://www.nrdc.org/water/pollution/storm/chap12.asp>

### **Confirmation**

- The builder must present documentation demonstrating compliance of criteria to the EarthCraft Technical Advisor at the pre-drywall inspection.
- The EarthCraft Technical Advisor will review documentation provided by the builder for compliance of criteria and visually confirm compliance of criteria at pre-drywall inspection.

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## **SP 2.4 Pervious paving for hardscapes and surface parking area with appropriate sub layers**

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**Criteria**

Pervious paving installed for at least 75% of hardscapes and parking area with appropriate sub layers.

**Clarifications**

To reduce storm water runoff, install pervious pavers for 75% of all hardscape areas on site and parking area. Appropriate sub layers used to allow proper drainage and function.

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance with criteria at install

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## **SP 2.5 Protect and restore riparian, wetland, and shoreline buffers**

---

**Criteria**

Preserve, restore and enhance riparian, wetland, and shoreline buffers to improve flood control and water quality, stabilize soils, control erosion, and provide wildlife corridors and habitat.

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm on site.

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## **SP 2.6 Street trees are ≤40' on center at minimum**

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**Criteria**

Plant or preserve shade trees at an average interval of ≤40 feet along 75% of new or existing streets internal to and immediately adjacent to the project boundary. Trees should be planted on both sides of internal streets and on the project side of adjacent streets.

**Confirmation**

- The project team must present documentation demonstrating compliance with criteria above from the projects landscape designer clearly indicating tree wells or strip dimensions, tree specifications, and street lengths.
- The EarthCraft Technical Advisor will review documentation provided by the project team for compliance with criteria and visually confirm compliance with criteria at final inspections.

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## **SP 2.7 Improved connectivity to adjacent sites**

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**Criteria**

Promote multiple road connections off-site to improve vehicular ingress and egress and improve pedestrian connections to adjacent sites.

No street or pedestrian networks can be gated.

***1. Improved vehicular access (2+ connections)***

The project must provide ≥2 connections to the off-site road network. The vehicular access points must include sidewalk accommodations.

## **2. Dedicated pedestrian and bike access**

Provide a non-vehicular pathway along the edge of the project's boundary adjacent to developed parcels and undeveloped parcels. Pedestrian and bicycle access to future phases of the same development do not qualify. However, plans to provide access in future phases to adjacent parcels will qualify.

Connections are not required where existing buildings, bodies of water, critical slope areas or other natural areas designated for preservation prohibit through streets.

### **Confirmation**

- The project team must present documentation showing the locations of connections in compliance with criteria.
- The EarthCraft Technical Advisor will review documentation provided by the project team for compliance with criteria and visually confirm compliance with criteria at final inspections.

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## **SP 2.8 Community gardens**

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### **Criteria**

Promote open space and the production of locally grown, community maintained vegetation through community gardening areas. Community gardens provide a catalyst for community development while offering multiple benefits to the environment.

1. A fenced community garden will provide a minimum planting area equal to the mean size of all residential units.
2. The gardens must be a permanent fixture with storage areas provided for garden tools and products.
3. Post signs dictating rules and safety guidelines at garden entrance.
4. Provide a water source nearby for watering the garden. The water source should take into consideration best practices for water conservation. Rain barrels may be used, but not as the primary source of water.
5. The soil must be properly prepared for planting.
6. Gardens shall be surrounded on all sides with a minimum 4' high fence of weatherproof construction to discourage small children and animals from entering the garden. If pressurized wood is used for fencing or raised-beds, ensure the manufacturer verifies that it is safe to grow edible plants in soil surrounded by their wood product.
7. The effects of any contaminants discovered in the Phase I Environmental Assessment must be considered before choosing to build the garden.

### **Clarification**

If the development has 3 unit types (1 bed is 750 square feet, 2 bed is 900 square feet, and 3 bed is 1200 square feet), determine the mean of the floor plans to determine the required square footage of the garden plot.

$$\frac{750+900+1200}{3(\text{unique unit types})} = 950 \text{ square feet required}$$

**Confirmation**

- The project team must present documentation showing the location and size of the community garden in compliance with the criteria above. The garden must also incorporate all requirements listed above.
- The EarthCraft Technical Advisor will review documentation provided by the project team for compliance with criteria and visually confirm compliance with criteria at final inspections.

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**SP 2.9 Outdoor Community gathering space**

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**Criteria**

Provide outdoor gathering space large enough to accommodate at least 5 people, for the purpose of building community and improving social ties. Gathering space should have adequate seating, lighting, and shade provided by either nearby trees or structures such as a pavilion.

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance with criteria at install

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**SP 2.10 Install local endangered plant species on site to promote ecological productivity**

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**Criteria**

Install native endangered plant species on site to promote ecological productivity

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance with criteria at install

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**SP 2.11 Install plant species that serve as pollinators on site for regional wildlife**

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**Criteria**

Install native plant species that serve as pollinators for regional animal and plant communities certified by a wildlife biologist, horticulturist and landscape architect.

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance with criteria at install

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**SP 2.12 Parking reduced below local ordinance (1:1 ratio)**

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**Criteria**

Reduce the amount of parking below a 1:1 ratio and below local zoning ordinance requirements and/or provide no new parking on site.

**Confirmation**

- The project team present documentation showing the local parking ordinance and the number of parking spaces on site, clearly showing the criteria above is achieved.
- The EarthCraft Technical Advisor will review documentation provided by the project team for compliance with criteria and visually confirm compliance with criteria at final inspections

**Site Preparation and Preservation Measures****SP 3.0 Workshop on erosion and sediment control****Criteria**

Site supervisor must attend and pass examination for either the "Fundamentals of Erosion Control and Sedimentation" workshop or the "Structural and Vegetative Design for Erosion and Sediment Control" workshop, or equivalent offered by the local Soil and Water Conservation Commission.

Site supervisor must inform all subcontractors of the Erosion and Sedimentation Control Plan.

**Confirmation**

- The builder must present documentation demonstrating compliance of criteria to the EarthCraft Technical Advisor at the pre-drywall inspection.
- The EarthCraft Technical Advisor will review documentation provided by the builder for compliance of criteria.

**SP 3.1 Site assessment identifying all greenspace and tree-save potential****Criteria**

Develop a site assessment plan (site plan, aerial photo or sketch) that identifies all greenspace features such as wetlands, stream banks/riparian buffers, steep slopes (15% or greater) and existing trees of 3" caliper or greater. Analyze which areas can be saved via reorientation of building and staging of construction materials and activities.

**Confirmation**

- The project team must present documentation demonstrating compliance with criteria to the EarthCraft Technical Advisor at the pre-drywall inspection.
- The EarthCraft Technical Advisor will review documentation provided by the project team for compliance with criteria.

**SP 3.2 Erosion and sedimentation control plan****Criteria**

Create an Erosion and Sedimentation Control Plan consistent with state or local best management practices.

Include, at a minimum, the following measures:

- Perimeter fencing installed and maintained properly to control runoff and siltation.

- Storm sewer inlets protected with straw bales, compost socks, silt stacks or comparable measure.
- Erosion control blanket used on steep slopes. Steep slopes are defined as areas with a slope ≥15% change in elevation.
- Stabilize all disturbed areas with temporary seeding, straw or wood mulch or permanent vegetation immediately after rough grading is completed if a delay in finished grade is expected.
- Protected excavated topsoil areas. Excavated topsoil should have properly installed perimeter silt fencing or equivalent, and be protected from erosion by wind and rain using tarps, seeding, mulch, compost or other suitable measures.

The prepared plan must consist of a project map with the following elements:

- A location sketch of the project and nearby major roadways, streams and other identifiable landmarks within 200' of the project boundary.
- A location sketch of major, onsite topographic features, streams, existing soil types and vegetation located on the project site. Existing and proposed topographic contours greater than 2' should be shown on the sketch.
- Location and extent of temporary and permanent erosion and sediment control measures including both vegetative and structural practices.

Erosion control measures and plan should be maintained by the on-site contractor and adjusted as necessary throughout all construction phases.

#### **Confirmation**

- The builder must submit documentation demonstrating compliance of criteria to the EarthCraft Technical Advisor at the pre-drywall inspection.
- The EarthCraft Technical Advisor will review documentation provided by the builder for compliance of criteria.

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## **SP 3.3 Do not install invasive plants on site**

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#### **Criteria**

The builder must not install invasive plants on site as defined by the local agricultural extension office and/or landscape architect.

#### **Additional Resources**

For state-specific resources on invasive plants see  
<http://www.invasivespeciesinfo.gov/unitedstates/state.shtml>.

For resources specific to the Southeast see  
<http://www.invasive.org/eastern/eppc/index.html>.

#### **Confirmation**

- The EarthCraft Technical Advisor will verbally and visually confirm compliance of criteria with the builder at the pre-drywall and final inspections.

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## **SP 3.4 Comply with all federal, state and local government erosion control and protection measures**

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#### **Criteria**

Project must meet all federal, state and local government erosion control and protection measures.

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at pre-drywall and final inspections.

**SP 3.5 Phase I environmental testing and remediation plan****Criteria**

Comply with all federal guidelines regarding Phase I environmental site assessments. If the phase I shows the need for soil or building abatement the team must show compliance with clean-up requirements through the Phase II assessment (or greater).

**Confirmation**

- The project team will provide a copy of Phase I assessment results as requested by the EarthCraft Technical Advisor. If additional phase assessments are conducted these may also be requested.

**SP 3.6 On-call personnel designated for erosion control during rain events****Criteria**

The project team must designate on-call personnel for the purpose of maintenance/repair of erosion control measures during rainfall events. The on-call personnel must possess an active Certified Land Disturber (RLD) certification from the appropriate state soil and water conservation regulatory body.

**Confirmation**

- The project team will identify the point person and provide a copy of the 1A certification as requested by the EarthCraft Technical Advisor.

**SP 3.7 Downstream water quality testing (if applicable)****Criteria**

The project must comply with stormwater discharge limitations required by the Federal Clean Water Act. If applicable, the general contractor will submit an updated Nephelometric Turbidity Units (NTU) report to the EarthCraft Technical Advisor before, during, and after construction is complete.

**Clarifications**

An EC Technical Advisor may request turbidity tests at any time. If test records indicate levels exceeding what is locally allowable, project personnel and contractor are responsible for adjusting best management practices to meet established performance targets.

If turbidity tests exceed allowable levels for two consecutive storm events, the project will be required to host a mandatory meeting between site contractor, turbidity testing agency and project manager to determine necessary changes for compliance. Documentation of the meeting must be submitted to ECMF.

If turbidity tests exceed allowable levels for a third consecutive storm event, the project will be unable to certify as an ECMF.

For allowable limits based on site acreage and stream types please review the NTU limits from your appropriate state authority.

For the Commonwealth of Virginia please visit the Department of Conservation and Recreation. <http://www.dcr.virginia.gov/>

**Confirmation**

- The project team must present documentation demonstrating compliance with criteria to the EarthCraft Technical Advisor during the inspection phase.
- The EarthCraft Technical Advisor will review documentation provided by the project team for compliance with criteria.

**SP 3.8 Label all storm drain or storm inlets to discourage dumping of pollutants****Criteria**

Label each storm drain within the development to discourage tenants from dumping pollutants in storm drains.

**Confirmation**

- The EarthCraft Technical Advisor will visually verify for compliance during final inspections.

**SP 3.9 Road/vehicle cleaning protocols posted and enforced****Criteria**

Designate a tire and vehicle washing area during the construction phase of the project. Create protocols to enforce both vehicle and road cleaning processes.

**Clarifications**

The vehicle cleaning area will have a clean path to, and will be located within 100 feet of the construction entrance. The area should consist of a 32 ft. x 12 ft. gravel bed atop permeable ground, and should have adequate water access for washing purposes.

This area should be properly documented in the Erosion and Sedimentation plan, Site plan, and marked on site. Washing must be enforced.

The project team should create protocols for off-site road cleaning to remove sediment and debris carried from the construction site.

**Confirmation**

- The projects civil engineer or other professional will identify the location and requirements for the above criteria within the projects site plans.
- The EarthCraft Technical Advisor will visually confirm location of the wash out station during the EarthCraft Kick-Off meeting.

**SP 3.10 Tree preservation and protection measures employed on site****Criteria**

Use mature vegetation to create a sense of place, aid in mitigation of heat island effect and preserve natural landscape.

Preserve at least 25% of existing trees that have a chest-height (4 feet above the ground) diameter of 8 inches or more. The tree root zones of the selected trees must be protected with a physical barrier during all site clearing, grading and construction activities.

Create a Tree Preservation Plan that includes the following:

**Tree Survey**

- Consult with a certified arborist to assess the existing tree stock prior to establishing the building footprint.
- Determine which trees are in good health and have cultural, native, aesthetic and/or monetary significance.

### **Tree Protection**

- Clearly indicate tree-save areas and protection measures in construction documents.
- Tree(s) must be fenced around the drip line throughout the construction process with tall, bright, protective fencing.
- Avoid soil being placed on top of any root zone for trees that are designated for preservation. Ensure the protected tree species' needs for growth, sunlight and water integrate well with the new building design.

### **Resources**

North Carolina State University, Construction and Tree Protection [www.ces.ncsu.edu](http://www.ces.ncsu.edu)

#### **Confirmation**

- The project team will identify tree preservation potential and identify the trees to be saved within the projects site plans.
- The EarthCraft Technical Advisor will visually verify the tree protection measures are appropriately employed and provided for the identified trees. Confirmation will begin at the EarthCraft Kick-Off meeting and continue until project completion.

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### **SP 3.11 Leave site undisturbed and protect greenspace (min 25%) from future development**

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#### **Criteria**

The site will permanently protect a minimum of 25% of buildable land area as permanent greenspace.

#### **Clarifications**

Buildable land area will exclude any areas that are protected through federal, local, or state requirements. Areas already required to be protected such as floodplains or specific project boundaries can only count towards the tree save percentage if the project team can develop permeable pathways to utilize the area as a community amenity.

#### **Confirmation**

- The project team must present documentation clearly identifying the percentage of greenspace protection complying with the criteria above.
- The EarthCraft Technical Advisor will visually verify the greenspace protection measures. Confirmation will begin at the EarthCraft Kick-Off meeting and continue until project completion.

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### **SP 3.12 Mill cleared logs**

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#### **Criteria**

Commercially process 100% of logs that meet sawmill standards into lumber, pulp or other use.

#### **Clarifications**

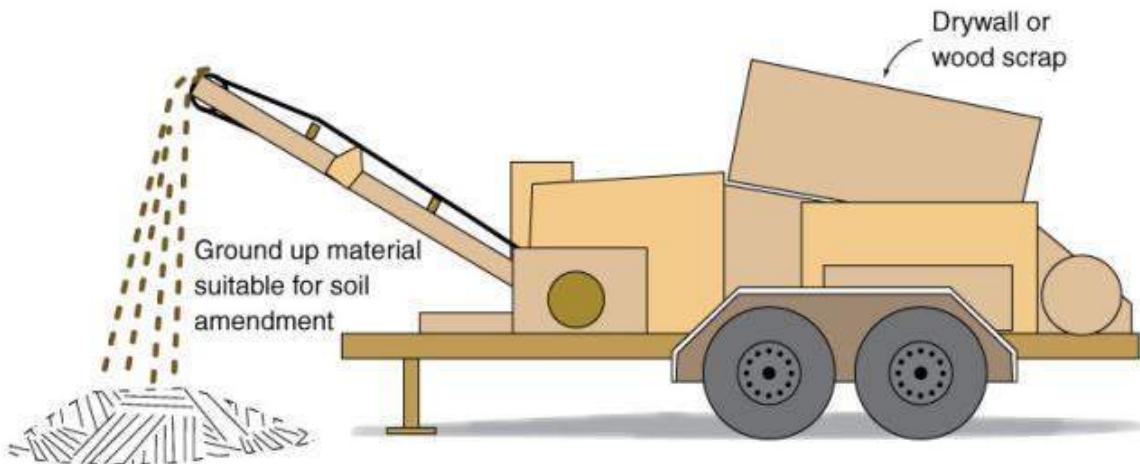
Logs cannot be buried in a landfill or chipped.

**Confirmation**

- The project team must present documentation demonstrating compliance with criteria to the EarthCraft Technical Advisor at the pre-drywall inspection.
- The EarthCraft Technical Advisor will review documentation provided by the project team for compliance with criteria.

**SP 3.13 Grind stumps and limbs for mulch****Criteria**

Grind 80% or greater of all tree stumps and limbs for mulch to be used on site or in a neighboring development. Mulched material cannot be buried in a landfill or burned.



**Figure 1: Waste grinder**

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance with criteria at the EarthCraft Kick-Off Meeting.

**SP 3.14 Tree planting (12 trees per acre; trees ≥2" diameter)****Criteria**

Plant a minimum of 12 trees per acre. All trees must be  $\geq 2"$  in diameter at breast height (DBH).

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance with criteria at final inspection.

## Alternative Transportation Accommodations

### SP 4.0 Bike Racks

#### Criteria

Provide bike racks for ≥10% of dwelling units.

#### Confirmation

- The project team will identify bike rack location and capacity on site plan.
- The EarthCraft Technical Advisor will confirm at final inspection.

### SP 4.1 Covered bike storage facility

#### Criteria

Provide Bike racks for ≥10% of dwelling units in a covered and secure location.

#### Confirmation

- The project team will identify bike rack location and capacity on site plan.
- The EarthCraft Technical Advisor will confirm at final inspection.

### SP 4.2 Tenant access to business center

#### Criteria

Provide community accessible meeting spaces for tenant use. Areas will have internet and phone capacity. Tenants will be allowed to sign up and use the meeting space in common areas for private business needs.

#### Confirmation

- The project team will include program in management guidelines and educate tenants upon move-in.
- The EarthCraft Technical Advisor will confirm at final inspection.

### SP 4.3 Covered bus stop

#### Criteria

This development will provide a covered bus stop that meets the intent of the regularly scheduled bus service.

#### Confirmation

- The project team will identify bus stop on site plan.
- The EarthCraft Technical Advisor will confirm at final inspection.

## Construction Waste Management

Each year, more than 130 million tons of debris from construction sites is sent to landfills in the United States, which accounts for one quarter of the non-industrial waste in the United States. However, the majority of construction debris is recyclable. By taking simple steps to recycle construction waste, a builder will reduce the amount of waste incinerated or placed in landfills, preventing pollution, and conserving and protecting our natural resources for future generations.

The Construction Waste Management category of EarthCraft House focuses on ways an EarthCraft Builder can reduce the amount of recyclable construction waste sent to landfills and reduce the need to extract virgin raw materials. The waste management

strategies include grinding and repurposing wood scraps and gypsum, crushing concrete to use as aggregate and recycling metals.

## **CW 1.0 No construction materials burned or buried on site**

### **Criteria**

No construction materials burned or buried on job site.

### **Confirmation**

- The EarthCraft Technical Advisor will verbally and visually confirm compliance of criteria with the builder at the pre-drywall and final inspections.

## **CW 1.1 Only state-approved landfills may be utilized**

### **Criteria**

Only state-approved landfills may be utilized for waste disposal.

### **Confirmation**

- The EarthCraft Technical Advisor will verbally confirm compliance of criteria with the builder at the pre-drywall and final inspections.

## **CW 1.2 Post waste management plan and divert ≥75% from landfill**

### **Criteria**

Post a construction waste management plan on site, educate each subcontractor on the aspects of the plan that pertains to their work and enforce these measures. Waste management plan must either provide for onsite separation of materials to be recycled or provide for separation of recyclable materials by clean-up or waste hauling firms. Maintain documentation on diversion rate for each material.

#### ***1. Wood***

Avoid disposal of 75% or greater (by weight or volume) of solid sawn wood by recycling through a state or county approved program or by on-site grinding and application of wood chips as mulch. Pressure treated wood is exempt from this requirement and may not be milled or applied as mulch.

#### ***2. Cardboard***

Avoid disposal of a minimum of 75% (by weight or volume) of cardboard generated from construction, including all material packaging.

#### ***3. Metal (including beverage containers)***

Avoid disposal of a minimum of 75% (by weight or volume) of metal generated from construction, including contractor beverage cans.

#### ***4. Drywall (recycle or grind and spread on site)***

Avoid disposal of a minimum of 75% (by weight or volume) of drywall generated from construction through an approved recycling program, or by onsite grinding and application of drywall as a soil amendment.

#### ***5. Plastics (including beverage containers)***

Avoid disposal of a minimum of 75% (by weight or volume) of plastic generated from construction, including contractor beverage containers.

#### ***6. Shingles***

Avoid disposal of a minimum of 75% (by weight or volume) of shingles generated from construction. Recycled shingle scraps offer a variety of uses including gravel substitutes for the wearing surface for rural roads, asphalt cement modifier and aggregate substitute and mineral filler for asphalt paving mixes.

### **Additional Resources**

For the NAHB Research Center's "Builder's Field Guide to Residential Construction Waste Management" publication see [www.nahbrc.org](http://www.nahbrc.org).

#### **Confirmation**

- The builder must present documentation demonstrating compliance of criteria to the EarthCraft Technical Advisor at the pre-drywall inspection.
- The EarthCraft Technical Advisor will review documentation provided by the builder for compliance of criteria and will visually confirm compliance of criteria at pre-drywall inspection.

## **Resource Efficiency**

Forests provide habitats to diverse animal species, offer watershed protection, prevent soil erosion and help maintain the water cycle. EarthCraft House encourages the protection of forests through resource efficient design. By taking the time to design a project to use less wood and by practicing simple measures to ensure that wood on site is used properly, a new construction project can reduce its impact to the environment as well as cost less money to build.

EarthCraft projects can meet the requirements of the Resource Efficiency category through methods such as designing buildings with 2' dimensions, employing advanced framing techniques and providing clear framing plans and cut lists to contractors. These methods not only reduce the amount of lumber used on site, but also save money through reduced material costs, reduced tipping fees and increased customer satisfaction including improving the project's energy efficiency.

Building materials come from a variety of sources, not all of which are environmentally friendly. The EarthCraft program strives to reduce the impact buildings have on the environment, including the impacts that result from the extraction and manufacture of materials used in construction. By choosing certain building materials, an EarthCraft project can conserve natural resources, prevent unnecessary waste and reduce pollution associated with manufacturing and transporting of materials.

## **Resource Efficient Design**

### **RE 1.0 Limit framing at all windows and doors**

#### **Criteria**

Limit framing at windows to a maximum of one pair of king studs and one pair of jack studs per window opening to support the header and window sill. Additional jack studs shall be used only as needed for structural support and cripple studs only as needed to maintain on-center spacing of studs.

#### **Clarifications**

The builder must present construction documents demonstrating structural requirements for excess framing, such as additional jack studs or excess cripple studs.

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at pre-drywall inspection.

**RE 1.1 Engineered roof framing ( $\geq 90\%$ )****Criteria**

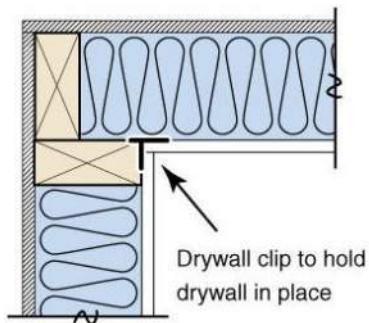
Construct 90% of roof framing using non-dimensional (engineered) structural wood, such as engineered trusses, pre-fabricated I-beams or non-wood material, such as steel. All engineered wood products must have no added urea-formaldehyde. If constructing a steel truss ceiling or steel joist ceiling, the entire exterior surface of the studs must be covered with a minimum of R-7.5 insulated sheathing.

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance with criteria at pre-drywall inspection.

**RE 1.2 Advanced Framing****Criteria*****1. 2-stud corners at all locations***

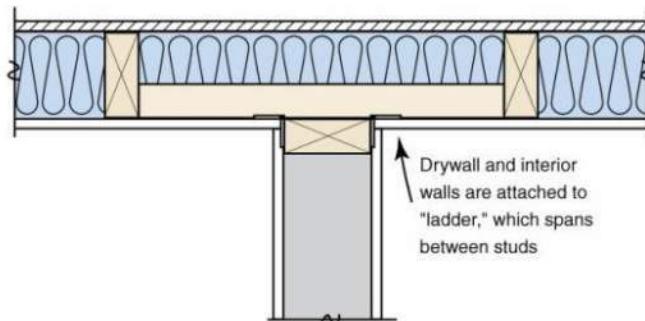
Use advanced framing techniques to frame the intersecting corner of two walls to reduce framing and provide continuous insulation (corners with more than two studs are not permitted).

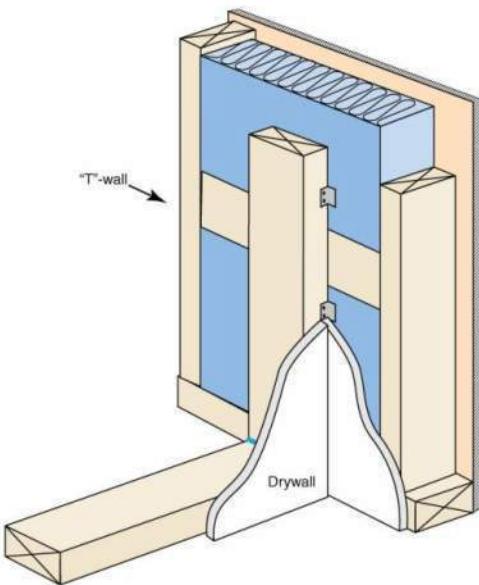


**Figure 2: 2-stud corner**

***2. Ladder T-walls at all locations***

Construct exterior/interior wall intersections to reduce framing members and provide continuous insulation.



**Figure 3: Ladder T-wall****Figure 4: Ladder T-wall****3. Size headers for loads (non-structural headers in non-load bearing walls)**

Design and install appropriately sized headers in all walls where structurally feasible. Eliminate load bearing headers in all non-load bearing walls and do not size all headers in load bearing walls to accommodate the greatest load case.

**Clarifications**

Consult local building codes in areas susceptible to high wind or seismic regions.

If installing a ladder T-wall, begin first ladder 2' above the subfloor to aid in the installation of drywall.

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at pre-drywall inspection.

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**RE 1.3 Average floor area of unit**

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**Criteria****A. < 800 sq ft**

The average conditioned floor area of all units is less than 800 sq ft.

**B. 800-1,100 sq ft**

The average conditioned floor area of all units is between 800 and 1,100 sq ft.

**Clarifications**

The average floor area must be derived from the areas specified by the conditioned floor areas in the unit schedule.

**Confirmation**

- The project team must present documentation demonstrating compliance with criteria to the EarthCraft Technical Advisor.

- The EarthCraft Technical Advisor will review documentation provided by the project team for compliance with criteria and will visually confirm compliance with criteria at pre-drywall and final inspections.

## RE 1.4 Floor joists are 24" on center ( $\geq 80\%$ )

### Criteria

Space at least 80% of all floor joists at 24" on center to minimize material waste.

### Confirmation

- The EarthCraft Technical Advisor will visually confirm at pre-drywall inspection.

## RE 1.5 Non-load bearing wall studs are 24" on center

### Criteria

Space all non-load bearing wall studs at 24" on center.

### Clarifications

The project team must present construction documents demonstrating structural requirements for excess framing greater than 5%.

### Example

Assuming 24" stud spacing, no more than one vertical stud (lacking a structural purpose) for every 30 linear feet of wall would be permitted.

### Confirmation

- The EarthCraft Technical Advisor will visually confirm compliance with criteria at pre-drywall inspection.

## Advanced Framing Products

## RE 2.0 Precast insulated foundation walls ( $\geq 90\%$ )

### Criteria

Construct a minimum of 90% of foundation walls using insulated precast concrete foundation walls. Foundation wall insulation must meet the prescriptive requirements for basement or mass walls as applicable in the 2009 IECC. Install walls according to manufacturer specifications.

### Confirmation

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at pre-drywall inspection.

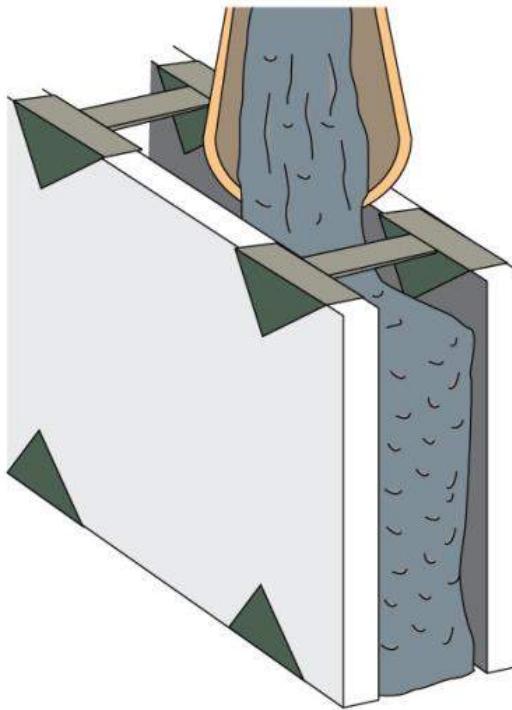
## RE 2.1 Insulated concrete forms or precast autoclaved aerated concrete ( $\geq 90\%$ )

### Criteria

#### 1. Foundation walls

Construct a minimum of 90% of foundation walls using either insulated concrete forms (ICF) or precast autoclaved aerated concrete (AAC). Install ICF walls according to manufacturer's specification, to a minimum of R-17 insulation, and meet state termite protection guidelines for ground contact insulation. Install AAC walls according to

manufacturer's specifications and meet the prescriptive requirements for basement or mass walls as applicable in the 2009 IECC.



**Figure 5: Insulated concrete form (ICF)**

## 2. Exterior Walls

Construct a minimum of 90% of exterior walls using either insulated concrete forms (ICF) or precast autoclaved aerated concrete (AAC). Install ICF walls according to manufacturer's specification, to a minimum of R-17 insulation, and meet state termite protection guidelines for ground contact insulation. Install AAC walls according to manufacturer's specifications and meet the prescriptive requirements for mass walls as applicable in the 2009 IECC.

### Confirmation

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at pre-drywall inspection.

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## RE 2.2 Engineered wall framing ( $\geq 90\%$ )

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### Criteria

Construct a minimum of 90% of total wall framing using non-solid sawn wood, such as laminated wood (e.g., laminated strand lumber) or finger-jointed studs.

### Clarifications

Steel studs are not eligible for meeting this criterion. All non-solid sawn wood products must have no added urea-formaldehyde.

### Confirmation

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at pre-drywall inspection.

## RE 2.3 Deliver panelized construction or SIPs to the site pre-framed (≥90%)

### Criteria

#### *1. Floors*

Construct a minimum of 90% of the floor area using a panelized floor system (e.g., structurally insulated panels) delivered to the jobsite pre-framed and precut. If installing structurally insulated panels (SIPs), a minimum of R-19 insulation must be used in Climate Zone 4, demonstrating code compliance for trade-offs where appropriate. In all cases, install panelized floor according to manufacturer specifications.

#### *2. Exterior walls*

Construct a minimum of 90% of all exterior walls using panelized wall systems (e.g., structurally insulated panels) delivered to the jobsite pre-framed and precut. If installing structurally insulated panels (SIPs), a minimum of R-13 insulation must be used. In all cases, install panelized walls according to manufacturer specifications.

#### *3. Roof*

Construct a minimum of 90% of the roof area using a panelized roof system (e.g., structurally insulated panels) delivered to the jobsite pre-framed and precut. If installing structurally insulated panels (SIPs), a minimum of R-19 insulation must be used in Climate Zone 4, demonstrating code compliance for trade-offs where appropriate. In all cases, install panelized roof according to manufacturer specifications.

#### *4. Modular construction*

Construct above grade sections off site and deliver in modules to the site.

### Clarifications

Thermal mass and infiltration effects may not be included in R-value.

Floor area must equal conditioned floor area used for the confirmed HERS energy model.

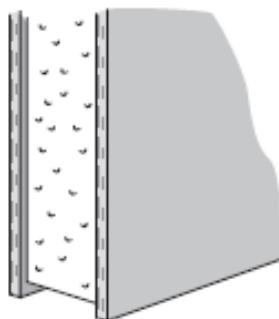


Figure 6: Structural insulated panel (SIP)

### Confirmation

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at pre-drywall inspection.

## RE 2.4 Structural headers are steel or engineered wood ( $\geq 90\%$ )

### Criteria

A minimum of 90% of the total headers must be manufactured from non-solid sawn wood, such as laminated wood (e.g., laminated veneer lumber (LVL), laminated strand lumber (LSL)), prefabricated insulated I-joist or steel beams. All non-solid sawn wood products must have no added urea-formaldehyde.

### Confirmation

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at pre-drywall inspection.

## Local, Recycled and/or Natural Content Materials

### RE 3.0 Use recycled concrete or alternate material as aggregate in foundation

### Criteria

At least 30% of coarse aggregate or 10% of fine aggregate in poured concrete structures must be from demolished concrete or alternative material (e.g., crushed porcelain).

### Confirmation

- The builder must present documentation demonstrating compliance of criteria to the EarthCraft Technical Advisor at the pre-drywall inspection.
- The EarthCraft Technical Advisor will review documentation provided by the builder for compliance of criteria.

### RE 3.1 Replace $\geq 25\%$ of cement in concrete with fly ash or slag

### Criteria

#### 1. Slab and/or foundation walls

Replace  $\geq 25\%$  of the cement with fly ash or slag in all concrete used for footings, foundation and basement walls and slabs.

#### 2. Exterior cladding and trim

Replace  $\geq 25\%$  of the cement with fly ash or slag in all concrete used for  $\geq 75\%$  exterior cladding and trim.

### Confirmation

- The builder must present documentation demonstrating compliance of criteria to the EarthCraft Technical Advisor at the pre-drywall inspection.
- The EarthCraft Technical Advisor will review documentation provided by the builder for compliance of criteria.

### RE 3.2 Sustainably harvested, FSC certified

### Criteria

#### 1. Lumber ( $\geq 50\%$ )

50% or greater of lumber used in project must be Forestry Stewardship Council (FSC) certified. FSC certified wood comes from forests that are managed to maintain ecological health and biodiversity.

**2. Lumber/millwork: FSC tropical wood (100%) or use no tropical wood**

All tropical wood, including lumber and millwork, in project must be Forestry Stewardship Council (FSC) certified. FSC certified wood comes from forests that are managed to maintain ecological health and biodiversity.

OR

Use no tropical wood in project, including all lumber and millwork.

**Confirmation**

- The builder must present documentation demonstrating compliance of criteria to the EarthCraft Technical Advisor at the pre-drywall inspection.
- The EarthCraft Technical Advisor will review documentation provided by the builder for compliance of criteria.

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**RE 3.3 Use building materials extracted, processed and manufactured  
≤500 miles from site**


---

**Criteria**

Use building materials that 90% by weight or volume have been extracted, processed and manufactured within 500 miles of the site.

Each product meeting the criteria earns 1 point; no more than five products may receive credit for these points.

**Confirmation**

- The project team must submit documentation demonstrating compliance with the criteria above. This can come in the form of product literature or official correspondence with a representative of the material manufacturer.
- The EarthCraft Technical Advisor will review documentation provided by the project team for compliance with criteria.

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**RE 3.4 Reused, recycled, MDF with no added urea-formaldehyde, local species or FSC certified wood**


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**Criteria****1. Cabinet faces**

Install cabinet faces either made from reclaimed wood, Medium Density Fiberboard (MDF) with no added urea-formaldehyde, FSC certified wood or other durable natural material from a local source ( $\leq 500$  miles from site) such as wood. Reused cabinet faces and cabinet faces made of  $\geq 25\%$  recycled content also qualify.

**2. Countertops**

Install countertops made from reclaimed wood, FSC certified wood or other durable natural material from a local source ( $\leq 500$  miles from site) such as stone. Reused countertops and countertops made of  $\geq 25\%$  recycled content also qualify.

**Clarifications**

Install only structural plywood and OSB certified compliant with PS1 or PS2 and made with moisture-resistant adhesives as indicated by "Exposure 1" or "Exterior" on the American Plywood Association (APA) trademark.

Install only hardwood plywood certified compliant with the formaldehyde emissions requirements of ANSI/HPVA HP-1-2004 and U.S. HUD Title 24, Part 3280, or certified compliant with CA Title 17.

Install only particleboard and MDF certified compliant with the formaldehyde emissions requirements of ANSI A208.1 and A208.2, respectively, and U.S. HUD Title 24, Part 3280, or certified compliant with EPPS CPA 3-08 by the CPA Grademark certification program, or certified compliant with CA Title 17.

Install only cabinetry made with component materials certified with the above requirements or registered brands or produced in registered plants certified under KCMA's Environmental Stewardship Certification Program (ESP 01-06).

#### **Confirmation**

- The builder must present documentation demonstrating compliance of criteria to the EarthCraft Technical Advisor at the final inspection.
- The EarthCraft Technical Advisor will review documentation provided by the builder for compliance of criteria.

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### **RE 3.5 Exterior cladding and trim ( $\geq 25\%$ recycled content material on $\geq 75\%$ area)**

---

#### **Criteria**

Install  $\geq 75\%$  of exterior cladding and trim with  $\geq 25\%$  recycled content material (pre or post-consumer, excluding fly ash) content by weight or volume. Recycled content must be certified by Scientific Certification Systems (SCS).

#### **Clarifications**

Recycled fly ash may not be counted under this criterion, but rather under RE 3.2.

#### **Additional Resources**

For more information about SCS-certified insulation see [www.scscertified.com](http://www.scscertified.com).

#### **Confirmation**

- The builder must present documentation demonstrating compliance of criteria to the EarthCraft Technical Advisor at the pre-drywall inspection.
- The EarthCraft Technical Advisor will review documentation provided by the builder for compliance of criteria.

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### **RE 3.6 Insulation ( $\geq 25\%$ recycled content material)**

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#### **Criteria**

Install 100% of insulation with  $\geq 25\%$  recycled material (pre or post-consumer) content by weight or volume in all walls, floors and ceilings.

#### **Additional Resources**

For more information about SCS-certified insulation see [www.scscertified.com](http://www.scscertified.com)

#### **Confirmation**

- The builder must present documentation demonstrating compliance of criteria to the EarthCraft Technical Advisor at the pre-drywall inspection.
- The EarthCraft Technical Advisor will review documentation provided by the builder for compliance of criteria.

## RE 3.7 Flooring

### Criteria

**1. Cork, natural linoleum, sealed concrete or bamboo flooring ( $\geq 20\%$  of total floor area)**

Install cork, natural linoleum, sealed concrete or bamboo flooring on  $\geq 20\%$  of total floor area. Bamboo flooring must be sustainably harvested.

**2. Recycled content tiles ( $\geq 30\%$  recycled content material on 100% of tile floor area)**

Install tile with  $\geq 30\%$  recycled content on 100% of tile floor area. Recycled content must be Scientific Certification Systems (SCS) certified.

**3. Carpet ( $\geq 50\%$  recycled content material on  $\geq 50\%$  of all carpeted floor area)**

Install carpet with  $\geq 50\%$  recycled content (pre or post-consumer) on 100% of carpet floor area. Recycled content must be Scientific Certification Systems (SCS) certified.

**4. Biodegradable carpet and backing ( $\geq 50\%$  of all carpeted floor area)**

Install carpet and backing that is constructed of organic materials (e.g., wool, hemp, etc.) that is readily biodegrade when exposed to moisture and sunlight on 50% of all carpeted floor area.

### Clarifications

Floor area must equal conditioned floor area used for the confirmed HERS energy model.

### Additional Resources

For more information about SCS-certified products see [www.scscertified.com](http://www.scscertified.com).

### Confirmation

- The builder must present documentation demonstrating compliance of criteria to the EarthCraft Technical Advisor at the final inspection.
- The EarthCraft Technical Advisor will review documentation provided by the builder for compliance of criteria and will visually confirm compliance of criteria at final inspection.

## RE 3.8 Engineered trim

### Criteria

**1. Interior ( $\geq 80\%$ )**

Construct a minimum of 80% of interior trim from non-solid sawn wood (e.g., finger-jointed wood, medium or high-density fiber board (MDF or HDF), etc.) or non-wood material, such as PVC. All non-solid sawn wood products must have no added urea-formaldehyde.

**2. Exterior, including soffit, fascia and trim ( $\geq 75\%$ )**

Construct a minimum of 75% of exterior trim (e.g., soffit, fascia and trim) from non-solid sawn wood (e.g., finger-jointed wood, cementitious fiberboard (MDF or HDF), etc.) or non-wood material, such as PVC. All non-solid sawn wood products must have no added urea-formaldehyde.

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at final inspection.

**RE 3.9 Roofing material ( $\geq 50\%$  recycled content material on  $\geq 90\%$  area)****Criteria**

Install roofing shingles, tile or other equivalent  $\geq 50\%$  recycled content materials on  $\geq 90\%$  of entire roof area.

**Confirmation**

- The builder must present documentation demonstrating compliance of criteria to the EarthCraft Technical Advisor at the pre-drywall inspection.
- The EarthCraft Technical Advisor will review documentation provided by the builder for compliance of criteria.

**Building Reuse****RE 4.0 Gut Rehab or Adaptive Reuse****Criteria**

The project will qualify as gut rehabilitation if a substantial renovation occurs and includes exposure of the wall cavities (through removing interior walls or exterior cladding) to allow for confirmation of air sealing and insulation requirements.

The project will qualify as an adaptive reuse project if the building shell is repurposed from a non-residential use to a residential dwelling structure.

For any adaptive reuse project, the project design must follow the adaptive reuse priority list found in the EarthCraft Multifamily worksheet.

**Confirmation**

- The EarthCraft Technical Advisor and EarthCraft Project Manager can help clarify whether a building will qualify as Gut Rehab or Adaptive Reuse.

**Durability and Moisture Management**

An important aspect of building sustainably is ensuring durability throughout a project's life cycle. The EarthCraft Multifamily program recognizes that proper design and installation are integral to building a durable building with minimal moisture management issues. Reducing the life cycle costs due to maintenance, repair and replacement decreases the impact that construction, and reconstruction, has on the environment. The durability and moisture management section includes items that improve long-term durability, occupant health and comfort.

**Products and Applications****DU 1.0 All roof valleys direct water away from walls, dormers, chimneys, etc.****Criteria**

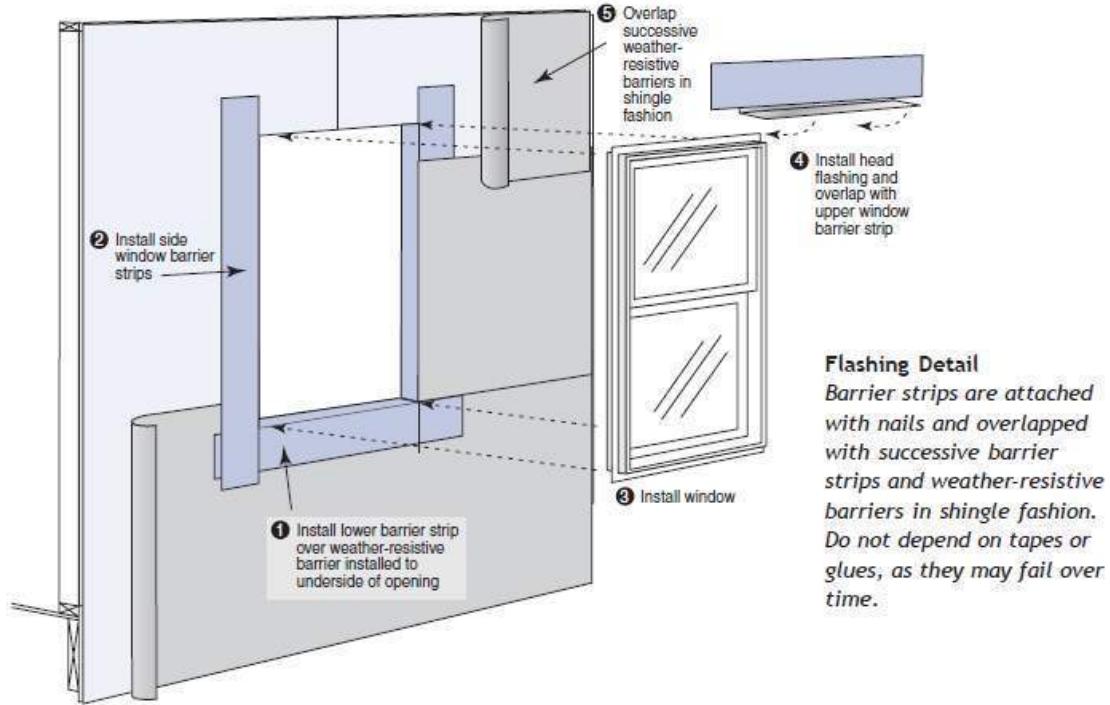
Roof must be designed and built so that all roof valleys direct water flow away from walls, dormers, chimneys or vertical surfaces of any kind.

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at pre-drywall inspection.

**DU 1.1 Install drainage plane per manufacturer's specifications****Criteria**

A drainage plane must be installed and sealed as instructed by the manufacturer on the entire building assembly exposed to the exterior.



**Figure 7: Example of manufacturer's specifications for drainage plane installation**

**Confirmation**

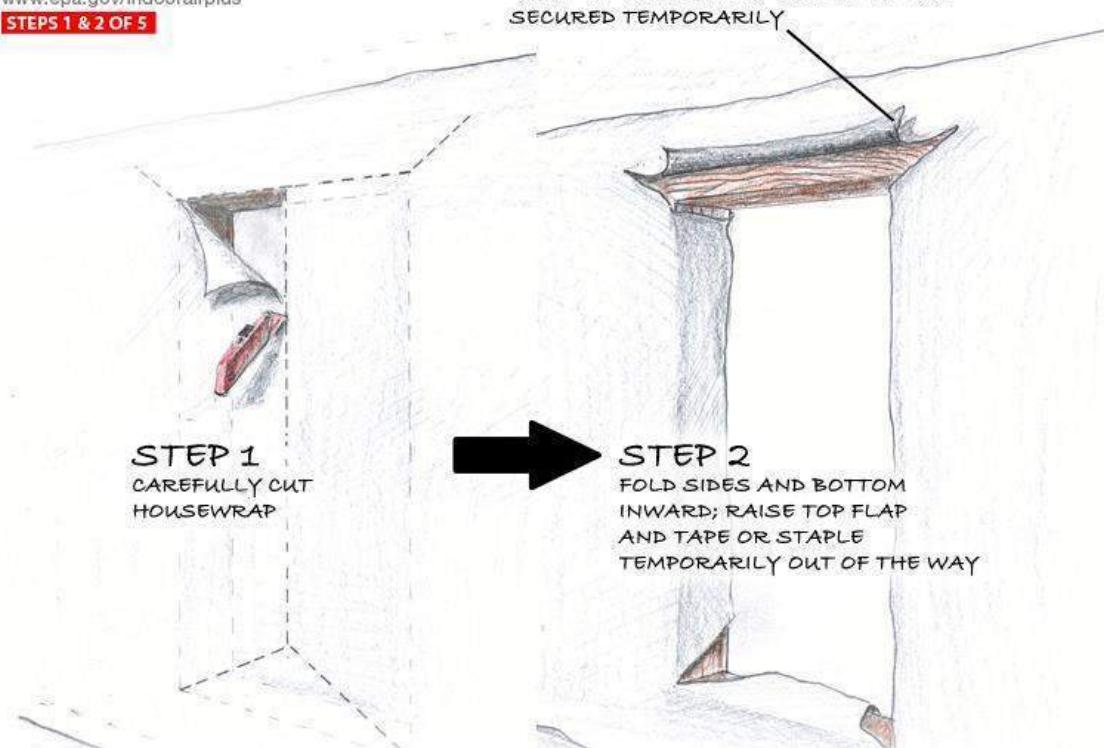
- The builder will illustrate compliance of criteria through photo documentation submitted to the EarthCraft Technical Advisor at pre-drywall.
- The EarthCraft Technical Advisor will review photo documentation provided by the builder for compliance of criteria.

**DU 1.2 Integrate drainage plane****Criteria****1. Window and door pan flashing at sills and side flashing**

Install water resistant flashing at the base and sides of all window and exterior door rough openings to direct water leaks out of the wall assembly. Side flashing must extend over sill flashing. All flashing must be integrated with drainage plane.

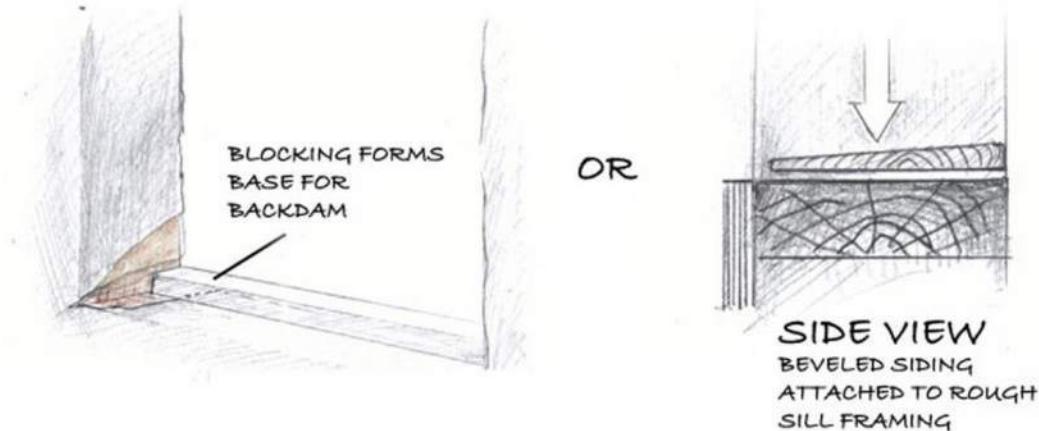
**2. Window and door head/top flashing**

Install water resistant flashing at the head of all windows and exterior doors. Flashing must extend a minimum of 6" above the top of the window or door, or per manufacturer's specifications. This head/top flashing must extend over side flashing and be integrated with drainage plane.



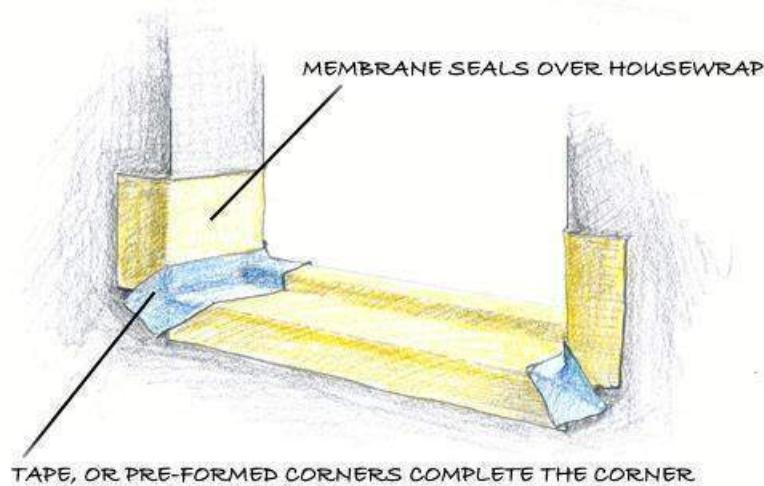
**Figure 8: Steps 1&2: Preparing house wrap or builder paper**  
 (Graphic courtesy of US EPA Indoor airPLUS)

CREATE BACK-DAM OR SLOPE TO DIRECT ANY WATER THAT DRAINS  
 TO THE SILL AREA OUTWARD AND ONTO THE DRAINAGE PLANE  
 (HOUSEWRAP)

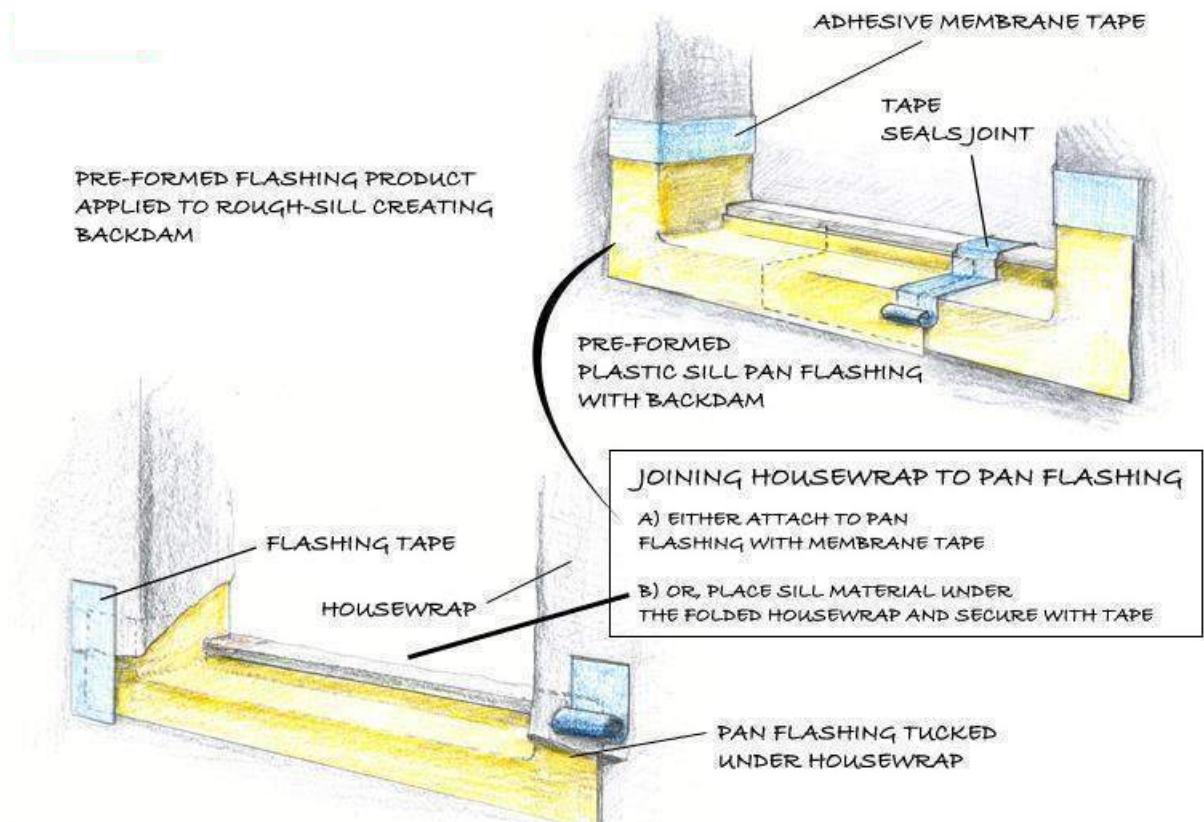


**Figure 9: Step 3: Create back dam or slope away from interior**  
 (Graphic courtesy of US EPA Indoor airPLUS)

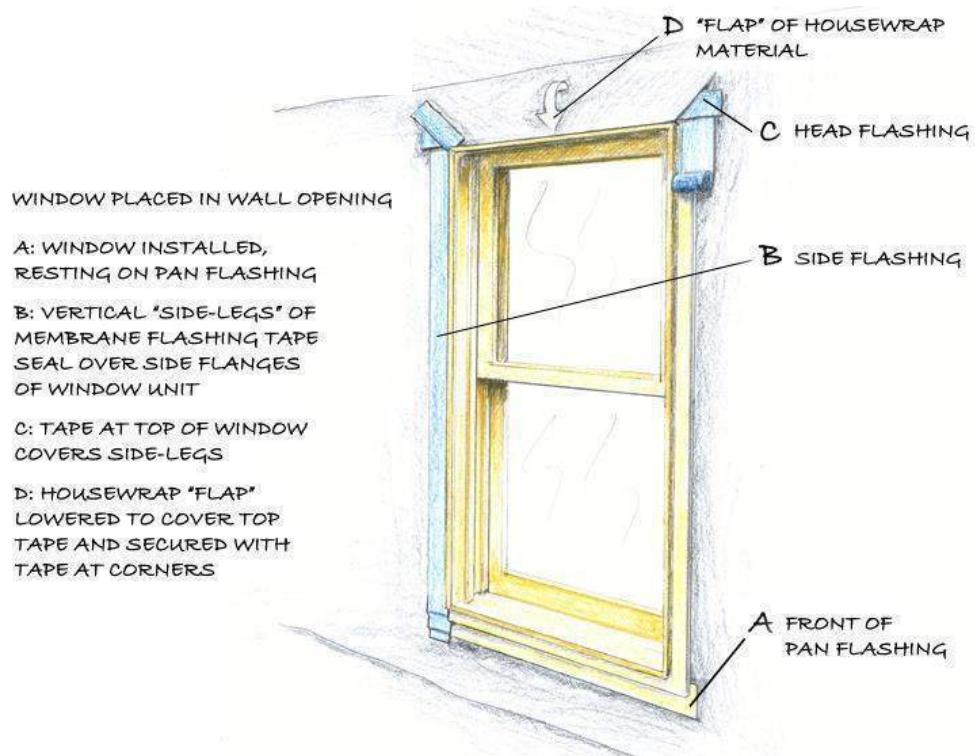
SELF-ADHESIVE MEMBRANE APPLIED TO SILL AREA, CREATING "PAN FLASHING"  
WHICH LAPs OVER AND ADHERES TO DRAINAGE PLANE



**Figure 10: Step 4: Pan flashing - Option 1**  
(Graphic courtesy of US EPA Indoor airPLUS)



**Figure 11: Step 4: Install plan flashing - Option 2**  
(Graphic courtesy of US EPA Indoor airPLUS)



**Figure 12: Step 5: Finishing window installation**  
(Graphic courtesy of US EPA Indoor airPLUS)

### Clarifications

Provide lapping as needed over lintels above window headers for brick cladding, or additional bond-break drainage plane layer provided behind all stucco and non-structural masonry cladding wall assemblies. Include weep holes for masonry veneer and weep screed for stucco cladding systems, according to the manufacturer's specifications.

### Exemptions

Sheathing products with integrated drainage planes, such as OSB with built-in protective overlays and extruded polystyrene foam boards, are not required to have an additional drainage plane installed provided the product is installed per manufacturer's specifications.

### Confirmation

- The builder will illustrate compliance of criteria through photo documentation submitted to the EarthCraft Technical Advisor at pre-drywall.
- The EarthCraft Technical Advisor will review photo documentation provided by the builder for compliance of criteria.

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## DU 1.3 Double layer of either building paper or housewrap behind cementitious stucco, stone veneer or synthetic stone veneer on framed walls

---

### Criteria

Install a double layer of either building paper or house-wrap behind stucco, stone veneer or synthetic stone veneer on framed walls in order to provide a drainage plane behind materials that absorb and retain moisture.

### Clarifications

All unvented, exterior cladding in contact with the substrate must meet the criteria.

A single layer of building paper coupled with a single layer of housewrap meets the intent of the criteria.

For stucco cladding systems, include weep screed per manufacturer's specifications.

**Confirmation**

- The builder will illustrate compliance of criteria through photo documentation submitted to the EarthCraft Technical Advisor at pre-drywall.
- The EarthCraft Technical Advisor will review photo documentation provided by the builder for compliance of criteria.

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**DU 1.4 Roof gutters discharge water ≥5' from foundation**

---

**Criteria**

All rain from the roof must be collected in a roof gutter system and directed via downspouts such that water is discharged on a sloping finished grade  $\geq 5'$  away from the foundation.

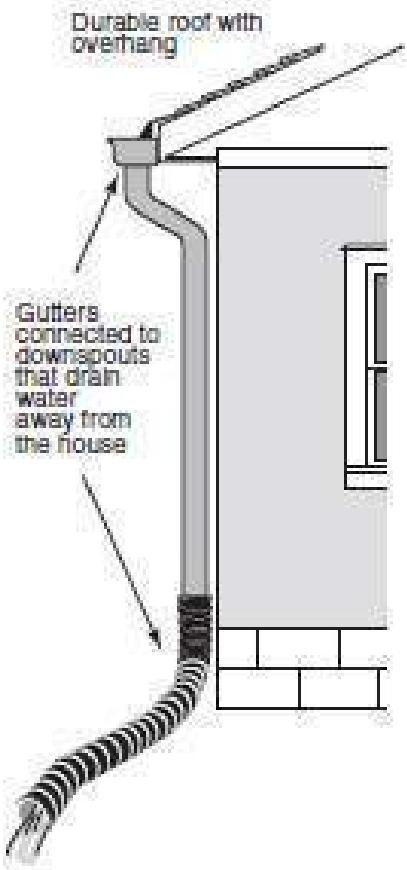
**Clarifications**

When grading is not possible, water must be directed to an underground catchment system (not connected to the foundation drain system) that deposits water a minimum of 10' from the foundation.

Roofs without gutters may be acceptable if rainwater is appropriately deposited to a grade-level rock bed with waterproof liner and drain pipe that discharges water according to the requirements above.

Rainwater-harvesting systems may be used to meet this requirement if they are able to drain overflow to meet requirements above.

For multifamily projects, non-permanent extensions do not qualify.



**Figure 13: Roof gutters connected to downspout for proper drainage**

#### Confirmation

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at final inspection.

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## DU 1.5 Flashing

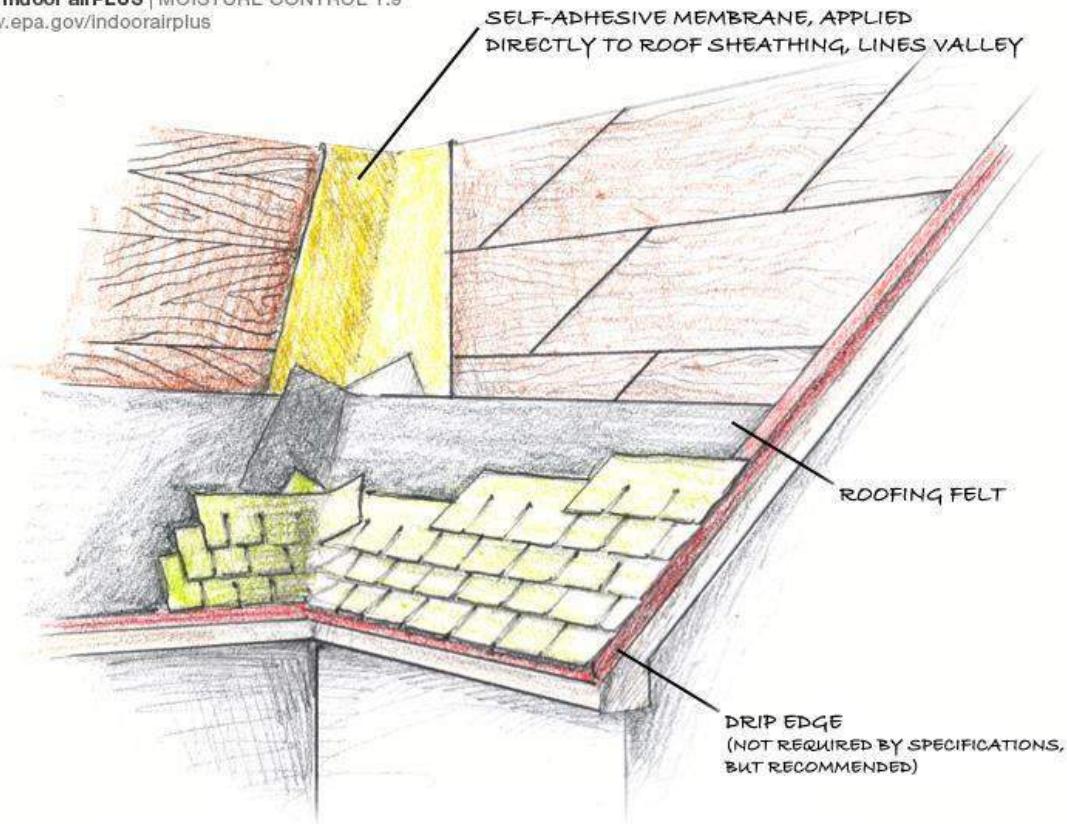
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#### Criteria

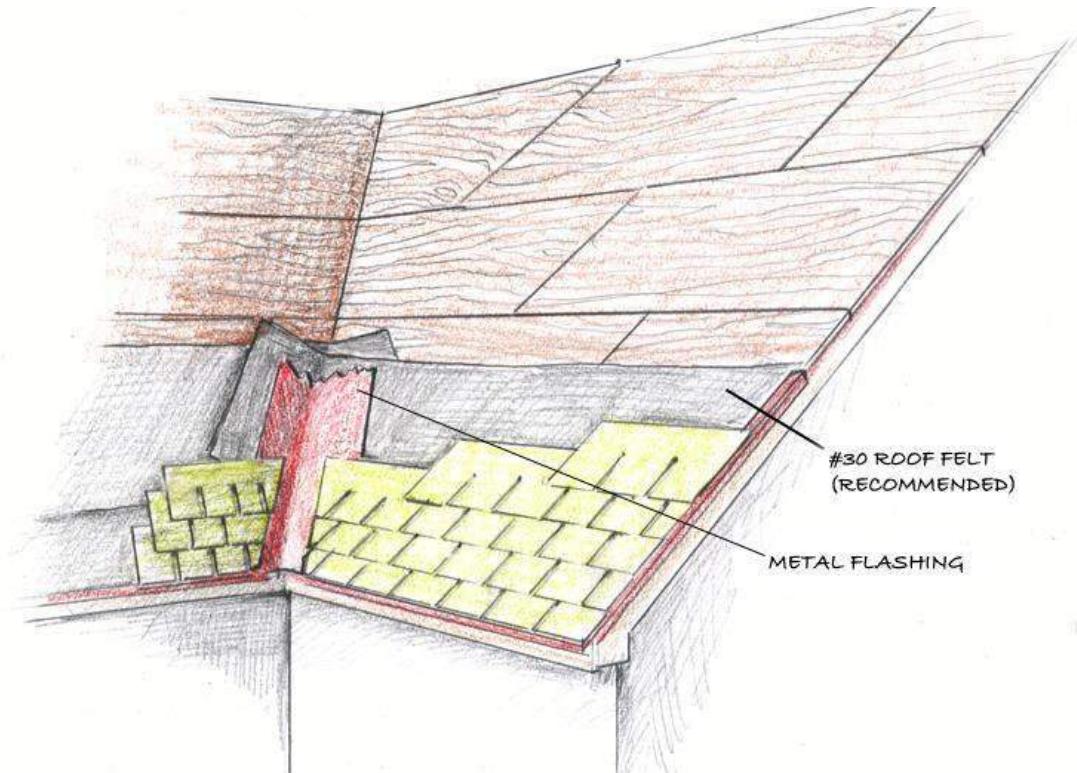
1. ***Self-sealing bituminous membrane or equivalent at valleys and roof deck penetrations***

Install a self-sealing bituminous membrane or equivalent at all valleys and roof decking penetrations for added durability.

Install flashing on all roof penetrations and integrate with roof drainage plan.



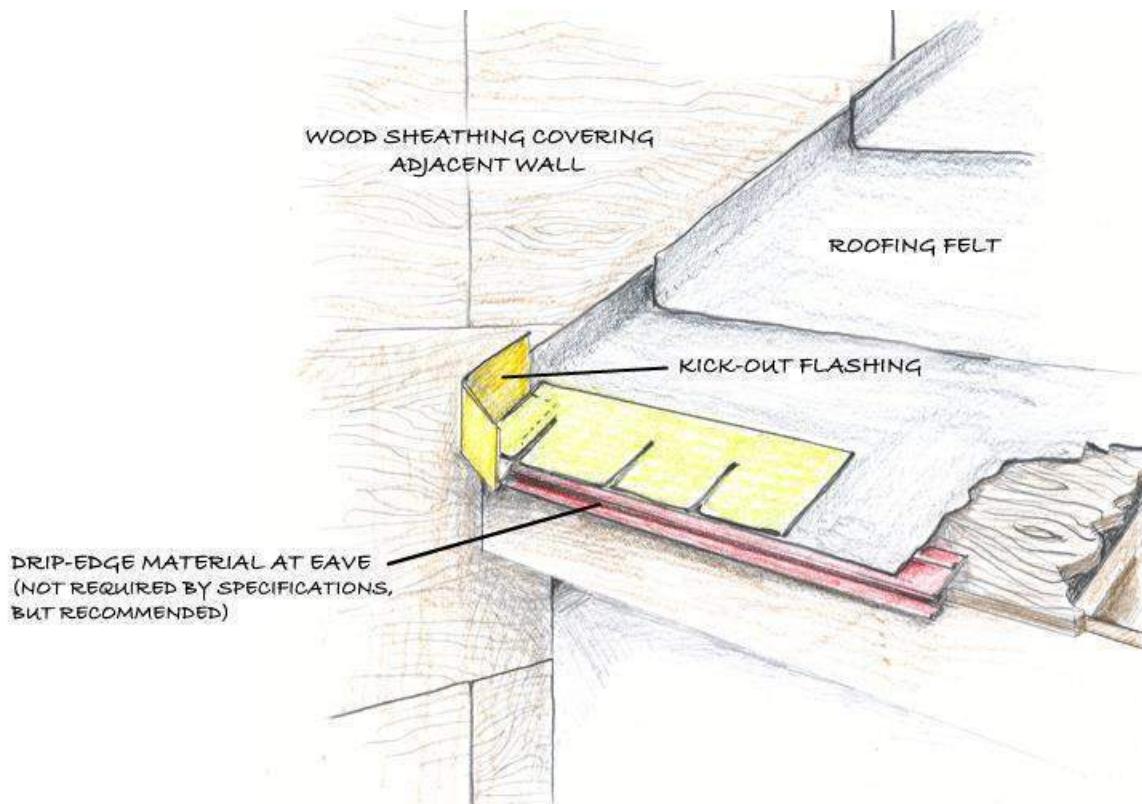
**Figure 2: Membrane protection of roof valley**  
 (Graphic courtesy of US EPA Indoor airPLUS)



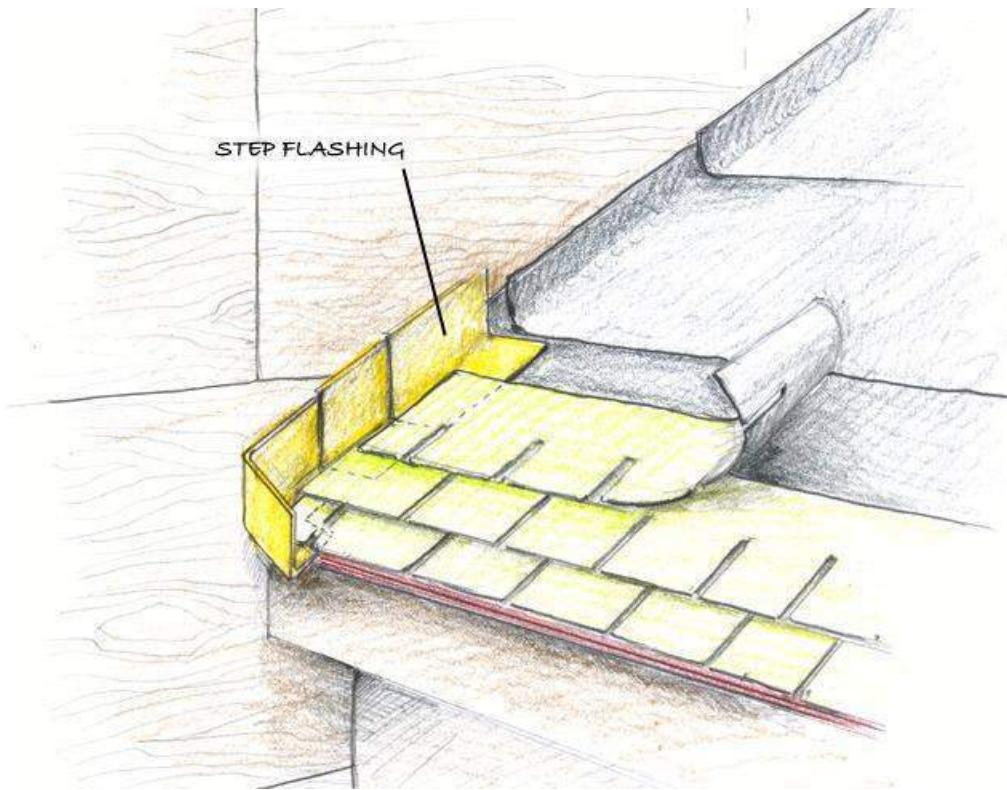
**Figure 15: Metal coil stock flashing formed to valley**  
 (Graphic courtesy of US EPA Indoor airPLUS)

**2. Step and kick-out flashing at wall/roof and wall/porch intersections, flashing ≥4" on wall surface and integrated with wall and roof/deck/porch drainage planes**

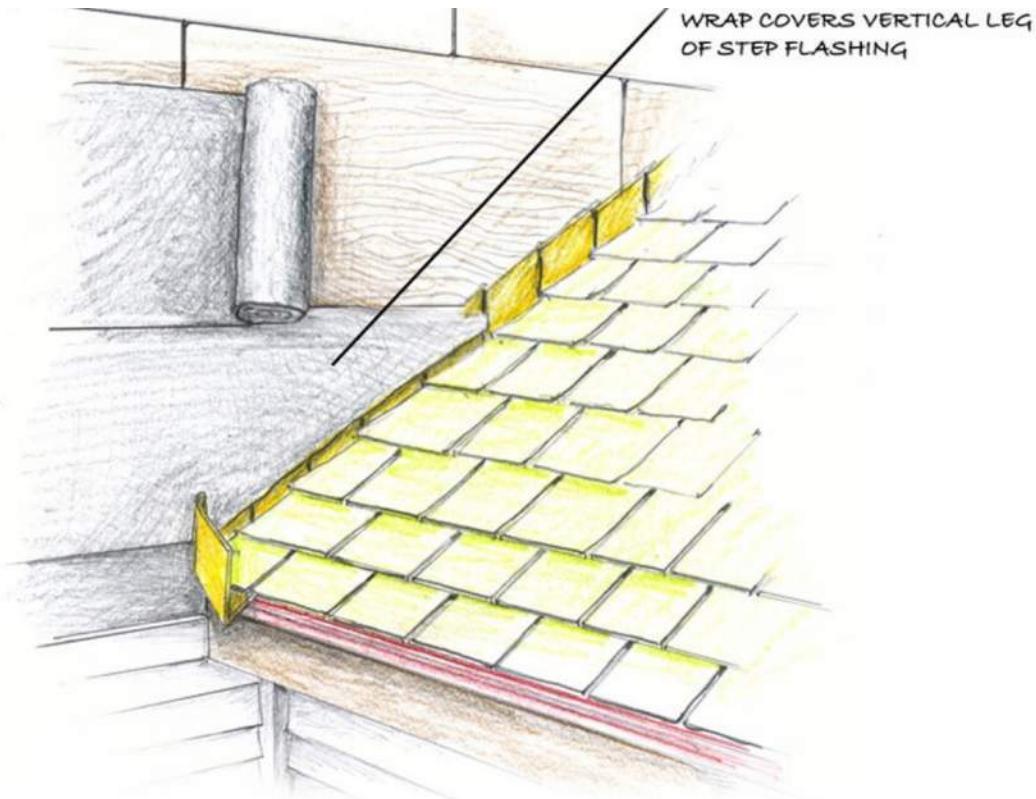
Install step and kick-out flashing at all wall/roof and wall/porch intersections. Extend flashing  $\geq 4"$  on the wall surface above the roof deck and integrate flashing with wall and roof drainage plans.



**Figure 16: Step 1: Kick-out flashing beginning run of step flashing**  
**(Graphic courtesy of US EPA Indoor airPLUS)**



**Figure 17: Step 2: Successive sections of step flashing integrated with courses of shingles**  
**(Graphic courtesy of US EPA Indoor airPLUS)**



**Figure 18: Step 3: Drainage plane material covers step flashing**  
**(Graphic courtesy of US EPA Indoor airPLUS)**

**Clarifications**

For metal and rubber membrane roofs, install continuous flashing in place of step flashing.

For porches, install L-shaped flashing to the top of the ledger board and integrate with drainage plane (vertical leg of the flashing must extend along the wall above the ledger and the horizontal leg extends over the top of the ledger).

**Confirmation**

- The builder will illustrate compliance of criteria through photo documentation submitted to the EarthCraft Technical Advisor at pre-drywall.
- The EarthCraft Technical Advisor will review photo documentation provided by the builder for compliance of criteria.

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**DU 1.6 Continuous foundation termite flashing (required if slab edge is insulated)**

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**Criteria**

Install a continuous termite shield that covers 100% of the foundation stem wall, piers and other potential entry points. The termite shield can be fabricated from metal or similar material that forms a physical barrier to termites. All seams and penetrations in the termite shield must be effectively sealed to prevent termite entry.

**Confirmation**

- The project team will illustrate compliance through photo documentation submitted to the EarthCraft Technical Advisor at pre-drywall.
- Project team must provide section details prior to the construction
- The EarthCraft Technical Advisor will review photo documentation provided by the project team at pre-drywall.

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**DU 1.7 Maintain 2" clearance between wall siding and roof surface**

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**Criteria**

Terminate wall siding a minimum of a 2" above roof surface unless otherwise directed by product manufacturer installation specifications.

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at pre-drywall inspection.

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**DU 1.8 Install air conditioner condensing unit pad**

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**Criteria**

Install condenser unit pad for all outdoor air-conditioner and heat pump condensing units.

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at final inspection.

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## DU 1.9 Roof drip edge with $\geq 1/4"$ overhang

---

**Criteria**

Protect the outer edge of all roof decking with a metal or plastic drip edge that has a minimum  $1/4"$  overhang beyond the exterior roofing material.

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance with criteria at pre-drywall inspection.

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## DU 1.10 Drain pan for water heaters and washing machines

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**Criteria**

Install an appropriately sized drain pan underneath all hot water heaters and washing machines.

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance with criteria at final inspection.

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## DU 1.11 If installed, crawlspace must be closed

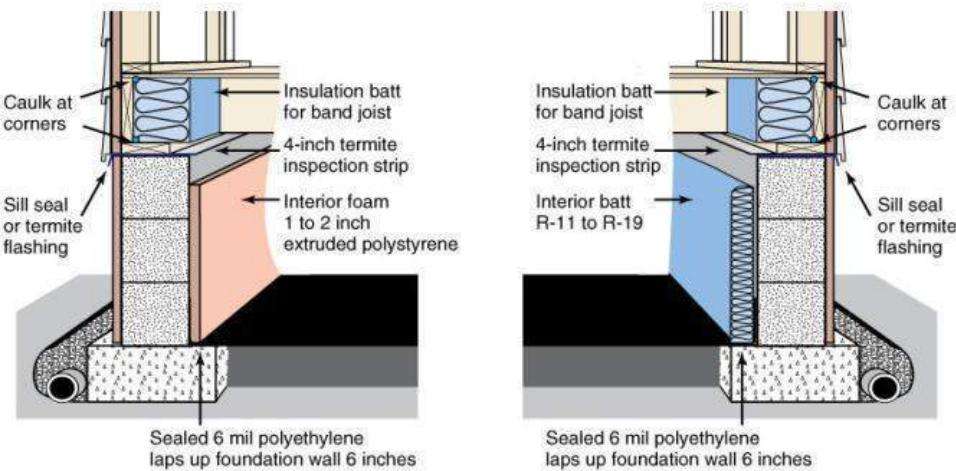
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**Criteria**

If installed, crawlspace must be closed. No vents are allowed. Crawlspace must be conditioned.

Additional strategies required to meet this credit intent include but are not limited to:

- DU 2.1 100% coverage of  $\geq 6$  mil vapor barrier in crawlspace or beneath slab
- DU 2.6 Capillary break
- IAQ 1.1 Sealed-combustion furnace or isolate furnace from conditioned space
- IAQ 1.2 Sealed-combustion, power vent or electric water heater, or isolate water heater from conditioned space
- BE 1.5 Seal penetrations through
- BE 1.9 Install weather stripping at all exterior doors
- BE 3.16 Seal and insulate crawlspace walls



**Figure 19: Enclosed crawlspace with insulation along walls**

### Clarifications

Projects built on 100-year flood plains are not eligible to earn this credit.

Drainage, pests and combustion safety issues are important considerations when sealing a crawlspace.

### Example

Conditioning may involve one of the following methods:

- Continuously operated mechanical exhaust ventilation at a rate of 1 cfm for each 50 sq ft of crawlspace floor area including a make-up air pathway to the main living area such as a transfer grill.
- Conditioned air supply (e.g. via supply duct) sized to deliver a rate of 1 cfm for each 50 sq ft of crawlspace area.
- DU 2.17-B Additional dehumidification system: Basement or sealed crawlspace system.

### Additional Resources

For more information about sealed crawlspaces, visit [www.crawlspaces.org](http://www.crawlspaces.org).

#### Confirmation

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at pre-drywall and final inspections.

## DU 1.12 Moisture-resistant wallboard in bathrooms

#### Criteria

Install cement board, fiberglass enhanced sheathing or equivalent moisture-resistant backing material on walls behind bathroom sinks, and tubs and showers with tile or panel assemblies with caulked joints. Install moisture-resistant backing material in accordance with manufacturer specifications.

Moisture-resistant gypsum board must be installed on exposed walls and ceilings above tubs and showers where the wall is not covered by tile or a panel assembly.

Moisture-resistant gypsum board must be installed on exposed walls behind bathroom sinks and kitchen sinks when the wall is not covered by tile or other water-resistant splash back assemblies.

**Clarifications**

Do not use paper-faced backer-board or gypsum-based backer-board (i.e., green board) behind the sink, tub, and shower assemblies.

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance with criteria at pre-drywall inspection.

**DU 1.13 Alternative termite treatment with no soil pretreatment****Criteria**

Install an alternative termite treatment system with no soil pretreatment.

Provide information on type of system, maintenance, and monitoring requirements in project-specific owner's manual.

**Confirmation**

- The project team will illustrate compliance with criteria through photo documentation submitted to the EarthCraft Technical Advisor at pre-drywall.
- The EarthCraft Technical Advisor will review photo documentation provided by the project team for compliance with criteria.

**DU 1.14 Non-toxic pest treatment****Criteria*****1. All lumber in contact with foundation ( $\geq 36"$  above foundation)***

Pre-treat all lumber in contact with the foundation with a non-toxic pest treatment such as borate. Lumber must be treated to a minimum height of 3' above the foundation.

***2. All lumber***

Pre-treat all lumber with a non-toxic pest treatment such as borate.

***3. Mold inhibitor with warranty applied to lumber***

Apply a non-toxic mold inhibitor with warranty to all lumber.

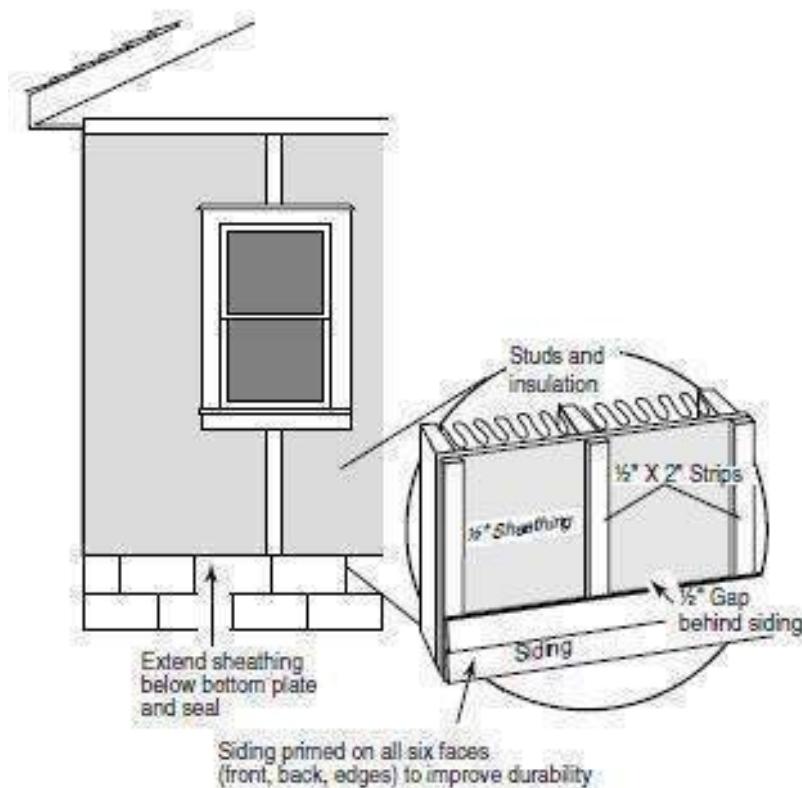
**Confirmation**

- The project team must present documentation demonstrating compliance with criteria to the EarthCraft Technical Advisor at the pre-drywall inspection.
- The EarthCraft Technical Advisor will review documentation provided by the project team for compliance with criteria.

**DU 1.15 Vented rain screen behind exterior cladding****Criteria**

All exterior wall area must have a weather resistive barrier such as building paper, house-wrap or similar material designed to protect the wall from water moving past the exterior cladding, and have an air space of at least 3/8" between the exterior cladding and weather resistive barrier.

The system must be integrated with flashing and be designed and installed to minimize moisture migration between the exterior cladding and the wall sheathing.



**Figure 20: Site-built vented rain screen**

### Clarifications

If installing masonry veneer, install full-head weep holes with a minimum 24" on center spacing.

#### Confirmation

- The builder will illustrate compliance of criteria through photo documentation submitted to the EarthCraft Technical Advisor at pre-drywall.
- The EarthCraft Technical Advisor will review photo documentation provided by the builder for compliance of criteria.

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## DU 1.16 Install termite mesh system

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#### Criteria

Install a termite mesh system that conforms to ASTM A 478 and ASTM A 580/A 580M, Type A1AA marine grade 316 stainless steel mesh of 0.18 mm (0.007") diameter wire with mesh openings of 0.66 x 0.45 mm. (0.026" x 0.018"). Follow manufacturer's installation specifications for proper termite prevention.

#### Confirmation

- The project team must present documentation demonstrating compliance with criteria to the EarthCraft Technical Advisor at the pre-drywall inspection.
- The EarthCraft Technical Advisor will review documentation provided by the project team for compliance with criteria and will visually confirm at pre-drywall inspection.

## DU 1.17 Exterior cladding ( $\geq 75\%$ facade) with 30-year warranty

### Criteria

#### 1. Exterior cladding ( $\geq 75\%$ facade) with 30-year warranty

Install exterior wall cladding with a 30-year manufacturer's warranty or constructed from durable natural material, such as masonry, stucco, stone or brick on a minimum of three sides of the building.

#### Confirmation

##### *Exterior cladding with 30-year warranty*

- The project team must present documentation demonstrating compliance with criteria to the EarthCraft Technical Advisor at the pre-drywall inspection.
- The EarthCraft Technical Advisor will review documentation provided by the project team for compliance with criteria and will visually confirm at pre-drywall inspection.

## DU 1.18 Windows, doors and skylights with $\geq 25$ -year warranty

### Criteria

All installed exterior windows, doors and skylight assemblies must have  $\geq 25$ -year manufacturer's warranty.

#### Confirmation

- The project team must present documentation demonstrating compliance with criteria to the EarthCraft Technical Advisor at the pre-drywall inspection.
- The EarthCraft Technical Advisor will review documentation provided by the project team for compliance with criteria.

## DU 1.19 Insulate cold water pipes $\geq R-2$

### Criteria

Insulate all cold water pipes located inside conditioned spaces and in inaccessible interstitial locations (e.g., in walls, floor cavities, etc.) to  $\geq R-2$  for condensation prevention.

#### Confirmation

- The EarthCraft Technical Advisor will visually confirm compliance with criteria at pre-drywall inspection.

## DU 1.20 All entrance doors have overhang $\geq 3'$ depth

### Criteria

On all exterior doors, including building entrances and exits, install a covered entry way that extends 3' out from door.

#### Confirmation

- The EarthCraft Technical Advisor will visually confirm compliance with criteria at final inspection.

## DU 1.21 Roofing warranty

### Criteria

#### A. 40-year warranty

Install shingles or other exterior roofing material that have ≥40 year manufacturer's warranty.

#### B. 50-year warranty

Install shingles or other exterior roofing material that have ≥50 year manufacturer's warranty.

#### Confirmation

- The project team must present documentation demonstrating compliance with criteria to the EarthCraft Technical Advisor at the pre-drywall inspection.
- The EarthCraft Technical Advisor will review documentation provided by the project team for compliance with criteria.

## Moisture Management

## DU 2.0 Gravel bed beneath sub-grade slabs

### Criteria

Install a ≥4" deep gravel bed (consisting of ≥0.5" clean aggregate) beneath all sub-grade concrete floor slabs.

OR

Install a ≥4" of uniform layer of sand with geotextile drainage matting.

### Clarifications

Gravel bed must be installed beneath vapor barrier.

#### Confirmation

- The builder will illustrate compliance of criteria through photo documentation submitted to the EarthCraft Technical Advisor at pre-drywall.
- The EarthCraft Technical Advisor will review photo documentation provided by the builder for compliance of criteria.

## DU 2.1 100% coverage of ≥6 mil vapor barrier beneath all slabs

### Criteria

Install a vapor barrier ≥6mil beneath all slabs to prevent soil moisture and gases from entering the building. Provide 100% coverage. Overlap all vapor barrier joints a minimum of 6".

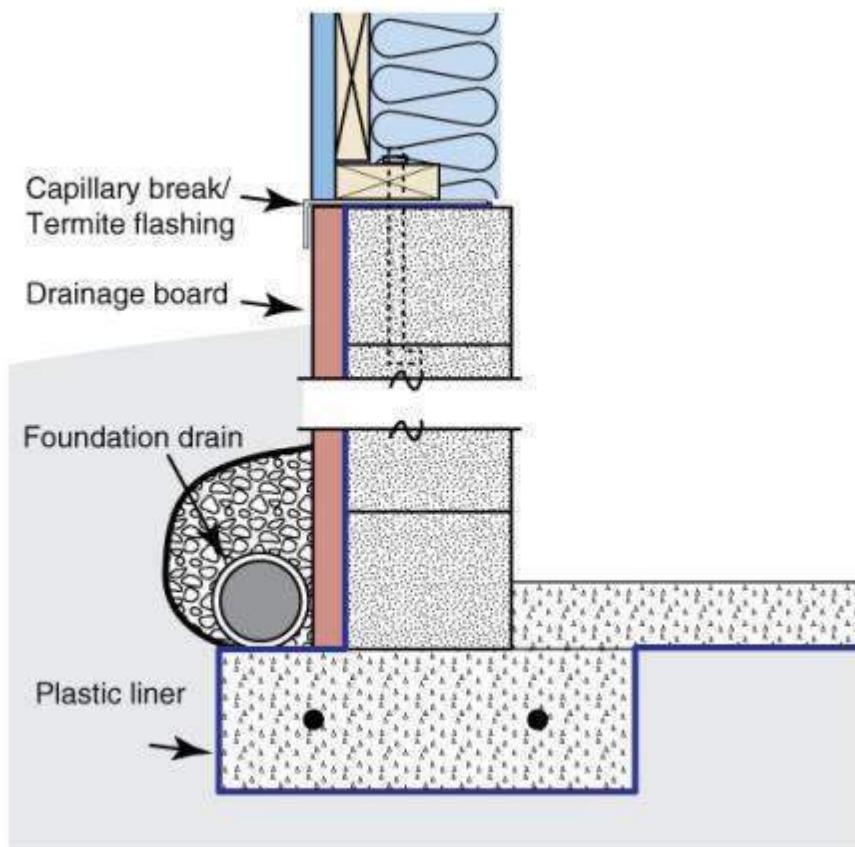
#### Confirmation

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at pre-drywall inspection.

## DU 2.2 Foundation drain on top of sub-grade footing

### Criteria

Install a protected foundation drain tile on top of the footing. Use appropriate drain elbows for bends to prevent drainage constriction around corners. Surround each pipe with  $\geq 6"$  of 1/2"- 3/4" gravel and wrap gravel layer fully with fabric cloth. Discharge all drain lines either away and downhill from the foundation to outside grade/daylight, drywell or to a sump pump.



**Figure 21: Foundation drain on top of footing**

### Clarifications

Installing the foundation drain at the outside perimeter edge of sub-grading footing and meeting the criteria of DU 2.9 meets this requirement.

### Confirmation

- The builder will illustrate compliance of criteria through photo documentation submitted to the EarthCraft Technical Advisor at pre-drywall.
- The EarthCraft Technical Advisor will review photo documentation provided by the builder for compliance of criteria.

---

## **DU 2.3 Patio slabs, walks and driveways sloped $\geq 1/4"$ per 1' away from building for $\geq 10'$ or to the edge of the surface, whichever is less**

---

### **Criteria**

Slope patio slabs, porch slabs, walks and driveways a minimum of  $1/4"$  per 1' away from house over a minimum distance of 10', or to the end of the slabs, walks and driveways. Tamp back-fill to prevent settling under patio slabs, walks and driveways unless proper drainage can be achieved using non-settling compact soils, as determined by a certified hydrologist, soil scientist or engineer.

### **Clarifications**

Where setbacks limit space to less than 10', install swales or drains designed to carry water away from the foundation.

#### **Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at final inspection.

---

## **DU 2.4 Final site grade sloped $\geq 1/2"$ per 1' away from building for $\geq 10'$ or to the edge of the site, whichever is less**

---

### **Criteria**

Slope final site grade away from the foundation at a rate of  $1/2"$  per 1' over a minimum distance of 10 feet. Tamp back-fill to prevent settling unless proper drainage can be achieved using non-settling compact soils, as determined by a certified hydrologist, soil scientist, or engineer.

### **Clarifications**

Where setbacks limit space to less than 10 feet, install swales or drains designed to carry water away from the foundation.

#### **Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at final inspection.

---

## **DU 2.5 Do not install wet or water-damaged building materials**

---

### **Criteria**

Do not install building materials that have visible signs of water damage or mold.

### **Clarifications**

If the framing members or the insulation has high moisture content (framing members should be dried to at least 18% moisture content), do not enclose interior walls. Follow the manufacturer's drying recommendations for wet-applied insulation and test framing members for moisture prior to enclosing wall cavities.

#### **Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at pre-drywall inspection.

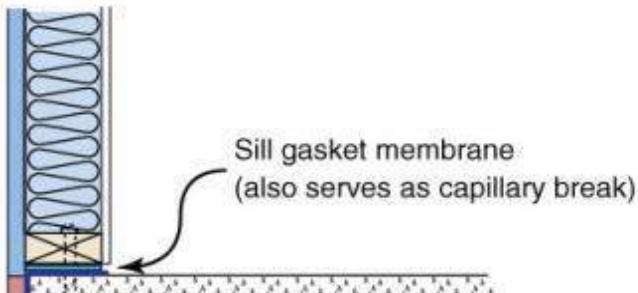
#### *If high moisture was present*

- The builder must present documentation demonstrating compliance of criteria to the EarthCraft Technical Advisor at the pre-drywall inspection.
- The EarthCraft Technical Advisor will review documentation provided by the builder for compliance of criteria.

## DU 2.6 Capillary break between foundation and framing at exterior walls

### Criteria

Install a capillary break between a concrete foundation wall/slab floor and sill plate. Install either a complete framed wall width sill gasket, EPDM-type rubber, sheet metal or other suitable membrane to prevent moisture from wicking through the foundation into the framing. Capillary break should be installed at all exterior wall locations.



### Confirmation

- The EarthCraft Technical Advisor will visually confirm compliance with criteria at pre-drywall inspection.

## DU 2.7 Drainage board and damp proofing for below-grade walls

### Criteria

Apply damp proofing and install a drainage plane material that channels water down to the footing drain tile for all below-grade walls.

### Clarifications

Wood-framed below-grade walls are not allowed along the exterior of the building.

Do not install Class 1 vapor retarders on the interior side of air permeable insulation in exterior below-grade walls, except for tile at showers and tub walls. Mirrors may be used if they are mounted with clips or other spacers that allow air to circulate behind them.

Additional strategies required to meet the intent of this credit include but are not limited to:

- BE 1.0 Install vapor barriers only under slabs and on crawlspace floors

### Confirmation

- The project team will illustrate compliance with criteria through photo documentation submitted to the EarthCraft Technical Advisor at pre-drywall.
- The EarthCraft Technical Advisor will review photo documentation provided by the project team for compliance with criteria.

## DU 2.8 Design for or install additional dehumidification

### Criteria

Rough in for, or install a whole-house dehumidifier as part of mechanical system to deal with elevated levels of humidity within dwelling units. For comfort, durability, and indoor air quality, recommended levels of relative humidity range from 40-50%.

- 1. Rough-in electrical and plumbing capacity for dehumidifier, to allow for dehumidification if necessary at a later date.**

**2. Install whole-house ENERGY STAR dehumidifier as permanent part of the mechanical system.**

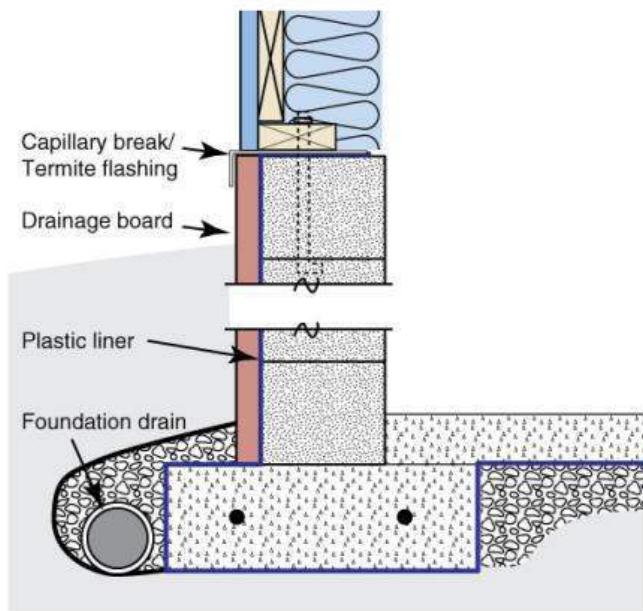
**Confirmation**

- The builder will illustrate compliance of criteria through photo documentation submitted to the EarthCraft Technical Advisor at pre-drywall.
- The EarthCraft Technical Advisor will review photo documentation provided by the builder for compliance of criteria.

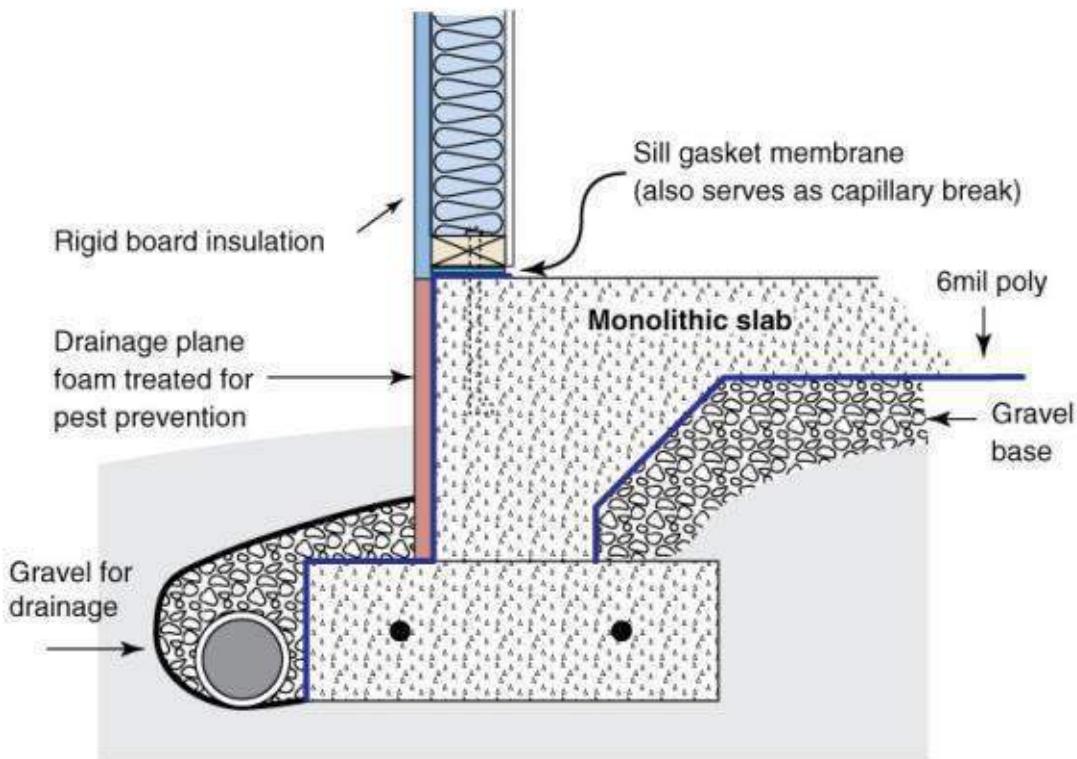
**DU 2.9 Foundation drain at outside perimeter edge of footing surrounded with 6" clean gravel and fabric filter**

**Criteria**

Install a protected foundation drain tile so that the top of the drain tile pipe is below the bottom of the concrete slab or crawlspace floor, or alongside the outside perimeter edge of the footing, whichever is lower. Use appropriate drain elbows for bends to prevent drainage constriction around corners, or use an EarthCraft approved product that meets the same intent. Surround each pipe with at least 6" of 1/2" to 3/4" gravel. Wrap gravel layer fully with fabric cloth. Discharge all drain lines either away and downhill from the foundation to outside grade/daylight or to a sump pump.



**Figure 22: Foundation drain next to footing**



**Figure 23: Foundation drain next to footing**

### Clarifications

If radon-resistant features are installed and drain tile discharges to daylight, install a check valve at the drain tile outfall.

### Confirmation

- The builder will illustrate compliance of criteria through photo documentation submitted to the EarthCraft Technical Advisor at pre-drywall.
- The EarthCraft Technical Advisor will review photo documentation provided by the builder for compliance of criteria.

## DU 2.10 Slab or crawlspace vapor barrier $\geq 10$ mil or reinforced

### Criteria

Install either a  $\geq 10$  mil polyethylene vapor barrier or a  $\geq 6$  mil reinforced polyethylene vapor barrier over all exposed earth (above grade) in crawlspaces and below slabs. Overlap sheeting 6"-12" at the seams and seal at seams and to walls with mastic or other appropriate sealant. Provide 100% coverage. Wrap plastic up the walls to be above grade of exterior soil or 2', whichever is greater.

### Confirmation

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at pre-drywall inspection.

## DU 2.11 Humidistat or thermidistat used with whole-house variable speed cooling system

### Criteria

Install a humidistat or thermidistat used with an air handler equipped with a central variable speed blower on all heating and cooling equipment for moisture removal.

### Clarifications

Equipment must be installed to maintain indoor relative humidity levels  $\leq 60\%$  relative humidity.

### Confirmation

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at final inspection.

## DU 2.12 Capillary break

### Criteria

#### *1. Between ground and footing or between footing and foundation*

Install plastic to form a capillary break between the ground and the footing or between the footing and foundation. The capillary break must be continuous from the edge of the footing to the slab with an overlapping seam of at least 6", and integrated in with the foundation wall drainage system.

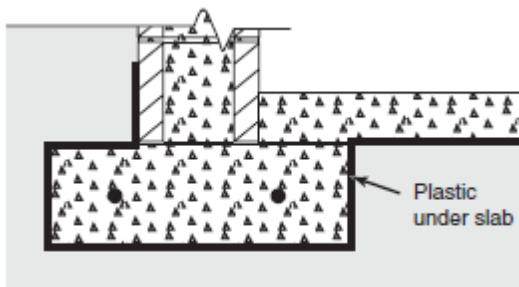


Figure 24: Capillary break between ground and footing

#### *2. Between foundation and framing for all walls*

Install a capillary break between a concrete foundation wall/slab floor and sill plate. Install either a complete framed wall width sill gasket, EPDM-type rubber, sheet metal or other suitable membrane to prevent moisture from wicking through the foundation into the framing. Capillary break should be installed between all foundations and sill plates, not just exterior walls.

### Confirmation

#### *Item 1*

- The builder will illustrate compliance of criteria through photo documentation submitted to the EarthCraft Technical Advisor at pre-drywall.
- The EarthCraft Technical Advisor will review photo documentation provided by the builder for compliance of criteria.

#### *Item 2*

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at pre-drywall inspection.

## Indoor Air Quality

Because the average American spends over 90% of their time indoors, creating a healthy and comfortable indoor environment is an important issue for any resident especially those who are more sensitive to air quality such as children, seniors, and individuals with respiratory problems and compromised immune systems. EarthCraft project teams can improve the health of occupants by installing materials with fewer pollutants, flushing any pollutants out through proper ventilation and controlling moisture to eliminate mold growth.

The Indoor Air Quality category consists of items that aim to reduce the presence of pollutants and contaminant in the air inside a building. Reducing or eliminating the presence of manmade pollutants such as volatile organic compounds or natural occurring carcinogens such as radon leads to a healthier environment for occupants.

### Combustion Safety

#### IAQ 1.0 No unvented combustion fireplaces, appliances or space heaters

##### **Criteria**

Do not install unvented combustion space-heating appliances.

##### **Clarifications**

Vent all combustion fireplaces and appliances to remove combustion products as well as process fumes to the outside air.

##### **Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at pre-drywall and final inspections.

#### IAQ 1.1 No atmospherically vented water heaters or furnaces

##### **Criteria**

Do not install atmospherically venter water heater or furnaces

##### **Clarifications**

All combustion water heaters and furnaces shall be power or direct vented.

##### **Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at pre-drywall and final inspections.

#### IAQ 1.2 Sealed-combustion or electric water heater must be installed in conditioned space

##### **Criteria**

Install gas water heater that has direct venting or power venting located within conditioned space.

OR

Install electric water heater.

**Clarifications**

If installing sealed combustion water heater, provide combustion air from outside the house in compliance with the mechanical code and manufacturer specifications.

Do not install atmospherically vented water heaters in conditioned space.

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at pre-drywall and final inspections.

**IAQ 1.3 Carbon monoxide detector (one per bedroom)****Criteria**

Install one carbon monoxide (CO) detector per bedroom, if combustion appliances exist. If all bedrooms are on the same floor, install the CO detector in a central location near all bedrooms. CO detectors must be certified by CSA 6.19-01 or UL 2034.

**Clarification**

Combination smoke/CO detectors meet the intent provided they are certified by CSA 6.19-01 or UL 2034.

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at final inspection.

**Indoor Pollutant Control****IAQ 2.0 Protect all ducts until floor/wall finishing is complete****Criteria**

All ducts (including those in floors, walls and ceilings) must be protected to prevent construction debris from entering ductwork.

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at pre-drywall inspection.

**IAQ 2.1 Filter(s) easily accessible for maintenance****Criteria**

Install all filters in an easily accessible location. Easily accessible is defined as any location which facilitates access and regular filter changes by future occupant.

**Clarifications**

Filters located in attics are considered easily accessible if drop-down stairs provide access to attic and a permanently installed walkway has been provided between the attic access location and the filter. Filters located within the units (e.g., at the return grill) are also considered easily accessible. Filters located within crawlspaces are considered easily accessible if within 5' of the entrance or in crawls with a height of 4' or greater at walk area between entrance and filter.

Filters perform best when the filter rack design includes flexible, air tight (e.g., closed-cell foam) gasket material on the downstream side of the filter and friction fit or spring clips installed on the upstream side of the filter. Non-standard efficiency ratings for filters (e.g., 3M's Microparticle Performance Rating [MPR]) and filters that do not have a MERV rating (e.g., electrostatic filters) need prior approval by EarthCraft.

Filter doors should not be obstructed by any permanent fixtures including water heaters, washer and dryers, vents, condensate line or refrigerant line sets.

HVAC system design and installation must ensure accessible criteria are met.

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance with criteria at pre-drywall and final inspections.

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## **IAQ 2.2 Provide rodent and corrosion proof screens with mesh ≤0.5" for all openings not fully sealed or caulked**

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**Criteria**

Install corrosion-proof rodent/bird screens (e.g., copper or stainless steel) with a mesh 0.5" or greater on all building openings, such as ventilation system intake/exhaust outlets and attic/crawl space vent openings that cannot be fully sealed or caulked.

**Clarifications**

Clothes dryer vents should use a flap damper to prevent rodent entry.

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at final inspection.

---

## **IAQ 2.3 All outdoor supply air crosses filter prior to distribution**

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**Criteria**

Design and install outdoor air supply ventilation so that all outdoor air crosses a filter prior to distribution.

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance with criteria at pre-drywall and final inspections.

---

## **IAQ 2.4 All interior paints have <100g/L VOC content**

---

**Criteria**

Use only interior paints with a VOC content of <100g/L for common areas and for all units.

**Confirmation**

- The EarthCraft Technical Advisor will verify compliance with criteria at final inspection.
- The project team can submit product literature and order forms indicating compliance with the VOC content of interior paints.

## IAQ 2.5 No carpet in below grade units

### Criteria

Do not install carpet in any below grade units.

### Confirmation

- The EarthCraft Technical Advisor will visually confirm compliance with criteria at final inspection.

## IAQ 2.6 Filters are ≥ MERV 6

### Criteria

Install an HVAC filter with a MERV 6 or higher filtration (according to ASHRAE 52.2) on all HVAC systems. HVAC design and installation must account for airflow based on filter selection.

### Confirmation

- The EarthCraft Technical Advisor will visually confirm compliance with criteria at final inspection.

## IAQ 2.7 Certified low or no VOC materials

### Criteria

#### *1. Interior paints*

Use only interior paints that are certified as low or no VOC by one of the following:

- Green Seal Standard GS-11
- Greenguard Certification for Paints and Coatings
- Scientific Certification Systems (SCS) Standard EC-10.2-2007
- Indoor Advantage Gold Master Painters Institute (MPI) Green Performance Standards GPS-1 or GPS-2
- a third-party low-emitting product list based on CA Section 01350

#### *2. Stains and finishes on wood floors*

Use only finishes on wood floors that are certified as low or no VOC by one of the following: Green Seal Standard GS-11, Greenguard Certification for Paints and Coatings, Scientific Certification Systems (SCS) Standard EC-10.2-2007, Indoor Advantage Gold Master Painters Institute (MPI) Green Performance Standards GPS-1 or GPS-2, or a third-party low-emitting product list based on CA Section 01350.

#### *3. Sealants and adhesives*

Use only interior sealants and adhesives that have a VOC (Volatile Organic Compound) content of 250 g/L or less.

#### *4. Carpet*

Install only carpet that qualifies as CRI Green Label or CRI Green Label Plus or has been tested and meets all the requirements of the CRI Green Label or CRI Green Label Plus testing program criteria.

#### *5. Carpet pad*

Install only carpet pad that qualifies as CRI Green Label Plus or has been tested to meet all the requirements of the CRI Green Label Plus testing program criteria.

#### *6. Carpet pad adhesive*

Install only carpet pad adhesives that qualify as CRI Green Label Plus or have been tested to meet all the requirements of the CRI Green Label Plus testing program criteria.

### **Additional Resources**

CRI Indoor Air Quality Carpet Testing Program: <http://www.carpet-rug.org/residential-customers/selecting-the-right-carpet-or-rug/green-label-plus-carpet-list.cfm>.

List of Green Label Plus qualifying carpet cushion: <http://www.carpet-rug.org/commercial-customers/green-building-and-the-environment/green-label-plus/green-label-cushion-list.cfm>.

List of Green Label Plus qualifying carpet adhesives: <http://www.carpet-rug.org/commercial-customers/green-building-and-the-environment/green-label-plus/green-label-plus-adhesive-list.cfm>.

### **Confirmation**

- The builder must present documentation demonstrating compliance of criteria to the EarthCraft Technical Advisor at the final inspection.
- The EarthCraft Technical Advisor will review documentation provided by the builder for compliance of criteria.

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## **IAQ 2.8 Protect all bath fans until floor/wall finishing is complete**

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### **Criteria**

Upon installation of all bath fans, seal all chases and openings to stop construction trash and dust from contaminating bath fan systems, and keep fans protected for the duration of construction.

### **Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance with criteria at pre-drywall and final inspections.

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## **IAQ 2.9 Flush building before occupancy**

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### **Criteria**

Flush building during and shortly after installing products that are known sources of contaminants (e.g., cabinets, carpet padding, painting) and for 48 hours prior to occupancy.

### **Example**

To flush building, either keep all windows open and run interior fans (e.g., HVAC system fans, exhaust fans and interior circulation fans) continuously, or close exterior windows and doors and run all HVAC fans, exhaust fans and interior circulation fans continuously at the highest rate. Keep all interior doors open, use additional fans to circulate air within buildings. Replace all filters after flushing building.

### **Confirmation**

- The EarthCraft Technical Advisor will verbally confirm compliance of criteria with the builder at the final inspection.

## IAQ 2.10 No added urea-formaldehyde

### Criteria

#### *1. Insulation*

Do not install insulation that contains added urea-formaldehyde.

#### *2. Subfloor*

Do not install subflooring that contains added urea-formaldehyde.

#### *3. All cabinets, shelves, and countertops*

Do not install cabinetry, shelves and countertops that contain added urea-formaldehyde.

### Confirmation

#### *Insulation and Subfloor*

- The builder must present documentation demonstrating compliance of criteria to the EarthCraft Technical Advisor at the pre-drywall inspection.
- The EarthCraft Technical Advisor will review documentation provided by the builder for compliance of criteria.

#### *Cabinets, Shelves, Countertops*

- The builder must present documentation demonstrating compliance of criteria to the EarthCraft Technical Advisor at the final inspection.
- The EarthCraft Technical Advisor will review documentation provided by the builder for compliance of criteria.

## IAQ 2.11 Seal all particle board surfaces with water-based sealant

### Criteria

Seal all particle board surfaces by coating all unsealed sides with water based polyurethane sealant or a formaldehyde sealant. Sealant must have a VOC (volatile organic compounds) content of 250 g/L or less.

### Confirmation

- The builder must present documentation demonstrating compliance of criteria to the EarthCraft Technical Advisor at the final inspection.
- The EarthCraft Technical Advisor will review documentation provided by the builder for compliance of criteria and will visually confirm compliance of criteria at final inspection.

## IAQ 2.12 No carpet in all units

### Criteria

Do not install carpet in units on any floor.

### Confirmation

- The EarthCraft Technical Advisor will visually confirm compliance with criteria at final inspection.

## IAQ 2.13 No Carpet in main living area of all units

### Criteria

Do not install carpet in main living area of all units including areas adjacent to unit entrances.

**Clarifications**

If the project already achieves **IAQ 2.12. No carpet in all units**, the additional points are not attainable.

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance with criteria at final inspection.

**IAQ 2.14 Install permanent walk-off mats at each entry****Criteria**

Install a built-in walk-off mat at each entry to the building from the exterior.

**Clarifications**

Walk off-mats must be at least 2' in length and allow accessibility for cleaning (e.g., grating with catch basin).

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at final inspection.

**High Performance Building Envelope**

One of the key elements to any energy efficient building is constructing a proper building envelope by sealing for air leaks, properly installing insulation and using high-quality windows. The building envelope is the barrier that separates the buildings conditioned space from unconditioned space or the outside. The building envelope consists of two parts – an air barrier and a thermal barrier (insulation) that must be both continuous and contiguous (touching each other). In a typical residence, the building envelope consists of the roof or ceiling, walls, windows, doors, and floor or foundation. Buildings account for about 40% of all energy use in the United States. EarthCraft encourages an energy efficient building envelope to reduce this impact.

**Energy Code and Energy Performance****BE 0.1 IECC adopted by jurisdiction plus applicable state amendments****Criteria**

Building must meet the International Energy Conservation Code (IECC) adopted by the project's jurisdiction plus any applicable state amendments.

In the case of a commercial construction type, the project must comply with the appropriate version of ASHRAE 90.1. This code will be in reference to commercial construction with a residential use. Projects such as these will be required to follow the mid-rise/high-rise energy simulation requirements detailed in section "BE 0.2" and "BE 0.3".

**Clarifications**

Where local code is more stringent than EarthCraft criteria, local code criteria must be met.

**Additional Resources**

An electronic copy of the 2009 IECC is available through the International Codes Council, [www.iccsafe.org](http://www.iccsafe.org).

For more information on state-adopted energy codes, visit [www.energycodes.gov](http://www.energycodes.gov).

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance with criteria at pre-drywall and final inspections.

**BE 0.2 Energy Compliance: CERTIFIED LEVEL****Criteria***a. Low-Rise Multifamily:*

For CERTIFIED projects complete worst case unit level energy models based on actual construction and demonstrate a confirmed HERS Rating Index that is less than or equal to 80.

*b. Mid-Rise/High-Rise Multifamily:*

For CERTIFIED projects complete a building level simulation (eQUEST) based on actual construction and demonstrate compliance with ENERGY STAR Multifamily High Rise energy goals, including a 15% improvement over ASHRAE 90.1-2007.

*c. Adaptive Reuse Projects:*

For CERTIFIED projects complete worst case unit level energy models based on actual construction and demonstrate a confirmed HERS Rating Index that is less than or equal to 80.

OR

For CERTIFIED Mid-Rise/High-Rise Multifamily projects complete a building level simulation (eQUEST) based on actual construction and demonstrate compliance with ENERGY STAR Multifamily High Rise energy goals, including a 15% improvement over ASHRAE 90.1-2007.

**Clarifications**Low-Rise residential:

- Units in buildings with  $\leq 4$  total units
- Units in buildings with  $\leq 3$  stories
- Units in buildings with 4-5 stories, in unit HVAC & DHW systems, AND  $\leq 20\%$  common space (as percentage of overall building square footage).

Mid-Rise/High-Rise Residential:

- Multifamily buildings with  $\geq 5$  total units
- Multifamily buildings with  $\geq 6$  stories
- Multifamily buildings with 4-5 stories, with central systems (HVAC or DHW), or  $>20\%$  common space (as percentage of overall building square footage).

Please contact EarthCraft Virginia for further clarification on whether the project should follow low-rise or mid-rise/high-rise requirements.

Adaptive Reuse:

Any project changing transforming a building from a previously non-residential use. This may include warehouses, hotels, gyms, school buildings, or other similar types. The adaptive reuse may be historic in nature.

**Additional Resources**

More information on ENERGY STAR New Homes may be found at [www.energystar.gov](http://www.energystar.gov).

**Confirmation**When seeking Certified Level Compliance:

- The EarthCraft Technical Advisor will develop an energy model in accordance with RESNET modeling criteria and confirm compliance with criteria at pre-drywall and final inspections.
- The project team must present documentation demonstrating compliance with criteria to the EarthCraft Technical Advisor prior to pre-drywall inspections.

**BE 0.3 Energy Compliance: GOLD****Criteria*****A. Low-Rise Multifamily:***

For GOLD projects complete worst case unit level energy models based on actual construction and demonstrate a confirmed HERS Rating Index that is less than or equal 75.

***B. Mid-Rise/High-Rise Multifamily:***

GOLD or PLATINUM High-Rise projects must achieve full certification in the ENERGY STAR Multifamily High Rise program in either the Performance or Prescriptive path.

For GOLD projects complete a building level simulation (eQUEST) based on actual construction and demonstrate compliance with ENERGY STAR Multifamily High Rise energy goals including a 15% improvement over ASHRAE 90.1-2007.

***C. Adaptive Reuse Projects:***

For GOLD projects complete worst case unit level energy models based on actual construction and demonstrate a confirmed HERS Rating Index that is less than or equal 75.

OR

For GOLD Mid-Rise/High-Rise projects complete a building level simulation (eQUEST) based on actual construction and demonstrate compliance with ENERGY STAR Multifamily High Rise energy goals, including a 15% improvement over ASHRAE 90.1-2007.

**Clarifications**Low-Rise residential:

- Units in buildings with ≤4 total units
- Units in buildings with ≤3 stories
- Units in buildings with 4-5 stories, in unit HVAC & DHW systems, AND ≤20% common space (as percentage of overall building square footage).

Mid-Rise/High-Rise Residential:

- Multifamily buildings with ≥5 total units
- Multifamily buildings with ≥ 6 stories
- Multifamily buildings with 4-5 stories, with central systems (HVAC or DHW), or >20% common space (as percentage of overall building square footage).

Please contact EarthCraft for further clarification on whether the project should follow low-rise or mid-rise/high-rise requirements.

**Adaptive Reuse:**

Any project changing transforming a building from a previously non-residential use. This may include warehouses, hotels, gyms, school buildings, or other similar types. The adaptive reuse may be historic in nature.

**Additional Resources**

More information on ENERGY STAR New Homes may be found at [www.energystar.gov](http://www.energystar.gov).

**Confirmation**

When seeking GOLD Level Compliance:

- The EarthCraft Technical Advisor will develop an energy model in accordance with RESNET modeling criteria and confirm compliance with criteria at pre-drywall and final inspections.
- The project team must present documentation demonstrating compliance with criteria to the EarthCraft Technical Advisor prior to pre-drywall inspections.

**BE 0.3 Energy Compliance: PLATINUM****Criteria*****A. Low-Rise Multifamily:***

For PLATINUM projects complete worst case unit level energy models based on actual construction and demonstrate a confirmed HERS Rating Index that is less than or equal 70.

***B. Mid-Rise/High-Rise Multifamily:***

GOLD or PLATINUM High-Rise projects must achieve full certification in the ENERGY STAR Multifamily High Rise program in either the Performance or Prescriptive path.

For PLATINUM projects complete a building level simulation (eQUEST) based on actual construction and demonstrate compliance with ENERGY STAR Multifamily High Rise energy goals including a 15% improvement over ASHRAE 90.1-2007.

***C. Adaptive Reuse Projects:***

For PLATINUM projects complete worst case unit level energy models based on actual construction and demonstrate a confirmed HERS Rating Index that is less than or equal 70.

OR

For PLATINUM Mid-Rise/High-Rise projects complete a building level simulation (eQUEST) based on actual construction and demonstrate compliance with ENERGY STAR Multifamily High Rise energy goals, including a 15% improvement over ASHRAE 90.1-2007.

**Clarifications****Low-Rise residential:**

- Units in buildings with ≤4 total units
- Units in buildings with ≤3 stories
- Units in buildings with 4-5 stories, in unit HVAC & DHW systems, AND ≤20% common space (as percentage of overall building square footage).

**Mid-Rise/High-Rise Residential:**

- Multifamily buildings with ≥5 total units
- Multifamily buildings with ≥ 6 stories
- Multifamily buildings with 4-5 stories, with central systems (HVAC or DHW), or >20% common space (as percentage of overall building square footage).

Please contact EarthCraft for further clarification on whether the project should follow low-rise or mid-rise/high-rise requirements.

#### Adaptive Reuse:

Any project changing transforming a building from a previously non-residential use. This may include warehouses, hotels, gyms, school buildings, or other similar types. The adaptive reuse may be historic in nature.

#### **Confirmation**

##### When seeking PLATINUM Level Compliance:

- The EarthCraft Technical Advisor will develop an energy model in accordance with RESNET modeling criteria and confirm compliance with criteria at pre-drywall and final inspections.
- The project team must present documentation demonstrating compliance with criteria to the EarthCraft Technical Advisor prior to pre-drywall inspections.

## Air Sealing

### **BE 1.0 Install vapor barriers only under slabs and on crawlspace floors and not on any vertical surfaces**

#### **Criteria**

No polyethylene or other materials with a perm rating ≤0.1, such as vinyl wall paper, may be used on foundation or above grade walls, or in any other assembly except under slabs and on crawlspace floors.

#### **Clarifications**

Tile is permitted on tub and shower walls and behind counters for backsplash protection.

#### **Additional Resources**

For perm ratings of materials, review manufacturer's product specifications or 2005 ASHRAE Handbook of Fundamentals, Chapter 25, Tables 7A and 7B.

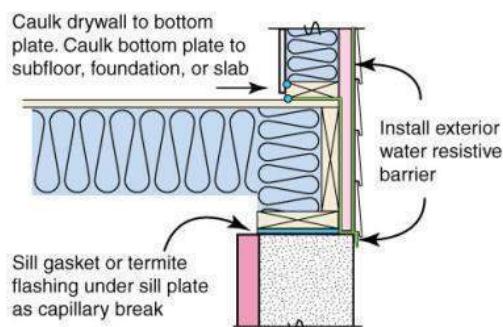
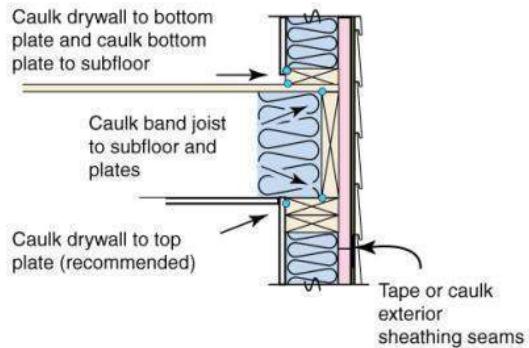
#### **Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance with criteria at pre-drywall inspection.

### **BE 1.1 Seal bottom plates to subfloor or foundation for entire unit envelope**

#### **Criteria**

Using the appropriate sealant, seal the bottom plates of walls separating conditioned and unconditioned spaces to subfloor or foundation, including the bottom plate to subfloor connections in garage.



**Figure 25: Sealed bottom plates**

### Clarifications

Foam gasket alone does not meet the criteria.

### Example

An acceptable strategy is a foam gasket beneath the bottom plate in combination with a suitable sealant.

#### Confirmation

- The EarthCraft Technical Advisor will visually confirm compliance with criteria at pre-drywall inspection.

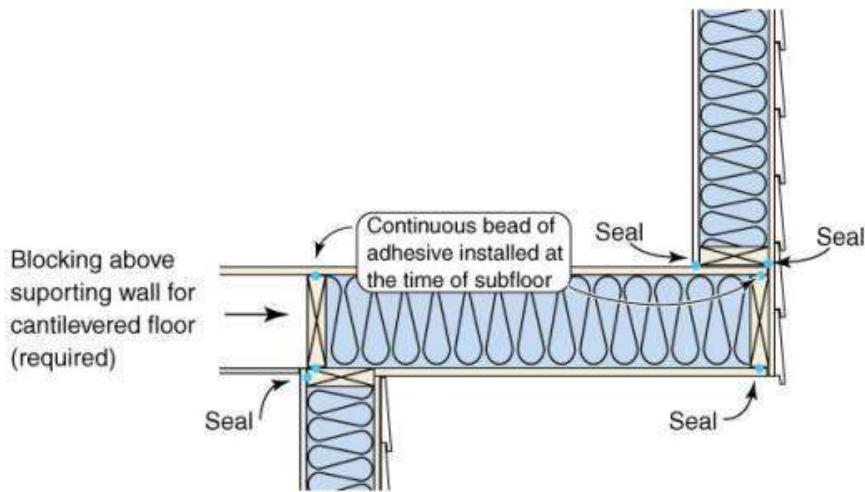
## BE 1.2 Block and seal joist cavities

### Criteria

#### 1. Above supporting wall at cantilevered floors

Block and seal all cantilevered floor joist cavities above the top plate of the supporting wall using rigid blocking and appropriate sealant.

Seal exterior sheathing on bottom of cantilevered floor.



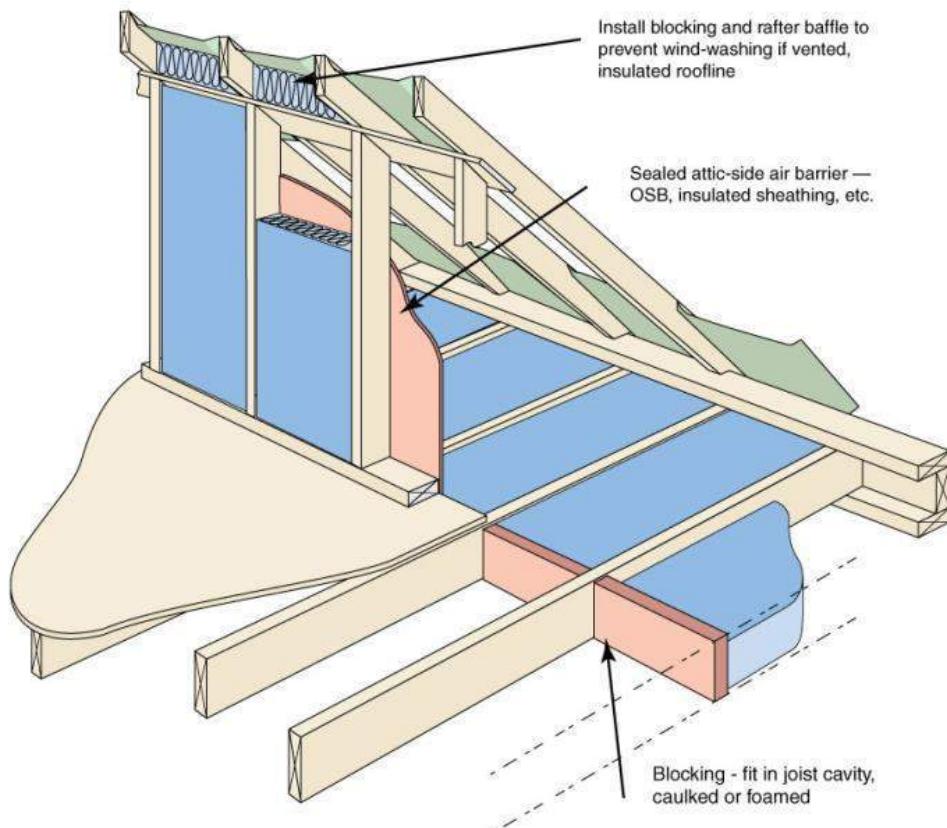
**Figure 26: Cantilevered floor blocking**

## 2. Under attic kneewalls

Block and seal all joist cavities below kneewall using rigid blocking and appropriate sealant.

### Clarifications

Attic kneewalls, defined as a vertical or near vertical wall separating conditioned space from unconditioned attic space which also include skylight shaft walls or walls adjacent to porch roofs.



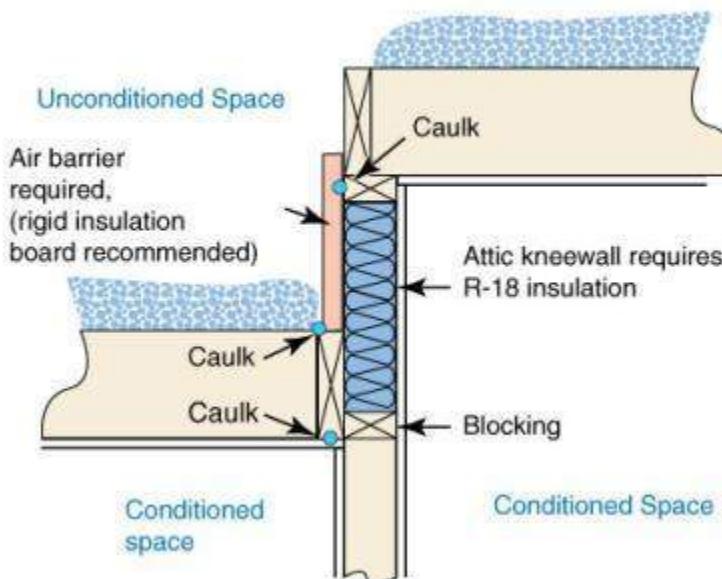
**Figure 27: Attic kneewall blocking**

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at pre-drywall inspection.

**BE 1.3 Block stud cavities at change in ceiling height****Criteria**

Block stud cavities at locations of varying ceiling height, including common walls between adjacent rooms and dropped ceilings in hallways.



**Figure 28: Blocking at change in ceiling height**

**Clarifications**

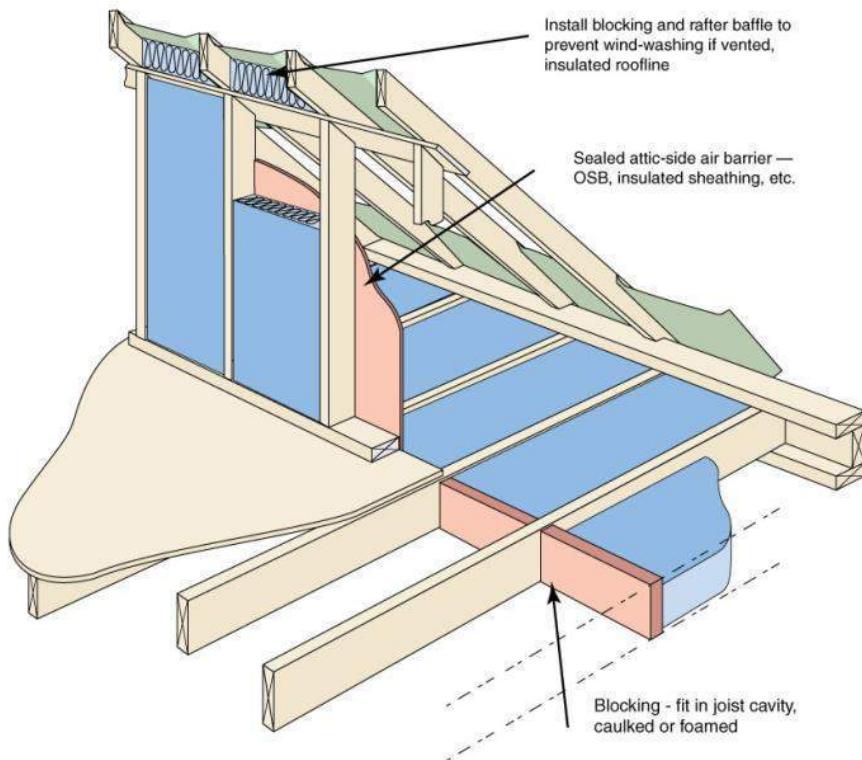
Changes in ceiling height 18" or greater are considered attic kneewalls.

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at pre-drywall inspection.

**BE 1.4 Install blocking and baffles in insulated and vented attics****Criteria**

Install blocking in rafter cavities above top plate of exterior wall if air-permeable insulation (e.g., fiberglass batts or cellulose insulation) is used and the roofing assembly must be ventilated. Blocking must be in contact with rafter baffle to allow proper roof deck ventilation and prevent wind-washing of insulation.



**Figure 28: Attic kneewall blocking**

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at pre-drywall inspection.

## BE 1.5 Seal penetrations through

**Criteria**

**1. Foundation and exterior wall assemblies**

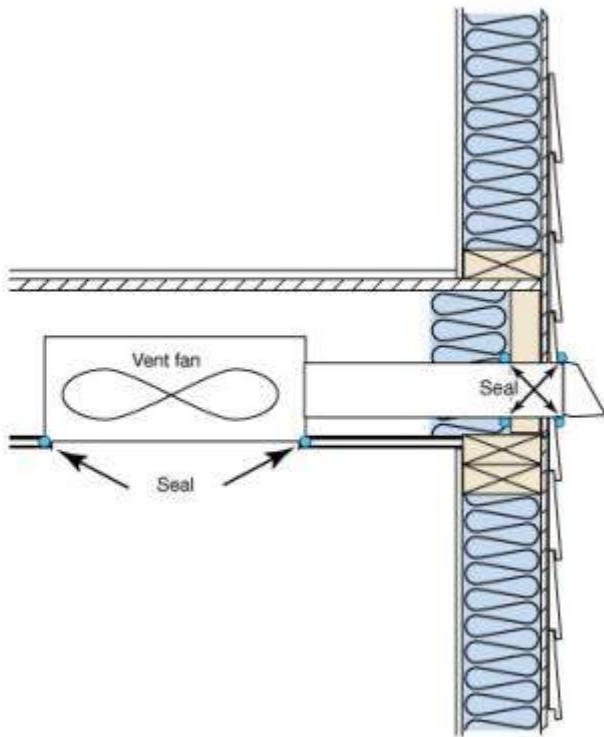
Seal penetrations and joints in and between the foundation and exterior wall assemblies with blocking materials, foam and polyurethane caulk or the equivalent.

**2. Top and bottom plate**

Seal all holes in the top and bottom plates for plumbing, wiring, ductwork and other purposes connecting conditioned and unconditioned (including exterior) areas, using appropriate sealant materials.

**3. Band and rim joists**

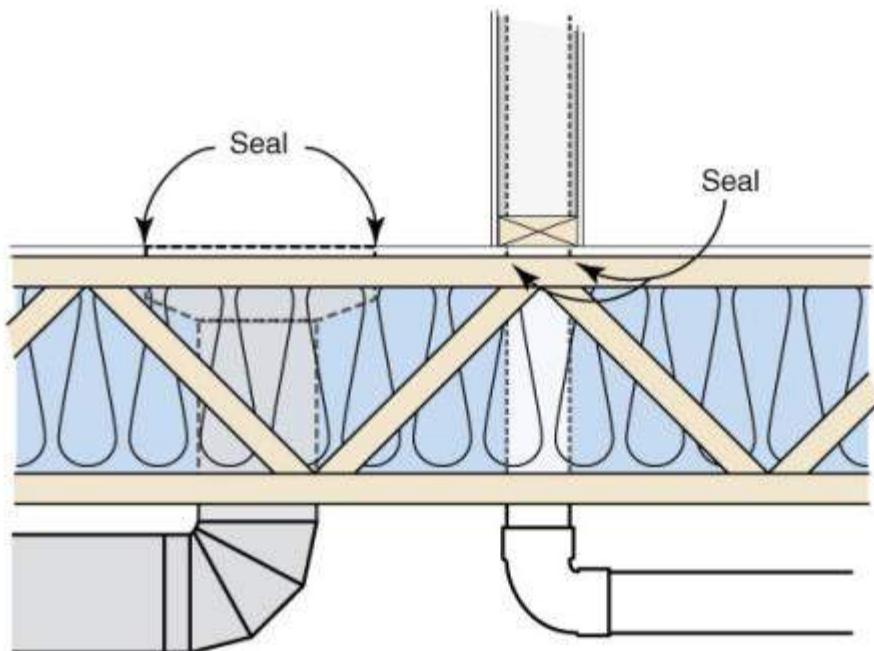
Seal all penetrations through the band and rim joist (between conditioned and exterior spaces and conditioned and garage spaces) including holes drilled for HVAC lines, plumbing lines, bathroom fans, exhaust fans and electrical lines using appropriate sealant.



**Figure 29: Bath fan vent sealed at rim joist**

#### 4. Insulated subfloor

Seal all penetrations (e.g. HVAC, plumbing and electrical) through insulated floor systems over unconditioned areas such as vented crawlspaces, unconditioned basements and garages.



**Figure 30: Air sealing at insulated subfloor**

## 5. Sheathing

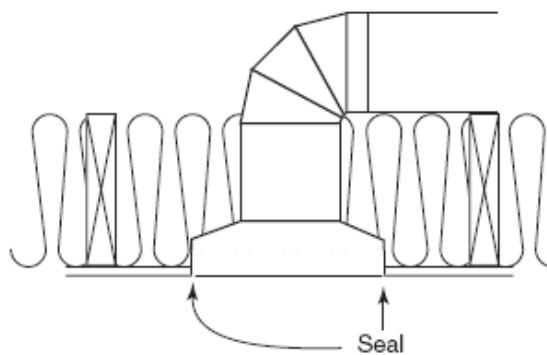
Seal penetrations in exterior wall sheathing including condensation lines, electrical outlets, water spigots, utility boxes and locations with broken or missing sheathing using appropriate materials and sealant.

## 6. Walls and ceilings in attached garages

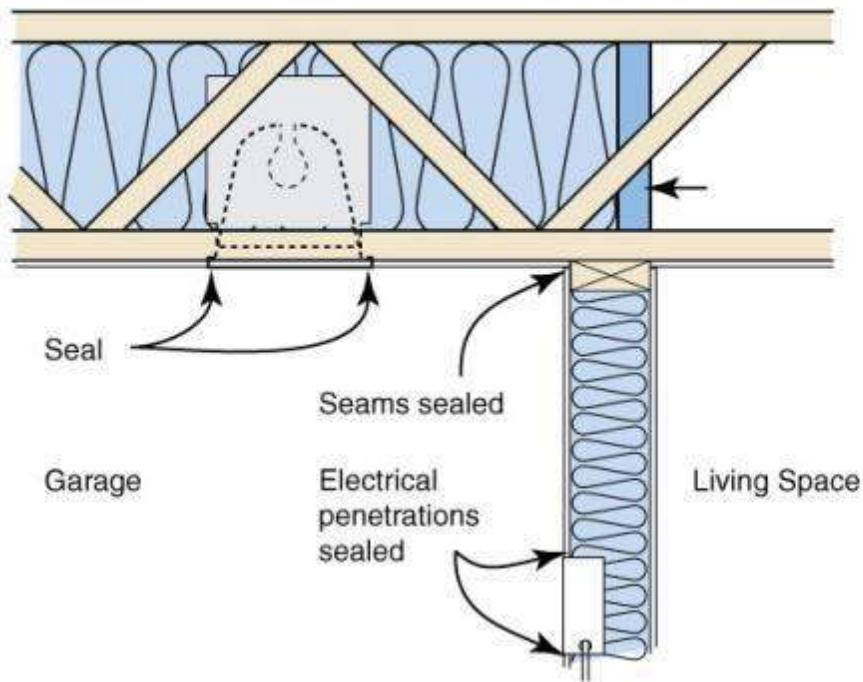
Seal penetrations such as light fixtures, switches, electric boxes and plumbing pipe penetrations through wall and ceiling drywall in attached garage using appropriate sealant.

## 7. All ceilings

Seal penetrations (e.g., rough openings for can lights, ceiling fans and low voltage fixture penetrations) through insulated ceilings using appropriate sealant.



**Figure 31: Air sealing at HVAC boot in insulated ceiling**



**Figure 32: Air sealing at can light**

**Clarifications**

Seal penetrations for flues and other heat-producing items with noncombustible sheet materials and high temperature sealant.

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at pre-drywall and final inspections.

**BE 1.6 Seal penetrations around****Criteria*****1. Shower, sinks, toilets and tub drains***

Block and seal subfloor penetrations for shower and tub drain using rigid sheeting and appropriate sealant. Plumbing penetrations in slab floors must be sealed with appropriate sealant.

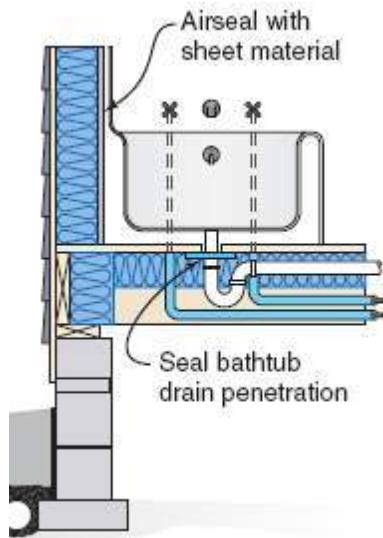
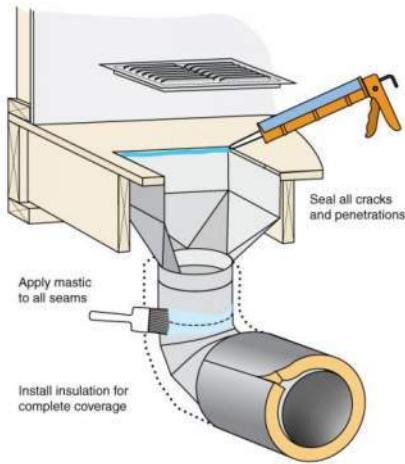


Figure 33: Air sealing at plumbing penetration in subfloor

***2. HVAC supply and return boots sealed to subfloor or drywall (floors, walls and ceilings)***

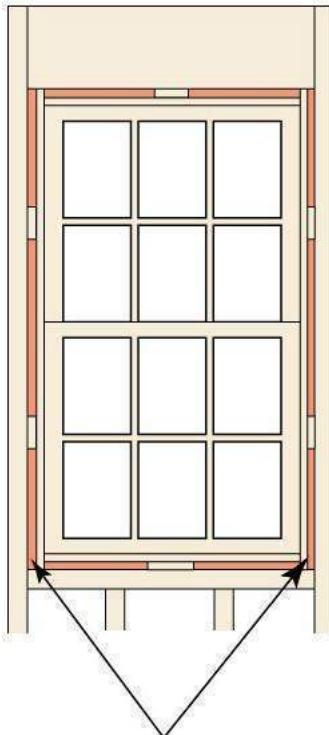
Seal all HVAC supply and return boots to subfloor or drywall using appropriate sealant.



**Figure 34: Sealing boot to subfloor**

### 3. Window and door rough openings

Seal the space between the framing for window and door rough openings and the installed units using non-expanding or low-expanding spray foam sealant or closed-cell foam backer rod with appropriate sealant. Seal thresholds for exterior doors to the subfloor or slab.



Use backer rod or low expanding spray foam (appropriate for windows) to fill gaps between window/door and rough opening

**Figure 35: Air sealing around window and door rough openings**

#### **4. All drywall penetrations (common walls between attached units included)**

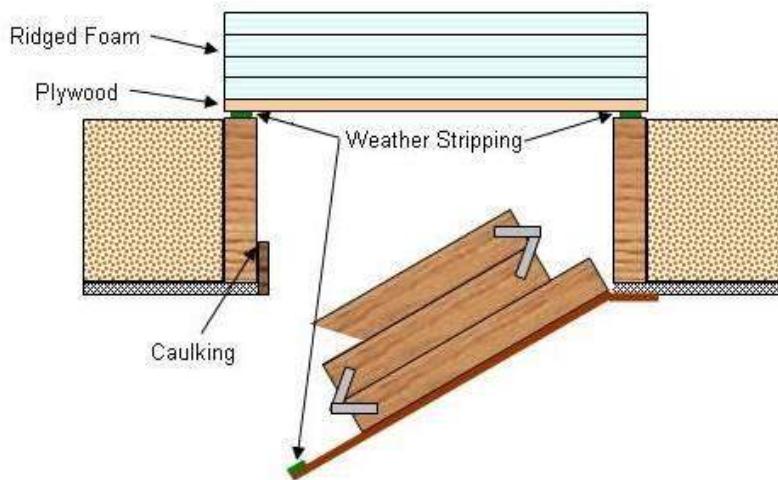
For all common walls between two dwelling units (e.g., duplexes, townhomes and multifamily), seal all penetrations through the top and bottom plate, and all drywall penetrations where permissible by fire code.

#### **5. Exhaust fans to drywall**

Seal all bathroom and kitchen exhaust fan housing units to drywall using appropriate sealant.

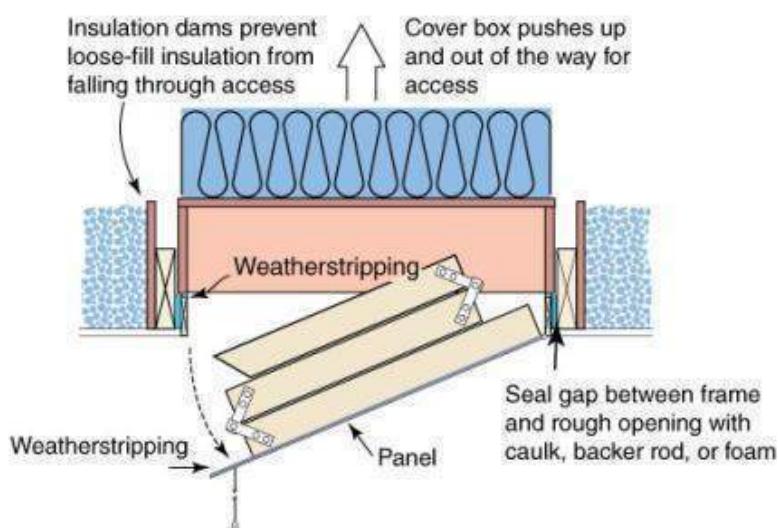
#### **6. Attic pull-down stairs, scuttle holes and kneewall doors**

Seal the space between the framing and attic pull-down stairs, scuttle holes or kneewall doors using non or low-expanding spray foam sealant or closed-cell foam backer rod with appropriate sealant.



**Figure 36: Attic pull-down stairs with foam board**

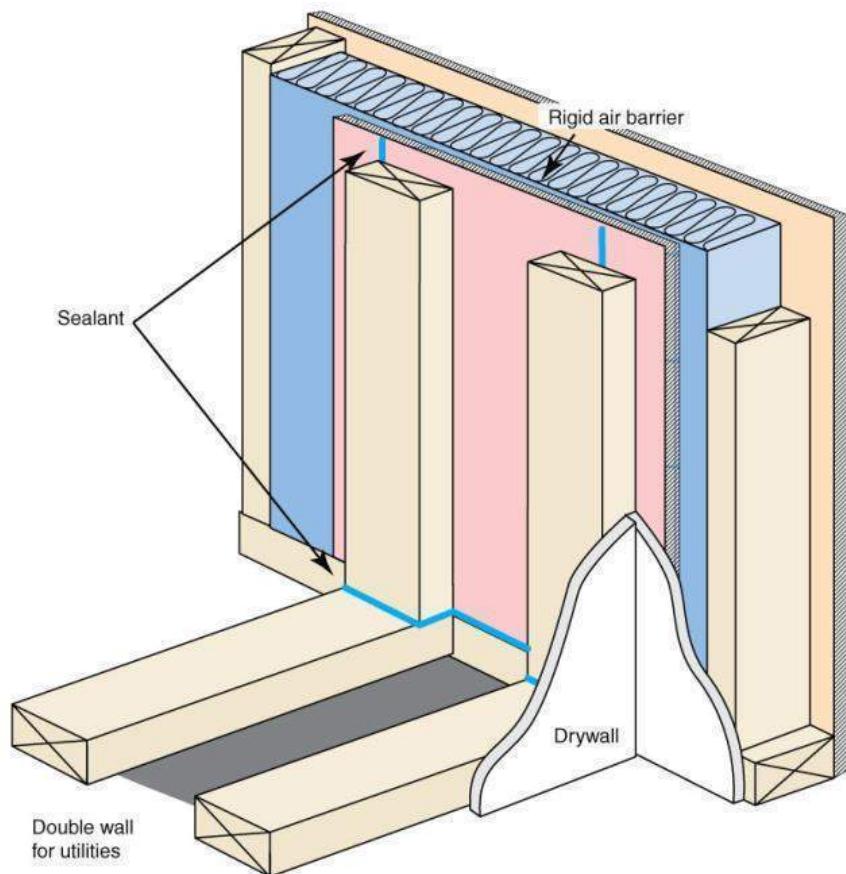
Rigid insulation box forms lid for pull-down attic staircase



**Figure 37: Attic pull-down stairs with batt insulation**

## 7. Chases

Seal and insulate framed spaces that connect conditioned areas to unconditioned areas above and below the chase (including attics, unconditioned basements or vented crawl spaces) using sheet material and appropriate sealant. These areas include chases for plumbing, duct work, chimneys and flues.



**Figure 38: Rigid air barrier at chase on insulated wall**

### Clarifications

Cellulose, fiberglass or rockwool batt insulation is not acceptable as a sealant.

For chases with high temperature heat sources, use noncombustible sheet materials such as sheet metal and high temperature caulk to seal chase.

### Confirmation

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at pre-drywall and final inspections.

## BE 1.7 Seal seams and gaps in:

### Criteria

#### 1. Band joist sheathing

Seal all seams in band joist sheathing separating conditioned and unconditioned spaces between conditioned floors. Band joist should be sealed to top plate, subfloor and at butt joints, or at exterior sheathing.

#### 2. Exterior wall sheathing

Seal all gaps  $\geq \frac{1}{8}$ " in exterior sheathing, such as seams between adjacent sheets, using appropriate sealant.

#### 3. All seams in SIPs

Seal all seams between structurally insulated panels (SIPs) with appropriate sealant on the interior and exterior of the building envelope.

### Confirmation

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at pre-drywall inspection.

## BE 1.8 Install rigid air barriers

### Criteria

#### 1. Behind tubs and showers on insulated walls

Install rigid interior air barrier behind tubs and showers on insulated walls before installing tub and shower assemblies.

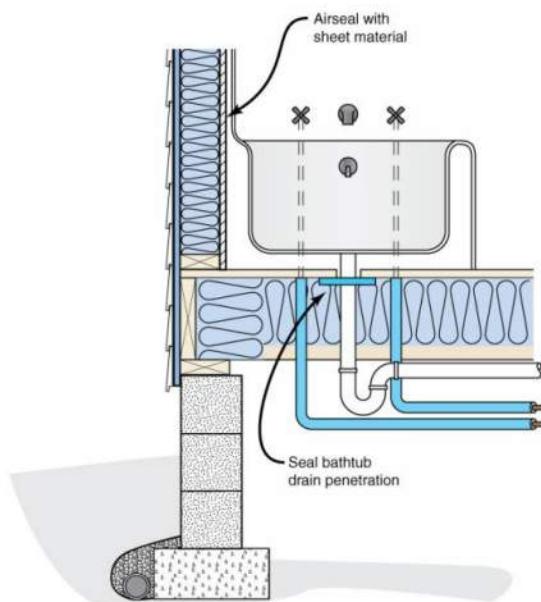


Figure 39: Air barrier behind tub

**2. At attic kneewall on attic-side (including skylight shafts)**

Install attic-side rigid air barrier to all kneewalls including skylight shafts. Seal seams of air barrier using appropriate sealant. Block and seal top and bottom of kneewall/skylight shaft stud cavity to encapsulate insulation.

**3. At chases in contact with the building envelope (including fireplace chases)**

All chases in contact with building envelope have air barrier applied to the interior of the chase where it meets the building envelope. All chase walls must be sealed using appropriate sealant (i.e., compliant with applicable fire code and manufacturer specifications).

**4. Along staircases on insulated walls**

Install rigid air barrier to the interior of all staircase walls adjoining unconditioned spaces (e.g., exterior walls, garages or unconditioned attics). Seal seams of air barrier and penetrations through air barrier using appropriate sealant. Air barrier should include areas under enclosed landings and bottom stairs.

**5. Along porch roofs**

Seal and insulate all porch roofs at the vertical connection between the conditioned interior of the dwelling unit and the porch roof area.

**6. At dropped ceiling/soffit**

Seal and insulate dropped ceilings/soffits between conditioned areas and the attic using sheet material and appropriate sealant.

**7. At all band joists above unit separation walls**

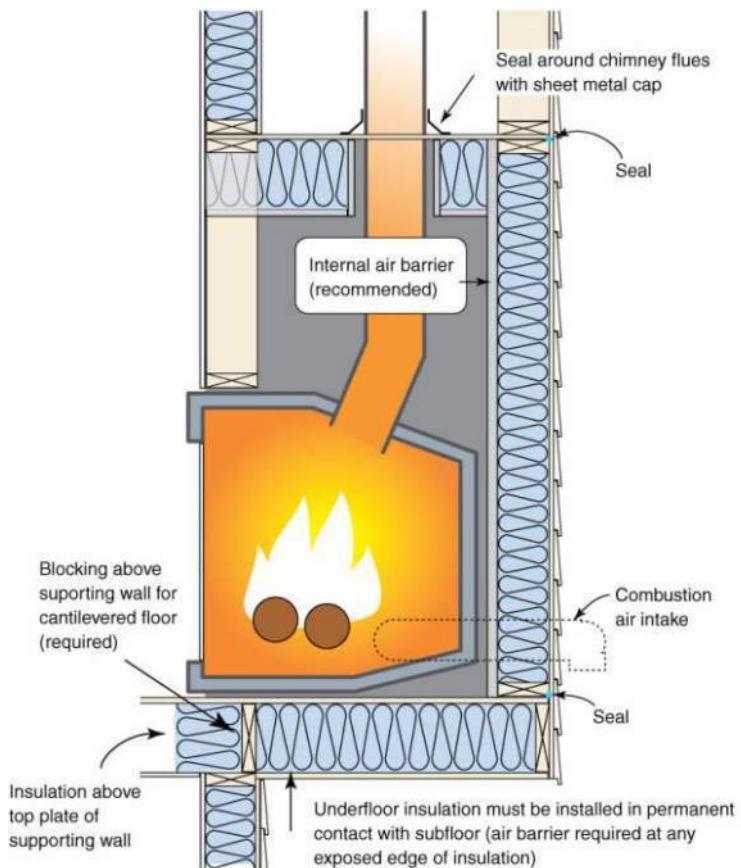
Using appropriate sealant, seal and insulate all band joists above unit separation walls.

**Clarifications**

If cavity will be inaccessible for insulation installation after sheathing is applied, install insulation prior to enclosing the cavity. All fireplace chase walls must be sealed using appropriate sealant (i.e., compliant with applicable fire code and manufacturer specifications).

For projects Climate Zone 4, an internal air barrier must be installed on fireplace chase walls in addition to the exterior air barrier on fireplace chase walls.

Changes in ceiling height 18" or greater are considered attic kneewalls.



**Figure 40: Insulated fireplace chase**

## Exemptions

For Climate Zones 2-3, projects with Grade I insulation installation and proper insulation support on fireplace walls, or other chases in contact with building envelope, are exempt from providing an internal air barrier along the fireplace chase walls. However, an air barrier must be installed along the exterior walls of the fireplace chase.

## Example

There are two options for insulating and air sealing a fireplace chase on an exterior wall. The builder can either define the building envelope along the exterior walls of the fireplace chase or along the interior wall between conditioned space and the fireplace chase. All flues must be sealed to metal caps with appropriate sealant unless not allowed by local code.

## Definitions

Attic kneewalls, defined as a vertical or near vertical wall separating conditioned space from unconditioned attic space, could include skylight shaft walls or walls adjacent to porch roofs. Changes in ceiling height 18" or greater are considered attic kneewalls.

## Additional Resources

For information on the definition of Grade I insulation, see RESNET's Mortgage Industries National Home Energy Rating Standards at: <http://resnet.us/standards>.

### Confirmation

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at pre-drywall and final inspections.

## BE 1.9 Install weather-stripping

### Criteria

**1. At all exterior doors (if not included in door assembly)**

Install weather-stripping to all exterior doors that connect conditioned space to unconditioned spaces like the garage or outdoors.

**2. At attic kneewall doors, scuttle holes and pull-down stairs**

Weather-strip all kneewall doors, scuttle holes and pull-down stairs that connect conditioned space to unconditioned attic areas. Kneewall doors must latch to provide tight closure. Install weather stripping prior to setting hinges on pull-down stairs to ensure tight closure of assembly between conditioned space and attic.

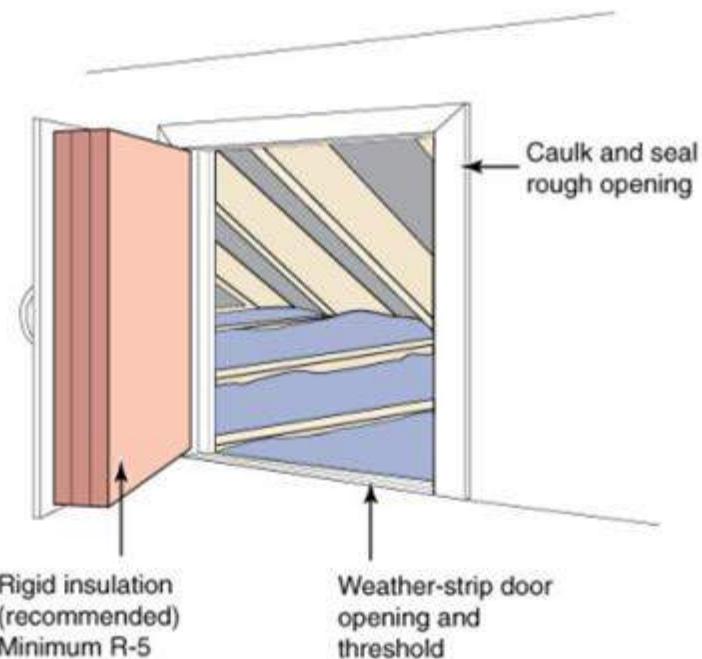
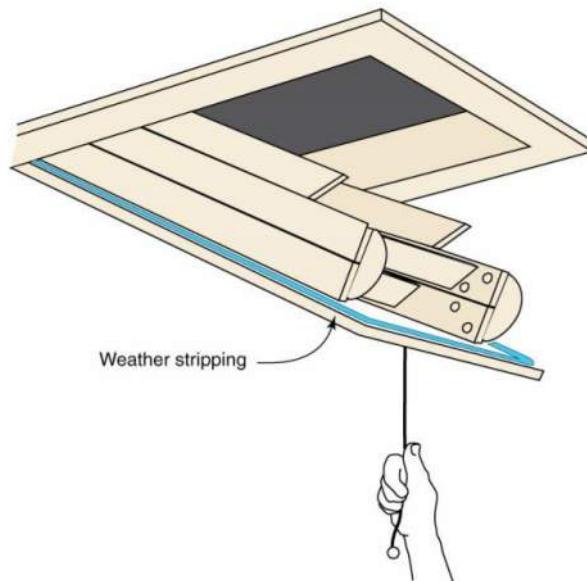


Figure 41: Kneewall door weather-stripping



**Figure 42: Pull-down stairs weather-stripping**

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at final inspection.

**BE 1.10 All recessed can lights must be air tight, gasketed and IC-rated in insulated ceilings; in Climate Zone 4, insulate exterior surface of fixture to  $\geq R-10$**

**Criteria**

Recessed light fixtures in insulated ceilings with an unconditioned area above must be air-tight and Insulation Contact (IC) rated, and must be fully gasketed and sealed to the drywall. Recessed can lights in Climate Zone 4 must be insulated to a minimum of R-10 to minimize condensation potential.

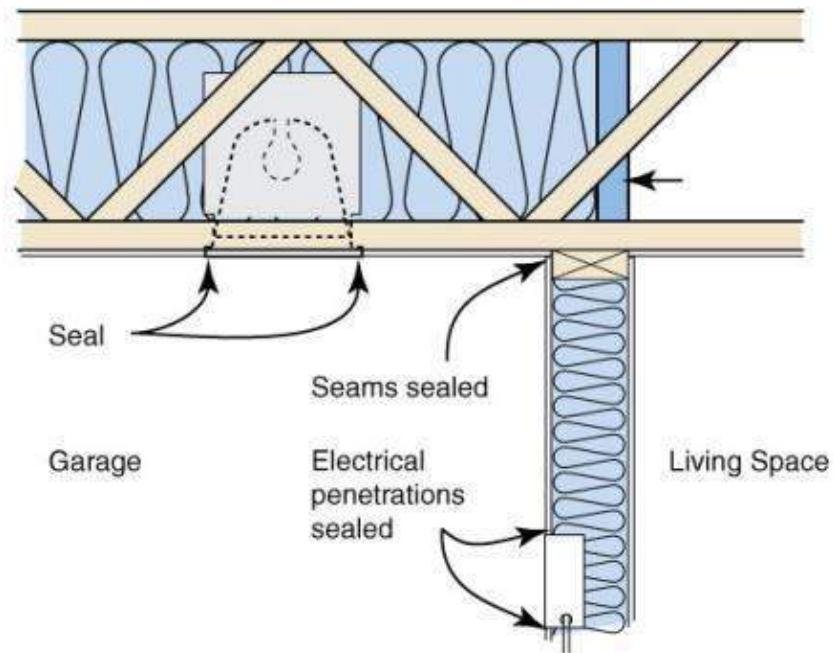


Figure 43: Can light installation

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at pre-drywall inspection.

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**BE 1.11 Fire rated assemblies that do not use draft block in band areas must comply with Air Tight Drywall approach**


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**Criteria**

Use an airtight drywall (ATD) approach to reduce air infiltration rates. Airtight drywall will qualify when a gasket or caulk is applied at all top plates at all exterior walls, interior partition walls, and unit separation walls. On bottom-floor or middle-floor units without gypcrete application, the gasket and caulk application will be required on all bottom plates at exterior walls, interior partition walls, and unit separation walls. All interior wall penetrations must be air sealed in walls and ceilings (including all fixtures and receptacle boxes).

**Clarification:**

Airtight drywall is required on projects that do not utilize **fire blocking** in the floor systems above tenant separation walls.

The ATD approach will reduce the unit envelope leakage in these circumstances in order to achieve the required envelope leakage goals. Projects that forego ATD in these locations and fail to reach the envelope leakage goals will not be eligible for ECMF certification.

See **ECMF Common Obstacles** Addendum for additional solutions for these locations.

Caulk or gaskets are acceptable applications, but liquid nails or other adhesives are not suitable for ATD applications.

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm ATD compliance during drywall installation and at final inspections.

---

**BE 1.12 Units adjacent to fire walls or CMU walls with an air gap assembly must follow Air Tight Drywall approach**


---

**Criteria**

Use an airtight drywall (ATD) approach to reduce air infiltration rates. Airtight drywall will qualify when a gasket or caulk is applied at all top plates at all exterior walls, interior partition walls, and unit separation walls. On bottom-floor or middle-floor units without gypcrete application, the gasket and caulk application will be required on all bottom plates at exterior walls, interior partition walls, and unit separation walls. All interior wall penetrations must be air sealed in walls and ceilings (including all fixtures and receptacle boxes).

**Clarification:**

Airtight drywall is required on projects with units adjacent to **fire walls or CMU walls** with an air gap as part of the required assembly.

The ATD approach will reduce the unit envelope leakage in these circumstances in order to achieve the required envelope leakage goals. Projects that forego ATD in these locations and fail to reach the envelope leakage goals will not be eligible for ECMF certification.

See **ECMF Common Obstacles** Addendum for additional solutions for these locations.

Caulk or gaskets are acceptable applications, but liquid nails or other adhesives are not suitable for ATD applications.

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm ATD compliance during drywall installation and at final inspections.

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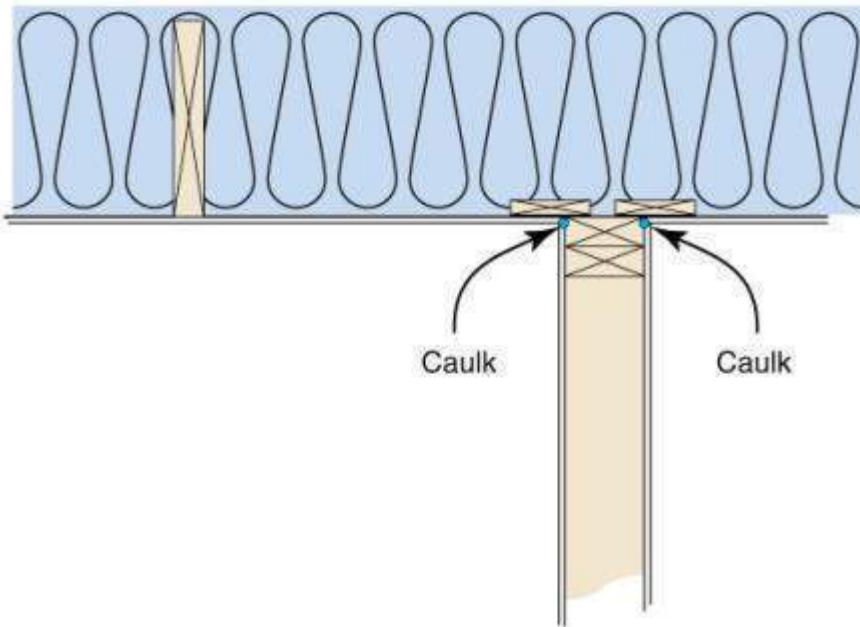
**BE 1.13 Seal top plate to drywall at the attic level**


---

**Criteria**

Seal top plate to drywall at all interfaces with appropriate sealant (gaskets, foam, caulk, etc.) between unconditioned spaces and wall. Sealant may be applied from attic side to joints between drywall and top plate.

Seal drywall to top plate for walls separating the conditioned space from garage space.



**Figure 44: Top plate sealed**

#### Clarifications

Construction adhesive is not permitted as sealant.

#### Confirmation

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at final inspection.

---

### BE 1.14 Comply with Air Tight Drywall approach

---

#### Criteria

Use an airtight drywall (ATD) approach to reduce air infiltration rates. Airtight drywall will qualify when a gasket or caulk is applied at all top plates at all exterior walls, interior partition walls, and unit separation walls. On bottom-floor or middle-floor units without gypcrete application, the gasket and caulk application will be required on all bottom plates at exterior walls, interior partition walls, and unit separation walls. All interior wall penetrations must be air sealed in walls and ceilings (including all fixtures and receptacle boxes).

#### Highly Recommended:

Airtight drywall is recommended on projects that do not utilize **fire blocking** in the floor systems above tenant separation walls and in dwelling units adjacent to **fire walls or CMU walls** with an air gap as part of the required assembly.

The ATD approach will reduce the unit envelope leakage in these circumstances in order to achieve the required envelope leakage goals (**BE 2: Envelope Leakage Ratio**). Projects that choose to forego ATD in these locations and fail to reach the envelope leakage goals will not be eligible for ECMF certification.

See **ECMF Common Obstacles** Addendum for additional solutions for these locations.

**Clarification**

Caulk or gaskets are acceptable applications, but liquid nails or other adhesives are not suitable for ATD applications.

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm ATD compliance during drywall installation and at final inspections.

**BE 1.15 Gypcrete on all framed floors separating unit envelopes****Criteria**

Apply gypcrete in space between tenant separation walls or any dead cavities existing between units or between units and common areas.

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm at pre-drywall inspections.

**BE 1.16 Two-pour application of gypcrete include areas blocked by drywall****Criteria**

Apply an additional application of gypcrete in areas otherwise blocked by drywall. Such areas will include space beneath tubs, chases, dead spaces between adjacent units and units and common areas.

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm at pre-drywall inspections.

**BE 1.17 Firewalls/party walls that eliminate air gap (UL 370 or equivalent)****Criteria**

Approved assemblies that do not utilize an air gap will qualify.

**Confirmation**

- Project team must supply plan details on the qualifying system.
- The EarthCraft Technical Advisor will visually confirm at pre-drywall inspections.

**BE 1.18 No recessed can lights installed****Criteria**

Do not install any recessed can lights in units.

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm.

**Blower door test****Criteria**

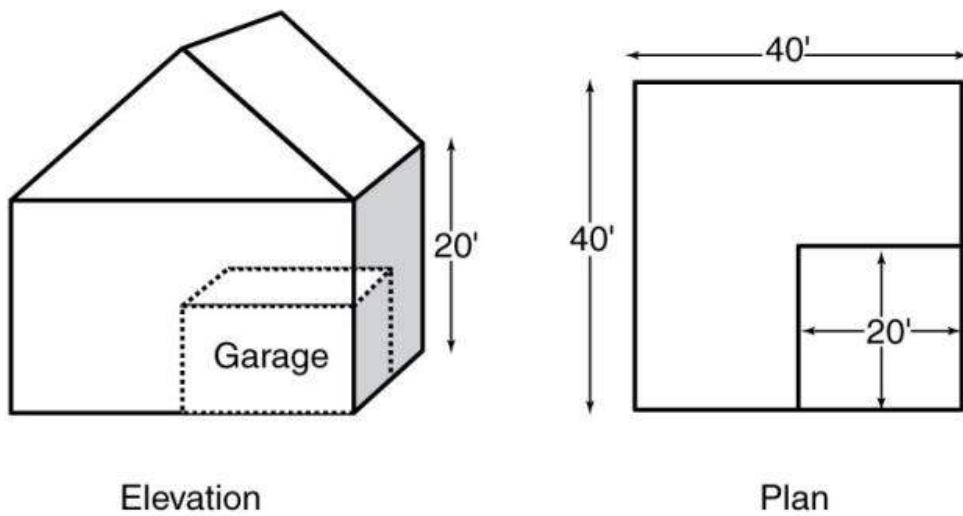
A blower door test is required for all EarthCraft projects. Various levels of tightness are needed for each level of certification.

**Clarifications**

Floor area must equal conditioned floor area used for the confirmed HERS energy model.

**Example**

The following diagram represents a two-story home on a slab with a flat ceiling and ventilated attic. The home has an attached 20'x20' garage.



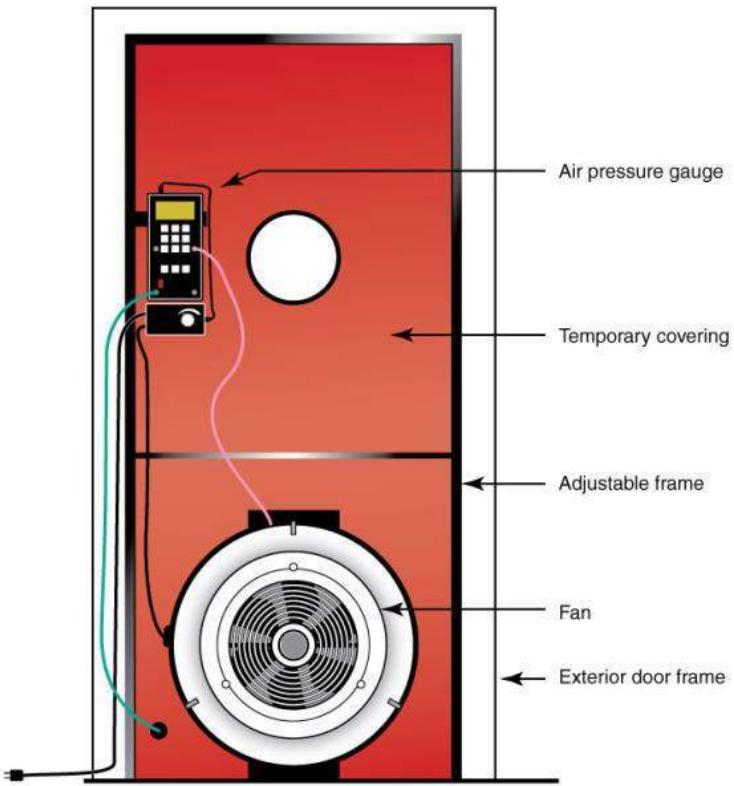
**Figure 45: Sample floor plan**

CALCULATION:  $\text{cfm}_{50} * 60 / \text{Volume} = \text{ACH}_{50}$

BLOWER DOOR TEST RESULT: 2,000 cfm at 50 Pa pressure (2,000  $\text{cfm}_{50}$ )

For the above referenced home VOLUME = 1200 ft. sq. \* 10 + 1600 ft. sq. \* 10 = 28,000 cu. Ft.

$2,000 \text{ cfm}_{50} * 60 / 28,000 \text{ cu. Ft.} = 4.28 \text{ ACH}_{50}$

**Figure 46: Blower door****Confirmation**

- The EarthCraft Technical Advisor will diagnostically test compliance of criteria at the final inspection.

**BE 2.0 Air Changes per Hour  $\leq$  6 ACH<sub>50</sub>****Criteria**

The envelope infiltration rate must be  $\leq$  6 ACH<sub>50</sub> to meet the minimum certification requirements

**Confirmation**

- The EarthCraft Technical Advisor will diagnostically test compliance of criteria at the final inspection.

**BE 2.1 Air Changes per Hour  $\leq$  5 ACH<sub>50</sub>****Criteria**

The envelope infiltration rate must be  $\leq$  5 ACH<sub>50</sub> to achieve the Platinum and Gold certification level.

**Confirmation**

- The EarthCraft Technical Advisor will diagnostically test compliance of criteria at the final inspection.

## BE 2.2 Air Changes per Hour $\leq 3 \text{ ACH}_{50}$

### Criteria

The envelope infiltration rate must be  $\leq 3 \text{ ACH}_{50}$

### Confirmation

- The EarthCraft Technical Advisor will diagnostically test compliance of criteria at the final inspection.

## Insulation

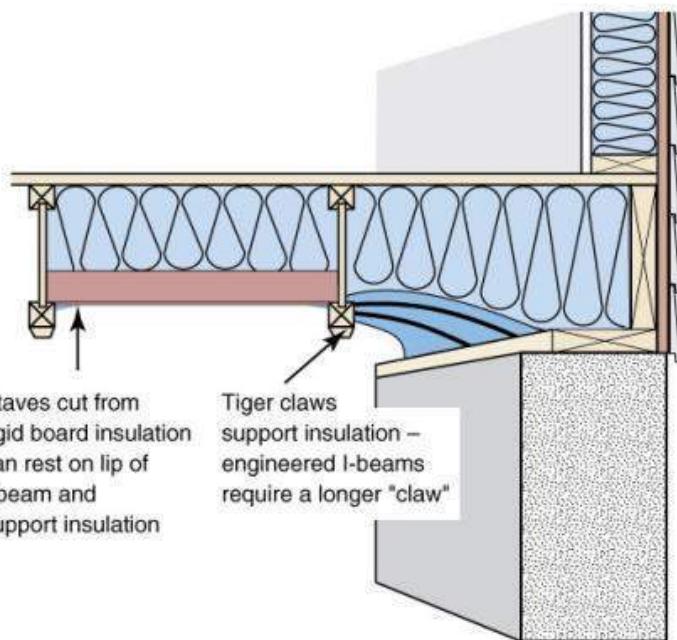
## BE 3.0 Floors

### Criteria

#### 1. *Framed $\geq R-19$*

Insulate framed floor over enclosed unconditioned spaces to R-19 or greater.

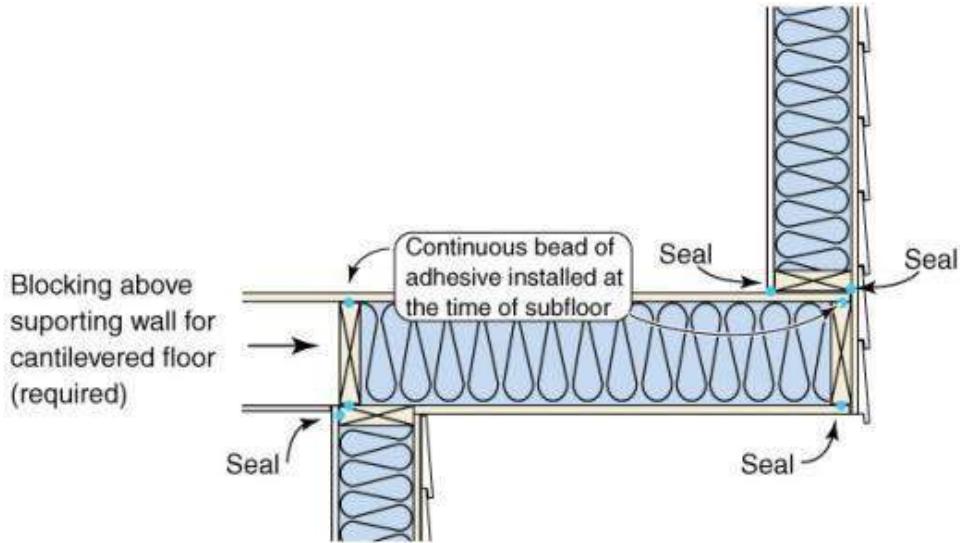
Insulation must be in permanent contact with subfloor, or a fully aligned air barrier on the exterior side of the conditioned space provided that the perimeter rim and band joists of the floor cavity are also sealed and insulated to comply with the insulation and air sealing requirements for walls.



**Figure 47: Floor insulation supports**

#### 2. *Cantilevered/over exterior spaces $\geq R-30$*

Block between joists and insulate all floors with conditioned space over ambient areas to R-30 or greater. Blocking between joists is required when joists cross from unconditioned spaces to conditioned spaces.



**Figure 48: Cantilevered floor insulation**

### **3. Podium/elevated slabs $\geq R-19$**

Insulate podiums or elevated slabs over unconditioned spaces to R-19 or greater.

Insulation must be in permanent contact with subfloor, or a fully aligned air barrier on the exterior side of the conditioned space provided that the perimeter rim and band joists of the floor cavity are also sealed and insulated to comply with the insulation and air sealing requirements for walls.

#### **Clarifications**

Framed floors over basement/crawlspace require insulation only if basement/crawlspace is outside of building envelope.

Trade-off to R-19 or greater is allowed in cantilevered floors/floors over exterior spaces using the performance path based on energy performance analysis.

If insulating a steel joist floor, R-6 continuous insulation must be installed in addition to floor insulation listed above.

Enclosed unconditioned spaces typically include vented crawlspace, unconditioned basement, garage, etc.

Conditioned spaces over ambient areas typically include floors over carports, cantilevered floors, etc.

#### **Confirmation**

The EarthCraft Technical Advisor will visually confirm compliance with criteria at pre-drywall and final inspections.

## BE 3.1 Walls

### Criteria

#### **1. Exterior walls and band joist $\geq R-13$**

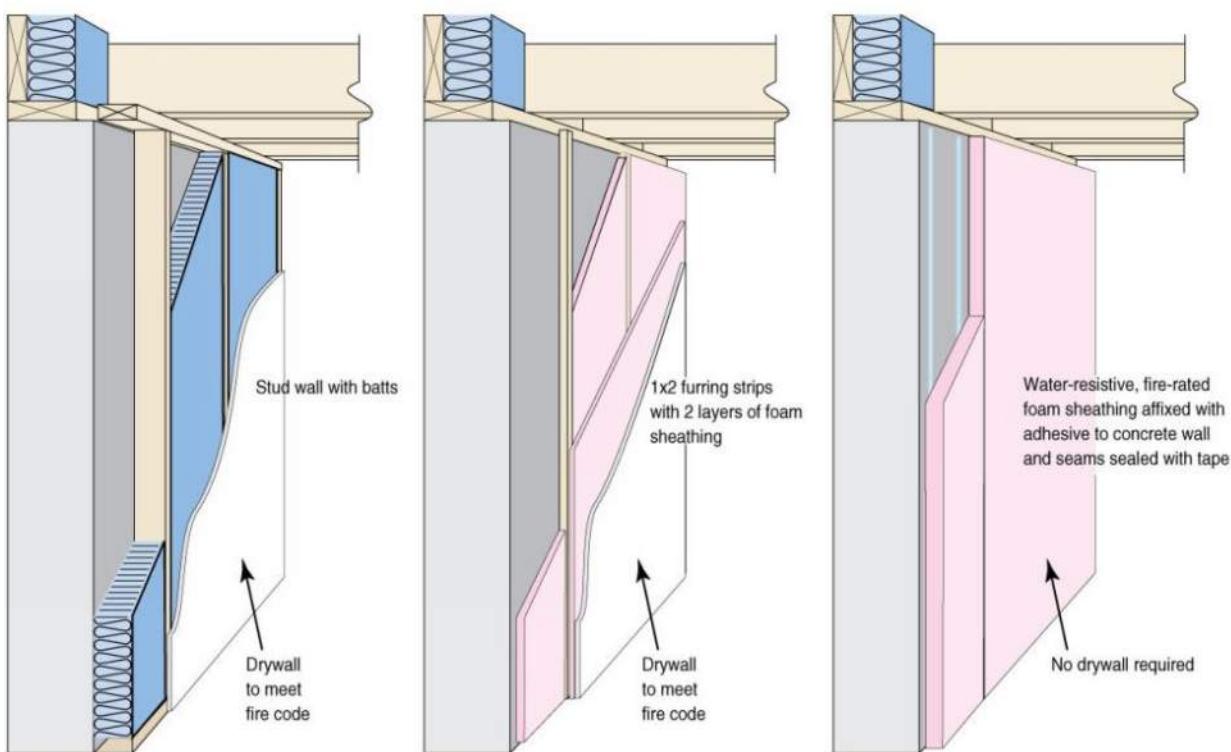
Install insulation on all exterior walls  $\geq R-13$ , including air-barriers behind showers and tubs on exterior walls. Cut batts in narrow cavities and around plumbing and wiring to fit per manufacturer's specifications, or fill narrow cavities with sprayed/blown insulation.

#### **2. Elevator walls adjacent to dwelling units $\geq R-13$**

Install insulation on elevator walls adjacent to dwelling units  $\geq R-13$ . Cut batts in narrow cavities and around plumbing and wiring to fit per manufacturer's specifications, or fill narrow cavities with sprayed/blown insulation.

#### **3. Foundation walls $\geq R-10$ continuous or $\geq R-13$ cavity**

Insulate foundation walls in Climate Zone 4 to minimum R-10 continuous or R-13 cavity insulation.



**Figure 49: Foundation wall insulation**

### Clarifications

Garage walls are considered exterior walls.

Foundation walls require insulation if inside building thermal envelope.

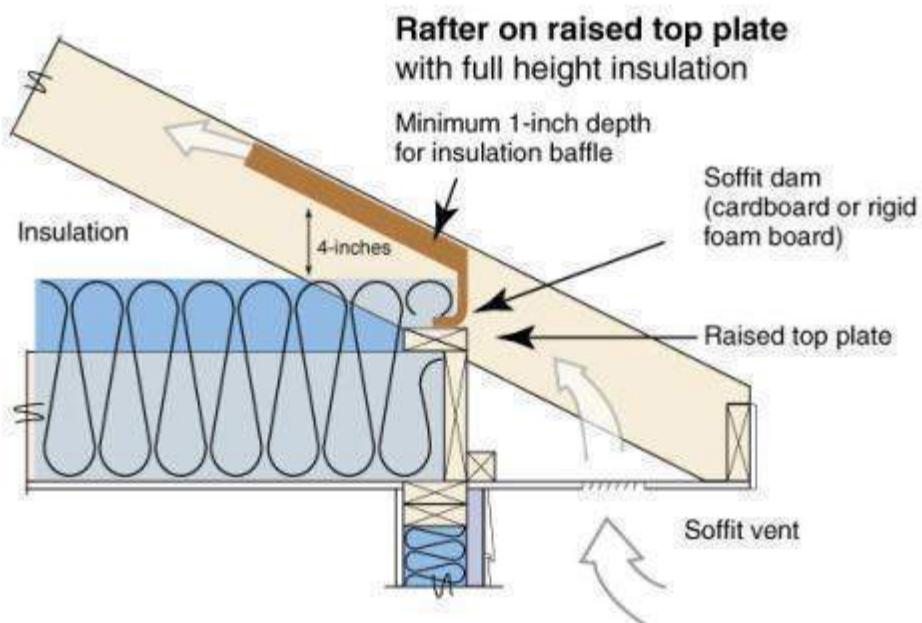
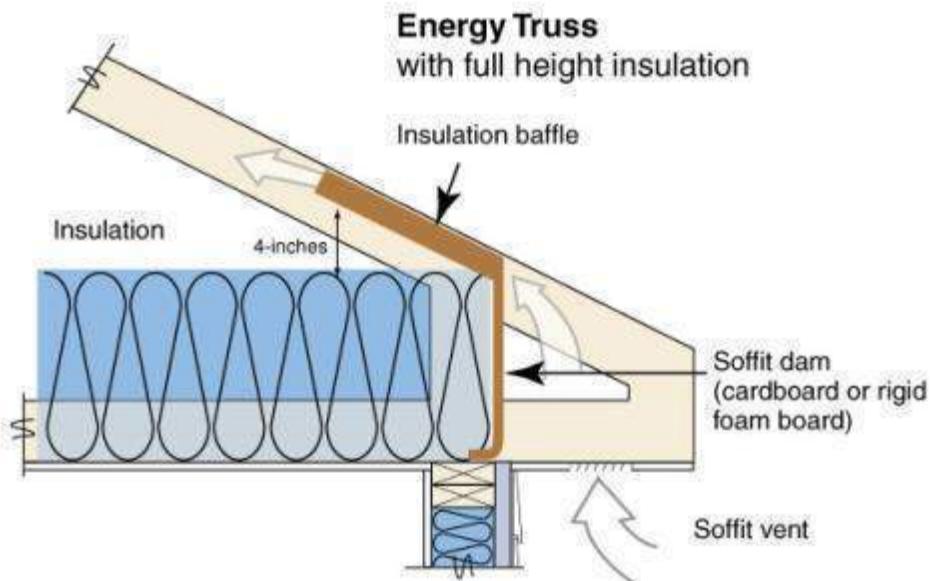
Insulation must be in permanent contact with foundation wall.

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at pre-drywall and final inspections.

**BE 3.2 Ceilings/Roof****Criteria****1. Vented Flat: Climate Zone 4  $\geq R-38$** 

Install insulation  $\geq R-38$  in Climate Zone 4. Continue full depth of insulation over perimeter top plates.



**Figure 50: Full insulation over top plate**

**2. Continuous Roof Deck: Climate Zone 4  $\geq R-20$** 

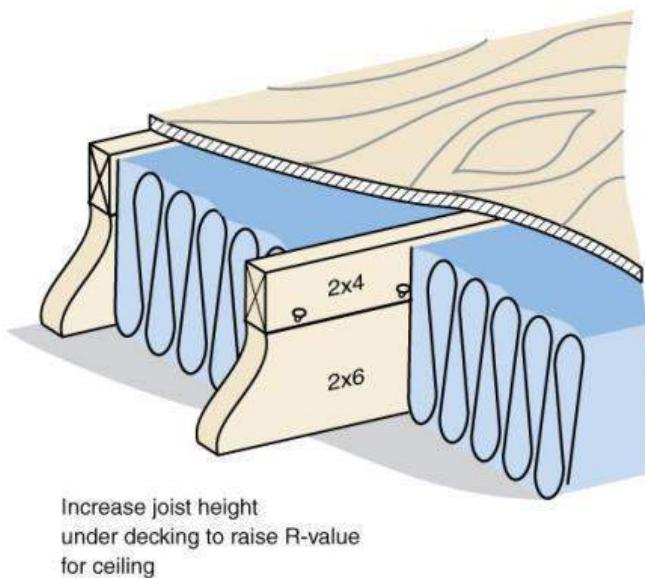
For roofs with continuous insulation located entirely above deck, insulate to  $\geq R-20$

**3. Sloped: Climate Zone 4  $\geq R-38$** 

In sloped ceilings with attic above, install insulation greater than or equal to R-38 in Climate Zone 4.

**Clarifications**

Flat ceiling insulation not installed to full depth (e.g., under attic platforms, over wall top plates at eaves, etc.) must be modeled at actual installed R-value but may not be modeled or installed less than R-21, and no more than 500 sq ft or 20% of the total insulated ceiling area, whichever is less, may be less than R-38 in Climate Zone 4.



**Figure 51: Raised joist to accommodate for insulation under attic platform**

Sloped ceilings with ambient above (e.g., cathedral ceilings) are not addressed under this criteria and should be addressed as part of the following EarthCraft criteria: "Insulate roofline of attic to create unvented attic  $\geq R-19$ ".

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at pre-drywall and final inspections.

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## BE 3.3 Attic/Roof

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**Criteria**

- 1. Install wind baffles at eaves in every vented bay, or equivalent air barrier at edge of ceiling**

Install wind baffles or blocking at eaves to prevent wind washing over insulation. Include a baffle in every bay or a tabbed baffle in each bay with a soffit vent that will also prevent wind washing of insulation in adjacent bays.

## 2. Energy heel trusses or raised top plates

Install energy heel trusses or raised top plates to ensure full depth of attic insulation above exterior wall top plates. Depth of insulation above top plate may be traded to R-21 when allowed by code and reflected in the energy model.

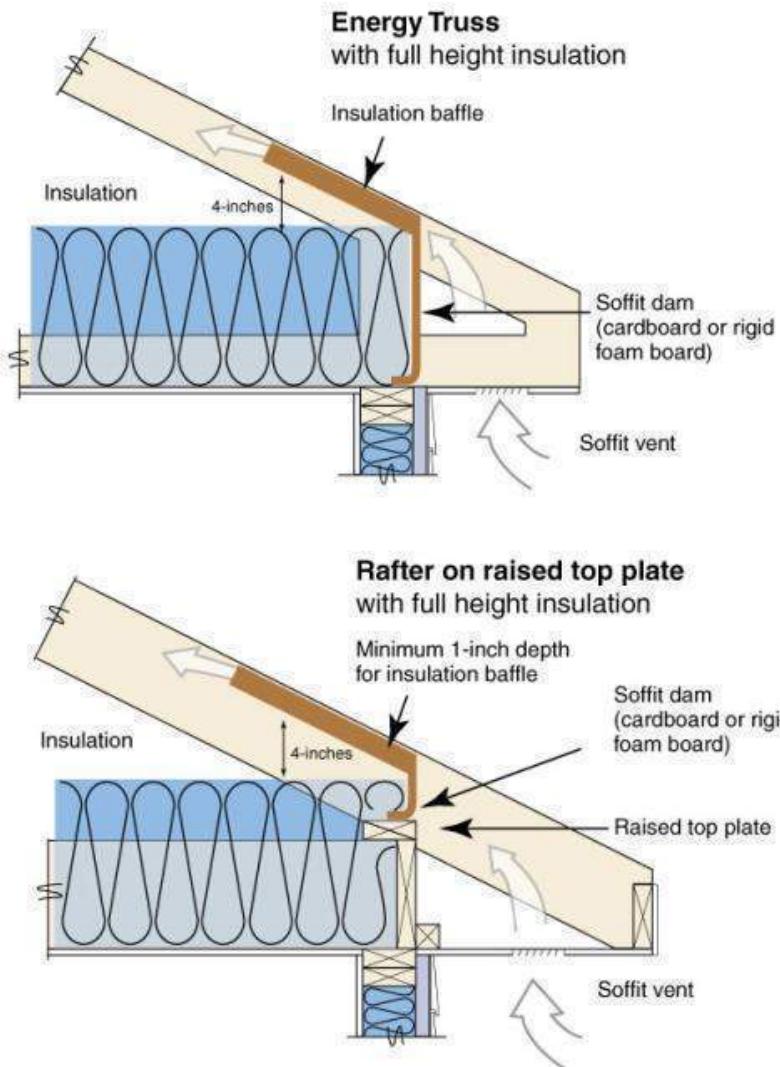


Figure 3: Energy heel truss (top), raised top plate (bottom)

## 3. Attic platforms allow for full-depth insulation below

Raise attic platforms to allow for full depth of insulation below meeting minimum flat ceiling R-value requirement. Access to equipment or storage with attic platform must be maintained without compressing insulation.

### Confirmation

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at pre-drywall inspection.

## BE 3.4 Attic kneewall

### Criteria

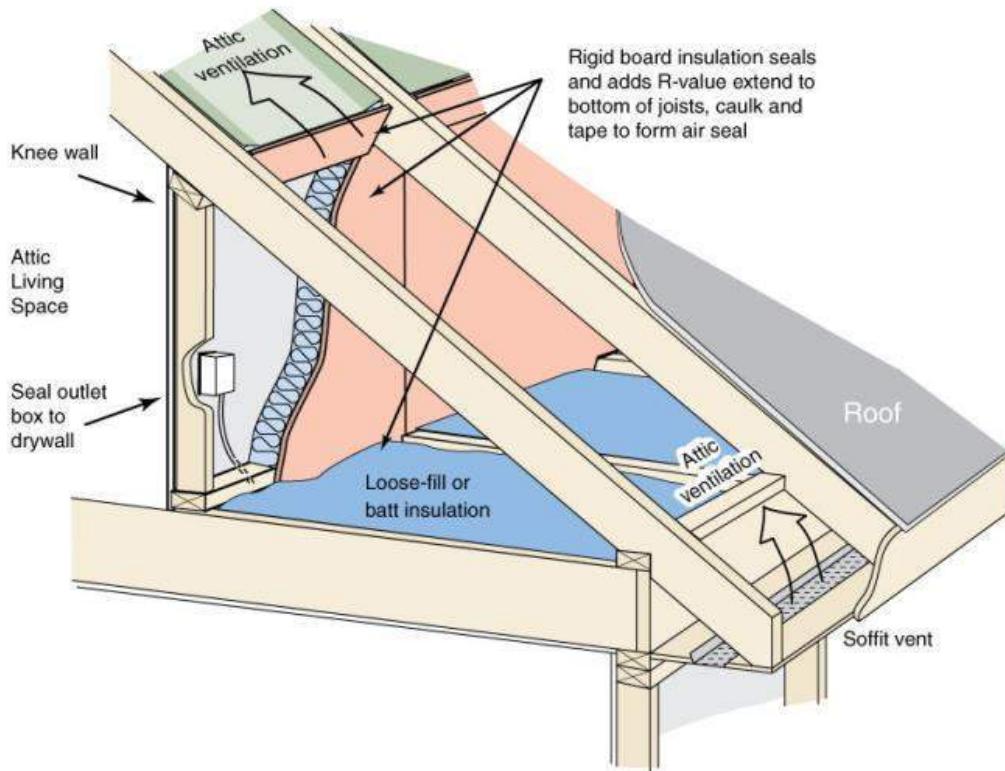
#### 1. Doors: Climate Zone 4 $\geq R-19$

Insulate doors separating conditioned space from unconditioned attic spaces to R-19 or greater in Climate Zone 4. Attic kneewall doors must allow for full depth of minimum R-value insulation when opened preventing damage of insulation overtime.

#### 2. Insulation and attic side air barrier: Climate Zone 4 $\geq R-19$

Install rigid attic side air barrier (e.g., foam board, plywood, OSB) along all kneewalls separating conditioned space from unconditioned attic space. Air barrier must align with bottom and top plates of attic kneewall to provide full insulation encapsulation on all 6 sides. Insulate kneewalls separating conditioned space from unconditioned attic space to R-19 or greater in Climate Zone 4.

Insulation must be in contact with attic side air barrier.



**Figure 53: Attic kneewall insulation and blocking**

### Example

A 2x4 wall assembly with R-13 batts and R-5 continuous rigid insulation, or a 2x6 wall assembly with R-19 batts.

### Confirmation

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at pre-drywall and final inspections.

## BE 3.5 Attic pull-down/scuttle hole: Climate Zone 4 ≥ R-38

### **Criteria**

Install pull-down attic stairs separating conditioned space from unconditioned attic space with an insulated box or other cover equal to or greater than R-38 in Climate Zone 4.

Insulate scuttle holes separating conditioned space from unconditioned attic space with batt insulation or rigid foam insulation equal to or greater than R-38 in Climate Zone 4.

### **Clarifications**

Insulation must completely cover rough opening of pull-down stairs. Compressed batts are not acceptable.

### **Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at final inspection.

## BE 3.6 If loose-fill attic insulation, install card and rulers

### **Criteria**

Install attic rulers facing the attic entrance every 300 sq ft to verify insulation depth. Post in the attic written documentation (an "attic card") specifying the insulation type, coverage area, and R-value.

### **Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at final inspection.

## BE 3.7 Steel-framed buildings require thermal break ≥ R-7.5

### **Criteria**

All steel-framed buildings must be insulated with continuous exterior insulation greater than or equal to R-7.5

### **Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance with criteria at final inspection.

## BE 3.8 Grade II insulation quality at all building envelope locations

### **Criteria**

Install insulation per manufacturer's recommendations to achieve quality Grade II as specified by criteria set forth by RESNET. All insulation must meet or exceed Grade II installation quality regardless of location in building.

### **Additional Resources**

For more details on RESNET insulation installation quality refer to Appendix A of RESNET Mortgage Industry National HERS Standards at:  
[http://resnet.us/standards/RESNET\\_Mortgage\\_Industry\\_National\\_HERS\\_Standards.pdf](http://resnet.us/standards/RESNET_Mortgage_Industry_National_HERS_Standards.pdf)

### **Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance with criteria at pre-drywall and final inspections.

## BE 3.9 Slab edge insulation: Climate Zone 4 $\geq R-10$

### Criteria

Install exterior slab insulation, Climate Zone 4  $\geq R-10$  (heated slabs  $\geq R-15$ ) so that it extends to the top of the slab. Slab edge insulation must extend to the bottom of the footing or 2' whichever is less.

### Clarifications

Where an insulated wall separates a garage, patio, porch or other unconditioned space from the conditioned space of the house, slab insulation shall also be installed at this interface to provide a thermal break between the conditioned and unconditioned slab, unless the slab is post-tensioned with integrated garage or porch foundations.

For exterior slab edge insulation, such as for monolithic slabs, install insulation with approved membranes, such as EPDM-type membranes, to protect against termites.

Non-monolithic slabs may use rigid insulation between the stem wall and the poured (floating) slab, using the protective membrane as a termite flashing and as a capillary break.

If the top edge of the insulation is installed between the exterior wall and the edge of the interior slab, it shall be permitted to be cut at a 45-degree angle away from the exterior wall.

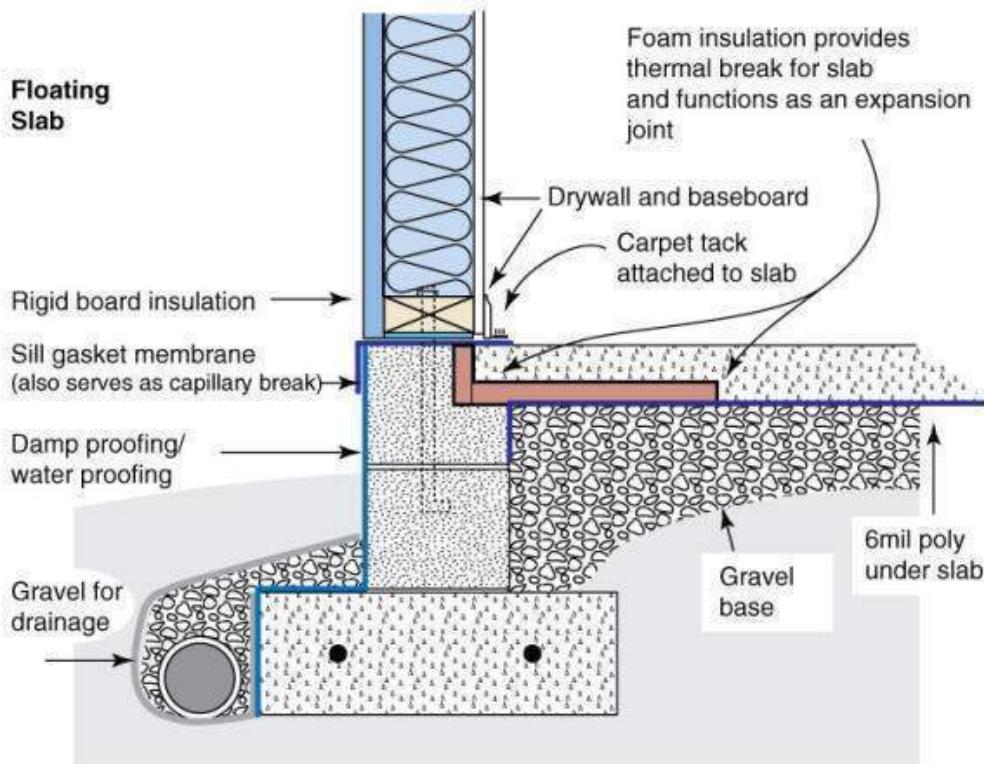


Figure 54: Slab edge insulation for floating slab

### Exemptions

Slab edge insulation is not required in jurisdictions designated by the local code official as having a very heavy termite infestation.

Slabs greater than 12" below grade as measured from the top of the slab are not required to have insulation.

#### **Confirmation**

- The builder will illustrate compliance through photo documentation submitted to the EarthCraft Technical Advisor at pre-drywall.
- The EarthCraft Technical Advisor will review photo documentation provided by the builder at pre-drywall.

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### **BE 3.10 Insulation installation quality (floors, walls and ceilings)**

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#### **Criteria**

##### **A. Grade I**

Install insulation per manufacturer's recommendations to achieve insulation quality Grade I as specified by criteria set forth by RESNET for all floors, walls and ceilings.

##### **B. Grade II with insulated sheathing $\geq R-3$ (100%)**

Install insulation with insulated sheathing  $\geq R-3$  on 100% of the building per manufacturer's recommendations to achieve insulation quality Grade II as specified by criteria set forth by RESNET for all floors, walls and ceilings. For steel-framed walls, the insulation must reach R-7.5 continuous insulation or greater.

#### **Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance with criteria at pre-drywall inspection.

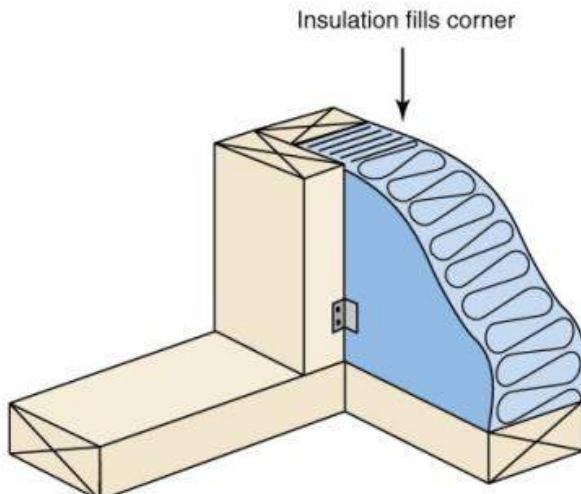
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### **BE 3.11 Corners $\geq R-6$**

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#### **Criteria**

Insulate the intersecting corner of two walls separating conditioned and unconditioned space to greater than or equal to R-6 so that insulation is continuous in the external wall.



**Figure 55: Insulated corner**

**Clarifications**

The "California corner" (i.e., two-stud corner with drywall clips or deadwood nails) is one method of meeting this requirement.

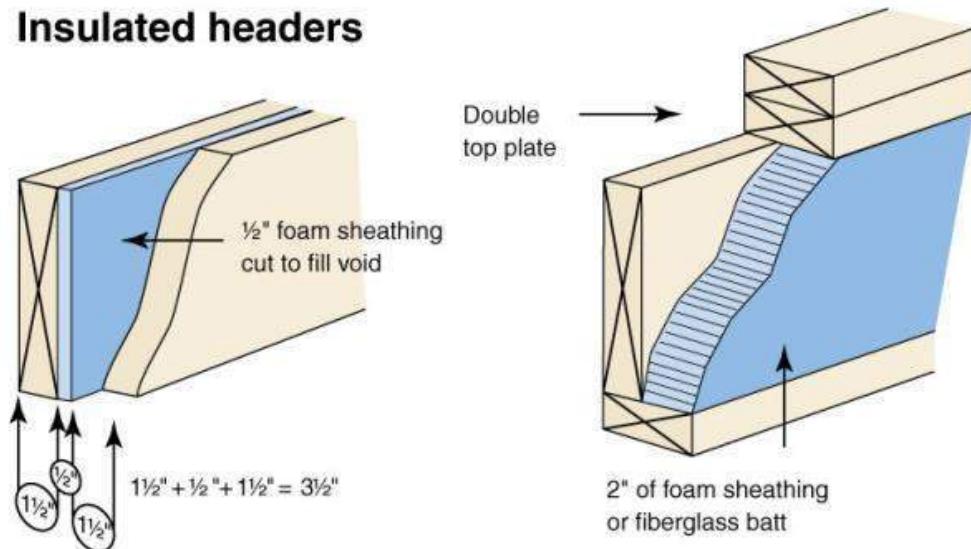
The corner must be fully insulated to achieve the intent; therefore corners with more than three studs are not permitted.

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance with criteria at pre-drywall inspection.

**BE 3.12 Headers ≥R-3****Criteria**

Insulate all headers on walls separating conditioned and unconditioned space to greater than or equal to R-3.

**Insulated headers**

**Figure 56: Insulated headers**

**Clarifications**

The R-value requirement refers to the insulation manufacturer's nominal insulation value.

**Examples**

Methods include substituting 1/2" plywood spacer with 1/2" rigid foam insulation, boxed headers with cavity insulation, pre-manufactured insulated headers, SIP headers and continuous rigid insulation sheathing.

**Exemptions**

Headers on exterior walls where the structural engineered framing layout indicates that full-depth solid headers are the only acceptable option are exempt from being insulated.

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance with criteria at pre-drywall inspection.

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**BE 3.13 Fiberglass batts are unfaced/friction fit**

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**Criteria**

Apply unfaced batt insulation to all exterior wall assemblies and use friction fit installation techniques between studs and joists.

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance with criteria at pre-drywall inspection.

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**BE 3.14 Exterior band areas have interior air barrier meeting required insulation values**

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**Criteria**

All exterior band areas must have an air barrier product applied to the interior side of the wall framing. One method to achieve this would include the application of a spray foam product to serve as insulation and an air barrier.

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance with criteria at pre-drywall inspections.

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**BE 3.15 Insulate with foam applied insulation**

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**Criteria**

1. *Exterior walls including band area*
2. *Floor system over crawlspace or basement*

**Clarifications**

Spray foam insulation must qualify as a full air barrier product in order to achieve credit.

**Confirmation**

- Project team will submit product specifications showing air barrier qualifications.
- The EarthCraft Technical Advisor will visually confirm compliance with criteria at pre-drywall inspection.

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**BE 3.16 Walls**

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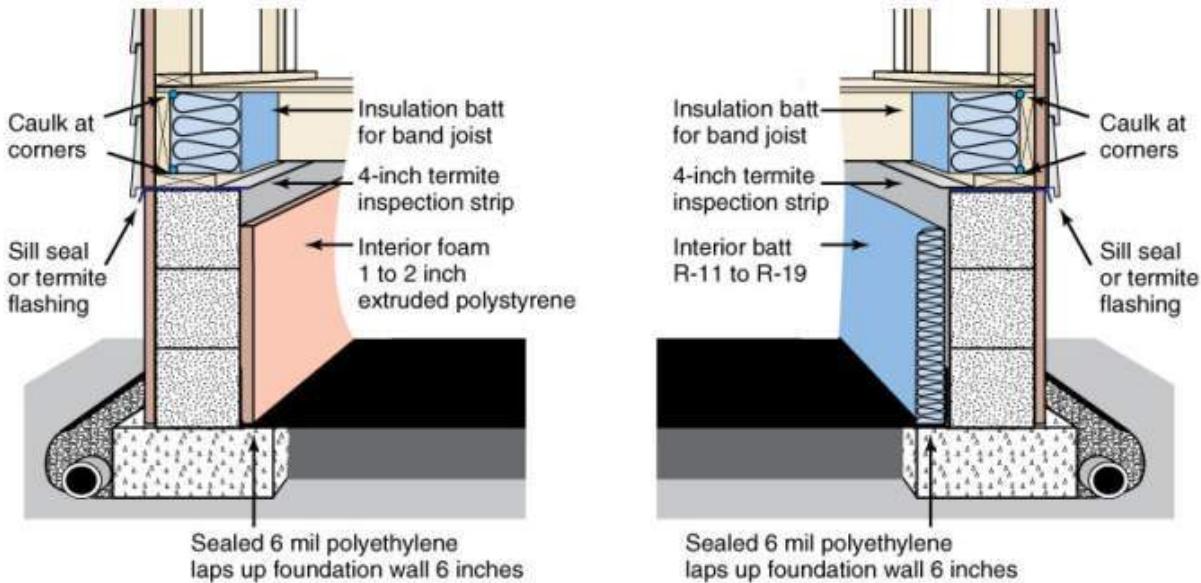
**Criteria**

1. *Seal and insulate crawlspace walls:*  
*Climate Zone 4 ≥R-10 continuous*

Permanently install insulation to crawlspace walls and extend downward from the termite inspection strip to within 9" of the finished interior grade adjacent to the foundation wall.

Provide a 3" inspection strip immediately below the floor joists to allow inspection for termites. (The inspection strip may be insulated with a removable section of insulation, but is not required to be insulated.)

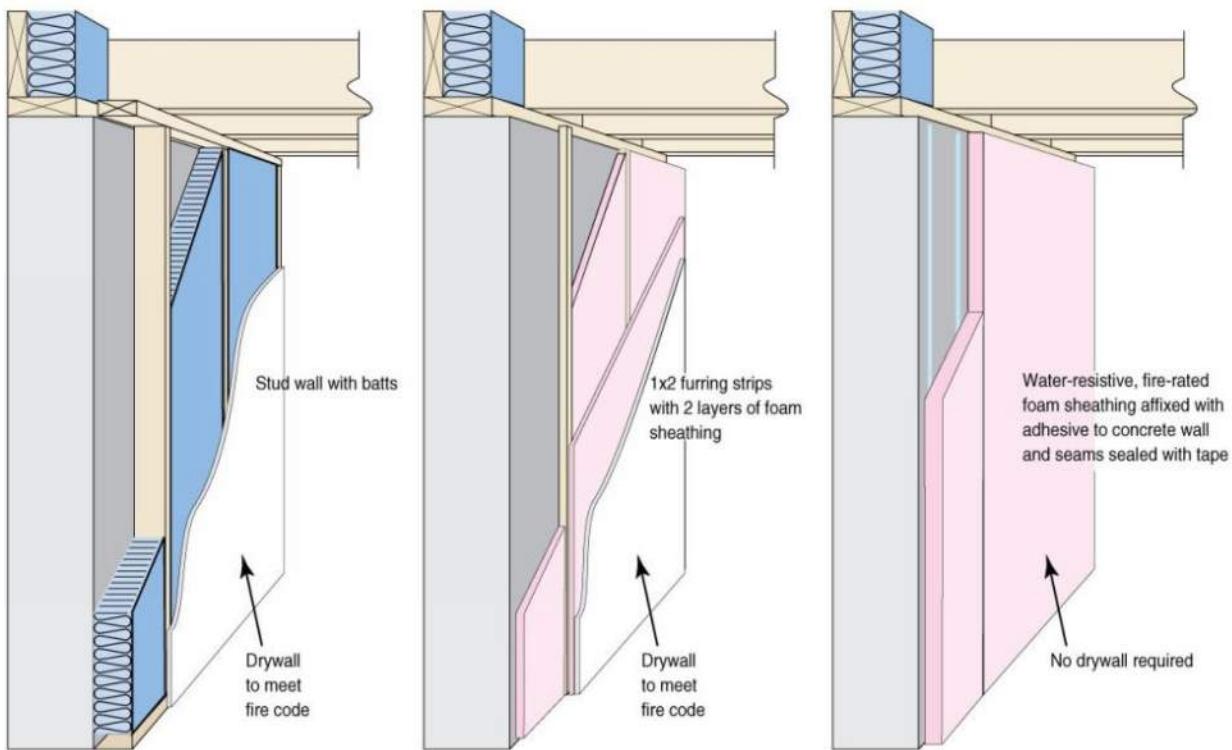
An additional strategy required to meet this credit intent is described in **DU 1.8**. If installed, crawlspace must be closed.



**Figure 57: Enclosed crawlspace with insulation along walls**

## 2. Insulate unfinished basement walls instead of ceiling

Insulate basement walls instead of floor-joist cavities over basement. Basement walls more than half below grade must be either R-13 cavity insulation or R-5 continuous insulation in Climate Zones 2 and 3 or R-10 continuous in Climate Zone 4. Use code-approved materials. Above-grade basement and foundation walls must be insulated to meet minimum wood or mass wall requirements (e.g., R-13 cavity insulation for wood frame wall).



**Figure 58: Basement wall insulation**

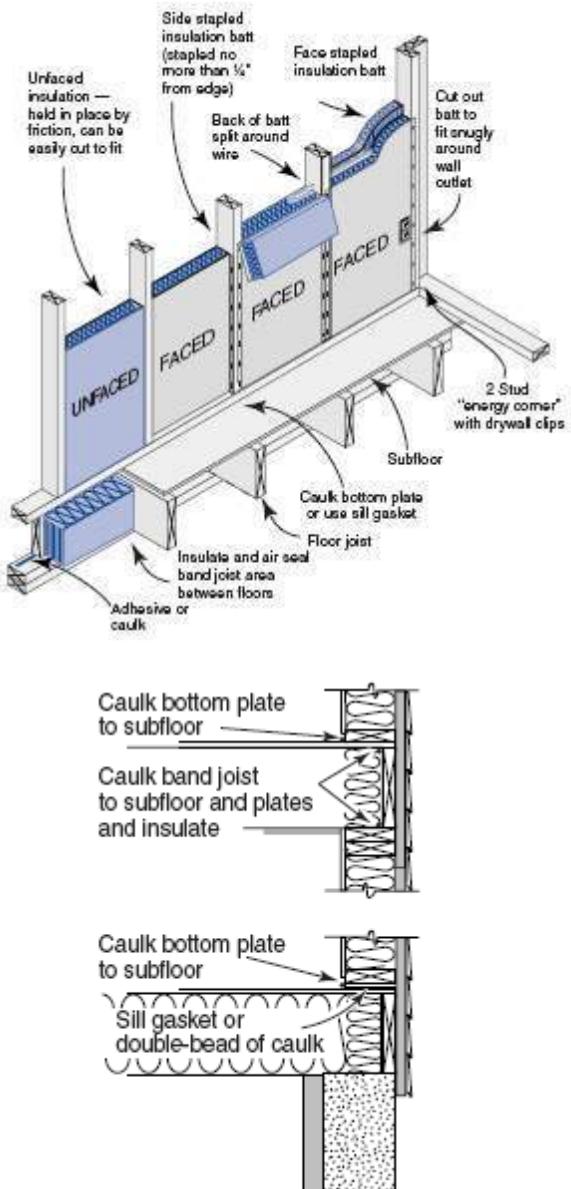
### **3. Insulate basement walls with continuous insulation**

Insulate below-grade basement walls with R-5 or greater continuous insulation in Climate Zones 2 and 3 or R-10 or greater continuous insulation in Climate Zone 4.

### **4. Insulate exterior walls and band joist $\geq R-19$**

Install wall stud cavity insulation to R-19 or greater in a minimum of 90% of all exterior framed walls and band joists adjacent to unconditioned spaces. Insulation must be installed according to manufacturer's specifications and meet RESNET Grade II criteria or better.

Insulate all band joist areas between conditioned floors using R-19 insulation. Insulation must be installed using manufacturer recommendation for permanent alignment with band joist.



**Figure 59: Exterior Wall and Band Joist Insulation**

## 5. Insulate exterior walls and band joist $\geq R-20$ or $\geq R-13$ cavity plus R-5 insulated sheathing

### Clarifications

Paper-faced batts may not be used on masonry walls.

### Example

To ensure continuous insulation, offset double stud walls, align double stud walls with continuous insulation between adjacent stud faces, or build single-stud walls with 2x2 or 2x3 cross-framing.

Typical products for providing continuous insulation of R-13 or greater include insulated concrete forms and structurally insulated panels (SIPs). SIP walls using occasional (e.g.,  $\geq 4'$  on center) studs for locking mechanisms between SIP panels qualify.

**Additional Resources**

For more detailed information on enclosing crawlspaces, refer to [www.crawlspaces.org](http://www.crawlspaces.org).

For more details on RESNET insulation installation quality refer to Appendix A of RESNET Mortgage Industry National HERS Standards at:

[http://resnet.us/standards/RESNET\\_Mortgage\\_Industry\\_National\\_HERS\\_Standards.pdf](http://resnet.us/standards/RESNET_Mortgage_Industry_National_HERS_Standards.pdf).

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance with criteria at pre-drywall inspection.

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**BE 3.17 Continuous exterior insulation**

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**Criteria****A.  $\geq R-3$  (100%)**

Install R-3 or greater continuous insulation on all exterior walls. Install sheathing to have no gaps greater than 1/4" and provide complete coverage. Where structural sheathing is required by code, install a structurally rated insulated sheathing or over-sheath using insulated sheathing.

**B.  $\geq R-5$  (100%)**

Install R-5 or greater continuous insulation on all exterior walls. Install sheathing to have no gaps greater than 1/4" and provide complete coverage. Where structural sheathing is required by code, install a structurally rated insulated sheathing or over-sheath using insulated sheathing.

**Clarifications**

Insulated siding may not be substituted for insulated wall sheathing without preapproval by EarthCraft.

These points are attainable only for wood-framed construction. Steel studs will require a thermal break of R-7.5 per ASHRAE 90.1 standards.

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance with criteria at pre-drywall inspection.

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**BE 3.18 Ceilings**

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**Criteria****1. Flat Vented: Climate Zone 4  $\geq R-49$** 

Insulate flat ceilings with unconditioned attic space above using R-49 or greater in Climate Zone 4. A maximum of 5% of ceiling area up to 500 sq ft may be R-30 or greater to accommodate elevated attic flooring for storage and mechanical equipment.

**2. Continuous Roof Deck: Climate Zone 4  $\geq R-30$** 

For roofs with continuous insulation located entirely above deck, insulate to  $\geq R-30$

**3. Sloped: Climate Zone 4  $\geq R-49$** 

Insulate sloped ceilings using R-49 or greater Climate Zone 4.

**Clarifications**

Insulated rooflines and vaulted cathedral ceilings are not considered sloped ceilings; sloped ceilings are defined to have unconditioned attic space above.

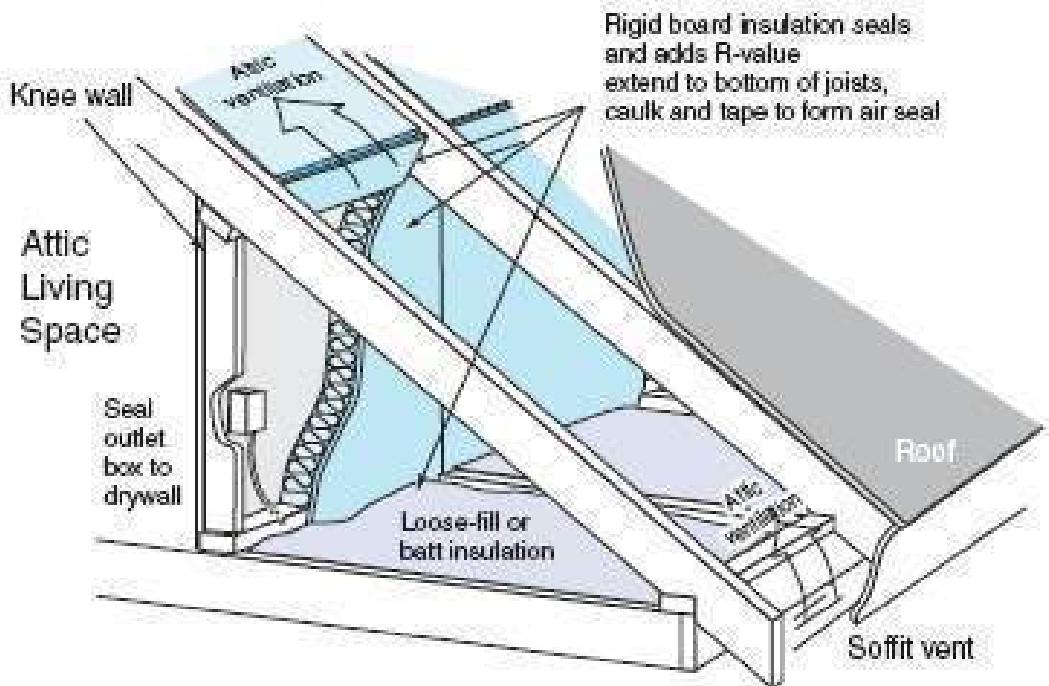
Please see the following criteria related to insulated rooflines and vaulted cathedral ceilings: "Insulate roofline of attic to create unvented attic  $\geq R-19$ ".

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at final inspection.

**BE 3.19 Attic kneewall insulated  $\geq R-22$** **Criteria*****2x6 with  $\geq R-19$  cavity insulation and  $\geq R-3$  insulated sheathing***

Construct attic kneewalls using 2x6 framing (or 2x4 framing furred out 2"), and install R-19 cavity insulation. Install R-3 rigid insulated sheathing on attic side of framing. Seal top and bottom of attic side sheathing to plates and seal all seams and joints.



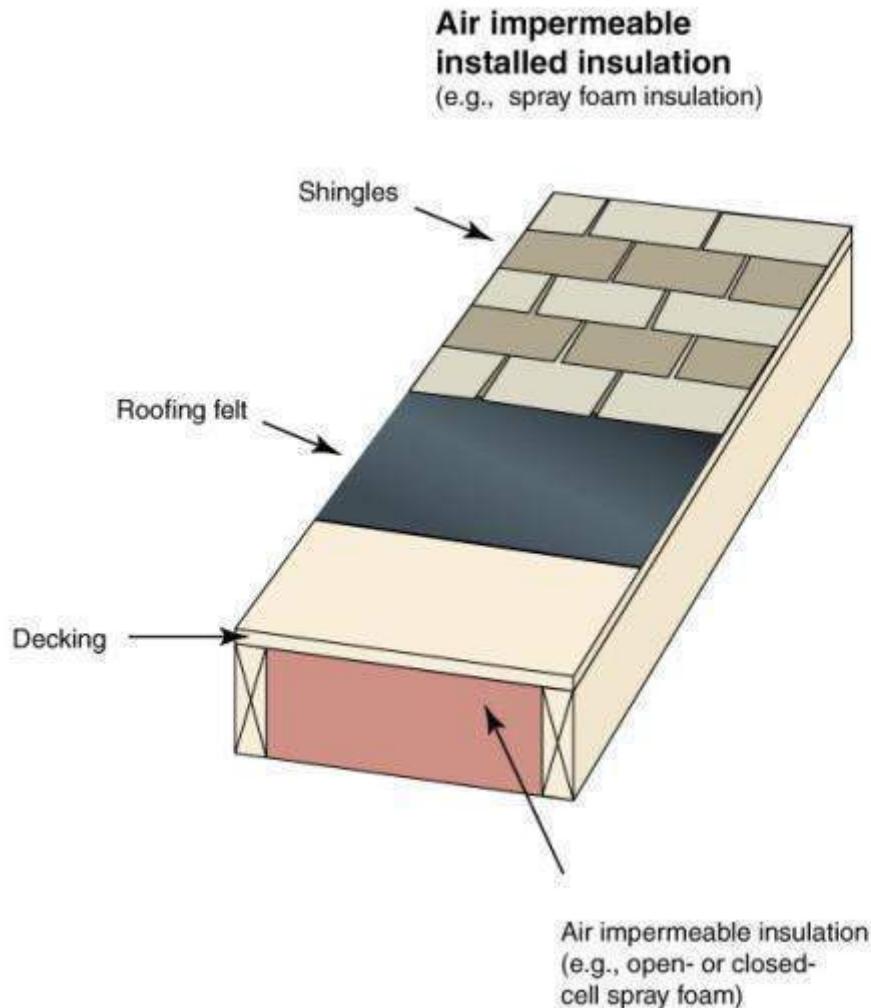
**Figure 60: Attic kneewall insulation**

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at pre-drywall and final inspections.

**BE 3.20 Insulate roofline to  $\geq R-30$** **Criteria*****Insulate roofline with spray foam***

Insulate roofline of attic using foam insulation  $\geq R-30$  to create an unvented attic.



**Figure 61: Insulated Roofline**

**Clarifications**

Ridge, soffit, gable or other attic ventilation is prohibited.

Manufacturer recommended installation procedures and ignition barrier code requirements must be followed.

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at pre-drywall and final inspections.

## Windows

### BE 4.0 Door U-factor and SHGC

#### Criteria

**1. U-factor: Climate Zone 4 ≤ 0.35**

All doors in Climate Zone 4 must have a U-factor less than or equal to 0.35.

**2. SHGC ≤ 0.30**

All doors in Climate Zones 4 must have a Solar Heat Gain Coefficient (SHGC) less than or equal to 0.30.



Figure 62: NFRC window label

#### Clarifications

The U-factor for doors applies to the whole door assembly not just the glass portion.

#### Exemptions

If a building meets the requirements for BE 4.12 "certified passive solar design", windows, skylights and doors need only meet mandatory U-factor (0.48 in Climate Zone 4) and SHGC (0.50 in Climate Zones 2 and 3) requirements in the 2009 IECC. The mandatory requirements are different from the prescriptive requirements.

**Confirmation**

- The builder must present documentation demonstrating compliance of criteria to the EarthCraft Technical Advisor at the pre-drywall inspection.
- The EarthCraft Technical Advisor will review documentation provided by the builder for compliance of criteria.

---

**BE 4.1 Window U-factor and SHGC**

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**Criteria****1. *U-factor Climate Zone 4 ≤ 0.35***

All windows in Climate Zone 4 must have a U-factor less than or equal to 0.35.

**2. *SHGC ≤ 0.30***

All windows in Climate Zones 4 must have a Solar Heat Gain Coefficient (SHGC) less than or equal to 0.30.

**Clarifications**

Floor area must equal conditioned floor area used for the confirmed HERS energy model.

**Exemptions**

If a building meets the requirements for BE 4.12 "certified passive solar design", windows, skylights and doors need only meet mandatory U-factor (0.48 in Climate Zone 4) and SHGC (0.50 in Climate Zone 2 and 3) requirements in the 2009 IECC. The mandatory requirements are different from the prescriptive requirements.

**Confirmation**

- The builder must present documentation demonstrating compliance of criteria to the EarthCraft Technical Advisor at the pre-drywall inspection.
- The EarthCraft Technical Advisor will review documentation provided by the builder for compliance of criteria.

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**BE 4.2 Skylight U-factor and SHGC**

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**Criteria****1. *U-factor; Climate Zone 4 ≤ 0.60***

All skylights in Climate Zone 4 must have a U-factor less than or equal to 0.60.

**2. *SHGC ≤ 0.30***

All windows in Climate Zones 4 must have a Solar Heat Gain Coefficient (SHGC) less than or equal to 0.30.

**Clarifications**

Floor area must equal conditioned floor area used for the confirmed HERS energy model.

**Exemptions**

If a building meets the requirements for BE 4.12 "certified passive solar design", windows, skylights and doors need only meet mandatory U-factor (0.48 in Climate Zone 4) and SHGC (0.50 in Climate Zone 2 and 3) requirements in the 2009 IECC. The mandatory requirements are different from the prescriptive requirements.

**Confirmation**

- The builder must present documentation demonstrating compliance of criteria to the EarthCraft Technical Advisor at the pre-drywall inspection.

- The EarthCraft Technical Advisor will review documentation provided by the builder for compliance of criteria.

## BE 4.3 NFRC certified Doors, windows and skylights with label

### Criteria

Install doors, windows and skylights labeled by the National Fenestration Rating Council (NFRC).

### Exemptions

Up to 15 sq ft of glazing are exempt from this requirement.

### Confirmation

- The builder must present documentation demonstrating compliance of criteria to the EarthCraft Technical Advisor at the pre-drywall inspection.
- The EarthCraft Technical Advisor will review documentation provided by the builder for compliance of criteria.

## BE 4.4 Door U-factor

### Criteria

**1. Opaque door: U-factor ≤0.21**

All opaque doors (doors with no glass) in climate zone 2, 3, and 4 must have a U-factor of 0.21 or less.

**2. Door with ≤ half-glass: U-factor ≤0.27**

All glass doors composed of less than half-glass or half glass must have a U-factor of 0.27 or less.

**3. Door with > half-glass: U-factor ≤0.32**

All glass doors composed of more than half-glass must have a U-factor of 0.32 or less.

### Clarifications

The U-factor for doors applies to the whole door assembly not just the glass portion.

### Confirmation

- The builder must present documentation demonstrating compliance of criteria to the EarthCraft Technical Advisor at the pre-drywall inspection.
- The EarthCraft Technical Advisor will review documentation provided by the builder for compliance of criteria.

## BE 4.5 Window U-factor and SHGC

### Criteria

**1. U-factor: Climate Zone 2 ≤0.45, Climate Zone 3 ≤0.35, Climate Zone 4 ≤0.32**

All windows in Climate Zone 2 must have a U-factor less than or equal to 0.45.

All windows in Climate Zone 3 must have a U-factor less than or equal to 0.35.

All windows in Climate Zone 4 must have a U-factor less than or equal to 0.32.

**2. SHGC: Climate Zone 2/3/4 ≤0.27**

All windows in Climate Zones 2, 3, and 4 must have a Solar Heat Gain Coefficient (SHGC) less than or equal to 0.27.

### **Clarifications**

0.75% window to conditioned floor area (WFA) ratio, up to 15 square feet of window area, may be used for decorative glass that does not meet this requirement.

The U-factor for doors applies to the whole widow assembly not just the glass portion.

Floor area must equal conditioned floor area used for the confirmed HERS energy model.

### **Confirmation**

- The builder must present documentation demonstrating compliance of criteria to the EarthCraft Technical Advisor at the pre-drywall inspection.
- The EarthCraft Technical Advisor will review documentation provided by the builder for compliance of criteria.

---

## **BE 4.6 Skylight U-factor and SHGC**

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### **Criteria**

#### **1. U-factor: Climate Zone 2 ≤0.70, Climate Zone 3 ≤0.57, Climate Zone 4 ≤0.55**

All skylights in Climate Zone 2 must have a U-factor less than or equal to 0.70.

All skylights in Climate Zone 3 must have a U-factor less than or equal to 0.57.

All skylights in Climate Zone 4 must have a U-factor less than or equal to 0.55.

#### **2. SHGC ≤0.27**

All skylights in Climate Zones 2, 3, and 4 must have a Solar Heat Gain Coefficient (SHGC) less than or equal to 0.27.

### **Clarifications**

0.75% window to conditioned floor area (WFA) ratio, up to 15 square feet of window area, may be used for decorative glass that does not meet this requirement.

Floor area must equal conditioned floor area used for the confirmed HERS energy model.

### **Confirmation**

- The builder must present documentation demonstrating compliance of criteria to the EarthCraft Technical Advisor at the pre-drywall inspection.
- The EarthCraft Technical Advisor will review documentation provided by the builder for compliance of criteria.

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## **BE 4.7 Window U-factor and SHGC**

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### **Criteria**

#### **1. U-factor: Climate Zone 2 ≤0.35, Climate Zone 3 ≤0.30, Climate Zone 4 ≤0.25**

All windows in Climate Zone 2 must have a U-factor less than or equal to 0.35.

All windows in Climate Zone 3 must have a U-factor less than or equal to 0.30.

All windows in Climate Zone 4 must have a U-factor less than or equal to 0.25.

#### **2. SHGC: Climate Zone2/3/4 ≤0.24**

All windows in Climate Zones 2, 3, and 4 must have a Solar Heat Gain Coefficient (SHGC) less than or equal to 0.24.

### **Clarifications**

0.75% window to conditioned floor area (WFA) ratio, up to 15 square feet of window area excluding western exposures, may be used for decorative glass that does not meet this requirement.

Floor area must equal conditioned floor area used for the confirmed HERS energy model.

### **Confirmation**

- The builder must present documentation demonstrating compliance of criteria to the EarthCraft Technical Advisor at the pre-drywall inspection.
- The EarthCraft Technical Advisor will review documentation provided by the builder for compliance of criteria.

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## **BE 4.8 Skylight U-factor and SHGC**

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### **Criteria**

#### **1. *U-factor: Climate Zone 2 ≤0.55, Climate Zone 3 ≤0.45, Climate Zone 4 ≤0.43***

All skylights in Climate Zone 2 must have a U-factor less than or equal to 0.55.

All skylights in Climate Zone 3 must have a U-factor less than or equal to 0.45.

All skylights in Climate Zone 4 must have a U-factor less than or equal to 0.43.

#### **2. *SHGC ≤0.24***

All windows in Climate Zones 2, 3, and 4 must have a Solar Heat Gain Coefficient (SHGC) less than or equal to 0.24.

### **Confirmation**

- The builder must present documentation demonstrating compliance of criteria to the EarthCraft Technical Advisor at the pre-drywall inspection.
- The EarthCraft Technical Advisor will review documentation provided by the builder for compliance of criteria.

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## **BE 4.9 West and East facing glazing**

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### **Criteria**

#### **1. *West facing glazing ≤2% of floor area***

The total window or door glazing area within 25 degrees of due west must be less than or equal to 2% of the total conditioned floor area.

#### **2. *East facing glazing ≤3% of floor area***

The total window or door glazing area within 25 degrees of due east must be less than or equal to 3% of the total conditioned floor area.

### **Clarifications**

Floor area must equal conditioned floor area used for the confirmed HERS energy model.

### **Example**

A unit with total conditioned floor area of 2,000 square feet may not have more than 60 sq ft of window and door glazing area within 25 degrees of due west.

**Confirmation**

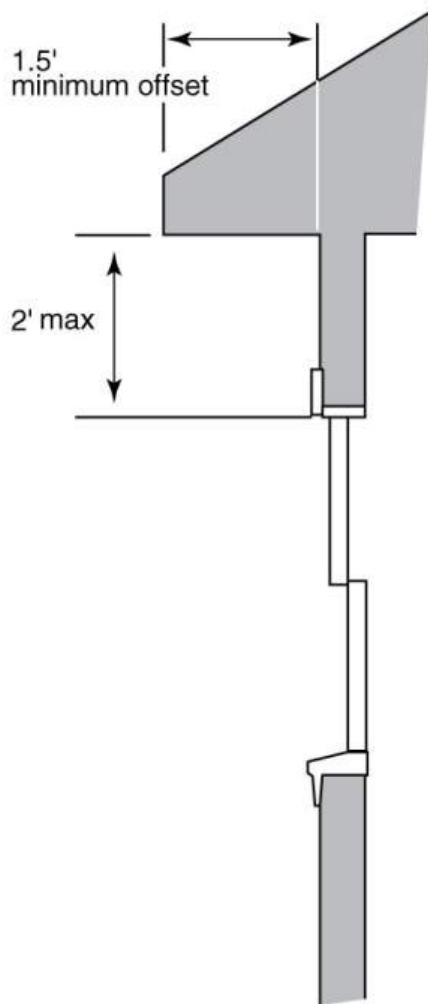
- The builder must present documentation demonstrating compliance of criteria to the EarthCraft Technical Advisor at the pre-drywall inspection.
- The EarthCraft Technical Advisor will review documentation provided by the builder for compliance of criteria and visually confirm at final inspection.

**BE 4.10 1.5' overhangs over 80% of south-facing window area****Criteria**

Maintain a 1.5' overhangs on 80% of all south-facing window area to protect against moisture and summer solar gain. Maximum overhang height above window is 2'.

**Clarifications**

Installed gutters may not contribute to the 1.5' distance.



**Figure 63: Window overhang**

**Additional Resources**

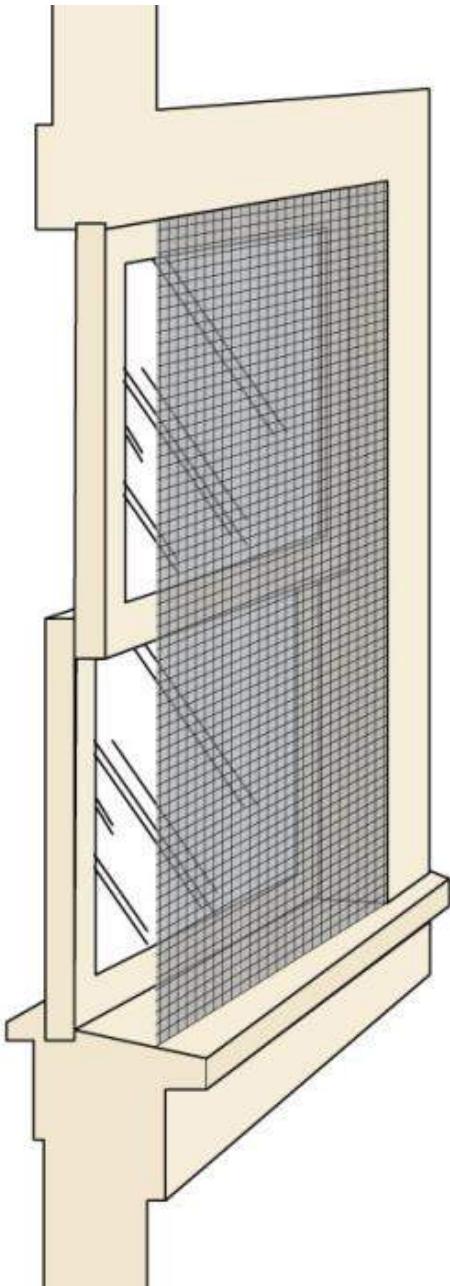
For an overhang design tool to analyze the shading performance of an overhang see [www.susdesign.com/overhang/index.php](http://www.susdesign.com/overhang/index.php).

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at pre-drywall inspection.

**BE 4.11 Solar shade screens (all east and west facing windows)****Criteria**

Install solar shade screens on all east and west facing windows with a shading coefficient of 0.7 or greater. Shade screen must be installed on exterior of window glazing.



**Figure 64: Solar shade screen**

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at final inspection.

## BE 4.12 Certified passive solar design (25% load reduction)

### Criteria

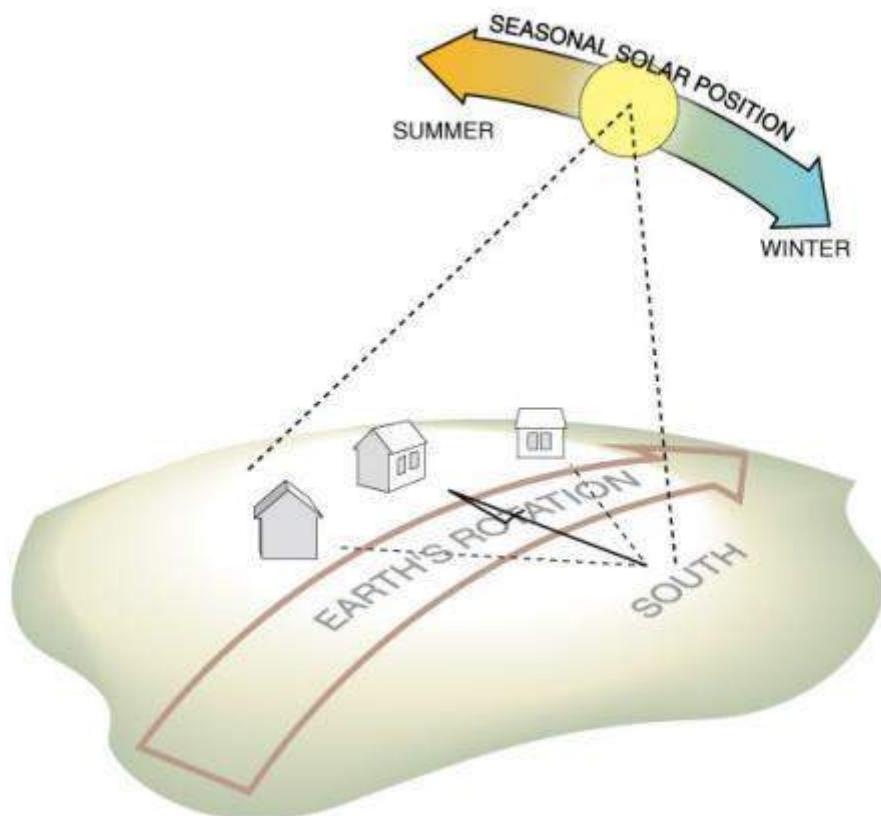
Certified passive solar heating contribution reduces the total heating loads by 25% or greater and does not increase cooling loads by more than 10%. Certification must be based on Energy 10 or similar EarthCraft approved modeling program.

### Clarifications

EarthCraft window requirements do not need to be met if windows are facing within 15 degrees of true south and directly coupled to a thermal storage mass that has a heat capacity  $\geq 20 \text{ Btu/ft}^3 \times ^\circ\text{F}$  and provided in a ratio of at least 3 sq ft per sq ft of south facing fenestration. For the required heat capacity, thermal masses typically must be at least 2" thick. Code compliance must be demonstrated using modeling software.

### Additional resources:

For additional information on Energy 10, go to [www.sbicouncil.org](http://www.sbicouncil.org).



**Figure 65: Seasonal solar position**

### Confirmation

- The project team must submit documentation demonstrating compliance with criteria to the EarthCraft Technical Advisor at the pre-drywall inspection.
- The EarthCraft Technical Advisor will review documentation provided by the project team for compliance with criteria.

## BE 4.13 Window area is ≤15% of conditioned floor area (all units)

### Criteria

To improve energy efficiency and comfort by reducing the solar heat gain into individual units. Keeping the window to conditioned floor area ratio at a minimum will improve the results of the unit level energy models.

### Clarification

Area of glazing equals 100 square feet and conditioned floor area of unit is equal to 850 square feet.

$$\frac{100\text{sf of glazing}}{850\text{sf of floor area}} = .118 \text{ ratio or } 11.8\%$$

### Confirmation

- The project team must submit unit level calculations demonstrating compliance with criteria.
- The EarthCraft Technical Advisor will visually verify window to CFA ratios during site inspections.

## Roof

## BE 5.0 Install green roof system

### Criteria

Install a green roof system on a percentage of the total roof area across the development in order to manage storm water runoff, provide additional insulation value, and combat the heat island effect.

- A. **≥20% of roof area is covered by a green roof system.**
- B. **≥40% of roof area is covered by a green roof system.**
- C. **≥60% of roof area is covered by a green roof system.**

### Example

A roof partially or completely covered by vegetation on top of a growing medium and a waterproof membrane.

### Confirmation

- The project team must provide design details demonstrating compliance with criteria at a specified level (20%/40%/60%).
- The EarthCraft Technical Advisor will visually confirm compliance with criteria at final inspection.

## Energy Efficient Systems

Constructing an energy-efficient development provides a variety of benefits to both occupants and to the environment. Once the building envelope has been designed, evaluating heating and cooling systems, ventilation, domestic water heating, lighting, and appliances, using the house-as-a-system approach is critical to achieving high performance buildings.

An energy efficient home not only saves a resident on their utility bills but also improves their comfort and health. Comfort is a function of air temperature, relative humidity, and radiant heating and cooling, all of which are impacted by the energy systems used in the project. In addition, using less energy reduces the need to extract natural resources,

reduces air pollution, and eases the strain on our water resources. Buildings account for about 40% of all energy use in the United States. EarthCraft encourages the use of energy efficient systems to reduce this impact.

## Heating and Cooling

### **ES 1.0 Size and select all HVAC equipment with ACCA Manuals J and S**

#### **Criteria**

Size and select all HVAC equipment in accordance with ACCA Manuals J and S. Load calculation must coordinate with accurate construction specifications and plans for the project as well as as-built conditions.

**1. Complete load calculation with accredited ACCA Manual J 8th Edition Software or stamp by a Professional Engineer**

Load calculation must be based on ACCA Manual J 8<sup>th</sup> Edition Software. The following software programs are ACCA Manual J 8<sup>th</sup> Edition compliant:

- Wrightsoft Right-J8
- Elite RHVAC

OR

Load calculation must be stamped by a Professional Engineer along with a signed "Professional Engineer Load Calculation Affidavit."

**2. Based on worst case unit orientation**

Load calculation must be based on worst case orientation for each unit type as constructed.

**3. Use 2009 ASHRAE Handbook of Fundamentals Climate Design Information for outdoor design temperatures**

Design heating and cooling systems using the annual outdoor design conditions as defined in the 2009 ASHRAE Handbook of Fundamentals, Chapter 14.

- The 99% design conditions must be used to size heating equipment
- The 1% design conditions must be used to size cooling equipment

**4. Indoor temperatures 70°F for heating and 75°F for cooling**

Design heating and cooling systems using indoor design temperatures of 70°F for heating and 75°F for cooling.

**5. Base infiltration on project team selected infiltration goal.**

Select project team infiltration goal or software equivalent for unit infiltration.

**6. Use actual area, U-factor and SHGC for windows and doors, actual area and R-values of floors, walls and ceilings**

Load calculation must be based on actual window, insulation and door specifications as installed. Window, door, wall, floor, and ceiling areas must be ±10% of actual areas as constructed.

**7. Base mechanical ventilation on ASHRAE 62.2 or BSC-01 standard**

Load calculation must be based on ventilation system designed and installed to meet ASHRAE 62.2-2007 or BSC - 01. This includes the ventilation system type, location, design rate, and frequency and duration of each ventilation cycle.

**8. Cooling equipment and/or single-stage heat pump between 95-125% for heat pump**

Cooling equipment selection must be between 95-115% of load calculation or the next available size unit. Installed heat pumps in Climate Zone 4 must be within 125% of load calculation or the next available size unit.

### **Clarifications**

The abridged edition of ACCA Manual J is not an acceptable methodology within the EarthCraft program.

Multispeed or multistage equipment may have OEM nominal size increments of one ton. Therefore, the use of multispeed or multistage equipment can provide extra flexibility to meet the equipment sizing requirements. The equipment oversizing limit should be based on the largest capacity of the unit.

Floor area must equal conditioned floor area used for the confirmed HERS energy model.

Base infiltration may use more stringent criteria such as "tight" for whole house infiltration.

### **Example #1**

Equipment sizing selection:

If the load calculation specifies a total sensible load of 36,000 Btuh, the 115% oversizing limit allows for using up to 41,400 Btuh:

$$36,000 \times 1.15 = 41,400 \text{ Btuh}$$

If Manufacturer X (the trusted brand of Builder Y) makes a nominal 3 ton unit and a nominal 4 ton unit, but no sizes in between, then Builder Y may install the 4 ton unit made by Manufacturer X as long the nominal 3 ton unit has insufficient capacity (i.e. total capacity of 33,000 Btuh). Alternately, if Builder Y wanted to use equipment from Manufacturer Z and Manufacturer Z offers nominal 3 ton (33,000 Btuh), 3.5 ton (39,400 Btuh) and 4 ton units (45,800 Btuh), then Builder Y must install the nominal 3.5 ton unit by Manufacturer Z because the unit is between the Manual J specification and the 115% oversizing limit required by EarthCraft.

### **Example #2**

The Builder meets with the HVAC contractor regarding the scope of work for the project including this line item. The HVAC contractor provides a Manual J load calculation to the builder that matches the construction specifications, plans, intended construction, and appropriate items on the EarthCraft Worksheet. Prior to submitting the documentation to the EarthCraft Technical Advisor, the builder randomly selects one of each window, door, wall, floor, and ceiling for area, U-factor, and SHGC to confirm that the load calculation and associated HVAC sizing meets the criteria intent. Then, prior to submittal to EarthCraft, the EarthCraft Technical Advisor randomly selects one of each window, door, wall, floor, and ceiling for area, U-factor, and SHGC to confirm that the load calculation and associated HVAC sizing meets the criteria intent.

### **Additional Resources**

2009 ASHRAE Handbook of Fundamentals Climate Design Information (abridged)

Meaning of acronyms: DB: Dry bulb temperature, °F MCWB: Mean coincident wet bulb temperature, °F WB: Wet bulb temperature, °F

Station	Elev	Heating DB 99%	Cooling DB/MCWB			
			1%	DB / MCWB		
<b>United States of America</b>						
<i>Alabama</i>						
AUBURN-OPELIKA APT	774	27.7	90.7	73.7		
BIRMINGHAM MUNICIPAL AP	630	24.0	92.6	74.9		
CAIRNS AAF/OZARK	299	30.3	93.4	76.1		
DO THAN MUNICIPAL	322	31.1	93.2	75.7		
GADSEN MUNI (AWOS)	568	22.1	91.2	74.5		
HUNTSVILLE INTL/JONES FIELD	643	21.6	92.2	74.7		
MAXWELL AFB/MONTGOM	174	31.5	95.2	76.6		
MOBILE REGIONAL AP	220	30.7	91.8	76.4		
MONTGOMERY DANNELLY FIELD	203	27.3	94.0	76.1		
MUSCLE SHOALS REGIONAL AP	561	22.1	93.1	75.2		
TUSCALOOSA MUNICIPAL AP	187	25.0	93.4	76.3		
<i>Georgia</i>						
ALBANY DOUGHERTY COUNTY AP	194	29.7	94.5	76.1		
ATHENS BEN EPPS AP	801	26.1	92.7	74.6		
ATLANTA (NEXRAD)	971	23.2	90.7	73.8		
ATLANTA HARTSFIELD INTL AF	1027	25.8	91.5	74.0		
AUGUSTA BUSH FIELD	148	25.8	94.7	76.0		
AUGUSTA DANIEL FLD	420	29.9	93.1	73.7		
COLUMBUS METROPOLITAN ARPT	394	28.9	94.1	74.8		
DEKALB PEACHTREE	1027	26.8	91.2	73.5		
DOBBINS AFB/MARIETT	1083	25.0	91.0	73.8		
FORT BENNING	289	26.6	94.3	75.7		
FULTON CO ARPT BROW	863	24.9	91.4	74.4		
GAINESVILLELEE GIL	1276	27.1	90.3	73.7		
HUNTER AAF	43	31.8	93.3	76.9		
MACON MIDDLE GA REGIONAL AP	361	27.4	94.3	75.5		
MOODY AFB/VALDOSTA	233	33.7	93.7	76.2		
ROME R B RUSSELL AP	643	22.1	93.3	74.3		
SAVANNAH INTL AP	52	30.6	93.3	76.9		
VALDOSTA WB AIRPORT	197	30.9	93.4	76.6		
WARNER ROBINS AFB	302	28.2	94.9	76.0		
<i>North Carolina</i>						
ASHEVILLE REGIONAL ARPT	2169	18.6	85.8	70.9		
CHARLOTTE DOUGLAS INTL AP	768	24.6	91.7	74.2		
FAYETTEVILLE RGNL G	194	25.6	93.1	75.6		
FORT BRAGG/SIMMONS	305	26.0	94.0	75.7		
GREENSBORO PIEDMONT TRIAD INT	886	21.7	89.9	73.9		
HICKORY REGIONAL AP	1188	23.3	90.1	72.9		
JACKSONVILLE (AWOS)	95	24.7	91.3	75.7		
NEW RIVER MCAF	26	26.8	91.1	77.5		

Station	Elev	Heating DB 99%	Cooling DB/MCWB			
			1%	DB / MCWB		
<b>United States of America</b>						
<i>South Carolina</i>						
NEW RIVER MCAF	26	26.8	91.1	77.5		
PITT GREENVILLE ARP	26	24.9	93.1	75.5		
POPE AFB	217	25.2	94.3	75.7		
RALEIGH DURHAM INTERNATIONAL	436	23.1	91.7	75.6		
RICHMOND INTERNATIONAL AP	164	20.8	92.3	75.4		
SEYMOUR-JOHNSON AFB	108	26.2	93.5	76.1		
WILMINGTON INTERNATIONAL ARPT	39	27.6	91.0	77.5		
WINSTON-SALEM REYNOLDS AP	971	22.8	90.3	73.9		
<i>Tennessee</i>						
CHARLESTON INTL ARPT	49	30.4	92.1	77.6		
COLUMBIA METRO ARPT	226	25.9	94.5	75.1		
FLORENCE REGIONAL AP	151	26.9	93.4	76.2		
FOLLY ISLAND	16	34.9	86.2	N/A		
GREER GREENVL-SPARTANBRG AP	971	24.7	91.4	73.9		
SHAW AFB/SUMTER	243	27.5	92.9	75.1		
<i>Virginia</i>						
BRISTOL TRI CITY AIRPORT	1526	16.9	87.5	71.7		
CHATTANOOGA LOVELL FIELD AF	689	22.3	92.1	74.6		
JACKSON MCKELLAR-SIPES REGL A	423	18.7	92.6	76.6		
KNOXVILLE MCGHEE TYSN AP	981	20.2	90.2	73.9		
MEMPHIS INTERNATIONAL AP	331	19.6	93.9	76.9		
MILLINGTON MUNI ARP	322	19.6	95.0	76.5		
NASHVILLE INTERNATIONAL AF	604	18.2	92.1	74.8		

Air Conditioning Contractors of America, see [www.acca.org](http://www.acca.org).

## 9. Provide OEM data for each unique system type

## 10. Internal loads that reflect design and occupancy ≤2400 Bth/h

### Confirmation

- The builder must submit documentation demonstrating compliance of criteria to the EarthCraft Technical Advisor prior to the pre-drywall inspection.
- The EarthCraft Technical Advisor will review documentation provided by the builder for compliance of criteria and will visually confirm compliance of criteria at pre-drywall and final inspections.

## ES 1.1 If programmable thermostat installed for heat pump, include adaptive recovery technology

### Criteria

If a heat pump is installed and a programmable thermostat is used, the thermostat must be equipped with an adaptive recovery technology. Adaptive recovery prevents the system from relying on strip heat to quickly raise temperatures also resulting in increased energy use.

**Confirmation**

- The project team must present documentation demonstrating compliance with criteria to the EarthCraft Technical Advisor at the pre-drywall inspection. If necessary, the mechanical contractor must confirm in writing that the adaptive recovery system has been activated during installation.
- The EarthCraft Technical Advisor will review documentation provided by the project team for compliance with criteria and will visually confirm compliance with criteria at final inspection.

**ES 1.2 AHRI performance match all indoor/outdoor coils****Criteria**

Indoor and outdoor coils must be matched in accordance with Air-Conditioning, Heating, and Refrigeration Institute (AHRI) standards.

**Additional Resources**

[www.ahridirectory.org](http://www.ahridirectory.org)

**Confirmation**

- The project team must submit documentation demonstrating compliance with criteria to the EarthCraft Technical Advisor at the pre-drywall inspection.
- The EarthCraft Technical Advisor will review documentation provided by the project team for compliance with criteria and will visually confirm compliance with criteria at final inspection.

**ES 1.3 Non-CFC and non-HCFC refrigerant****Criteria**

Install cooling equipment that contains non-CFC or non-HCFC refrigerant (e.g., R410a).

**Exemptions**

Projects not using any refrigerants automatically meet intent provided they demonstrate alternative cooling strategies appropriate for a mixed-humid climate.

**Confirmation**

- The project team must present documentation demonstrating compliance with criteria to the EarthCraft Technical Advisor at the pre-drywall inspection.
- The EarthCraft Technical Advisor will review documentation provided by the project team for compliance with criteria.

**ES 1.4 No electric resistance heat as primary heat source or reheat****Criteria**

Electric resistance heaters, such as an electric furnace, electric radiant or a baseboard heater, may not be used as the primary heat source for any portion of the conditioned space or used in a reheat design.

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance with criteria at pre-drywall and final inspections.

**ES 1.5 Heat pump efficiency  $\geq$  8.0 HSPF or equivalent COP****Criteria**

Heat pumps must have an efficiency of at least 8.0 HSPF or greater.

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance with criteria at final inspection.

**ES 1.6 Furnace efficiency  $\geq 90$  AFUE****Criteria**

Furnaces must be rated at least 90 AFUE.

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance with criteria at final inspection.

**ES 1.7 Cooling equipment  $\geq 14$  SEER or  $\geq 11$  EER****Criteria**

Cooling equipment must surpass 14 SEER or 11 EER ratings.

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance with criteria at final inspection.

**ES 1.8 Heating equipment efficiency****Criteria*****A. A. ENERGY STAR qualified furnace(s)  $\geq 90\%$  AFUE and within 40% of load calculation***

All heating equipment must be ENERGY STAR qualified and 90%+ Annual Fuel Utilization Efficiency (AFUE) for gas combustion furnaces. All furnaces must be sized within 40% of the heating load as determined by the load calculation.

***B. ENERGY STAR qualified heat pump(s) Climate Zone 2/3  $\geq 8.2$  HSPF and within 15% of load calculation, Climate Zone 4  $\geq 8.5$  and within 25% of load calculation***

All heating equipment must be ENERGY STAR qualified meeting an 8.2+ Heating Seasonal Performance Factor (HSPF) for heat pumps in Climate Zones 2 and 3 or 8.5 HSPF in Climate Zone 4.

Heat pumps in Climate Zones 2 and 3 must be within 15% of the load calculation or the next available size. Heat pumps in Climate Zone 4 must be within 25% of the load calculation or the next available size.

**Clarifications**

An 8.2 HSPF for heat pumps in Climate Zone 4 qualifies when the heat pump is ENERGY STAR qualified with dual-fuel back-up.

As products and ENERGY STAR qualifications are periodically updated, the product must be on the list of ENERGY STAR qualified products at the time it was purchased.

**Additional Resources**

A list of qualified products can be found at: <http://www.energystar.gov>.

**Confirmation**

- The project team must present documentation demonstrating compliance with criteria to the EarthCraft Technical Advisor at the pre-drywall inspection.
- The EarthCraft Technical Advisor will review documentation provided by the project team for compliance with criteria and will visually confirm compliance with criteria at final inspection.

## **ES 1.9 Verification of proper refrigerant charge with subcooling deviation ±3°F or superheat deviation ±5°F**

**Criteria**

Perform refrigerant charge test to ensure appropriate charge for HVAC equipment with subcooling deviation  $\pm 3^{\circ}\text{F}$  or superheat deviation  $\pm 5^{\circ}\text{F}$ . Document test results on EarthCraft Refrigerant Charge Test Sheet or ENERGY STAR HVAC Quality Contractor Installation Checklist.

**Clarifications**

This requirement may be met by any of the following methods according to ACCA 5 QI-2007:

- Superheat method test measurement within 5% of the manufacturer-recommended charge
- Subcooling method test measurement within 3% of the manufacturer-recommended charge
- Other equivalent method/tolerance approved by the equipment manufacturer.

Geothermal heat pumps, mini-split heat pumps and hermetically sealed factory-charged stems may not be appropriate for standard subcooling or superheat refrigerant charge testing. To accommodate these system types, an OEM (original equipment manufacturer) test procedure may be used and documented.

**Additional Resources**

The EarthCraft Refrigerant Charge Test Sheet is available as a tab in the EarthCraft Worksheet.

**Confirmation**

- The project team must submit documentation demonstrating compliance with criteria to the EarthCraft Technical Advisor at the final inspection.
- The EarthCraft Technical Advisor will review documentation provided by the project team for compliance with criteria.

## **ES 1.10 ENERGY STAR qualified cooling equipment $\geq 14.5$ SEER**

**Criteria**

Install high efficiency ENERGY STAR qualified cooling equipment (SEER 14.5+). All cooling equipment must have a minimum Seasonal Energy Efficiency Ratio (SEER) of 14.5 or a minimum of 12 Energy Efficiency Ratio (EER) showing the SEER rating of each unit.

**Clarifications**

As products and ENERGY STAR qualifications are periodically updated, the product must be on the list of ENERGY STAR qualified products at the time it was purchased.

**Additional Resources**

A list of qualified products can be found at: <http://www.energystar.gov>.

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance with criteria at final inspection.

**ES 1.11 Variable speed blower****Criteria**

Install variable speed blower fan to allow for improved humidity removal and quieter operation. System must be installed such that static pressure across the blower with filter installed is within manufacturer specifications.

**Clarifications**

Multi-speed air handlers do not meet this credit intent.

**Confirmation**

- The builder must submit documentation demonstrating compliance of criteria to the EarthCraft Technical Advisor at the final inspection.
- The EarthCraft Technical Advisor will review documentation provided by the builder for compliance of criteria.

**ES 1.12 Ground-source heat pump(s) ≥17 EER****Criteria**

Install a ground-source heat pump for whole-house heating and cooling. All ground-source heat pumps must have a minimum cooling Energy Efficiency Ratio (EER) of 17 and a minimum heating Coefficient of Performance (COP) of 3.5 as determined by the Air Conditioning, Heating and Refrigeration Institute (AHRI).

**Additional Resources**

Air Conditioning, Heating and Refrigeration Institute (AHRI) at <http://www.ahrinet.org>.

**Confirmation**

- The builder must submit documentation demonstrating compliance of criteria to the EarthCraft Technical Advisor at the pre-drywall inspection.
- The EarthCraft Technical Advisor will review documentation provided by the builder for compliance of criteria and will visually confirm compliance of criteria at pre-drywall and final inspections.

**ES 1.13 ENERGY STAR qualified cooling equipment ≥16 SEER****Criteria**

Install high efficiency ENERGY STAR qualified cooling equipment (SEER 16.0+). All cooling equipment must have a minimum Seasonal Energy Efficiency Ratio (SEER) of 16.0 or a minimum of 13 Energy Efficiency Ratio (EER) showing the SEER rating of each unit.

**Clarifications**

As products and ENERGY STAR qualifications are periodically updated, the product must be on the list of ENERGY STAR qualified products at the time it was purchased.

**Additional Resources**

A list of qualified products can be found at: <http://www.energystar.gov>

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at final inspection.

**ES 1.14 Heat pump efficiency ≥ 9.0 HSPF****Criteria**

Installed heat pumps must have an efficiency rating of at least 9.0 HSPF.

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance with criteria at final inspection.

**ES 1.15 Dual-stage compressor****Criteria**

All cooling equipment must have a dual-stage (or two-stage) compressor for improved humidity removal and increased efficiency. The higher stage compressor must comply with the maximum 15% oversizing criteria as required for all cooling equipment.

**Clarifications**

When a dual-stage compressor is used for a heat pump to lower the balance point, size the air conditioner at design conditions for the lower fan speed only. The second stage should not come on at design temperatures. Use the second stage to size the heat pump at design heating conditions.

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance with criteria at final inspection.

**ES 1.16 Condenser units are spaced 2 feet apart****Criteria**

Condenser units must be spaced at least 2 feet apart to reduce restriction of airflow across the condensing coil.

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance with criteria at final inspection

**ES 1.17 Variable Refrigerant/Mini-Split system utilized for primary heating and cooling****Criteria**

Primary heating and cooling provided to the space using Variable Refrigerant/Mini-Split system.

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at pre-drywall and final inspections.

**Ductwork/Air handler**

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## ES 2.0 Seal air handlers and duct systems with mastic

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**Criteria**

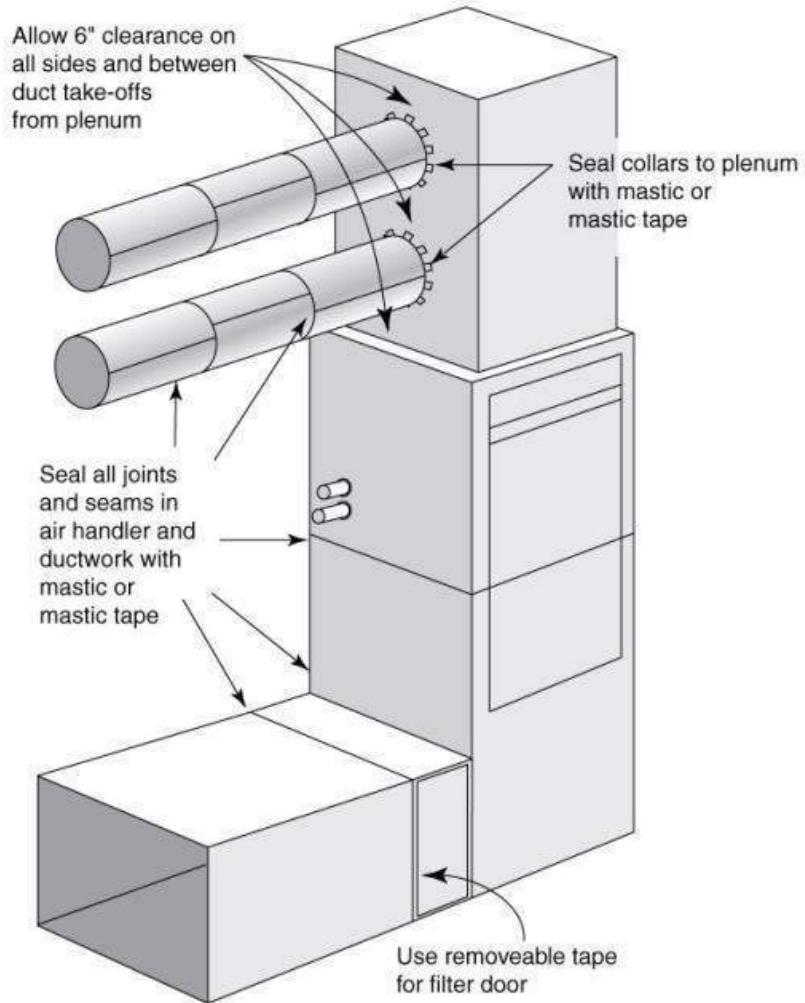
Seal all seams, joints, and connections in forced-air delivery systems using mastic paste or Butyl rubber backed foil tape(mastic tape), including but not limited to:

- Supply and return ducts
- Supply and return plenums
- Duct-to-plenum connection
- Y-splits, butt joints, and boot connections
- Outdoor air intakes
- Air handler condensate and refrigerant line, wire penetrations, and unused holes in the air handler cabinet

Wrap mastic tape at least two times around duct seam touching at least 1 1/2" of duct inner liner and metal collar or sleeve. Assemble duct board using code-approved foil tape and coat seams with layer of mastic paste covering seams by 1.5" on both sides and as thick as a nickel.

**Clarifications**

Duct tape is not a suitable sealant for ducts. Foil tape may only be used for sealing leaks at the air handler's removable access panels and at filter access panels. Duct boots may be sealed to floor, wall, or ceiling using caulk, foam, mastic tape, or mastic paste.



**Figure 66: Common mastic locations**

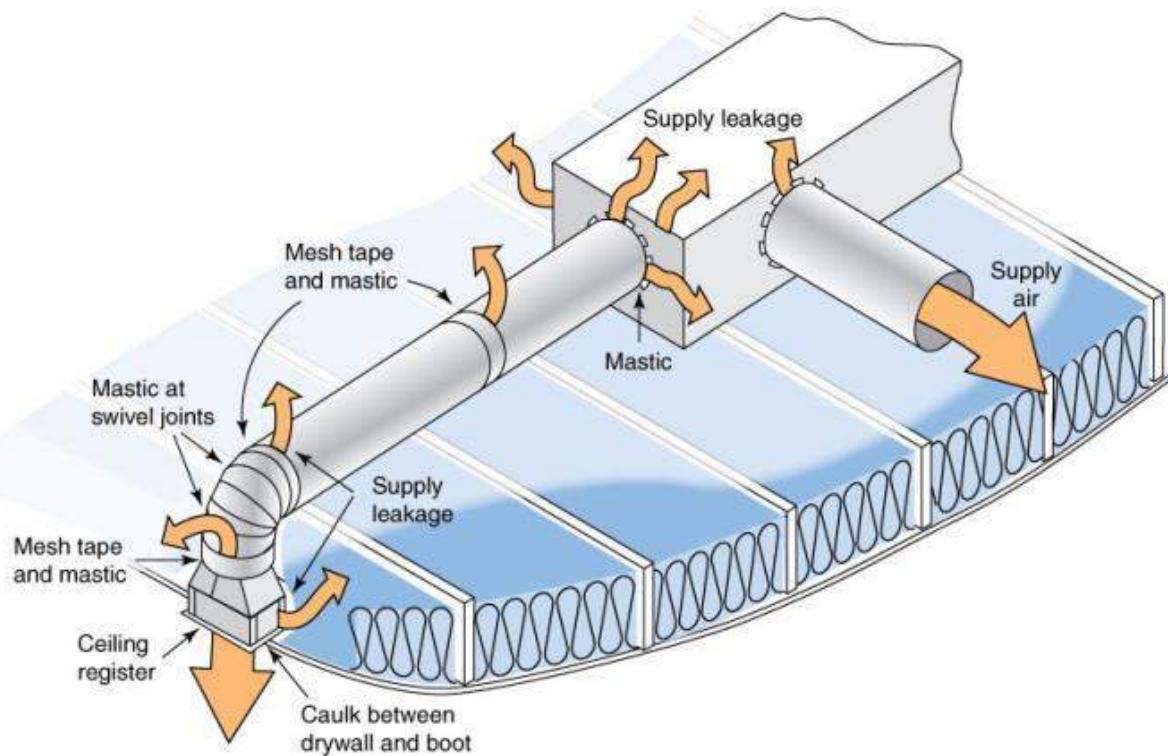


Figure 67: Common mastic locations (1)

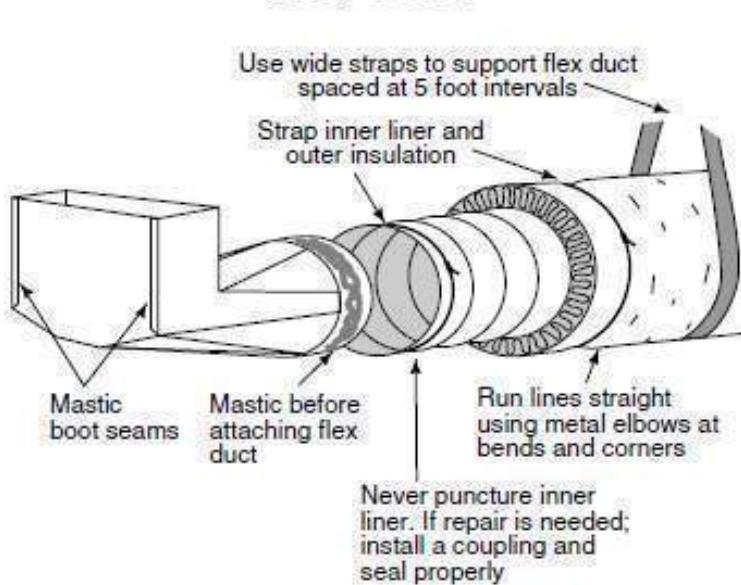


Figure 68: Common mastic locations (2)

#### Confirmation

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at pre-drywall and final inspections.

## ES 2.1 Code approved solid connector for all flex to flex connections

### Criteria

Connect all flex-to-flex duct connections together using code approved rigid connectors or sleeves. Connect flex duct liner to sleeve using a duct tie and mastic paste or Butyl rubber backed foil tape (mastic tape).

### Confirmation

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at pre-drywall and final inspections.

## ES 2.2 Fully duct all supply and return ducts

### Criteria

Install all supply and return ducts using code approved air duct materials.

### Clarifications

Do not use building cavities as a supply duct (e.g., panned joists and stud cavities are not allowed as supply or return ducts). An open return may be acceptable if a locked, full louvered door is provided. Additional attention will be placed on utilizing the mechanical closet as a plenum.

Supplies located in toe kicks must be fully ducted and sealed to the exterior face of the toe-kick.

### Confirmation

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at pre-drywall inspection.

## ES 2.3 Duct insulation

### Criteria

#### *1. R-4: Conditioned spaces*

All ducts located in conditioned space and interstitial spaces (between floors) must be insulated to R-4.

#### *2. R-8: Unconditioned attics and exterior*

Insulate all ducts and all duct connections in unconditioned attics and exterior locations using R-8 insulation or greater.

### Clarifications

Ducts left completely exposed inside conditioned space (e.g., modern loft-style duct systems) are not required to be insulated, but must be 90% visible at final inspection. Duct insulation within conditioned space is primarily for condensation prevention.

### Confirmation

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at pre-drywall and final inspections.

## ES 2.4 No ducts in exterior walls or vaulted ceilings

### Criteria

Design and install duct layout such that no ducts are located in exterior walls or insulated vaulted ceilings. This includes insulated walls between conditioned and unconditioned space such as the common wall between the stairwell and the unit.

### Clarifications

Ducts in exterior walls may be installed if a minimum of R-6 continuous insulation (in addition to the required duct and wall insulation) is provided on the exterior side of the cavity with an interior and exterior air barrier, and the wall cavity is large enough to accommodate the full duct diameter with no crimps.

### Confirmation

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at pre-drywall inspection.

## ES 2.5 Locate air handler within conditioned space

### Criteria

Locate all air handlers within conditioned space.

### Clarifications

Any atmospherically-vented furnace (e.g., 80 AFUE furnaces) are required to be isolated from conditioned space (e.g., located in combustion closets) and thus are not considered to be within conditioned space.

### Example

A sealed combustion, 90% furnace or heat pump located within conditioned space would satisfy this requirement.

### Confirmation

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at pre-drywall and final inspections.

## ES 2.6 Indoor coil protected

### Criteria

Protect and cover indoor coil until finished floor is installed to reduce particulate matter and pollutants from entering the HVAC system.

### Confirmation

- The EarthCraft Technical Advisor will visually confirm compliance with criteria at pre-drywall and final inspections.

## ES 2.7 Install ducts per ACCA Manual D duct design

### Criteria

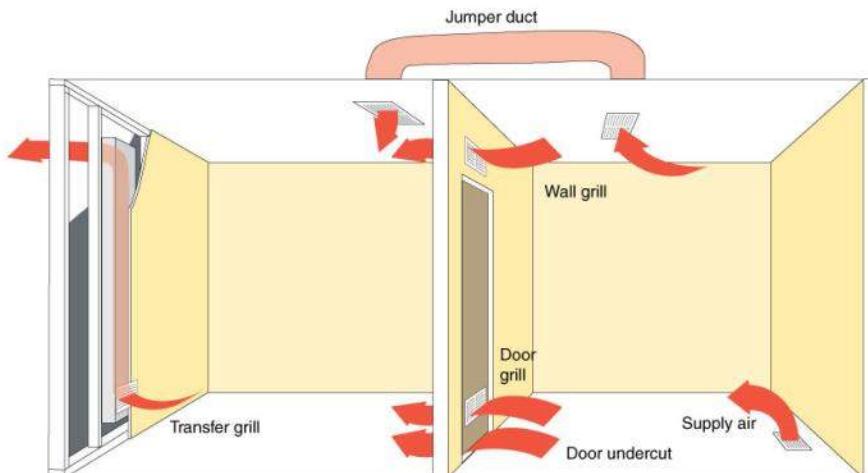
Design and install ductwork in accordance with ACCA Manual D guidelines latest edition or equivalent ASHRAE Handbook of Fundamentals method. Integrate duct layout with construction documentation to ensure proper installation and provide clash detection. At a minimum, duct layout must document duct diameter and length, and register location.

**Confirmation**

- The builder must submit documentation demonstrating compliance of criteria to the EarthCraft Technical Advisor at the pre-drywall inspection.
- The EarthCraft Technical Advisor will review documentation provided by the builder for compliance of criteria and will visually confirm compliance of criteria at pre-drywall inspection.

**ES 2.8 Minimize pressure imbalance within units ≤3 pa****Criteria**

1. *Reduce pressure imbalance between bedrooms and area of central return (living room) through various methods including appropriate duct sizing, door undercuts, dedicated return ducts, jumper ducts, transfer grills or other.*
2. *Measured Pressure imbalance must achieve ≤3 pa between bedrooms and central return.*

**Figure 69: Return air pathways****Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance with criteria at pre-drywall inspection or will diagnostically test for compliance with criteria at the final inspection.

**ES 2.9 Install rigid duct work or pull all flex duct tight with no pinches and support at intervals ≤5'****Criteria**

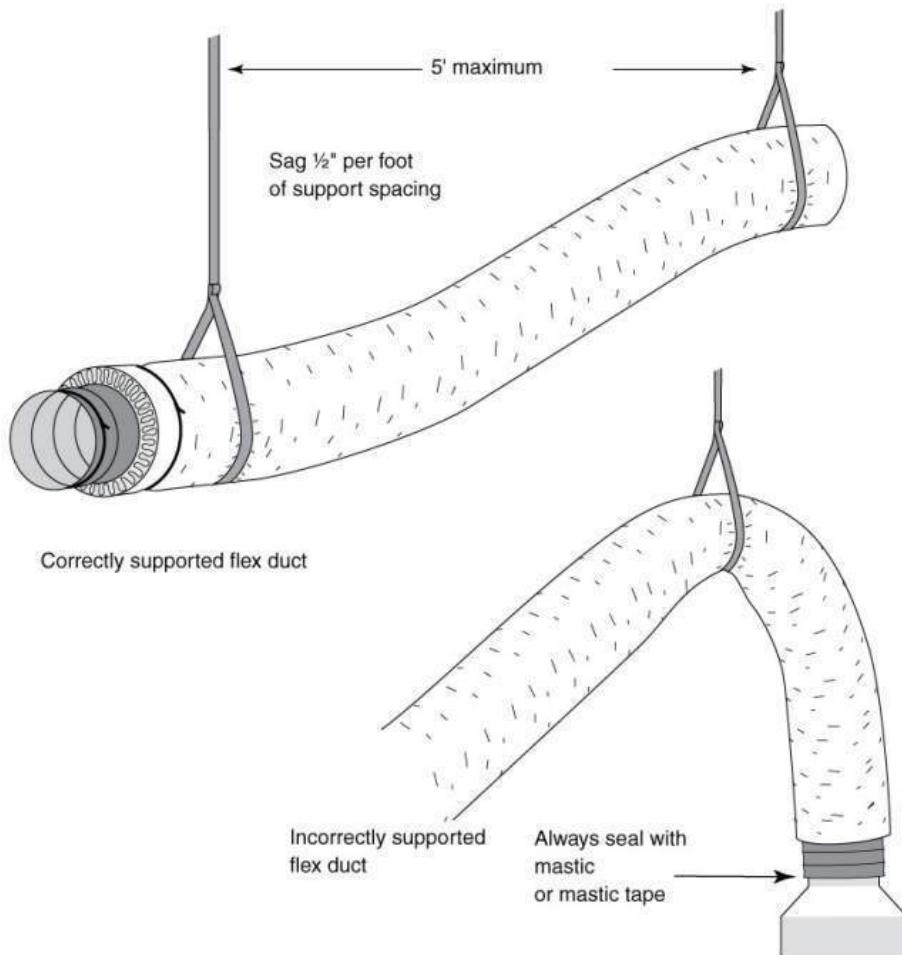
Construct all duct work using rigid duct materials (sheet metal or duct board) or ensure all flex duct is pulled tight and that inner liner is not constricted to allow for optimal airflow. Bends in flex duct must have a radius of at least the diameter of the duct or more. Use balancing dampers instead of loops to limit flow to diffusers, and use baffles for acoustical control. Support flexible ducts at intervals recommended by the

Manufacturers, but at least every 5 feet using bands that are at least 1 1/2" wide, and located above ceiling insulation to prevent condensation.

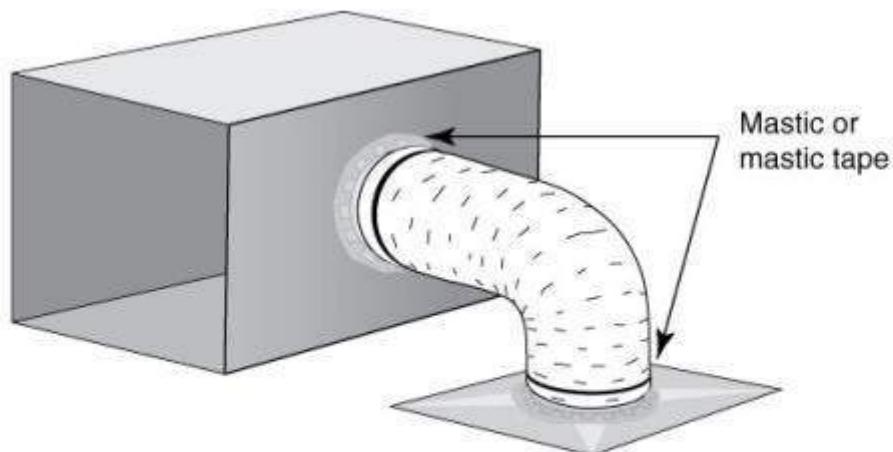
**Clarifications**

Do not install ducts in contact with roof decking.

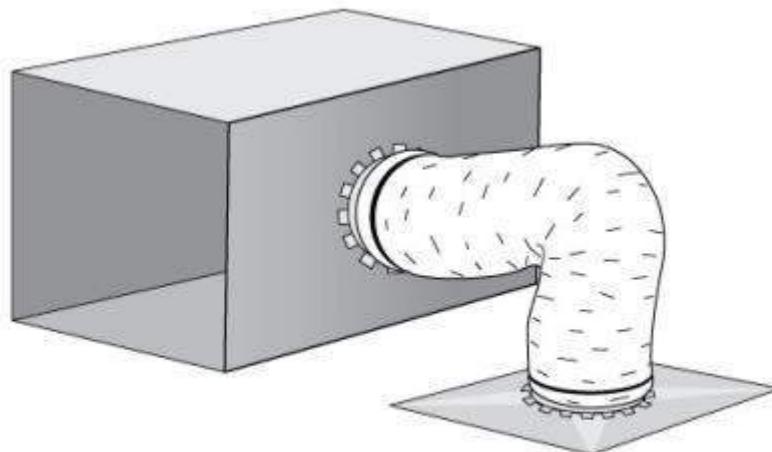
Do not install flex duct located in unconditioned spaces in cavities smaller than the outer duct diameter or flex duct located in conditioned spaces in cavities smaller than the inner duct diameter.

**Examples**

**Figure 70: Correct (top) and incorrect (bottom) ductwork installation**



Correct: flex duct installed with enough material, to create smooth turns with proper angles



Incorrect: flex duct installed with extra material, creating bunched turns with pinched angles

**Figure 71: Correct (top) and incorrect (bottom) ductwork installation**

#### Confirmation

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at pre-drywall and final inspections.

### **ES 2.10 Measure and balance airflow for each duct run**

#### Criteria

Measure and balance airflow for each room using a flow hood, anemometer or EarthCraft approved equivalent with all interior doors closed. Adjust airflow to within the greater of  $\pm 20\%$  or 25 cfm of the load calculation room-by-room specifications.

**Clarifications**

Ducts shall not include coiled or looped ductwork except to the extent needed for acoustical control.

Balancing dampers or proper duct sizing shall be used instead of loops to limit flow to diffusers.

When balancing dampers are used, they shall be located at the trunk to limit noise unless the trunk will not be accessible when the balancing process is conducted. In such cases, opposable blade dampers or dampers located in the duct boot are permitted.

**Confirmation**

- The builder must submit documentation demonstrating compliance of criteria to the EarthCraft Technical Advisor at the final inspection.

**ES 2.11 Verify supply and return duct static pressure****Criteria**

Verify supply and return duct static pressure is within manufacturer and design specifications to have the capacity to meet the calculated loads.

**Clarifications**

Pressure must be measured in the ducts and not in the air handler itself.

HVAC contractor test-hole locations must be well marked and easily accessible for verification. Supply and return duct static pressure measurements in inches of water column (IWC) must be submitted to builder by HVAC contractor.

Verification of static pressure using the same test holes must confirm results are <110% of contractor values.

**Confirmation**

- The builder must present documentation demonstrating compliance of criteria to the EarthCraft Technical Advisor at the final inspection.
- The EarthCraft Technical Advisor will review documentation provided by the builder for compliance of criteria and will diagnostically test compliance of criteria at the final inspection.

**ES 2.12 HVAC system and ductwork is dry and clean****Criteria**

Inspect ductwork before installing registers, grilles, and diffusers to verify it is dry and substantially free of dust or debris, and that there are no disconnects or visible air gaps.

Inspect air-handling equipment and verify that heat exchangers/coils are free of dust caused by construction activities and the filter is new. After installation of registers, grilles, and diffusers, verify detectable airflow from each supply outlet.

**Clarifications**

If duct openings were uncovered during construction, thoroughly vacuum out each opening prior to installing registers, grilles and diffusers.

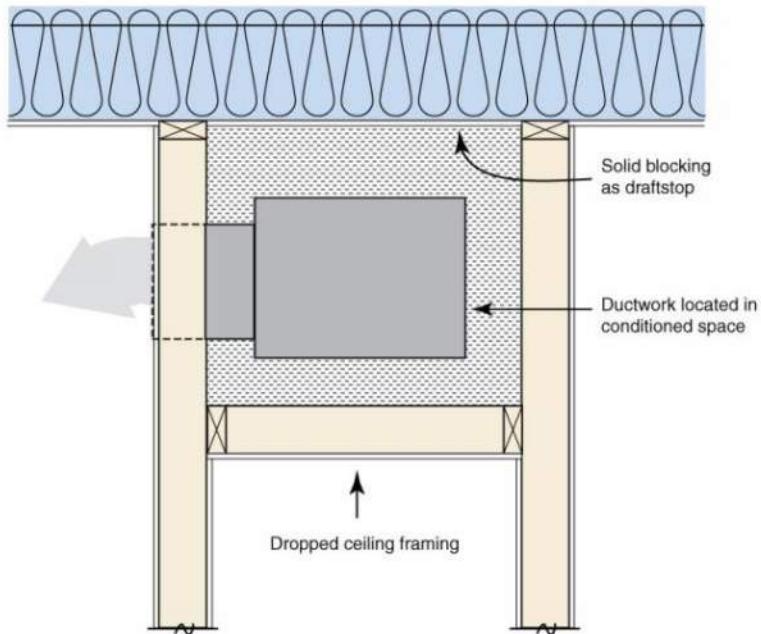
**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance of criteria with the builder at the final inspection.

## ES 2.13 Locate entire duct system within conditioned space

### Criteria

Locate entire supply and return ducts within conditioned space.



**Figure 72: Ducts in conditioned space**

### Confirmation

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at pre-drywall and final inspections.

## ES 2.14 Duct design and installation

### Criteria

#### 1. No duct take-offs within 6" of supply plenum cap

Space all duct take-offs at least 6" away from supply plenum cap with no duct take-offs originating from the cap of the supply plenum.

#### 2. Rigid metal supply trunk line

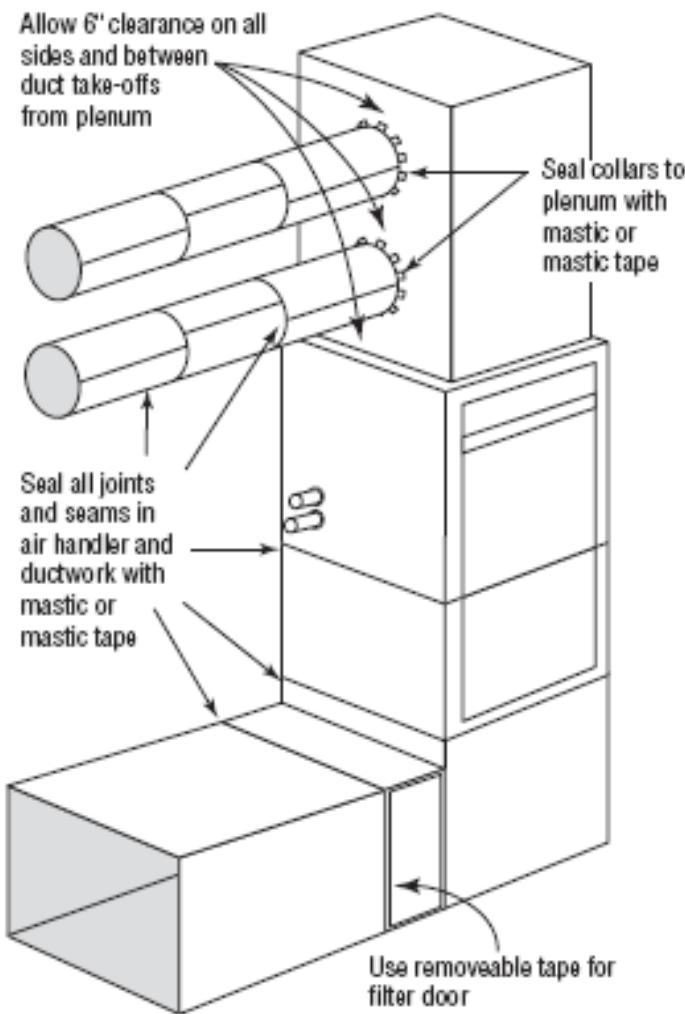
Design and install all duct systems using the "trunk and branch" configuration. The trunk and branch configuration requires that each HVAC system has at least one rigid supply trunk with multiple, short branch take-offs to each supply register.

#### 3. Space all supply duct take-offs ≥6" apart

Space all supply duct take-offs at least 6" apart from each other with no duct take-offs originating from the cap of the supply plenum. Junction boxes with 4 take-offs or less and no take-off(s) directly opposite main supply to junction box are excluded.

#### 4. Install rigid circular duct as supply plenum from air handler

To improve ductwork efficiency by reducing the duct leakage commonly found at the plenum board connection to the air handler. Seal all duct connections with mastic.



**Figure 73: Duct installation at plenum**

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at pre-drywall and final inspections.

## **ES 2.15 Duct insulation in unconditioned spaces $\geq R-10$**

**Criteria**

Insulate all ducts outside of conditioned spaces (e.g., in unconditioned attics, vented crawlspaces, and exterior locations) to R-10 insulation or greater.

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at pre-drywall and final inspections.

## **ES 2.16 Return plenum duct take-off free area is 120% of supply plenum duct take-off free area**

**Criteria**

Install all ductwork to provide capacity for at least 120% more return air than supply air for every system.

**Exemptions**

This line item is waived if the duct system is installed per Manual D.

**Example**

A 2 ton system with a 0.09 friction rate has the following flex duct supply take-offs:

Two 10" ducts = 570 cfm

One 8" duct = 160 cfm

One 6" duct = 75 cfm

805 cfm total supply side

To achieve a return capacity that is at least 120% of the supply capacity, the system would need the following flex duct return take-offs:

Two 10" ducts = 570 cfm

Two 8" ducts = 320 cfm

One 6" duct = 75 cfm

965 cfm total return side

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at pre-drywall inspection.

**ES 2.17 Design and construct accessible mechanical closets****Criteria**

Design and construct mechanical closets that are easily accessible for routine maintenance, repairs, and filter replacement.

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at pre-drywall and final inspections.

**Duct Leakage Test Results****ES 3.0 Test duct leakage based on conditioned floor area (CFA)****Criteria*****1. Leakage to outside ≤5%***

Duct blaster test result for leakage to outside is equal to or less than 5% of floor area served.

***2. Total leakage ≤8%***

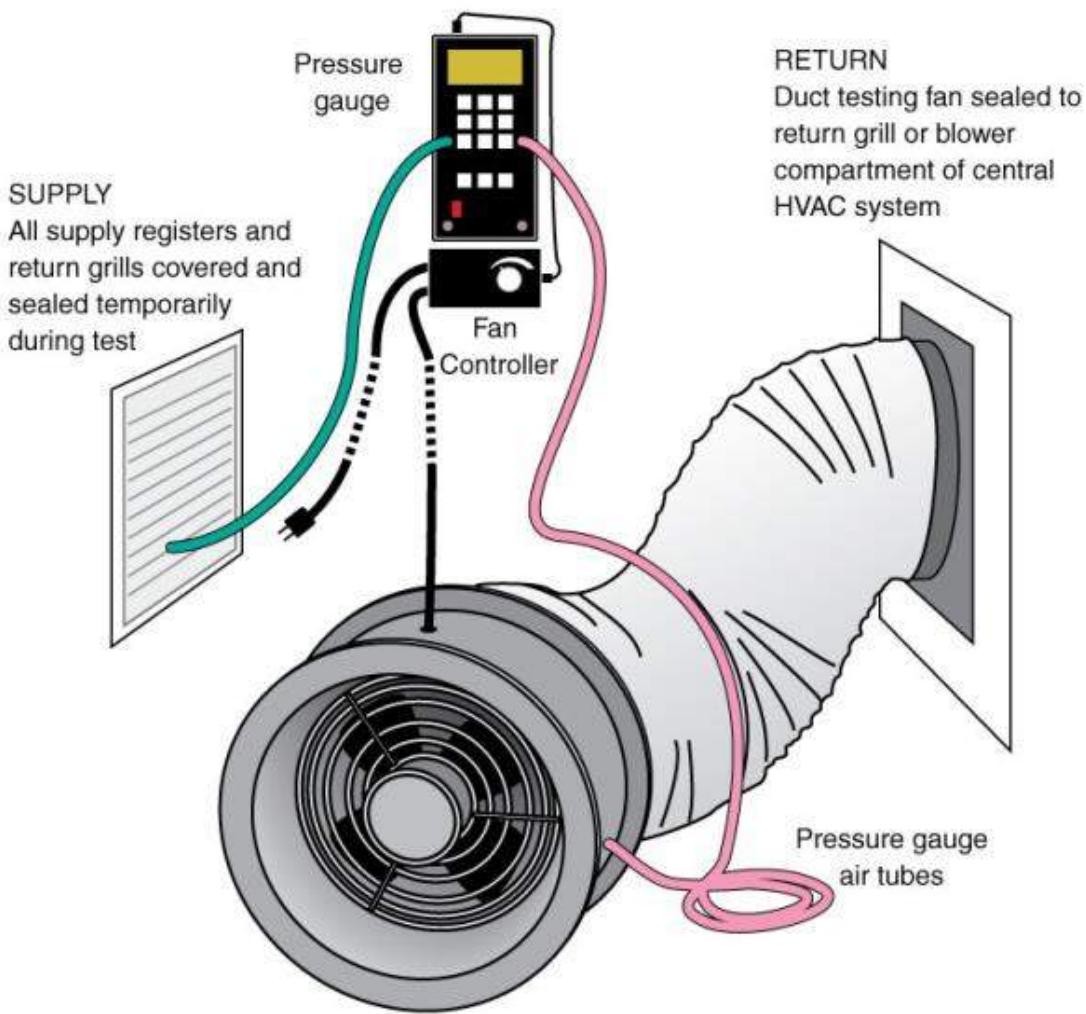
Duct blaster test result for total leakage is equal to or less than 8% of floor area served.

**Definitions**

Duct leakage is calculated using the standard protocol set forth by ASTM for duct pressurization testing at 25 Pascals.

Duct leakage to outside is defined as the amount of duct leakage that leaves the building envelope and is tested separately from total duct leakage.

Total duct leakage is defined as the amount of total leakage that leaves the ducts.



**Figure 74: Duct leakage tester**

Calculate duct leakage using the following formula:

$$\text{Duct Leakage} = \frac{\text{cfm}_{25}}{\text{square foot of floor area served}}$$

Where  $\text{cfm}_{25}$  is the volume of air in cubic feet per minute moved through the duct blaster fan to maintain a 25 Pa pressure difference between inside and outside of ductwork. Total duct leakage is the percentage of duct leakage for the entire duct system including the air handler, regardless of duct location.

### Clarifications

Both the leakage to the outside and the total leakage duct tests apply to all HVAC systems, even those fully inside the building envelope of the unit or building.

Floor area must equal conditioned floor area used for the confirmed HERS energy model.

Rough-in test results may not be used to satisfy this requirement.

Floor area must equal conditioned floor area used for the confirmed HERS energy model.

**Example**

A duct system that serves 2,000 sq ft of living space and has a total duct leakage at a 25 Pascal pressure difference of 240 cfm would have a duct leakage of 12%.

$$12\% \text{ leakage} = \frac{240 \text{ cfm}_{25}}{2,000 \text{ sq ft}}$$

**Confirmation**

- The EarthCraft Technical Advisor will diagnostically test compliance of criteria at the final inspection.

**ES 3.1 Test duct leakage based on conditioned floor area (CFA)****Criteria****1. Leakage to outside ≤3%**

Duct leakage test result for leakage to outside for each HVAC system is equal to or less than 3% of floor area served.

**2. Total leakage ≤5%**

Duct leakage test result for total leakage for each HVAC system is equal to or less than 5% of floor area served.

**Clarifications**

Both the leakage to the outside and the total leakage duct tests apply to all HVAC systems, even those fully inside the building envelope of the unit or building.

Floor area must equal conditioned floor area used for the confirmed HERS energy model.

Leakage rates are specific to each air handler and duct system and may not be averaged in units with multiple systems.

Rough-in test results may not be used to satisfy this requirement.

**Confirmation**

- The EarthCraft Technical Advisor will diagnostically test compliance of criteria at the final inspection.

**Ventilation****ES 4.0 Install exhaust fans in all bathrooms and duct to outside****Criteria**

Vent all bathroom exhaust fans to outdoors.

**Clarifications**

Any room with at least two of the following fixtures is considered a bathroom: sink, toilet, shower, tub, or urinal.

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at pre-drywall and final inspections.

## ES 4.1 Gas kitchen range or cooktop vented to exterior with $\geq 100$ cfm

### Criteria

For each gas range or cooktop, install a kitchen exhaust fan (e.g., kitchen range or downdraft hood) and vent directly to the outdoors.

Kitchen exhaust fans must meet ASHRAE 62.2-2007 section 5 requirements. If exhausting continuously, fan must exhaust greater than 5 ACH, based on kitchen volume; if controlled by occupant to exhaust intermittently, fan must exhaust at least 100 cfm.

To ensure the installed fan exhausts the correct amount of cfm, kitchen exhaust fans must either be rated at a higher airflow than 100 cfm (minimum of 130 cfm on high setting) or have an installed measured airflow verified by a third-party  $\geq 100$  cfm and within 20% of the design rate.

### Clarifications

Intentional make-up air must be provided for any kitchen vent fan rated at greater than 150 cfm so that total exhaust flow (makeup airflow minus fan rated exhaust) is no greater than 150 cfm.

#### Confirmation

*Measured airflow fan (testing not required)*

- The builder must present documentation demonstrating compliance with criteria to the EarthCraft Technical Advisor at the pre-drywall inspection.
- The EarthCraft Technical Advisor will review documentation provided by the builder for compliance with criteria.

OR

*Third-party testing*

- The EarthCraft Technical Advisor will diagnostically test for compliance with criteria at the final inspection.

## ES 4.2 Outside air ventilation strategy complies with ASHRAE 62.2-2007 or BSC-01 and must be conditioned prior to distribution

### Criteria

Install outside air intake with ventilation cfm, mechanical damper, and controls meeting ASHRAE 62.2-2007 or BSC-01 mechanical ventilation requirements and must be conditioned prior to distribution.

Provide information on type of system, maintenance, and monitoring requirements in project-specific owner's manual.

#### *Intermittent ventilation with timer, manual flow damper, and electric shutoff damper*

Install outdoor air intake duct with a ventilation timer, manual flow damper and electric shutoff damper to the return side of each air handler to bring in outside air for ventilation.

Calculate flow rate according to ASHRAE Standard 62.2-2007 for intermittent mechanical ventilation:

$$\text{Fan Flow} = \underline{0.01 * \text{Floor Area} + 7.5 * (\# \text{ Bedrooms} + 1)}$$

% on Time

Designed and installed to operate at least once per day and at least 10% of the time (one hour out of every twelve).

The inlet must meet manufacturers' requirements for return air temperature (e.g., most manufacturers recommend a minimum of 60 °F airflow across furnace heat exchangers).

Intermittent ventilation system that utilize the HVAC air handler must include a controller to regulate the ventilation run time by accounting for hours when HVAC systems are not heating or cooling.

#### ***Continuous ventilation***

Calculate flow rate according to ASHRAE Standard 62.2-2007 for continuous mechanical ventilation:

$$\text{Fan Flow} = 0.01 * \text{Floor Area} + 7.5 * (\# \text{ Bedrooms} + 1)$$

Design continuous ventilation system to operate during all occupiable hours.

Continuous ventilation system that utilize the HVAC air handler must install a fan speed type that shall be Electronically Commutated Motor/ Integrally Controlled Motor (ECM/ICM), variable speed, and run at a reduced speed during ventilation.

BSC-01 criteria can be found online at:

<http://www.buildingscience.com/documents/special/ventilation-new-low-rise-residential-buildings>

#### ***Clarifications***

Floor area must equal conditioned floor area used for the confirmed HERS energy model.

#### ***Confirmation***

- The builder must submit documentation demonstrating compliance of criteria to the EarthCraft Technical Advisor at the pre-drywall inspection.
- The EarthCraft Technical Advisor will review documentation provided by the builder for compliance of criteria and will visually confirm compliance of criteria at final inspection.

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### ***ES 4.3 When installed, fresh air intakes must achieve the following standards:***

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#### ***Criteria***

##### ***1. ≥10' away from exhaust outlets and vehicle idling zones***

Locate air intakes for all building systems at least 10 feet away from any exhaust outlets, the driveway and garage, and other areas where vehicle exhaust may be present. Air intake must pull air directly from outdoors and not from adjacent dwelling units, garages, unconditioned crawlspaces or attics.

##### ***2. ≥2 above grade***

Locate air intakes 2 feet above finished grade.

##### ***3. When run to the soffit, the duct must be extended and affixed through soffit vent.***

If running fresh air through the soffit, it must extend and be affixed all the way through the soffit vent and may not terminate and rest on top of the soffit.

##### ***4. Fresh air duct may not be run to the roof***

Do not run fresh air to the roof of the structure. Exception: Central fresh air systems.

**5. Fresh air shutoff may not be controlled by humidistat**

If using a fresh air shutoff, it cannot be controlled by the humidistat.

**6. Install rigid duct with insulation**

When ducting the fresh air into a unit, use rigid duct work with insulation that meets at least code minimum.

**7. All intakes must be ducted to the exterior of the building**

Locate air intakes for all building systems outside of the building shell.

**Clarifications**

Air intakes include intakes for closed-system combustion equipment, outdoor ventilation air supply, etc., and exhaust outlets include bathroom exhaust fans, range hood exhaust fan outlet, dryer exhaust, combustion exhaust, radon vent, etc.

Design air-intake locations to minimize obstruction by snow, plantings, condensing units or other material.

Only air intakes used specifically for combustion air are permitted on rooftops.

Ventilation inlet screens can become clogged with debris over time, therefore EarthCraft recommends, but does not require, that builders locate inlets to facilitate access and regular service by the maintenance staff.

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance with criteria at pre-drywall and final inspections.

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## ES 4.4 Seal seams of all intake and exhaust ducts with mastic

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**Criteria**

Mastic paste must be used on the sealing of all ducts. Coat duct seams and connections with layer of mastic paste covering seams by 1.5" on both sides and as thick as a nickel.

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance with criteria at pre-drywall inspection.

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## ES 4.5 Duct clothes dryers to outside

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**Criteria**

All clothes dryers must be ducted to the outside.

**Clarifications**

For electric condensing dryers, plumb condensate to a drain according to manufacturer instructions.

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance with criteria at pre-drywall and final inspections.

## ES 4.6 No power roof vents

### Criteria

Do not install electrically-powered or solar-powered attic exhaust vents.

### Confirmation

- The EarthCraft Technical Advisor will visually confirm compliance with criteria at pre-drywall and final inspections.

## ES 4.7 Back-draft dampers for kitchen, bathroom and dryer exhausts

### Criteria

Install back-draft dampers for all exhaust fans sharing a common exhaust.

### Clarifications

Common exhausts may not be shared by fans in separate dwelling units (e.g., townhomes).

### Confirmation

- The EarthCraft Technical Advisor will visually confirm compliance with criteria at pre-drywall inspection.

## ES 4.8 If installed, ceiling fans must be ENERGY STAR qualified

### Criteria

If installed, all ceiling fans must be ENERGY STAR qualified. One per bedroom and one in the living room.

### Clarifications

As products and ENERGY STAR qualifications are periodically updated, the product must be on the list of ENERGY STAR qualified products at the time it was purchased.

### Additional Resources

A list of qualified products can be found at: <http://www.energystar.gov>

### Confirmation

- The builder must submit documentation demonstrating compliance with criteria to the EarthCraft Technical Advisor at the final inspection.
- The EarthCraft Technical Advisor will review documentation provided by the builder for compliance with criteria and will visually confirm compliance with criteria at final inspection.

## ES 4.9 ENERGY STAR bath fans with properly sized ductwork and measured airflow $\geq 50$ cfm

### Criteria

All bathroom ventilation fans must be ENERGY STAR qualified with properly sized ductwork and measured airflow  $\geq 50$  cfm.

To ensure the installed fan exhausts the correct amount of cfm, bath fans must either be rated at a higher airflow than 50 cfm (minimum 70 cfm rating) or have an installed measured airflow verified by a third-party  $\geq 50$  cfm.

**Clarifications**

As products and ENERGY STAR qualifications are periodically updated, the product must be on the list of ENERGY STAR qualified products at the time it was purchased.

**Additional Resources**

A list of qualified products can be found at: <http://www.energystar.gov>

**Exemptions**

Multi-port fans exhausting multiple bathrooms and bath fans with a flow rate greater than or equal to 500 cfm also qualify as meeting this criteria.

**Confirmation**

*Measured airflow fan (testing not required)*

- The builder must present documentation demonstrating compliance with criteria to the EarthCraft Technical Advisor at the pre-drywall inspection.
- The EarthCraft Technical Advisor will review documentation provided by the builder for compliance with criteria.

OR

*Third party-testing*

- The EarthCraft Technical Advisor will diagnostically test for compliance with criteria at the final inspection.

**ES 4.10 Vent kitchen exhaust fans to exterior ≥100 cfm: electric ranges****Criteria**

For each electric range, install a kitchen exhaust fan (e.g., kitchen range or downdraft hood) and vent directly to the outdoors.

Kitchen exhaust fans must meet ASHRAE 62.2 section 5 requirements. If exhausting continuously, fan must exhaust greater than 5 ACH, based on kitchen volume, if controlled by occupant to exhaust intermittently, fan must exhaust at least 100 cfm.

To ensure the installed fan exhausts the correct amount of cfm, kitchen exhaust fans must either be rated at a higher airflow than 100 cfm (minimum of 130 cfm on high setting) or have an installed measured airflow verified by a third-party ≥100 cfm and within 15% of the design rate.

**Clarifications**

Intentional make-up air must be provided for any kitchen vent fan rated at greater than 150 cfm so that total exhaust flow (makeup airflow minus fan rated exhaust) is no greater than 150 cfm.

**Confirmation**

*Measured airflow fan (testing not required)*

- The builder must present documentation demonstrating compliance of criteria to the EarthCraft Technical Advisor at the pre-drywall inspection.
- The EarthCraft Technical Advisor will review documentation provided by the builder for compliance of criteria.

OR

*Third party testing*

- The EarthCraft Technical Advisor will diagnostically test compliance of criteria at the final inspection.

## **ES 4.11 Verify outdoor air supply ventilation airflow test within +/- 20% of design values**

### **Criteria**

Measure ventilation rates to be within +/- 20% of design rate.

### **Confirmation**

- The EarthCraft Technical Advisor will diagnostically test compliance of criteria at the final inspection.

## **ES 4.12 Install and label accessible ventilation controls, with override controls for continuously operating ventilation fans**

### **Criteria**

Label ventilation controls unless function is obvious (e.g., bathroom exhaust fan).

### **Clarifications**

Include readily accessible override controls for continuously-operating ventilation and exhaust fans (e.g., ERVs and other outdoor air supply ventilation systems).

### **Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at final inspection.

## **ES 4.13 Supply and exhaust fans rated at ≤3 sones (intermittent) and ≤1 sone (continuous)**

### **Criteria**

Install intermittent supply and exhaust fans that are rated at less than 3 sones by manufacturer, unless rated flow is greater than 400 cfm.

Install continuous supply and exhaust fans that are rated at less than 1 sone by manufacturer.

### **Clarifications**

HVAC and remote-mounted fans (i.e., fans with 4 ft. or more of ductwork between the fan and intake grill and outside of habitable spaces, bathrooms, toilets, and hallways) are exempt from these requirements.

### **Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at pre-drywall inspection.

## **ES 4.14 Radon resistant construction**

### **Criteria**

#### ***1. Passive, labeled radon/soil gas system***

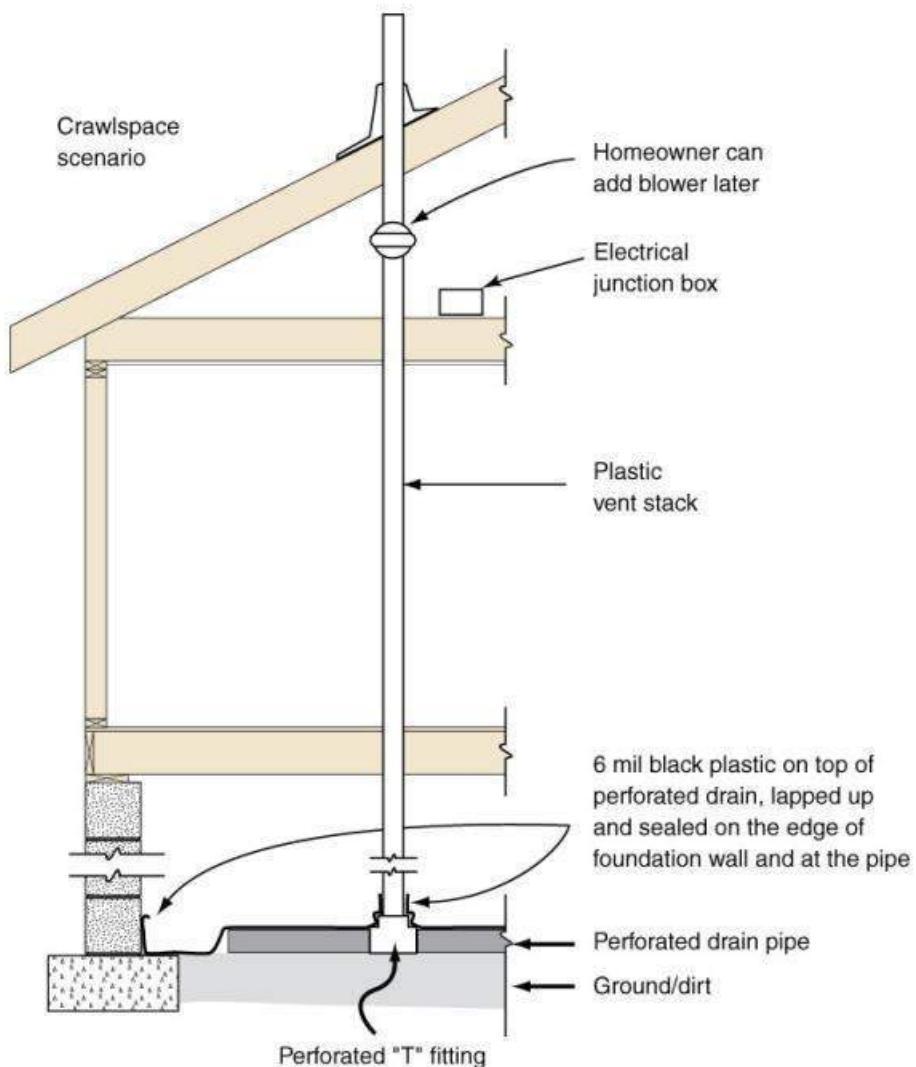
Install a passive radon vent system in compliance with EPA's "Building Radon Out".

#### ***2. Radon test of Building prior to occupancy***

Test building for radon prior to occupancy according to EPA testing procedures. Disclose test results to potential occupants.

OR

Provide two radon test kits designed for 48-hour exposures to the occupant(s), including test kit instructions and EPA guidance on follow-up actions to be taken in response to the test results.



**Figure 75: Radon vent pipe**

### Clarifications

Projects in all radon zones must comply.

### Additional resources

EPA's "Building Radon Out" can be found online at:  
[www.epa.gov/radon/pdfs/buildradonout.pdf](http://www.epa.gov/radon/pdfs/buildradonout.pdf)

### Confirmation

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at pre-drywall and final inspections.

## ES 4.15 Exhaust fan wired with light in bathroom

### Criteria

Bath fan must be wired to the lighting system in the bathroom to encourage proper ventilation.

### Confirmation

- The EarthCraft Technical Advisor will visually confirm compliance with criteria at final inspection.

## ES 4.16 Duct all exhaust fans with rigid duct

### Criteria

Duct all exhaust fans with rigid duct material and seal connections with mastic or mastic tape.

### Confirmation

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at pre-drywall inspection.

## ES 4.17 Automatic bathroom exhaust fan controls

### Criteria

Install either a timer, occupancy sensor, or humidity control (i.e., a humidistat) for all bath fans installed in rooms with tubs, showers or similar sources of moisture. Include instructions for using controls in homeowner manual.

Provide information on type of system, maintenance, and monitoring requirements in project-specific owner's manual.

### Confirmation

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at final inspection.

## ES 4.18 Energy recovery ventilator

### Criteria

Install an Energy Recovery Ventilator (ERV) according to the manufacturer's specifications and meeting ASHRAE 62.2-2007.

### Confirmation

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at pre-drywall inspection.

## ES 4.19 Vent storage room to outside

### Criteria

Provide a separate storage room in the garage with a lockable door vented directly to the outdoors with a minimum of 100 sq in of net free vent area per 100 sq ft of floor area.

### Clarifications

No combustion equipment or HVAC equipment may be installed in the storage room.

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at final inspection.

**Water Heater****ES 5.0 If gas, direct vent****Criteria**

If installing a gas water heater it must be directly vented to the exterior and bring in combustion air from the exterior.

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at final inspection.

**ES 5.1 Heat trap on storage water heaters****Criteria**

If installing storage water heater, either purchase storage water heater with heat trap installed or install heat trap on storage water heater.

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at final inspection.

**ES 5.2 Electric water heaters  $\geq 0.93$  EF****Criteria**

The minimum efficiency requirement for a water heater is 0.93EF

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at final inspection.

**ES 5.3 Pipe insulation on first 2'****Criteria**

Water heater must have pipe insulation on the first 2' of hot water supply pipe.

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at final inspection.

**ES 5.4 High efficiency water heater****Criteria**

Install high efficiency water heater that meets the energy factor (EF) requirements in the following for gas or electric operation:

**A. Storage water heater Natural Gas  $\geq 0.67$  EF, Electric  $\geq 0.95$  EF**

**B. Tankless water heater Natural Gas  $\geq 0.90$  EF**

Install a tankless gas water heater according to manufacturer specifications that meets a minimum of 0.90 energy factor for gas.

#### **Confirmation**

- The builder must present documentation demonstrating compliance of criteria to the EarthCraft Technical Advisor at the final inspection.
- The EarthCraft Technical Advisor will review documentation provided by the builder for compliance of criteria and will visually confirm compliance of criteria at final inspection.

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## **ES 5.5 Type of water heater**

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#### **Criteria**

##### **A. Solar domestic ( $\geq 40\%$ of annual load)**

Install a solar domestic water heater according to manufacturer specifications to handle a minimum of 40% of the annual water-heating load.

##### **B. High efficiency tankless water heater with insulated buffer tank**

Install a tankless gas water heater according to manufacturer specifications that meets a minimum of 0.92 energy factor for gas with an insulated buffer tank to reduce water wasted while tankless water heater ramps up to desired hot water temperature.

##### **C. ENERGY STAR qualified heat pump**

Install ENERGY STAR heat pump water heater with a minimum Energy Factor of 2.0 and according to manufacturer's specifications.

OR

Install heat recovery water heating (refrigerant-to-water desuperheating coil) according to manufacturer specifications to recover waste heat from an air conditioner or heat pump to heat domestic water.

#### **Clarifications**

As products and ENERGY STAR qualifications are periodically updated, the product must be on the list of ENERGY STAR qualified products at the time it was purchased.

#### **Additional Resources**

A list of qualified products can be found at: <http://www.energystar.gov>

#### **Confirmation**

- The builder must present documentation demonstrating compliance of criteria to the EarthCraft Technical Advisor at the final inspection.
- The EarthCraft Technical Advisor will review documentation provided by the builder for compliance of criteria and will visually confirm compliance of criteria at final inspection.

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## **ES 5.6 Hot water pipe insulation $\geq R-4$ (100%)**

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#### **Criteria**

Insulate all hot water pipes to R-4 or greater using polyethylene, neoprene, fiberglass or other insulation types. Fit insulation tightly around hot water pipe, face seam down, and secure insulation every 2 feet using wire, tape or clamp. Install insulation on all piping elbows to adequately insulate 90-degree bend.

**Exemptions**

Hydronic heating systems are not required to insulate pipes in slabs or other approved materials intended for radiating heat into conditioned space and therefore do not apply to this criteria.

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at pre-drywall inspection.

**Lighting and Appliances****ES 6.0 High-efficacy lighting in 100% of all permanent fixtures****Criteria**

Install high-efficacy lighting in 100% or more of all permanent fixtures. High efficacy lighting includes compact fluorescent bulbs, T-8 or smaller diameter linear fluorescent bulbs, or bulbs with a minimum efficacy of:

- 60 lumens per watt for bulbs over 40 watts
- 50 lumens per watt for bulbs from 15 watts to 40 watts
- 40 lumens per watt for bulbs 15 watts or less

**Example**

3 bedroom, 3 bathroom townhome has the following permanent lighting fixtures:

Kitchen: five can lights, one 2-bulb fixture = 6 fixtures and 7 bulbs  
 Laundry: one 2-bulb fixture = 1 fixture and 2 bulbs  
 Hallways: two 2-bulb fixtures = 2 fixtures and 4 bulbs  
 Closets: five one-bulb fixtures = 5 fixtures and 5 bulbs  
 Bedrooms: three 3-bulb fixtures = 3 fixtures and 9 bulbs  
 Bathrooms: four 3-bulb fixtures, three 1-bulb fixtures = 7 fixtures and 15 bulbs  
 Living Room: one 4-bulb fixture and 2 can lights = 3 fixtures and 6 bulbs  
 Dining Room: one 8-bulb fixture = 1 fixture and 8 bulbs  
Garage: two 2-bulb fixtures = 2 fixtures and 4 bulbs  
**Unit TOTAL: 30 fixtures and 60 bulbs**

At least 30 bulbs in the unit must be high efficacy.

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at final inspection.

**ES 6.1 If installed, ENERGY STAR dishwasher****Criteria**

All installed dishwashers must be ENERGY STAR qualified.

**Clarifications**

As products and ENERGY STAR qualifications are periodically updated, the product must be on the list of ENERGY STAR qualified products at the time it was purchased.

**Additional Resources**

A list of qualified products can be found at: <http://www.energystar.gov>

**Confirmation**

- The builder must present documentation demonstrating compliance of criteria to the EarthCraft Technical Advisor at the final inspection.
- The EarthCraft Technical Advisor will review documentation provided by the builder for compliance of criteria and will visually confirm compliance of criteria at final inspection.

**ES 6.2 If installed, ENERGY STAR refrigerator****Criteria**

All installed refrigerators must be ENERGY STAR qualified.

**Clarifications**

As products and ENERGY STAR qualifications are periodically updated, the product must be on the list of ENERGY STAR qualified products at the time it was purchased.

**Additional Resources**

A list of qualified products can be found at: <http://www.energystar.gov>

**Confirmation**

- The builder must present documentation demonstrating compliance of criteria to the EarthCraft Technical Advisor at the final inspection.
- The EarthCraft Technical Advisor will review documentation provided by the builder for compliance of criteria and will visually confirm compliance of criteria at final inspection.

**ES 6.3 ENERGY STAR Advanced Lighting Package****Criteria**

Design and construct units in accordance to ENERGY STAR Advanced Lighting Package. A minimum of 60% ENERGY STAR qualified hard-wired fixtures (both indoor and outdoor).

**Clarifications**

ENERGY STAR qualified recessed light fixtures, ceiling fan light kits, and ventilation fans with lighting can be counted toward the fixture requirement.

All installed ceiling fans must be ENERGY STAR qualified.

As products and ENERGY STAR qualifications are periodically updated, the product must be on the list of ENERGY STAR qualified products at the time it was purchased.

**Additional Resources**

A list of qualified products can be found at: <http://www.energystar.gov>.

**Confirmation**

- The EarthCraft Technical Advisor will review documentation provided by the builder for compliance with criteria and will visually confirm compliance with criteria at final inspection.

## ES 6.4 Control systems

### Criteria

#### **1. Automatic indoor lighting controls**

All kitchens, bathrooms, hallways, closets, and utility rooms must have an automatic lighting control system such as a vacancy sensor or timer with manual-on control.

#### **2. Automatic outdoor lighting controls**

Control exterior lighting with automatic motion or timer controls that incorporate a photocell to prevent daytime use.

#### **Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance with criteria at final inspection.

## ES 6.5 Fixtures and bulbs

### Criteria

#### **A. ENERGY STAR qualified compact fluorescent fixtures or LED bulbs (100%)**

Install ENERGY STAR qualified compact fluorescent fixtures or LED screw-in bulbs for 100% of all interior lighting.

#### **B. Ballasted compact fluorescent fixtures or LED bulbs at all recessed light fixtures**

Install ballasted compact fluorescent fixtures or ENERGY STAR qualified LEDs in all recessed light fixtures.

#### **C. Compact fluorescent bulbs ( $\geq 90\%$ )**

Install ENERGY STAR qualified screw-in compact fluorescent bulbs for 90% or greater of the interior lighting.

### Clarifications

Projects may use a combination of fixtures and bulbs outlined in A, B and C, but can receive credit only on the lower pointed item.

Bulbs in appliances (refrigerators, ovens, etc.) are excluded from the bulb percentage count.

As products and ENERGY STAR qualifications are periodically updated, the product must be on the list of ENERGY STAR qualified products at the time it was purchased.

### Additional Resources

A list of qualified products can be found at: <http://www.energystar.gov>.

### Example

A project with 20% ENERGY STAR qualified compact fluorescent fixtures and 70% ENERGY STAR qualified screw-in compact fluorescent bulbs would qualify for C.

#### **Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance with criteria at final inspection.

## Common Area Lighting/Appliances

### **ES 7.0 Ballasted compact fluorescents and/or LED bulbs in all corridor/breezeway and all common spaces**

#### **Criteria**

All lighting in corridor/breezeway and all common spaces must be ballasted compact fluorescents and/or LED bulbs. It can be a combination of both types but must comprise 100 percent of the lighting installed.

#### **Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance with criteria prior to the final inspection.

### **ES 7.1 If installed, ENERGY STAR qualified clothes washer**

#### **Criteria**

If installed, all installed clothes washers must be ENERGY STAR qualified.

#### **Clarifications**

As products and ENERGY STAR qualifications are periodically updated, the product must be on the list of ENERGY STAR qualified products at the time it was purchased.

#### **Additional Resources**

A list of qualified products can be found at: <http://www.energystar.gov>.

#### **Confirmation**

- The builder must present documentation demonstrating compliance with criteria to the EarthCraft Technical Advisor prior to the final inspection.

### **ES 7.2 If installed, High Efficiency clothes dryer with moisture sensor**

#### **Criteria**

If installed, all clothes dryers must be high efficiency with moisture sensor.

#### **Clarifications**

As products and qualifications are periodically updated, the product must be on the list of qualified products at the time it was purchased.

#### **Additional Resources**

A list of qualified products can be found at:  
<http://www.appliances.energy.ca.gov/Default.aspx>

#### **Confirmation**

- The builder must present documentation demonstrating compliance with criteria to the EarthCraft Technical Advisor prior to the final inspection.

### **ES 7.3 High-efficiency exterior lighting:**

#### **Criteria**

Reduce high energy use in exterior lighting environments through improved design practices. The lighting design must account for the following elements:

1. Exterior lighting for walkways and other pedestrian paths;
2. Exterior lighting for parking area lighting;

3. Design must include exterior lighting mounted to the building (wall packs), tenant porch lighting, and lighting at the building entrance/site entrance;
4. To achieve this credit, down lighting controls must be included on all exterior light fixtures (Dark Sky Compliant);
5. Lighting shutoff controls must be included at all possible locations (porches, site, and building).

**1. *Design to reach IES guidelines: Lighting for Exterior Environments***

Outdoor Lighting must meet IES guidelines (IESNA publication, RP-33-1999).

**2. *Achieve 50% reduction based on Advanced Energy Design Guide (ASHRAE/IES)***

Outdoor lighting must meet the 50% reduction based on the Advanced Energy Design Guide. (AHSRAE/IES publication, Advanced Energy Design Guide for Small to Medium Office Buildings)

**3. *High-efficiency lighting using 100% fluorescent and/or LED bulbs***

Outdoor lighting must use 100% fluorescent and/or LED bulbs.

#### **Additional Resources**

A list of qualified outdoor lighting products can be found at: <http://www.energystar.gov> and <http://www.darksky.org/outdoorlighting>.

Design guidelines can be located at: [www.ies.org](http://www.ies.org) and [www.ashrae.org](http://www.ashrae.org).

#### **Confirmation**

- The lighting designer must present documentation demonstrating compliance with criteria to the EarthCraft Technical Advisor prior to the final inspection.
- The EarthCraft Technical Advisor will review documentation provided by the project team for compliance with criteria and will visually confirm compliance with criteria at final inspection.

## **ES 7.4 High-efficiency Elevators**

#### **Criteria**

Elevators installed must meet efficiency criteria of Traction (ThyssenKrupp), MRL (Machine Room- Less), or equivalent elevator systems.

#### **Confirmation**

- The EarthCraft Technical Advisor will review documentation provided by the project team for compliance with criteria and will visually confirm compliance with criteria at final inspection.

## **Water Efficiency**

Conserving our finite fresh water resources has become vitally important in both protecting our environment and helping sustain economic growth in our region. The use of certain strategies like water-efficient fixtures, water-efficient landscaping and irrigation, and reusing water on-site through rainwater or gray water systems can significantly reduce a residents water consumption as well as their utility bills.

The Water Conservation category emphasizes the efficient use of potable water indoors and outdoors. An EarthCraft project aims to reduce water waste and storm water run-off. Strategies include drought adapted landscaping, improved plumbing distributions systems and efficient plumbing fixtures.

## Indoor Water Use

### WE 1.0 Meet National Energy Policy Act low-flow standards for all fixtures

#### Criteria

All fixtures must meet the National Energy Policy Act low-flow standards for flow requirements.

#### Confirmation

- The EarthCraft Technical Advisor will visually confirm compliance with criteria at final inspection.

### WE 1.1 Detect no leaks at any water-using fixture, appliance or equipment

#### Criteria

There must be no detected leaks from any water-using fixture, appliance or equipment as determined by pressure-loss testing and visual inspections.

#### Confirmation

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at final inspection.

### WE 1.2 If installed, water treatment system NSF certified, ≥85% efficient

#### Criteria

Any installed drinking water systems must be certified to meet applicable NSF/ANSI standards with a minimum of 85% efficiency rating:

- NSF/ANSI 42 Drinking Water Treatment Units – Aesthetic Effects
- NSF/ANSI 53 Drinking Water Treatment Units – Health Effects
- NSF/ANSI 55 Ultraviolet Microbiological Water Treatment Systems
- NSF/ANSI 58 Reverse Osmosis Drinking Water Treatment Systems
- NSF/ANSI 62 Drinking Water Distillation Systems.

Each system must yield 85 gallons or greater of treated water for each 100 gallons of water processed.

#### Confirmation

- The project team must present documentation demonstrating compliance with criteria to the EarthCraft Technical Advisor prior to the final inspection.
- The EarthCraft Technical Advisor will review documentation provided by the project team for compliance with criteria and will visually confirm compliance with criteria at final inspection.

### WE 1.3 If installed, water softeners certified to NSF/ANSI Standard 44

#### Criteria

Any installed self-regenerating water softeners must be certified to meet NSF/ANSI 44 Residential Caution Exchange Water Softeners, including the voluntary efficiency rating standards in Section 7 – Mandatory testing for elective claims for efficiency rated systems. These standards state that water softeners must:

- Be a demand-initiated regeneration system (i.e., it must use a flow meter or water hardness sensor to initiate regeneration; devices that use time clock-

initiated regeneration [fixed time schedule] do not qualify for the efficiency rating).

- Have a rated salt efficiency of not less than 3,350 grains of total hardness exchange per pound of salt, based on sodium chloride (NaCl) equivalency (477 grams of total hardness exchange per kilogram of salt).
- Not generate more than 5 gallons of water per 1,000 grains of hardness removed during the service cycle (18.9 liters per 64.8 grams of total hardness removed).

#### **Confirmation**

- The project team must present documentation demonstrating compliance with criteria to the EarthCraft Technical Advisor prior to the final inspection.
- The EarthCraft Technical Advisor will review documentation provided by the project team for compliance with criteria and will visually confirm compliance with criteria at final inspection.

## **WE 1.4 Store ≤0.5 gal of water between water heater and fixture**

#### **Criteria**

The hot water distribution system must store no more than 0.5 gallons of water in any piping/manifold between the hot water source and any hot water fixture.

To account for the additional water that must be removed from the system before hot water can be delivered, no more than 0.6 gallons of water must be collected from the hot water fixture before hot (105°F) water is delivered.

#### **Clarifications**

If a circulation system is used, it must be on-demand circulation. Continuous circulation systems and circulation systems with timers are not approved methods. This credit is not applicable to central water heating systems.

Project teams are encouraged to design systems to store less than 0.35 gallons of water in any piping/manifold between the hot water source and any hot water fixture to ensure no more than 0.6 gallons of water are collected from the hot water fixture before hot water is delivered.

#### **MAXIMUM LENGTH OF PIPE OR TUBE**

<u>Nominal Pipe or Tube Size (inch)</u>	<u>Liquid Ounces per Foot of Length</u>	<u>Maximum Pipe or Tube Length</u>	
		<u>System without a Circulation Loop or Heat Traced Line (feet)</u>	<u>System with a Circulation Loop or Heat Traced Line (feet)</u>
1/4 <sup>a</sup>	0.33	50	16
5/16 <sup>a</sup>	0.5	50	16
3/8 <sup>a</sup>	0.75	50	16
1/2	1.5	43	16
5/8	2	32	12
3/4	3	21	8
7/8	4	16	6
1	5	13	5
1 1/4	8	8	3
1 1/2	11	6	2
2 or larger	18	4	1

- a. The flow rate for 1/4 inch size is limited to 0.5 gpm; for 5/16 inch size is limited to 1 gpm; for 3/8 inch size is limited to 1.5 gpm.

*Table provided by Gary Klein*

#### **Confirmation**

- The project team must present documentation demonstrating compliance with criteria to the EarthCraft Technical Advisor at the pre-drywall inspection.
- The EarthCraft Technical Advisor will review documentation provided by the project team for compliance with criteria and will visually confirm compliance with criteria at pre-drywall inspection and test compliance at final inspection.

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## **WE 1.5 Low-flow fixtures (units and common facilities):**

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#### **Criteria**

##### **1. WaterSense labeled toilet ( $\leq 1.28$ avg. gal/flush)**

All installed toilets must be WaterSense labeled with an average maximum gallon per flush of 1.28 or less.

##### **2. WaterSense labeled urinal ( $\leq 0.5$ gal/flush)**

All installed urinals must be WaterSense labeled with an average maximum gallon per flush of 0.5 or less.

##### **3. WaterSense labeled lavatory faucet and accessories ( $\leq 1.5$ gpm at 60 psi)**

All installed bathroom sink faucets and accessories must be WaterSense labeled with an average maximum gallon per minute of 1.5 or less at 60 psi.

##### **4. WaterSense labeled Showerhead ( $\leq 2$ gpm)**

All installed showerheads must be WaterSense labeled with an average maximum flow rate of 2 gallons per minute.

#### **Clarifications**

Dual-flush toilet average flush rates should be calculated as follows: (2 low flush + 1 high flush)/3.

#### **Additional Resources**

A list of WaterSense labeled fixtures can be found at: [www.epa.gov/watersense](http://www.epa.gov/watersense).

#### **Confirmation**

- The builder must present documentation demonstrating compliance of criteria to the EarthCraft Technical Advisor at the final inspection.
- The EarthCraft Technical Advisor will review documentation provided by the builder for compliance of criteria at final inspection.

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## **WE 1.6 Toilet ( $\leq 1.1$ avg gal/flush)**

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#### **Criteria**

All installed toilets must have an average maximum gallon per flush of 1.1 or less.

#### **Clarifications**

Dual flush toilet average flush rates should be calculated as follows: (2 low flush + 1 high flush)/3.

**Confirmation**

- The builder must present documentation demonstrating compliance of criteria to the EarthCraft Technical Advisor at the final inspection.
- The EarthCraft Technical Advisor will review documentation provided by the builder for compliance of criteria at final inspection.

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**WE 1.7 Waterless urinals in common areas, all fixtures**

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**Criteria**

All urinals installed in common areas must be waterless.

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at final inspection.

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**WE 1.8 Greywater system for toilet flushing**

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**Criteria**

Install greywater system designed to capture, at a minimum, the greywater from the master shower and be reused for flushing the master toilet.

**Clarifications**

Any installed greywater system must comply with any and all applicable state and local laws.

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at final inspection.

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**WE 1.9 Rainwater harvest system for indoor water use**

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**Criteria**

Install rainwater harvest system with minimum capacity, to flush at least one primary toilet in each dwelling unit or wash clothes.

**Clarifications**

Any installed rainwater system must comply with any and all applicable state and local laws.

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at final inspection.

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**WE 1.10 Hot water demand ≤0.13 gal of water between loop and fixture and ≤2 gal of water in loop between water heater and furthest fixture**

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**Criteria**

Install a demand controlled hot water priming loop such that the volume from the loop to the hot water outlets is 0.13 gallons or less.

Zone the hot water distribution system so that volume in one or more demand controlled priming loops is kept to less than 2 gallons from the water heater to the furthest fixture on the loop.

Install buttons or motion sensors, either wired or wireless, in each hot water location to activate pump(s).

Meet the installation procedures in ES 5.4 for pipe insulation.

### **Clarifications**

For pipe lengths to volume conversion, see Maximum Length of Pipe or Tube table under WE 1.4.

### **Confirmation**

- The builder must present documentation demonstrating compliance of criteria to the EarthCraft Technical Advisor at the pre-drywall inspection.
- The EarthCraft Technical Advisor will review documentation provided by the builder for compliance of criteria and will visually confirm compliance of criteria at pre-drywall inspection and test compliance at final inspection.

## **Outdoor Water Use**

### **WE 2.0 Cover all exposed soil with 2"-3" mulch layer**

#### **Criteria**

Install mulch to cover planting beds with at least 2 inches but no more than 3 inches of mulch during landscaping installation.

#### **Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at final inspection.

### **WE 2.1 If installed, irrigation system**

#### **Criteria**

##### ***1. Must have rain sensor shutoff switch***

Irrigation systems must be equipped with technology (either a rain sensor or soil moisture sensor) that inhibits or interrupts operation of the irrigation system during periods of rainfall or sufficient soil moisture.

##### ***2. Provide operating manual to property management***

The builder must develop and provide property management a written operating and maintenance manual for all water-using equipment or controls installed in the house or yard, including all relevant WaterSense materials on indoor and outdoor water use. This may be a chapter or folder in an existing manual.

##### ***3. Provide irrigation system layout to property management***

The builder must provide irrigation system layout to property management.

**Confirmation***Rain sensor shutoff switch*

- The EarthCraft Technical Advisor will verbally and visually confirm compliance of criteria with the builder at the final inspection.

*Manual*

- The builder must present documentation demonstrating compliance of criteria to the EarthCraft Technical Advisor at the final inspection.
- The EarthCraft Technical Advisor will review documentation provided by the builder for compliance of criteria.

**WE 2.2 If installed, ornamental water features must recirculate water and serve beneficial use****Criteria**

Install ornamental water feature that recirculates water from the feature itself and serve a beneficial use.

Provide information on type of system, maintenance, and monitoring requirements in project-specific owner's manual.

**Clarifications**

Beneficial uses include wildlife habitat, stormwater management and/or noise reduction.

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at final inspection.

**WE 2.3 Install plants to maintain ≥2' distance from building at maturity****Criteria**

Locate all bushes, shrubs, trees, vines, and other vegetation so that at maturity the plantings are  $\geq 2'$  from the building exterior.

**Clarifications**

In order to meet the 2' spacing requirement at maturity, most plants will need to be greater than 2' from the building at the time of the final inspection.

Measurement is from the closest edge of the plant foliage to the building, not the center or stem of the plant.

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance with criteria at final inspection.

**WE 2.4 Turf ≤40% of landscaped area****Criteria**

Install turf grass on 40% or less of the landscaped area.

**Confirmation***Turf 40% or less of landscaped area*

- The EarthCraft Technical Advisor will verbally and visually confirm compliance of criteria with the builder at the final inspection.

## WE 2.5 Vegetate slopes exceeding 4:1

### **Criteria**

Install erosion resistant vegetation on all slopes greater than 4 feet of horizontal run per 1 foot vertical rise, or provide terracing.

### **Example**

Trees, shrubs, taller growing grasses, and wildflowers can be effective plantings for preventing erosion.

### **Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at final inspection.

## WE 2.6 If installed, irrigation system

### **Criteria**

**1. Design, install and audit irrigation system by WaterSense Irrigation Partner with no leaks**

Irrigation system must be designed, installed, and audited by a WaterSense irrigation partner in accordance with the WaterSense program. The system must be checked for leaks by the WaterSense irrigation partner during the post-installation audit.

**2. Micro-irrigation system (e.g., drip irrigation) includes pressure regulator, filter, and flush end assemblies**

If installed, micro-irrigation system (a low-pressure irrigation systems that sprays, mists, sprinkles, or drips) includes a pressure regulator, filter and flush end assemblies.

**3. Distribution uniformity ≥65% lower quarter**

Irrigation systems must achieve lower quarter distribution uniformity ( $DU_{LQ}$ ) of 65 percent or greater. Measure the distribution uniformity on the largest spray-irrigated area during the post-installation audit.

**4. Install sprinklers only on turfgrass, pop-up height ≥4"**

Install sprinkler heads so that the heads have a 4" or greater pop-up height, matched precipitation nozzles, and check valves. Use sprinkler irrigation on turfgrass only, on strips 4' wide or greater, and slopes less than or equal to 4:1.

**5. Establish grow-in phase and post landscape seasonal water schedules at irrigation controller**

Establish grow-in phase and post landscape seasonal water schedules at irrigation controller

Post two watering schedules developed by the WaterSense irrigation controller at the irrigation controller. The first schedule must address the initial grow-in phase of the landscape and the second schedule must address the established landscape. Both schedules must vary according to the season.

### **Exemptions**

Waivers from this requirement may be available if there are an insufficient number of available WaterSense irrigation partners, proximate to the project site.

**Definitions**

Distribution uniformity is the measure of uniformity of applied irrigation water over an area. DU<sub>LQ</sub> is the ratio of the average of the lowest 25 percent of measurements to the overall average measurement.

**Additional Resources**

A list of WaterSense irrigation partners is available at:  
[www.epa.gov/watersense/meet\\_our\\_partners.html](http://www.epa.gov/watersense/meet_our_partners.html).

Auditing procedures are described in the Irrigation Audit Guidelines for WaterSense Labeled New Homes at: [www.epa.gov/watersense/nhspecs/cert\\_new\\_homes.html](http://www.epa.gov/watersense/nhspecs/cert_new_homes.html).

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance of criteria at final inspection.

*Items 1 and 3 only*

- The builder must submit documentation demonstrating compliance of criteria to the EarthCraft Technical Advisor at the final inspection.
- The EarthCraft Technical Advisor will review documentation provided by the builder for compliance of criteria.

**WE 2.7 Drought-tolerant/native landscaping turf and plants****Criteria**

Install 85% or more drought-tolerant/native landscaping turf and plants.

**Additional Resources**

A list of drought-tolerant/native landscaping turf and plants may be obtained through a local cooperative extension office.

**Confirmation**

- The EarthCraft Technical Advisor will verbally and visually confirm compliance of criteria with the builder at the final inspection.

**WE 2.8 Xeriscape™ guidebook given to property management or owner****Criteria**

A drought tolerant landscape plan developed by a landscape architect, horticulturist, or other professional shall be provided to the property management staff or landscaper. A copy of Virginia Tech's Cooperative Extension guide, "Creating a Water-Wise Landscape" given to the property management staff or landscaper.

**Additional Resources**

The Virginia Tech Cooperative Extension guide, "Creating a Water-Wise Landscape" can be found at [http://pubs.ext.vt.edu/426/426-713/426-713\\_pdf.pdf](http://pubs.ext.vt.edu/426/426-713/426-713_pdf.pdf)

**Confirmation**

- The EarthCraft Technical Advisor will verbally and visually confirm compliance of criteria with the builder at the final inspection.

## WE 2.9 Test and amend soil

### Criteria

Test soil using a soil testing kit from the local cooperative extension office or other reliable source such as a garden supply store. Till and amend soil as needed to provide the appropriate balance of nutrients, pH, organic material content, and percolation based on designed landscape. Till soil 3-6 inches deep.

### Confirmation

- The builder must submit documentation demonstrating compliance of criteria to the EarthCraft Technical Advisor at the final inspection.
- The EarthCraft Technical Advisor will review documentation provided by the builder for compliance of criteria.

## WE 2.10 Irrigation

### Criteria

#### *1. Greywater irrigation system*

Install a greywater system for landscape irrigation. The system must be approved by local building and/or health department, include a tank or dosing basin, and collect water from a minimum of the clothes washer or shower.

#### *2. Rainwater irrigation system*

Design and install a rainwater harvesting and storage system for landscape irrigation. Size the storage system to hold water from a 1" rainfall event (0.62 gallons per square foot) from 50% or greater of the total roof area of the building.

#### *3. Zone irrigation system for specific water needs in each planting area*

Design irrigation system with zones based on water needs in each planting area. Attention should be given to the sprinklers at the tops and bottoms of sloped areas to prevent runoff. Microirrigation should be installed on separate zones from the rest of the irrigation system if sprinkler heads are used in other parts of the landscape.

#### *4. Provide weather station or soil moisture sensor on irrigation system*

Equip irrigation systems with technology that inhibits or interrupts operation of the irrigation system during periods of rainfall or sufficient moisture (e.g., rain sensors, soil moisture sensors).

### Clarifications

For multifamily projects, water captured from HVAC condensate drain may be used to meet the intent of #2 listed above.

## WE 2.11 Timer on exterior water spigots

### Criteria

Install timer on all exterior water spigots.

### Confirmation

- The EarthCraft Technical Advisor will visually confirm compliance of criteria with the builder at the final inspection.

# Education and Operations

## Education

The best designed and constructed building can still be inefficient if the resident does not utilize its high performance benefits properly. The Education and Operations category provides strategies for informing residents of the benefits of an EarthCraft house as well as how to best use energy efficient features to maximize efficiency. Improved occupant education may lead to fewer comfort complaints and call backs in green projects.

### **EO 1.0 Provide property management with project-specific owner's manual**

#### **Criteria**

Provide property management with project-specific owner's manual. Manual must contain, at a minimum, the following information:

- General
  - The final EarthCraft Worksheet for the project with cover sheet, and a copy of the EarthCraft certificate for the project.
- Energy Efficient Systems
  - Instructions for the proper use and maintenance of all energy-using systems, including, but not limited to:
    - Exhaust fans (kitchen range, bath, etc.)
    - Fireplaces
    - HVAC systems including filters, whole-house ventilation and thermostats
    - Water heaters
- Education and Operations
  - Provide at least three additional green activities such as recycling, proper management of hazardous waste disposal, gardening, the use of healthy cleaning materials, alternative measures to pest control, neighborhood conveniences to facilitate a healthy lifestyle and the purchase of green power.
  - Recycling information must include recycling facilities conveniently located to the project as well as a list of haulers that provide curbside service.
- Credit Specific Items requiring operating manuals/instructions:
  - DU 1.13 Alternative termite treatment with no soil pretreatment
  - ES 4.2 Install outside air intake with ventilation CFM, damper and controls meeting ASHRAE 62.2-2007 ventilation requirements
  - ES 4.15 Automatic bathroom exhaust fan controls
  - WE 2.1-2 & 3 Irrigation system
  - EO 3.1 Indoor airPLUS
  - EO 3.2 WaterSense New Home

- Credit Specific Items requiring warranty information:
  - DU 1.14-3 Mold inhibitor with warranty applied to all lumber
  - DU 1.17 Exterior cladding with 30-year warranty
  - DU 1.18 Windows, doors and skylights with ≥ 25-year warranty
  - DU 1.21-A & B Roofing warranty

### **Clarifications**

Equipment manuals are acceptable, but should be supplemented with clear and specific instructions to the tenant on when and how equipment should be used.

Detailed information on credit specific items is located under that line item in the guidelines.

### **Additional Resources**

For templates of guides that not only list the environmental features of the units but also explain their intent, benefits and maintenance, see:  
<http://www.greencommunitiesonline.org/tools/resources/>.

#### **Confirmation**

- The builder must present documentation demonstrating compliance of criteria to the EarthCraft Technical Advisor at the final inspection.
- The EarthCraft Technical Advisor will review documentation provided by the builder for compliance of criteria.

---

## **EO 1.1 Local recycling contact**

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#### **Criteria**

Provide residents a location for local recycling if recycling is not collected on site.

#### **Clarification**

The project team will not achieve points if recycling is completed by the local municipality or if the project team provides a recycling center on site.

#### **Confirmation**

- The EarthCraft Technical Advisor will review documentation provided by the project team for compliance with criteria.

---

## **EO 1.2 Label all storm drain or storm inlets to discourage dumping of pollutants**

---

#### **Criteria**

Label each storm drain within the development to discourage tenants from dumping pollutants in storm drains.

#### **Clarification**

Find more information about labeling storm drains here: <http://www.cbf.org/join-us/education-program/resources/storm-drain-stenciling>

#### **Confirmation**

- The EarthCraft Technical Advisor will visually verify for compliance during final inspections.

## EO 1.3 Household hazardous waste resources

### Criteria

The property management team must provide the tenant with a copy of hazardous cleaning material products and suggest environmentally preferable alternatives to common but harmful cleaning products.

Property management must include environmentally preferable products in their own protocols for purchase of cleaning supplies.

### Confirmation

- The project team must present documentation demonstrating compliance with criteria to the EarthCraft Technical Advisor prior to the final inspection.

## Operations and Management

Incorporating high performance measures and green construction technologies requires the review of all operations, not just construction practices, for evaluation of sustainability. The builders that integrate green business strategies into their entire company operations may have the greatest success in market transformation.

Although the EarthCraft program's main goal is to reduce the environmental impact of the buildings certified under the program, the program has an additional goal of encouraging EarthCraft Builders to minimize the negative environmental impacts of all of their projects. For example, EarthCraft Builders can earn points in the Operations and Management category by providing environmental checklists to all subcontractors or by committing to build at least 80% of their projects to EarthCraft standards.

## EO 2.0 Provide all subcontractors with EarthCraft Multifamily worksheets

### Criteria

Provide and review the relevant EarthCraft Multifamily measures with each subcontractor to ensure their compliance with the program guidelines.

### Confirmation

- The EarthCraft Technical Advisor will verbally confirm compliance with criteria with the project team at the pre-drywall and final inspections.

## EO 2.1 Property Maintenance Staff representative attends design review and/or kick off meeting

### Criteria

Property Maintenance Staff representative attends design review and/or kick off meeting.

### Confirmation

- The EarthCraft Technical Advisor will verbally confirm compliance with criteria with the project team at the design review and/or kick off meeting

## EO 2.2 Market EarthCraft Multifamily program

### Criteria

Include the EarthCraft Multifamily logo in all print materials, websites, advertisements and other promotional materials associated with project promotion.

Post an EarthCraft Multifamily sign during construction that is visible from the site entrance.

**Confirmation**

- The EarthCraft Technical Advisor will verbally and visually confirm compliance with criteria with the project team at the pre-drywall and final inspections.

---

### **EO 2.3 Provide pre-occupancy briefing for tenant**

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**Criteria**

Provide pre-occupancy briefing for all tenants. Walk through main green features of the unit and inform tenant on proper use of programmable thermostat, HVAC system and all major appliances in the unit.

**Confirmation**

- The EarthCraft Technical Advisor will verbally confirm compliance with criteria with the project team upon reviewing the pre-occupancy briefing plan.

---

### **EO 2.4 Project participates in post occupancy project debriefing**

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**Criteria**

Project team (maintenance, management staff, and owner) participates in post occupancy project debriefing to review the final worksheet and primary green building features of the project.

**Confirmation**

- The EarthCraft Technical Advisor will verbally confirm compliance with criteria with the project team upon attendance at post occupancy project debriefing.

---

### **EO 2.5 Environmental management and building maintenance guidelines for property management staff**

---

**Criteria**

The property management group must develop and utilize maintenance guidelines related to the green features of the project. These features must include all energy and water efficiency features of the units and common spaces. The goal of these guidelines will be to promote improved maintenance of the buildings sustainable features.

**Confirmation**

- The project team must present management guideline documentation demonstrating compliance with criteria to the EarthCraft Technical Advisor at the final inspection.

---

### **EO 2.6 Landscape maintenance guide for maintenance and management personnel**

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**Criteria**

The property management group must develop and utilize landscape maintenance guidelines for maintenance and management staff. The goal of these guidelines will be to promote proper maintenance of the landscaping.

**Confirmation**

- The project team must present the landscape management guideline documentation demonstrating compliance with criteria to the EarthCraft Technical Advisor at the final inspection.

## Third Party Programs

### EO 3.0 ENERGY STAR Qualified New Home or ENERGY STAR MFHR

#### Criteria

Construct and certify project in accordance with current ENERGY STAR qualified new home specifications. Complete all necessary steps to qualify project under ENERGY STAR, including all checklists and inspections.

#### Clarifications

Project team must be an active ENERGY STAR Partner and complete the online ENERGY STAR Orientation Training to be eligible to build homes qualified under current ENERGY STAR version.

HVAC contractors must complete the current ENERGY STAR training and be credentialed through an EPA-recognized industry organization.

#### Additional Resources

For more information about ENERGY STAR see: [www.energystar.gov](http://www.energystar.gov).



#### Confirmation

- The project team must submit documentation demonstrating compliance with criteria to the EarthCraft Technical Advisor at the pre-drywall inspection and final inspection.
- The EarthCraft Technical Advisor will review documentation provided by the project team for compliance with criteria and will diagnostically test compliance with criteria at the pre-drywall inspection and final inspection.

### EO 3.1 Indoor airPLUS

#### Criteria

Construct and certify project in accordance with Indoor airPLUS guidelines. Complete Indoor airPLUS Verification Checklist and include a copy in the project-specific owner's manual.

#### Additional Resources

See [www.epa.gov/radon/zonemap.html](http://www.epa.gov/radon/zonemap.html)

#### Confirmation

- The project team must submit documentation demonstrating compliance with criteria to the EarthCraft Technical Advisor at the pre-drywall inspection and final inspection.
- The EarthCraft Technical Advisor will review documentation provided by the project team for compliance with criteria and will diagnostically test for compliance with criteria at the pre-drywall inspection and final inspection.

## EO 3.2 WaterSense New Homes

### Criteria

To label a project as a WaterSense New Home, the builder must sign a WaterSense partnership agreement, build the project to WaterSense specifications, submit the project for inspection by a certified WaterSense Inspector, and pass inspection. The builder must also complete WaterSense Labeled New Home Inspection Checklist.

Include the following in the project-specific owner's manual:

- Information for all water-using equipment or controls installed and relevant WaterSense materials on indoor and outdoor water use.
- If installed, a record drawing (schematic) of the irrigation system, an itemized list of irrigation components, copies of irrigation schedules, and information about reprogramming the irrigation schedule after the establishment of the landscape.
- General information on water-efficient appliances.

### Additional Resources

For more information about EPA's Water Sense Homes program see:  
[www.epa.gov/WaterSense](http://www.epa.gov/WaterSense).

#### Confirmation

- The builder must submit documentation demonstrating compliance with criteria to the EarthCraft Technical Advisor at the pre-drywall inspection and final inspection.
- The EarthCraft Technical Advisor will review documentation provided by the builder for compliance with criteria and will diagnostically test for compliance with criteria at the pre-drywall inspection and final inspection.

## EO 3.3 EarthCraft Community Certification

### Criteria

Build the project in an EarthCraft Community.

### Clarifications

Community must either be actively pursuing EarthCraft Communities certification or be a certified EarthCraft Community.

### Additional Resources

For more information, visit <http://www.earthcraft.org/earthcraft-programs>.

#### Confirmation

- The EarthCraft Technical Advisor will verbally confirm compliance with criteria with the project team at the final inspection.

## EO 3.4 EarthCraft Light Commercial for Community Center

### Criteria

Certify the project's Community Center under the EarthCraft Light Commercial program.

### Additional Resources

For more information, visit <http://www.earthcraft.org/light-commercial>

#### Confirmation

- The EarthCraft Technical Advisor will confirm EarthCraft Light Commercial certification achieved at the final inspection.

## EO 3.5 EarthCraft Light Commercial Ready Spaces

---

### Criteria

For mixed-use developments that include both residential units and commercial retail spaces sharing the same building shell, meet the following criteria in order to designate the retail tenant spaces as EarthCraft Light Commercial Ready (ECLC Ready):

- Owner must agree to a smoking policy within retail corridors and other shared public spaces within the building and designate public smoking areas at least 25 feet away from all retail entrances and exits
- Apply minimum thermal break of R-2 for steel stud framing regardless of climate zone (no trade-offs allowed)
- Tenant partition walls must be insulated to a minimum of R-13
- Meet or exceed ASHRAE 90.1-2007 Energy Standard for the following commercial building components: walls, ceilings, floors, and glass
- Submit the following Energy Code Compliance Documentation:
  - Use Prescriptive values in ASHRAE 90.1-2007 Climate Zone Table for project's respective Climate Zone – or – use COMcheck Software to demonstrate compliance via a Trade-off Approach
  - Visual inspection of envelope components at pre-drywall, including glass U-factor and SHGC via NFRC labels and/or certification of compliance for storefront glass (within its assembly)
- Meet the following air sealing and insulation requirements:
  - Exterior walls, corridor walls, and tenant partition walls and penetrations must be air sealed to reduced air connectivity between retail tenant and other adjacent spaces
  - Ceiling chases within the tenant space to other spaces must be sealed air tight at tenant build-out completion
  - All installed ductwork must meet EarthCraft Multifamily/EarthCraft Light Commercial requirements for air sealing (mastic or mastic paste)
  - Insulation must meet Grade 2 level installation
- Locate outside air intakes 15 feet away from moderate contaminant sources (such as exhaust outlets, garbage pick-up/dumpster areas, and garage entries) and 25 feet away from high contaminant sources (such as truck loading docks, vehicle idling, and high vehicle traffic areas).
  - All retail tenant air intakes must be a least 10 feet away from contaminate sources and air intakes must draw air from the outside and be fully ducted to the building envelope
- Installed Lighting, HVAC, and Ductwork must meet or exceed ASHRAE 90.1-2007 Energy Standard
- Must meet ASHRAE 62.1-2007, Ventilation for Acceptable Indoor Air Quality for all applicable areas within the project scope

### Clarification

All projects that intend to seek ECLC Ready Spaces must pre-qualify with an EarthCraft Light Commercial approved EarthCraft Technical Advisor.

**For projects Additional Resources**

For information on ASHRAE 90.1-2007 and ASHRAE 62.1-2007, visit American Society of Heating, Refrigerating and Air-conditioning Engineers (ASHRAE) website at [www.ashrae.org](http://www.ashrae.org).

To download free COMcheck Software, visit [www.energycodes.gov](http://www.energycodes.gov).

For more information on meeting ASHRAE referenced standards and minimum envelope requirements for light commercial spaces, refer to the EarthCraft Light Commercial Technical Guidelines, downloadable for free at: [www.earthcraft.org/light-commercial](http://www.earthcraft.org/light-commercial).

**Confirmation**

- Provide applicable signed COMcheck compliance certificates and COMcheck File to prior to Pre-Construction Meeting
- Provide Certificate of Compliance for storefront glass (as applicable)
- Pre-drywall and Final Inspections by an EarthCraft Light Commercial approved EarthCraft Technical Advisor to view air sealing measures, applied insulation, glazing, and installed ductwork

**EO 3.6 Building America Builder's Challenge****Criteria**

Construct and certify project according to the requirements in the Building America Builder's Challenge program.

**Additional Resources**

For more information, see [www1.eere.energy.gov/buildings/challenge](http://www1.eere.energy.gov/buildings/challenge).

**Confirmation**

- The project team must submit documentation demonstrating compliance with criteria to the EarthCraft Technical Advisor at the final inspection.
- The EarthCraft Technical Advisor will review documentation provided by the project team for compliance of criteria.

**Innovation**

EarthCraft strives to advance market transformation towards green and high-performance building construction in the Southeast. While the program is comprehensive in scope, new products, technologies and strategies are continuing to be developed supporting the mission of EarthCraft and EarthCraft Builders. The Innovation category is intended to provide builders the opportunity to present new ideas for advancing green building and reward those implementing cutting-edge technologies. Builders are encouraged to present products, technologies, and strategies not covered elsewhere within the EarthCraft program.

**IN 1.0 On-site fuel cell or cogeneration system****Criteria**

Install on-site fuel cell or cogeneration system to provide energy (in the form of heat and/or electricity) to project.

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance with criteria at final inspection.

## IN 1.1 Solar, micro-hydro or wind electric system

### Criteria

Install on-site solar, micro-hydro, or wind electric system to provide energy (in the form of heat and/or electricity) to project.

### Confirmation

- The EarthCraft Technical Advisor will visually confirm compliance with criteria at final inspection.

## IN 1.2 Solar-ready design

### Criteria

Design and construct project with the intent of being retro-fitted with solar hot water and/or solar power. There must be space on lot for a solar power array that can produce, at minimum, 20% of building(s) electrical load. The space must allow the array to remain un-shaded year round, be oriented to within 15 degrees of true south, and be angled horizontally within 15 degrees of latitude.

Install and label conduits from the mechanical room and water heater to the attic.

Install extra plumbing valves and fittings on the water heater and an electrical outlet at the planned solar tank location.

Construction plans must designate future component (solar power and solar hot water) locations.

### Confirmation

- The project team must present documentation demonstrating compliance with criteria to the EarthCraft Technical Advisor at the pre-drywall inspection.
- The EarthCraft Technical Advisor will review documentation provided by the project team for compliance with criteria and will visually confirm compliance at pre-drywall and final inspections.

## IN 1.3 Solar electric system (10% of project demand)

### Criteria

The project will utilize a solar electric array with the capacity to offset 10% of electrical load demand required by all building(s) within the development. This power may be directly tied to the building(s) common areas and units or may be transferred to the grid.

### Clarifications

To qualify, the project team must clearly indicate the expected electrical load requirements of the building(s) within the development and then provide a solar PV design showing that 10% of that demand is attainable.

Efficient lighting strategies (outlined in IES/ASHRAE design guidelines, see ES 7.2) are encouraged as a first step, in order to reduce the overall electrical load requirement before installing the required 10% PV capacity at final design.

**Confirmation**

- The project team must present documentation demonstrating compliance with criteria to the EarthCraft Technical Advisor.

The documentation must include:

1. A letter from the solar designer/installer indicating the kwh production of the solar system installed.
2. The electrical engineer must indicate the total expected electric capacity of the entire building(s) in the project.
3. If tied to the grid, the project team must provide details of the agreement with the power provider.

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## **IN 1.4 100% of stormwater kept on site and used for development operations**

---

**Criteria**

The project prevents 100% of the stormwater from entering the main sewer system by storing it on site to be used in the building/development operations.

**Clarifications**

To qualify, all stormwater must be stored on site and used in the building/development operations.

**Confirmation**

- The EarthCraft Technical Advisor will visually confirm compliance with criteria at final inspection.

---

## **IN 1.5 Common areas use solar electric system (80% of demand)**

---

**Criteria**

The project will utilize a solar electric array with the capacity to offset 80% of electrical load demand required by all common areas within the building(s). This power may be directly tied to the building or may be transferred to the grid.

**Clarifications**

To qualify, the project team must clearly indicate the expected electrical load requirements of all common areas (including but not limited to clubhouses, offices, hallways, laundry facilities, bathrooms, outdoor common areas, etc.) and then provide a solar PV design showing that 80% of that demand is attainable.

Efficient lighting strategies and controls (outlined in IES/ASHRAE design guidelines, see ES 7.2) are encouraged as a first step in order to reduce the overall electrical load requirement before installing the required 80% PV capacity at final design.

**Confirmation**

- The project team must present documentation demonstrating compliance with criteria to the EarthCraft Technical Advisor.

The documentation must include:

1. A letter from the solar designer/installer indicating the kwh production of the solar system installed.
2. The electrical engineer must indicate the total expected electric capacity of all common areas within the project.
3. If tied to the grid, the project team must provide details of the agreement with the power provider.

## IN 1.6 Housing affordability

### Criteria

A percentage of total housing units within the project are reserved for tenants qualifying for a low-income housing assistance program.

*A.≥20% total units*

*B.≥50% total units*

### Confirmation

- The project team will submit details of affordable housing funding mechanism and the numbers of units qualifying as affordable within the entire development.

## IN 1.7 Developer contracts for at least 12 months post construction energy monitoring

### Criteria

Upon certification, the developer will contract for at least 12 months of post construction energy monitoring.

### Confirmation

- The EarthCraft Technical Advisor will confirm compliance and the developer will share the 12 month study results with EarthCraft upon completion.

## IN 1.8 Project-specific innovation points

### Criteria

Prior to certification, submit specifications for innovative products, or design features to EarthCraft for approval to qualify for additional points.

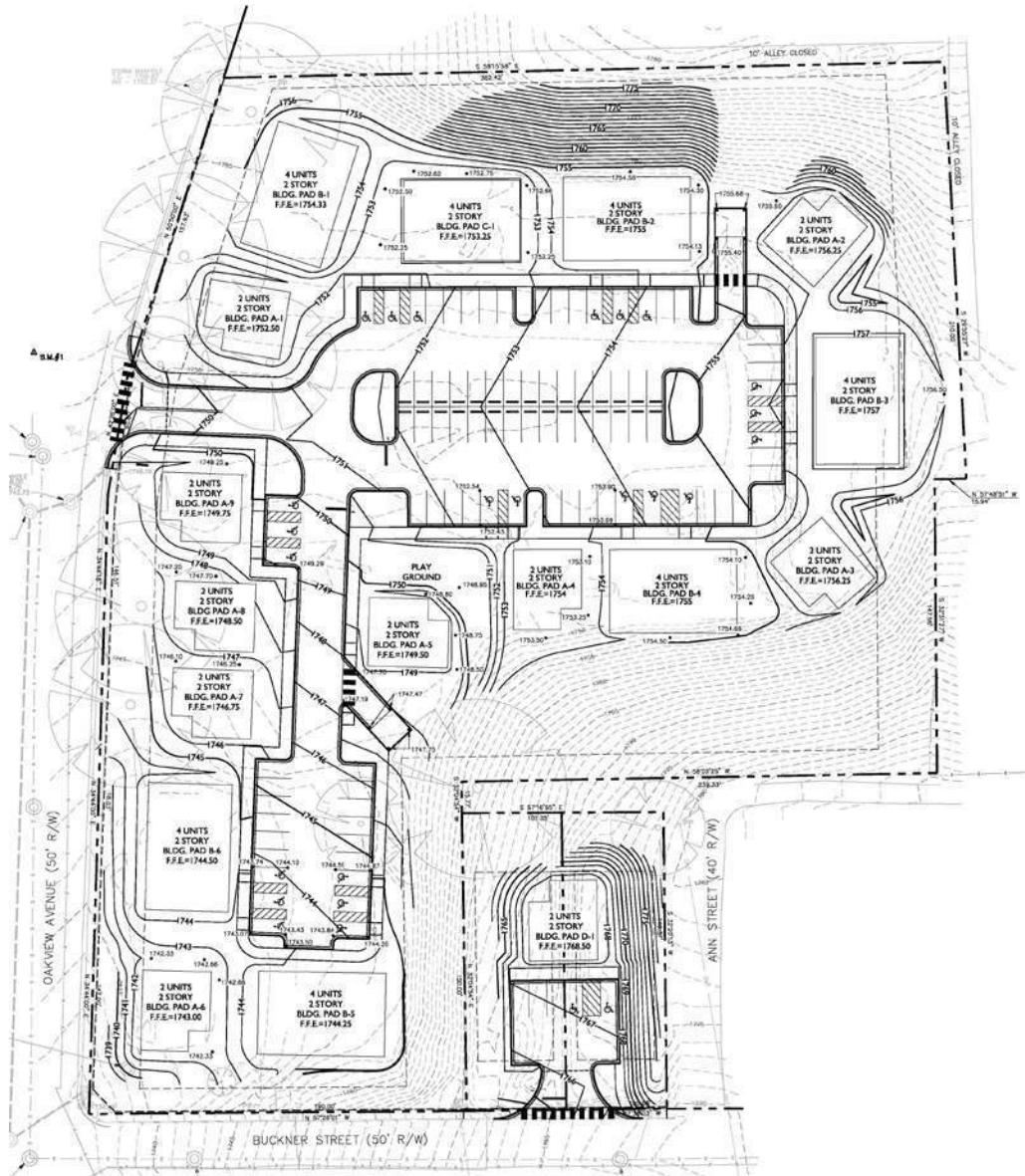
### Confirmation

- The EarthCraft Technical Advisor will submit to EarthCraft for approval and point award.

## **PROJECT MANUAL APPENDIX TWO**

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# GEOTECHNICAL EXPLORATION REPORT



# **BONHAM CIRCLE REDEVELOPMENT BRISTOL REDEVELOPMENT AND HOUSING AUTHORITY BRISTOL, VIRGINIA**

**CLIENT: THOMPSON + LITTON, INC**

**REPORT DATE: MAY 28, 2015**

FSE PROJECT NUMBER: 215163



Foundation Systems  
Engineering, P.C.

Geotechnical Engineering and Consulting

May 28, 2015

Mr. Scott Wilson, P.E.  
Thompson + Litton, Inc.  
100 Fifth Street, Suite 400  
Bristol, Tennessee 37620

**RE: GEOTECHNICAL EXPLORATION REPORT  
BONHAM CIRCLE REDEVELOPMENT  
BRISTOL REDEVELOPMENT AND HOUSING AUTHORITY  
BRISTOL, VIRGINIA  
FSE FILE NO.: 215163**

Dear Mr. Wilson:

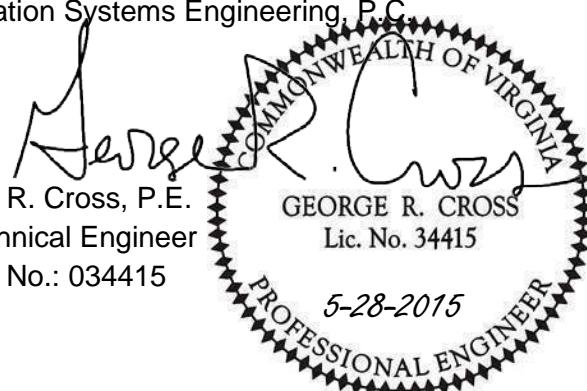
At your authorization of FSE proposal 15.111, we have completed a geotechnical exploration of the above referenced site. The purpose of the evaluation was to gather site and subsurface information from which to provide engineering recommendations concerning site preparation methods, soil design recommendations and other construction considerations. The following report presents our findings and recommendations.

We have appreciated the opportunity to provide our geotechnical engineering and testing services. If you have any questions regarding the information within this report, please contact us at your convenience.

Sincerely,  
Foundation Systems Engineering, P.C.

  
Wes Loerger, P.E.  
Staff Engineer  
Virginia No.: 046000

  
George R. Cross, P.E.  
Geotechnical Engineer  
Virginia No.: 034415



GRC/km

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Pre-Demo Boring Location Plan  
Test Boring Location Plan  
Test Boring Records  
Site Location Map  
Area Geology Map  
Aerial Photograph  
Lab Data

## **EXECUTIVE SUMMARY**

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The proposed project includes the construction of a multi-family development for the Bristol Redevelopment and Housing Authority (BRHA). The project is located at the site of a recently demolished multi-family complex also operated by the BRHA. The site is located at the intersection of Oakview Avenue and Buckner Street in Bristol, Virginia. Site plans for both the old (demolished) and the proposed building locations are depicted in the exhibit drawings included with this report.

The subsurface conditions on the site were explored with the use of eighteen (18) soil test borings and seven (7) soil test pits. The approximate test locations are indicated on the *Boring Location Plans* provided.

A summary of our findings and recommendations is listed below.

- ◆ The test locations encountered fill, alluvial and residual soil types. The soil types generally included low and high plasticity silts and clays with sand lenses.
- ◆ The fill soil was placed during past construction activities on the site and the recent demolition work. The fill soil was encountered in soft to stiff consistencies at soil test locations B-1 through B-7, B-11, B-17, B-18, TP-3 and TP-4 to approximate depths varying from 2 to 10 feet. Disturbed (fill) soil generally exists in the upper 1 to 2 feet throughout the site due to the past demolition activities. Some of the fill soil encountered included construction debris not associated with the recent demolition activity. This debris appeared to be remnants of old homes and included wood, glass, block, brick and metal. The older fill was predominately encountered in a discrete area of the site as indicated on the *Boring Location Plans*.
- ◆ The alluvial soil encountered was deposited on the site by past flowing water. Topographic mapping indicates that a natural drainage feature is located on the site, flowing generally west by southwest from the intersection of Moore and Chester Streets to the intersection of Oakview Avenue and Buckner Street. The alluvial soils encountered were generally gray and brown clays and silts, soft to medium in consistency and very moist to wet.
- ◆ The residual soil was derived from the underlying bedrock and was primarily yellow tan clayey silt and red tan silty clay encountered in a generally soft to medium consistency and a very moist to wet condition. With increasing depth, the residual soils will typically exhibit increasing moisture content and decreasing consistency.
- ◆ Auger refusal was encountered at the following test boring locations (with interpreted refusal material): B-7 (sandstone bedrock at 10.5 feet below ground surface), B-11 (rock in fill at 6.5 feet below ground surface), and B-18 (sandstone bedrock at 16.5 feet below ground surface).
- ◆ Ground water was encountered at two locations (B-2 and B-3) at the time of drilling.
- ◆ It is the opinion of FSE that the proposed structures should not be directly supported on the fill soil that exists on the site. All foundations should bear on stiff native soil, select fill materials placed over excavated foundation, or new compacted fill soil placed in the building pad areas.

- ◆ FSE recommends the following building pad preparation options:
  - **Selective Foundation Undercutting** - For improved support of shallow foundations we recommend undercutting of foundations to allow replacement of undesirable soils with select compacted fill material. Undesirable soils include all existing fill materials and soils encountered in a less than stiff consistency. We recommend a minimum undercut excavation with a width equal to the width of the foundation (1W) with an undercut depth equal to 2 times the foundation width (2W) below the design foundation bearing elevation.
  - **Whole Building Pad Undercut** - This method includes removal of existing fill soil from under the building footprint plus at least 5 feet beyond the building perimeter. A removal depth of 6 feet below the planned finish floor elevation is recommended. A compacted soil fill pad over geogrid reinforcement is constructed across the undercut area. This method provides for increased soil strength and uniformity for foundation and slab support.
- The recommended building pad undercut depth is 6 feet below the planned finish floor elevation. Over the undercut building pad area a layer of geogrid reinforcement (Type 2, Biaxial Geogrid) should be placed prior to backfilling the pad.
- **Stiffened Slabs** - If the building pad is not undercut as described above, we recommend that the building slabs be structurally stiffened with steel reinforcement to assist in bridging areas of weak soils.
- ◆ On the prepared site and/or foundation excavations, shallow foundations may be designed using an allowable soil bearing capacity of 2000 psf.
- ◆ The site grading and foundation construction should be performed under the observation of a geotechnical engineer to assist with continued evaluation of soil conditions during the construction process.
- ◆ This summary should be used in conjunction with the entire report for design purposes. Details were not included or fully developed in this section, and the report must be read in its entirety for a comprehensive understanding of the items contained herein. The section titled "General Qualifications" should be read for an understanding of the report limitations.

## SCOPE OF SERVICES

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Item	Description
<b>Information Reviewed</b>	<ul style="list-style-type: none"><li>✓ USGS Topographic Mapping</li><li>✓ Geologic Mapping of Virginia/Tennessee, Bristol Quadrangle</li><li>✓ 2012 International Building Code</li><li>✓ Past and proposed site plans provided by Thompson + Litton</li></ul>
<b>Site Reconnaissance</b>	<ul style="list-style-type: none"><li>✓ topographic features</li><li>✓ drainage patterns</li><li>✓ ground surface cover</li><li>✓ surface improvements</li><li>✓ exposed rock</li></ul>
<b>Soil Test Borings (18)</b>	<ul style="list-style-type: none"><li>✓ Eighteen (18) soil test borings advanced to auger refusal or planned termination depth of 20 feet below ground surface with a CME 75 drill rig</li><li>✓ Standard Penetration testing (SPT), 4 tests in upper 10 feet, 1 every 5 feet thereafter</li><li>✓ Observation of soil for type, consistency and moisture content</li><li>✓ Backfilled boring locations with soil cuttings</li><li>✓ Soil test borings were located in the field by FSE using the drawings provided.</li></ul>
<b>Test Pits (7)</b>	<ul style="list-style-type: none"><li>✓ Seven (7) test pits were advanced in areas inaccessible to our drilling equipment and in locations selected to enhance our soil test boring information</li><li>✓ Backfilled test pits with excavated materials</li><li>✓ Observation of soil for type, consistency and moisture content</li></ul>
<b>Groundwater Measurement</b>	<ul style="list-style-type: none"><li>✓ Groundwater measurements made at the time of exploration</li></ul>

## PROJECT/SITE INFORMATION

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### PROJECT DESCRIPTION

Item	Description	
<b>Project Location</b>	The main entrance to the project is located at the intersection of Oakview Street and Buckner Street in Bristol, Virginia.	
<b>Project Information</b>	General	Construction of seventeen (17), 2- to 4-unit multi-family residential structures
	Structures	Two level buildings, slab on grade, wood framed construction
	Cut / Fill	Fill up to 5 feet of existing grades Cut (excavation) up to 8 feet of existing grades
	Embankments	Yes
	Below Grade Walls	Minor (less than 4 feet in height)
	Paved Areas	Access roads and parking lots

### SITE DESCRIPTION

Item	Description
<b>Current Site Use</b>	The site is currently vacant.
<b>Past Site Use</b>	A recently demolished multi-family development was located on the property. The existing buildings, utilities and surface improvements have been removed. Evidence of buildings predating the previous multi-family development was encountered during our exploration. The site has been disturbed by recent demolition activates.
<b>Topography</b>	USGS Mapping - A natural drainage feature is located within the site. This feature conveys water from the approximate midpoint of the eastern property line to the southwest corner of the site. The majority of the site lies within this feature with steeply sloping sides to the north and east.  <b>Topography</b> The general area consists of mild to moderately sloping terrain. No blue line streams are mapped on the site. Closed ground depressions (sinkholes) are not mapped on the site but are in the vicinity.  <b>Site Observations</b> - There is an approximate elevation change of 45 feet across the site, from the northern property line to the southwest corner.

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The project site is located in the Valley and Ridge physiographic province of southwest Virginia. A review of published State of Virginia geologic mapping of the area indicates that the project location lies within the sedimentary bedrock of the Conococheague Formation. The Conococheague Formation consists of dark gray to blue gray, medium bedded, partly cherty limestone, with light gray, dense dolomite and thin beds of brown, medium-grained sandstone.

Localized concentration of bedding planes; fractures and other discontinuities often result in weathering and decomposition extending to greater depths into the subsurface profile. Ridges or lenses of weathering resistant rock form pinnacles and ledges of unweathered rock extending nearly to the ground surface. The localized greater depths of decomposition, solution cavities and rock pinnacles all combine to form what is a highly irregular rock surface profile.

## Regional Geology

### Karst Considerations -

Sedimentary bedrock containing dolomite and limestone material is subject to karst activity or the formation of closed ground depressions known as sinkholes.

The depth of the soil profile is continually altered over geologic time by gradual weathering at the soil/rock interface, and more rapidly by erosion of surficial soils. Weathering of the parent bedrock is generally more rapid near fracture zones. Therefore, the bedrock surface will be irregular.

Observation of the site and review of USGS topographic and site mapping provided indicates there are no mapped sinkhole formations on the site. Sinkhole activity and karst terrain does exist in the vicinity of the site.

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## SUBSURFACE DESCRIPTION

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The following is a brief summary of the soils encountered at the soil test boring locations. Additional subsurface details may be seen on the attached *Test Boring Records*. Subsurface stratification indicated on the test boring records is approximate and represents our interpretation of the soils encountered at the Standard Penetration testing intervals.

<b>Strata</b>	<b>Description</b>	
<b>Oakview Avenue Parcel</b>		
Ground Cover	Topsoil	6 to 12 inches, recently placed
	Asphalt basestone	Approximately 3 to 4 inches under the demolished asphalt entrance
<b>Buckner Street Parcel</b>		
Fill Soil	Vegetation	Moderately vegetated with trees and brush
	Debris	Several areas of dumped construction debris
	Topsoil	Approximately 12 inches
Alluvial Soil	Comments	Variation in ground cover will occur across the site
	Origin	Manmade, deposited by past construction activities.
	Test Locations	B-1~7, B-11, B-17, B-18, TP-3, TP-4 (less than 2 feet at others)
	Description	Tan, brown and red clays and silts. Construction debris.
	Consistency	Soft to stiff, moist to wet
Residual Soil	Depth	Varying from 2 to 9 feet below ground surface elevations
	Origin	Deposited on the site by water
	Test Locations	B-3~7, B-14, TP-3, TP-4
	Description	Tan and brown silts and clays with sand
	Consistency	Soft to medium, very moist to wet
Bedrock/Auger Refusal	Origin	Native, product of weathering process of underlying bedrock
	Test Locations	All
	Description	Tan, red and brown, low and high plasticity silts and clays with iron staining and some sand and sandstone seams
	Consistency	Soft to very stiff, moist to wet
	Comments	A general decrease in shear strength and increase in moisture with depth was noted.
Ground-water	Auger refusal	3 of 18 locations, from 6.5 to 16.5 feet below ground surface
	Comments	The auger refusal material was interpreted as sandstone bedrock at test locations B-7 and B-18, and rock in fill at B-11

## TEST BORINGS / PITS SUMMARY

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**Soil Test Boring / Pit Summary Table**

Boring/Pit Number	Ground Surface	Fill		Alluvial		Residual		Refusal Depth
		Top	Thickness	Top	Thickness	Top	Thickness	
B-1	1746	1746	4	-	-	1738	16+	-
B-2	1742	1742	9	-	-	1733	11+	-
B-3	1741	1741	6.5	1734.5	5.5	1729	8+	-
B-4	1741	1741	6.5	1734.5	6	1728.5	7.5+	-
B-5	1746	1716	6.5	1739.5	8.5	1731	5+	-
B-6	1746	1746	8	1738	5	1733	7+	-
B-7	1748.5	1748.5	4	1744.5	2.5	1742	4	1738
B-8	1752	-	-	-	-	1752	20+	-
B-9	1755	-	-	-	-	1755	20+	-
B-10	1755	-	-	-	-	1755	20+	-
B-11	1755	1755	6.5	-	-	-	-	1748.5
B-12	1755.5	-	-	-	-	1755.5	20+	-
B-13	1754	-	-	-	-	1754	20+	-
B-14	1754	-	-	1754	6	1748	14+	-
B-15	1754	-	-	-	-	1754	20+	-
B-16	1751	-	-	-	-	1751	20+	-
B-17	1751	1751	8	-	-	1743	12+	-
B-18	1748	1748	6	-	-	1742	10.5	1731.5
TP-1	1755	1755	2.5	-	-	1752.5	2.5+	-
TP-2	1754	1754	0.5	-	-	1753.5	2+	-
TP-3	1754	1754	9	1745	1.5+	-	-	-
TP-4	1747	1747	8	-	-	1739	1+	-
TP-5	1764	1764	1	-	-	1763	3+	-
TP-6	1769	1769	0.7	-	-	1768.3	1.8+	-
TP-7	1769	1769	0.5	-	-	1768.5	2.5+	-

## LABORATORY TESTING

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### NATURAL MOISTURE CONTENT

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The Natural Moisture Content tests provide data that assist in evaluating the onsite soil moisture for engineering properties and the amount of moisture conditioning that may be anticipated in order to dry the onsite soils for use as structural fill.

The following table summarizes the Natural Moisture Content Testing:

Natural Moisture Content Data Summary					
Boring Location	Depth (Feet)	Natural Moisture Content (%)	Boring Location	Depth (Feet)	Natural Moisture Content (%)
B-1	8.5-10.0	57.3	B-10	6.0-7.5	50.8
B-1	13.5-15.0	44.0	B-10	8.5-10.0	50.8
B-3	6.0-7.5	29.5	B-10	13.5-15.0	43.8
B-3	8.5-10.0	28.0	B-10	18.5-20.0	49.6
B-4	8.5-10.0	19.0	B-12	1.0-2.5	35.2
B-4	13.5-15.0	45.0	B-12	3.5-5.0	31.4
B-5	8.5-10.0	20.1	B-12	6.0-7.5	30.5
B-6	13.5-15.0	31.8	B-12	8.5-10.0	31.8
B-6	18.5-20.0	42.1	B-14	6.0-7.5	25.0
B-7	6.0-7.5	25.6	B-14	8.5-10.0	23.6
B-7	8.5-10.0	24.9	B-14	13.5-15.0	49.6
B-8	1.0-2.5	46.7	B-15	1.0-2.5	44.4
B-8	3.5-5.0	37.3	B-15	3.5-5.0	39.5
B-8	6.0-7.5	42.9	B-15	6.0-7.5	44.6
B-8	8.5-10.0	48.2	B-16	3.5-5.0	38.3
B-10	1.0-2.5	15.1	B-16	6.0-7.5	45.6
B-10	3.5-5.0	18.2			

## **ATTERBERG LIMITS**

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The Atterberg Limits Determination provides the Liquid and Plastic limits for soil classification purposes and to assist in evaluating the soil for engineering properties.

The soil liquid limit is the moisture content at which the soil passes from a plastic to a liquid state. Soil cohesion is negligible at the liquid limit. High liquid limit values (greater than 50) indicate soils of high clay content and low load carrying characteristics.

The soil plastic limit is the moisture content at which the soil changes from a semisolid to a plastic state. Some silts and sands are non-plastic; however, most soils composed of silts and clays do have a plastic limit. The moisture content of silts and clays does have a direct bearing on their load carrying characteristics.

An important change in load carrying capacity of soil occurs at the plastic limit. Load carrying capacity decreases as the soil moisture content increases above the plastic limit.

The following table summarizes the Atterberg Limits Determination Testing:

Atterberg Limits Data Summary						
Boring Location	Sample Depth (Feet)	Natural Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index	USCS Soil Classification
B-1	8.5-10.0	57.3	63	34	29	MH
B-8	8.5-10.0	48.2	54	32	22	MH
B-12	8.5-10.0	31.8	43	24	19	CL

## **LABORATORY TESTING SUMMARY**

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The soils present on the site are classified as low to high plasticity silts and low plasticity clays based on the USCS soil classification system. These soil types are given the soil symbol CL and MH. Some discrete seams of sand and sandstone are also present. The soils types have a generally medium to high potential for volume change due to changing moisture contents and loading conditions.

Such soils have fair compaction characteristics with compaction typically achieved using a vibratory sheep's foot roller. Moisture conditioning (drying) will be required to achieve specified compaction density. We anticipate that the onsite soil will generally exist at a moisture content that is 5% to 20% above the optimum moisture, as determined by laboratory testing.

With proper moisture conditioning (drying), the onsite residual soil or clean fill soil material will be suitable for reuse as structural fill material.

## **RECOMMENDATIONS**

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### **GENERAL CONSTRUCTION CONSIDERATIONS**

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Moisture Sensitive Soil - Unstable subgrade conditions may develop during general construction operations, particularly if the soils are wetted and/or subjected to repetitive construction traffic. Should unstable subgrade conditions develop stabilization measures will need to be implemented.

Upon completion of filling and grading, care should be taken to maintain the subgrade moisture content prior to construction of floor slabs and pavements. Construction traffic over the completed subgrade should be avoided to the extent practical. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. If the subgrade should become frozen, desiccated, saturated, or disturbed, the affected material should be removed or these materials should be scarified, moisture conditioned, and recompacted prior to floor slab and pavement construction.

Excavations - Temporary excavations will be required during grading operations. The grading contractor, by his contract, is usually responsible for designing and constructing stable, temporary excavations and should shore, slope or bench the sides of the excavations as required, to maintain stability of both the excavation sides and bottom. All excavations should be sloped or braced to comply with applicable local, state and federal safety regulations, including the current OSHA Excavation and Trench Safety Standards.

Permanently excavated slopes in soil should not exceed a slope geometry of 2H:1V up to a maximum height of 15 feet. Additional evaluation should be performed for a slope of greater height. For permanently maintained grass or lawn areas, the excavated slopes should not exceed a geometry of 3H:1V.

Karst (sinkhole) Activity - Past experience has found that sites where grading/construction activities remove all or a portion of the stiff upper crust of soil overburden are at a higher risk of sinkhole activity (dropouts) than sites where no such excavation is made.

Similarly, sinkholes may be induced by ponding water or from leaking pipes, etc. The risk of induced sinkhole activity is increased for sites where the stiff upper crust of residual soil is removed during site grading/construction activities.

Soil supported foundations overlying rock units that are susceptible to solutioning and sinkhole development are at risk of damage from sinkhole activity.

Construction projects in karst are subject to risk of encountering or developing sinkholes and require an awareness of the site conditions that are unique to this geology. We recommend the following measures be considered:

Care should be taken to avoid creating localized low areas where surface water could pond. Provide positive drainage at all times. If rain is anticipated, use a smooth drum roller to seal the exposed ground surface to prevent water infiltration.

Exposed bedrock conditions should be over excavated allow the placement of a fine grained soil cap over the rock area to prevent seepage of surface water and subsurface erosion.

Any changes to the ground surface such as depressions or dropouts should be immediately brought to the attention of the geotechnical engineer. The site conditions can be evaluated and an appropriate method of repair can be developed.

Utility trenches should *not* be backfilled with open graded gravel to limit subsurface lateral water movement on the site. We recommend the use of compacted, select crushed gravel with fines, (VDOT 21-A or B) and/or fined grained soil for backfill material.

**Site Drainage** - Drainage should be controlled during construction and once the site is completed to prevent ponding of surface water. If necessary, pumps, ditches or other grading methods should be used to prevent ponding surface water. Roof water should be collected into piping and conducted away from the building areas to prevent moisture related soil movements.

**Fill Slopes** - All fill embankments less than 15 feet in height should be constructed with a slope geometry of no steeper than 2H:1V. All fill embankments greater than 15 feet in height should be evaluated for stability. For fill embankments that will be permanently maintained as grassed or lawn areas, the embankments should not exceed a slope geometry of 3H:1V.

Fill placed in sloping areas should use a series of horizontal benches or terraces to tie the existing soil and proposed new fill together. The benching operation should begin at the toe of the slope. Benches should be placed as required to ensure that no fill is placed on sloping surfaces. Benched areas should be stripped of organics and soft or wet soil conditions.

**Construction Observation** - The site grading and foundation construction should be performed under the observation of a geotechnical engineer and/or their representative to assist with continued evaluation of soil conditions during the construction process.

**Plan Review** - The design civil/site preparation and foundation plans for the project should be provided to the geotechnical engineer to assist with the review process.

## **SITE PREPARATION**

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The area to be developed with buildings should be stripped of organic soil, construction materials, fill soil and soft/wet soil. After clearing and grubbing is complete, the site should be proofrolled to evaluate the subgrade soil strength characteristics.

The soil subgrade should be proofrolled with a fully loaded dump truck (minimum load of 20 tons) in a slow crossing pattern. Proofroll testing should be performed under the observation of a geotechnical engineer to evaluate the subgrade and provide recommendations for any unsuitable areas encountered.

Soft or wet soil conditions revealed by proofroll testing or other methods should be evaluated by the geotechnical engineer and stabilized accordingly. The best method of subgrade stabilization can be performed in the field at the time of the proofroll evaluation.

The site grading and foundation construction should be performed under the observation of a geotechnical engineer to assist with continued evaluation of soil conditions during the construction process.

## ENGINEERED FILL

### FILL PLACEMENT

Item	Description
Fill Lift Thickness	8 inches or less in loose thickness when heavy, self-propelled compaction equipment is used
	4 to 6 inches in loose thickness when hand guided equipment (i.e. jumping jack or plate compactor) is used
Compaction (Building Areas)	At least 98% of the materials standard Proctor maximum dry density (ASTM D 698)
Compaction (Drive/Parking Areas - upper 2 ft)	At least 98% of the materials standard Proctor maximum dry density (ASTM D 698)
Compaction (Drive/Parking Areas - below 2 ft)	At least 95% of the materials standard Proctor maximum dry density (ASTM D 698)
Compaction (General)	Compaction all fill soil plus 5 feet beyond the perimeter in locations supporting structures and drive areas
Compaction (Trench Lines)	Per the above depending upon location/elevation
Moisture Content Cohesive Soil	Within the range of -2% below to +3% above the optimum moisture content value as determined by the standard Proctor test at the time of placement and compaction
Testing Frequency	1 test per 2500 square feet or less of fill area for each soil fill lift.
Testing Personnel	A qualified soil technician, under the direction of a geotechnical engineer, should perform the soil density testing.
Building Pad Subgrade	For building pad soil subgrade preparation, the upper 1 foot should be scarified and recompacted to 98% of its Standard Proctor density. All prepared subgrades should pass proofroll testing.
Soil Subgrade Approval	Prior to fill placement, the soil subgrade should be proofrolled under the observation of a geotechnical engineer for approval to begin fill placement.

### FILL MATERIALS

Fill Type <sup>1</sup>	USCS Classification	Acceptable Location for Placement
Soil	Various (PI<30)	All Locations and elevations
Well graded granular	GW <sup>2</sup>	All Locations and elevations

- Controlled, compacted fill should consist of approved materials that are free of organic matter, debris, particles greater than 4 inches. Frozen material should not be used and fill should not be placed on a frozen subgrade. Minimum Standard Proctor (ASTM D-698) dry unit weight 90pcf. Each soil type should be submitted to the geotechnical engineer for evaluation.
- Similar to TDOT Section 903.05 Type A, Grading D crushed limestone aggregate, limestone screenings, or such as well graded gravel or crushed stone.

## PAD AND FOUNDATION PREPARATION

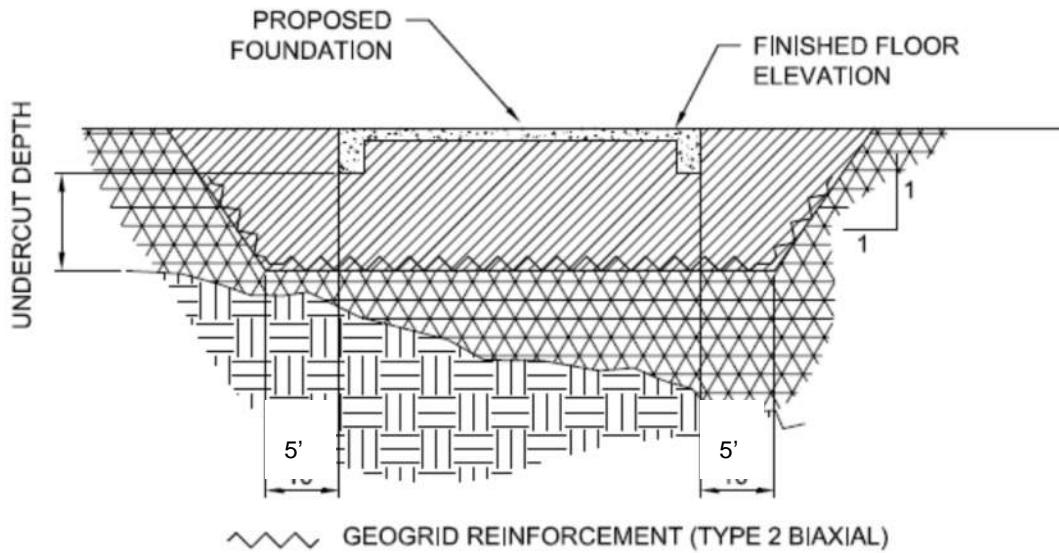
Based on our findings, we recommend the implementation of one of the following two options in preparing the building pads and foundations.

- **Option A - Whole Building Pad Undercut**

This method includes partial removal of existing soil from under the building footprint plus at least 5 feet beyond the building perimeter to a specified depth. A compacted soil fill pad over geogrid reinforcement is constructed across the undercut area. This method provides for increased soil strength and uniformity for foundation and slab support.

The recommended building pad undercut depth is 6 feet below the planned finish floor elevation. Over the undercut building pad area a layer of geogrid reinforcement (Type 2 Biaxial Geogrid) should be placed prior to backfilling the pad.

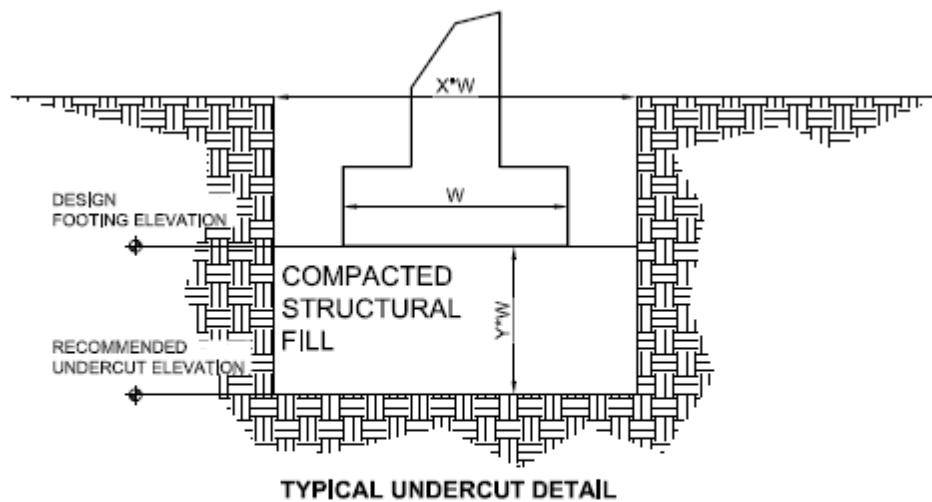
TYPICAL BUILDING PAD UNDERCUT DETAIL



- **Option B - Selective Foundation Undercutting**

For improved support of shallow foundations we recommend undercutting of individual foundation excavations to allow replacement of onsite soil with select compacted fill material. We recommend an undercut excavation width that is equal to the width of the foundation ( $X = 1$ ). The foundation should be undercut to the depth necessary to reach stiff native soil or to a depth of 2 times ( $Y = 2$ ) the width of the foundation.

All undercut foundations should be backfilled with a compacted, select crushed, limestone aggregate. The upper 2 feet of stone fill should consist of select, crusher run basestone. The stone backfill should be placed in loose horizontal lifts not to exceed 6 inches in thickness. Compaction of the stone should be performed until at least 95% of its Standard Proctor Density is achieved. No. 57 stone should be placed below the crusher run stone to the bottom of the excavation. The stone should be placed in 12 inch lifts and consolidated by vibration with the excavator bucket. Flowable fill concrete may also be used as foundation undercut backfill material.



**TYPICAL UNDERCUT DETAIL**

NOTE: Excavations in sketch shown vertical for convenience. Excavations should be sloped as necessary for safety.

Foundation construction should begin as soon as possible after foundation excavations are performed. A geotechnical engineer should observe all foundation excavations at the time of construction to confirm that the soil conditions are suitable for the recommended design parameters. Dynamic Cone Penetrometer (DCP) testing should be performed in foundation excavations to verify that the specified bearing capacity exists in the foundation excavations.

## DESIGN RECOMMENDATIONS

### SEISMIC SITE CLASSIFICATION

Code Used	Site Classification
2012 International Code (IBC) <sup>1</sup>	D <sup>2</sup>
1. In general accordance with the 2012 International Building Code, Section 1613.3.2.	
The 2012 International Building Code (IBC) requires a site soil profile determination extending a depth of 100 feet for seismic site classification. The current scope requested does not include the required 100 feet soil profile determination. This seismic class definition considers that bedrock is present below the refusal depths encountered.	

### FOUNDATIONS

Description	Recommendation
Net allowable bearing pressure <sup>1</sup>	2000 psf
Minimum width	24 inches
Minimum embedment below finished grade for frost protection <sup>2</sup>	24 inches
Approximate differential settlement <sup>3</sup>	< 1inch
Approximate total settlement <sup>3</sup>	< 1inch
1. The net allowable bearing pressure is the pressure in excess of the minimum overburden pressure at the footing base elevation. Assumes preparation of site is performed per the recommendations provided in this report and under the direction of the geotechnical engineer. All foundations should bear on stiff native ground or approved fill materials.	
2. For perimeter footing and footings beneath unheated areas. Also to reduce the effects of seasonal moisture variations in the high plasticity subgrade soils.	
3. The foundation settlement will depend upon the variations within the subsurface soil profile, the structural loading conditions, the embedment depth of the footings, the thickness of compacted fill, and the quality of the earthwork operations.	

### SLABS ON GRADE

Item	Description
Floor slab support <sup>1</sup>	Compacted fill soil or native soil passing density/proofroll testing
Modulus of subgrade reaction Option A - Building Pad Undercut	150 pounds per square inch per in (psi/in) for point loading conditions
Modulus of subgrade reaction Option B * -Foundation Undercutting	100 pounds per square inch per in (psi/in) for point loading conditions (*with rebar reinforcement)

### SLABS ON GRADE

Aggregate base course/capillary break <sup>2</sup>	4 inches of free draining material
Vapor Barrier	Project Specific <sup>3</sup>
1. All floor slab subgrade areas should be moisture conditioned and properly compacted to the recommendations in this report immediately prior to placement of the stone base and concrete.	
2. The floor slab design should include a capillary break, comprised of free-draining, compacted, granular material, at least 4 inches thick. Free-draining granular material should have less than 5 percent fines (material passing the #200 sieve).	
3. The use of a vapor retarder should be considered beneath concrete slabs on grade that will be covered with wood, tile, carpet or other moisture sensitive or impervious coverings, or when the slab will support equipment sensitive to moisture.	

### PAVEMENT

It is common for site grading to be completed for some time prior to placing aggregate base and asphalt paving material. We strongly recommend that just prior to placement of the aggregate base course that the subgrade be proofrolled as outlined in the Site Preparation section of this report. This will allow any softened and/or disturbed areas to be identified and properly reworked and recompacted.

We recommend that the asphalt pavement section consist of the following minimum compacted thickness of aggregate base and asphalt. A California Bearing Ratio (CBR) value of 4% has been assumed for the soil types present on the site.

### ASPHALT PAVEMENT SECTION

Pavement Course <sup>1</sup>	Thickness, inches	
	Light Duty	Heavy Duty
Asphalt Surface Course – VDOT SM-9.5-A <sup>2</sup>	1.5	1.5
Asphalt Base Course – VDOT BM-25.0 <sup>3</sup>	2.0	3.0
Aggregate Base – VDOT 21A <sup>4</sup>	4.0	6.0

1. The asphaltic surface and base courses should be compacted to a specified % of the maximum theoretical density (MTD), ASTM D-2041 per VDOT Section 315, Asphalt Concrete Pavement.
2. The asphalt surface course should meet the specifications of VDOT 211, Asphalt Concrete.
3. The asphaltic base course should meet specifications of VDOT 211, Asphalt Concrete.
4. The aggregate base should consist of a crushed limestone meeting the requirements of the Virginia Department of Transportation (VDOT) specifications, Section 208. The aggregate base should be compacted to a minimum of 95% of its theoretical maximum density as determined in accordance with the requirements of VTM 1.

## **GENERAL QUALIFICATIONS**

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This report has been prepared for the exclusive use of Thompson + Litton, Inc. for the proposed redevelopment of the Bonham Circle multi-family development located in Bristol, Virginia. This report has been prepared in accordance with generally accepted geotechnical engineering practice for specific application to this project. The conclusions contained in this report are based upon applicable standards of our practice in this geographic area at the time this report was prepared. No other warranty, expressed or implied, is made.

Foundation Systems Engineering, P.C., is not responsible for any claims, damages, or liability associated with any other party's interpretation of this report's subsurface data or reuse of this report's subsurface data or engineering analysis without our express written authorization.

The analyses and professional opinions submitted herein are based, in part, upon the data obtained from the subsurface evaluation. The nature and extent of subsurface variations between the borings will not become evident until construction.

We strongly recommend that the services of a geotechnical engineer be obtained for the construction phase of the project to provide engineering evaluation and testing services.

## **APPENDICES**

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Pre-Demo Boring Location Plan

Test Boring Location Plan

Test Boring Records

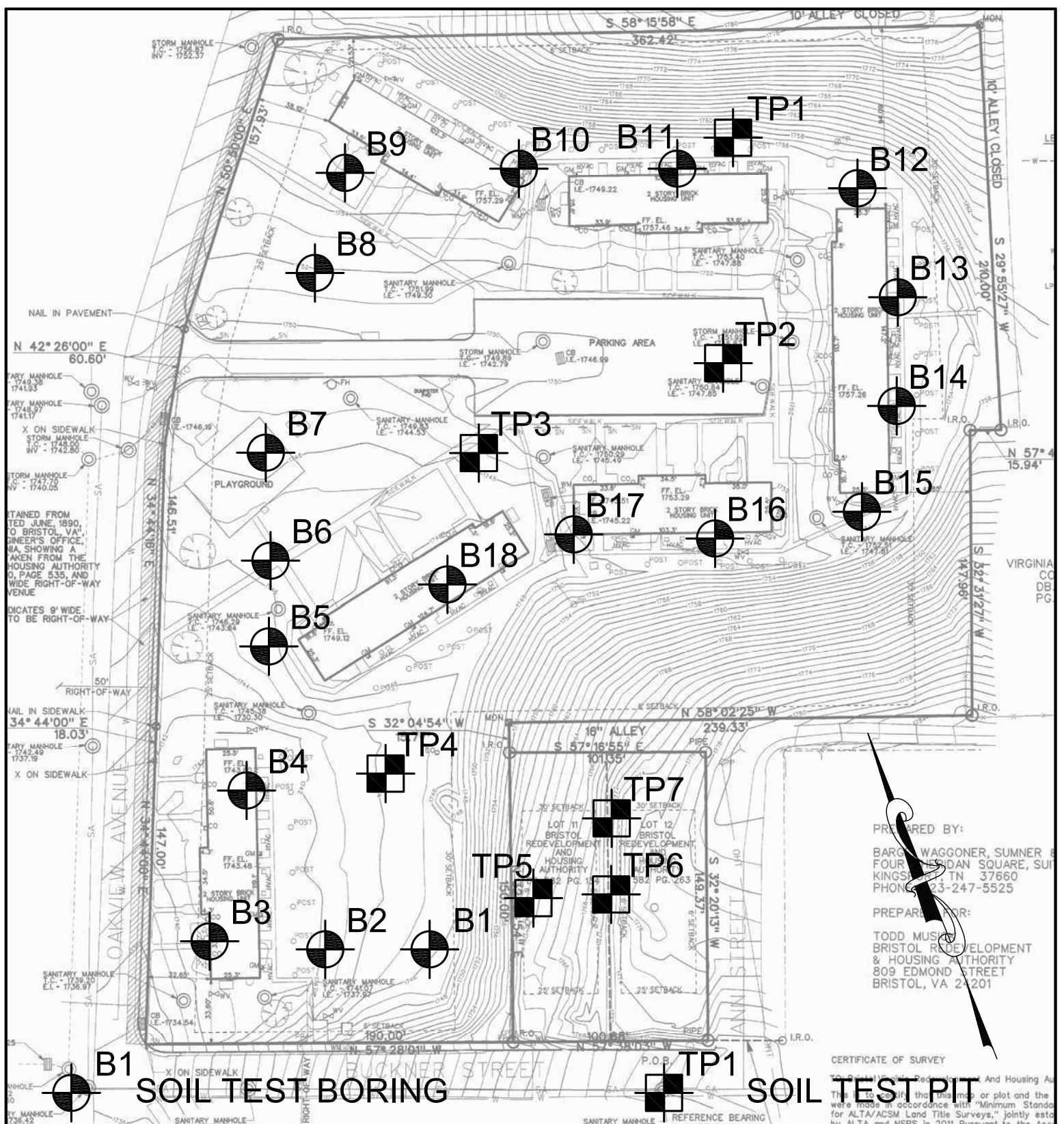
Site Location Map

Area Geology Map

Aerial Photograph

Lab Data

# **APPENDICES**



**Foundation Systems  
Engineering, P.C.**

Geotechnical Engineering and Consulting

P.O. BOX 5267  
KINGSPORT, TN 37663

[www.fsepc.com](http://www.fsepc.com)

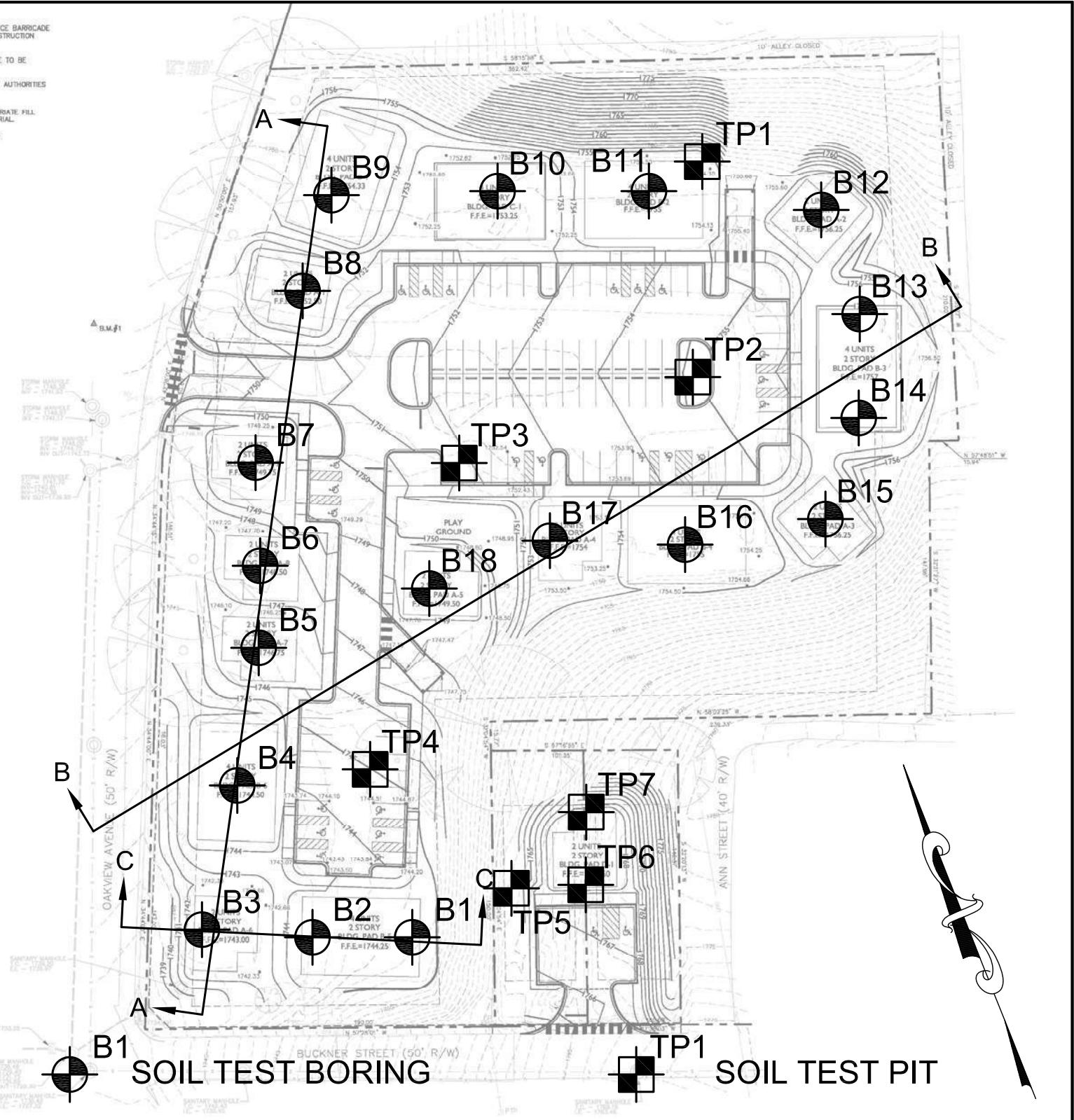
423-239-9226  
FAX 239-8677

**PRE-DEMO BORING LOCATION PLAN  
BRISTOL REDEVELOPMENT  
AND HOUSING AUTHORITY PROPERTY  
BRISTOL, VIRGINIA**

**FOR: THOMPSON AND LITTON**

DRAWN BY: HWI	NOTES:
PROJ #: 214163	BORING LOCATIONS ARE APPROXIMATE
SCALE: NONE	DATE: 05/27/2015

DWG #: BLP-PRE



# Foundation Systems Engineering, P.C.

Geotechnical Engineering and Consulting

**BORING LOCATION PLAN  
BRISTOL REDEVELOPMENT  
AND HOUSING AUTHORITY PROPERTY  
BRISTOL, VIRGINIA**

FOR: THOMPSON AND LITTON

P.O. BOX 5267  
KINGSPORT, TN 37663

423-239-9226  
FAX 239-8677

[www.fsepc.com](http://www.fsepc.com)

DRAWN BY: HWI NOTES:

**PROJ #:**

**SCALE: NONE**

## WI NOTES:

**BORING LOCATIONS ARE APPROXIMATE**

DATE: 05/27/2015

DWG #: BLP

Project: **Bonham Circle Redevelopment**

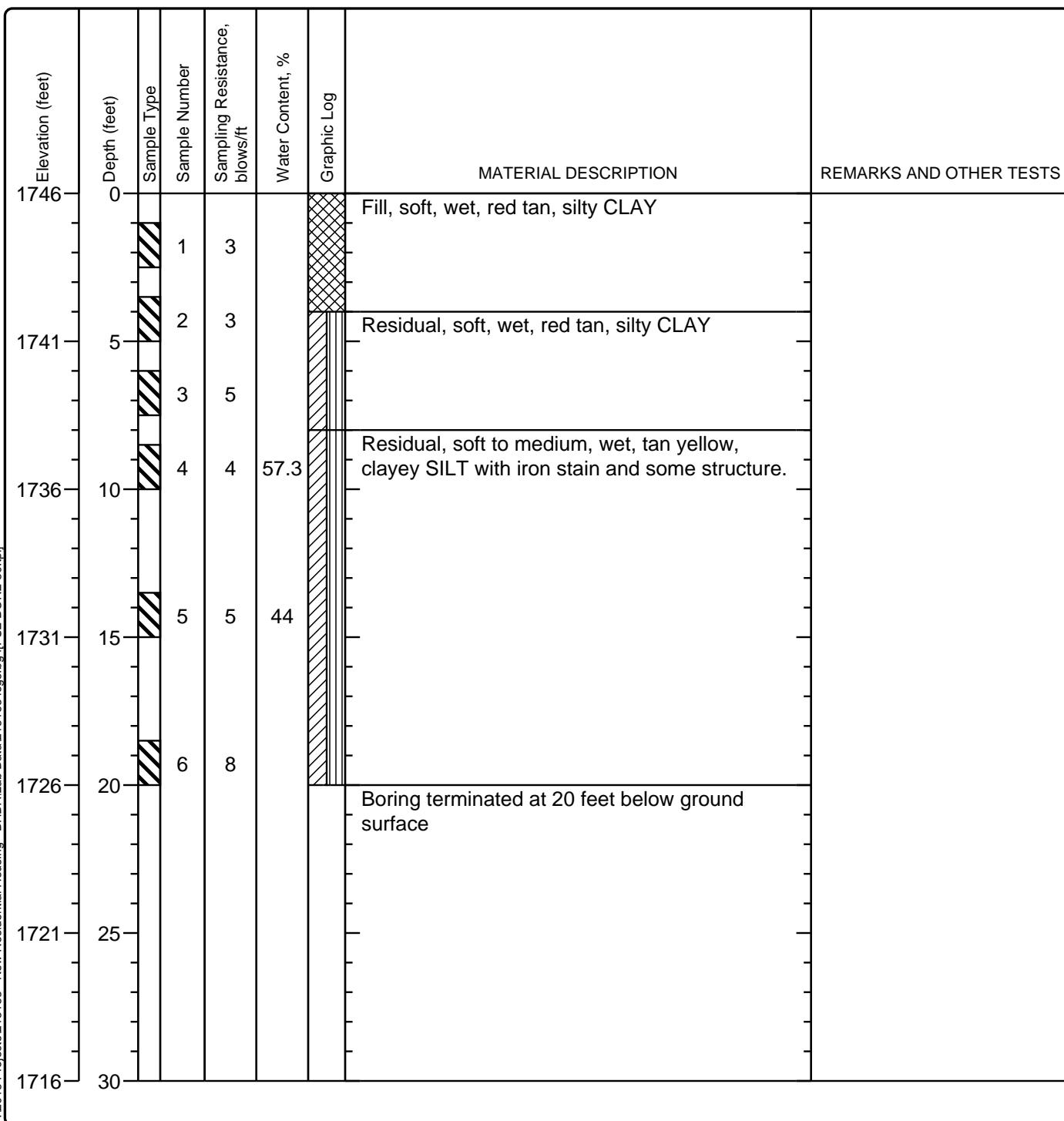
Project Location: **Bristol, Virginia**

Project Number: **215163**

## Log of Boring B-01

**Sheet 1 of 1**

Date(s) Drilled 5/7/2015	Logged By <b>Joe Martin</b>	Checked By <b>Wes Iorger</b>
Drilling Method <b>Hollow Stem Rotary</b>	Drill Bit Size/Type <b>6" Bullet Point</b>	Total Depth of Borehole <b>20 feet bgs</b>
Drill Rig Type <b>CME 75</b>	Drilling Contractor <b>CML</b>	Approximate Surface Elevation <b>1746</b>
Groundwater Level and Date Measured	Sampling Method(s) <b>SPT</b>	Hammer Data <b>Manual drop hammer</b>
Borehole Backfill <b>Cuttings</b>	Comments <b>Elevations derived by interpreting the pre-demolition topographic survey and should be considered approximate.</b>	



Project: **Bonham Circle Redevelopment**

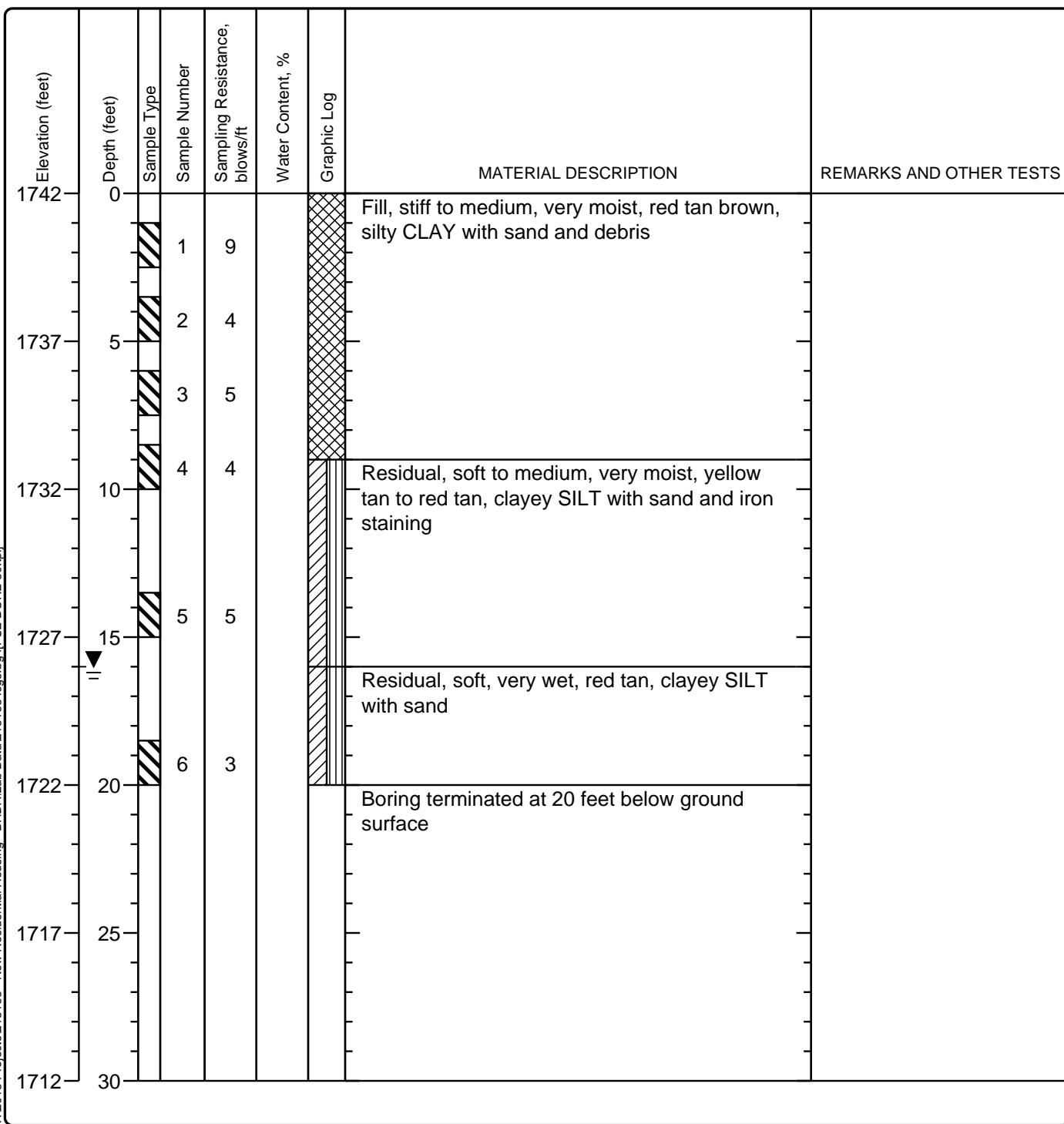
Project Location: **Bristol, Virginia**

Project Number: **215163**

## Log of Boring B-02

**Sheet 1 of 1**

Date(s) Drilled	5/7/2015	Logged By <b>Joe Martin</b>	Checked By <b>Wes Iorger</b>
Drilling Method	<b>Hollow Stem Rotary</b>	Drill Bit Size/Type <b>6" Bullet Point</b>	Total Depth of Borehole <b>20 feet bgs</b>
Drill Rig Type	<b>CME 75</b>	Drilling Contractor <b>CML</b>	Approximate Surface Elevation <b>1742</b>
Groundwater Level and Date Measured	<b>Water encountered at 16 feet below ground surface</b>	Sampling Method(s) <b>SPT</b>	Hammer Data <b>Manual drop hammer</b>
Borehole Backfill	<b>Cuttings</b>	Comments <b>Elevations derived by interpreting the pre-demolition topographic survey and should be considered approximate.</b>	



Project: Bonham Circle Redevelopment

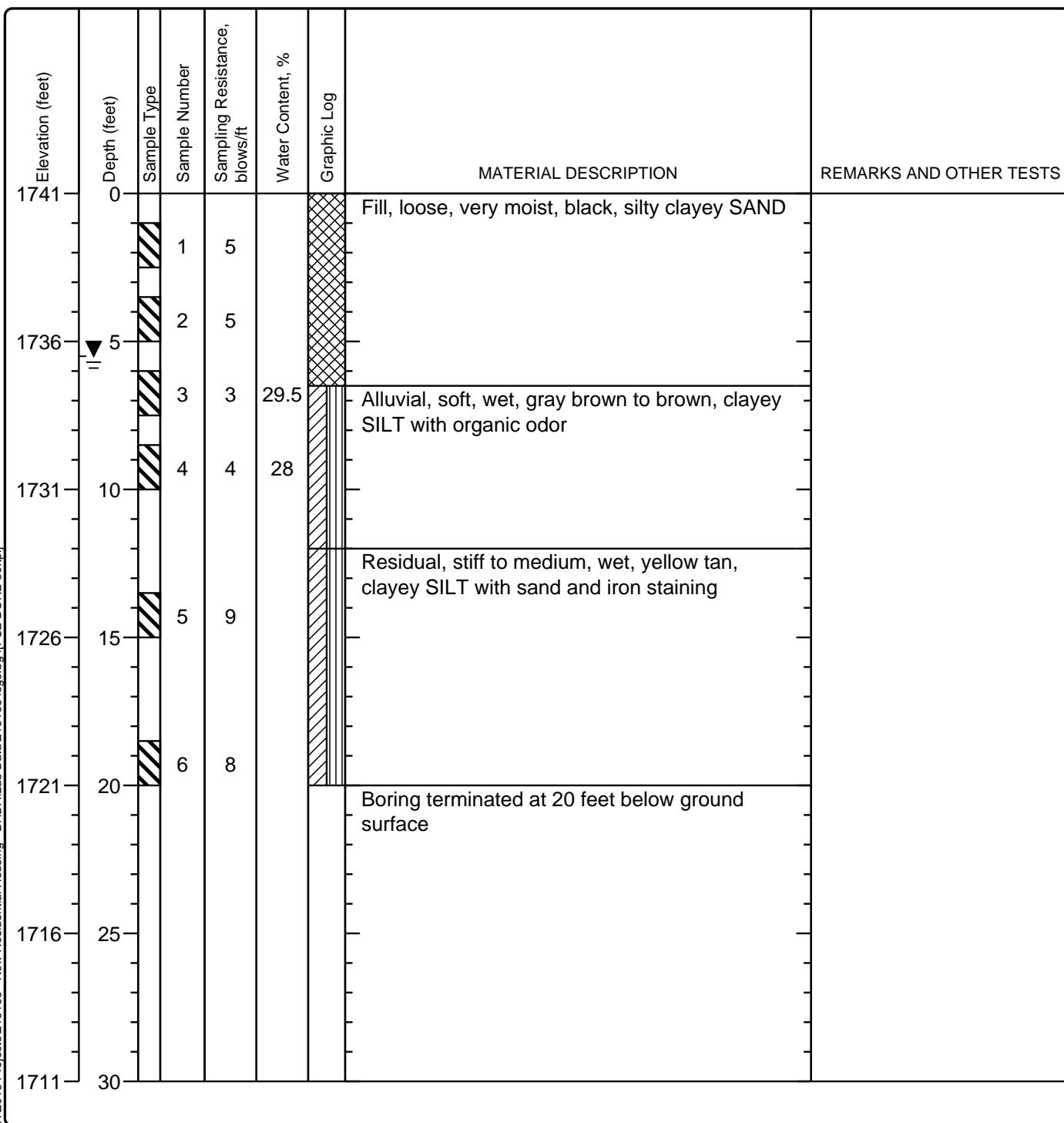
Project Location: Bristol, Virginia

Project Number: 215163

## Log of Boring B-03

Sheet 1 of 1

Date(s) Drilled 5/7/2015	Logged By Joe Martin	Checked By Wes Iorger
Drilling Method Hollow Stem Rotary	Drill Bit Size/Type 6" Bullet Point	Total Depth of Borehole 20 feet bgs
Drill Rig Type CME 75	Drilling Contractor CML	Approximate Surface Elevation 1741
Groundwater Level and Date Measured Water encountered at 5.5 feet below ground surface	Sampling Method(s) SPT	Hammer Data Manual drop hammer
Borehole Backfill Cuttings	Comments Elevations derived by interpreting the pre-demolition topographic survey and should be considered approximate.	



Project: Bonham Circle Redevelopment

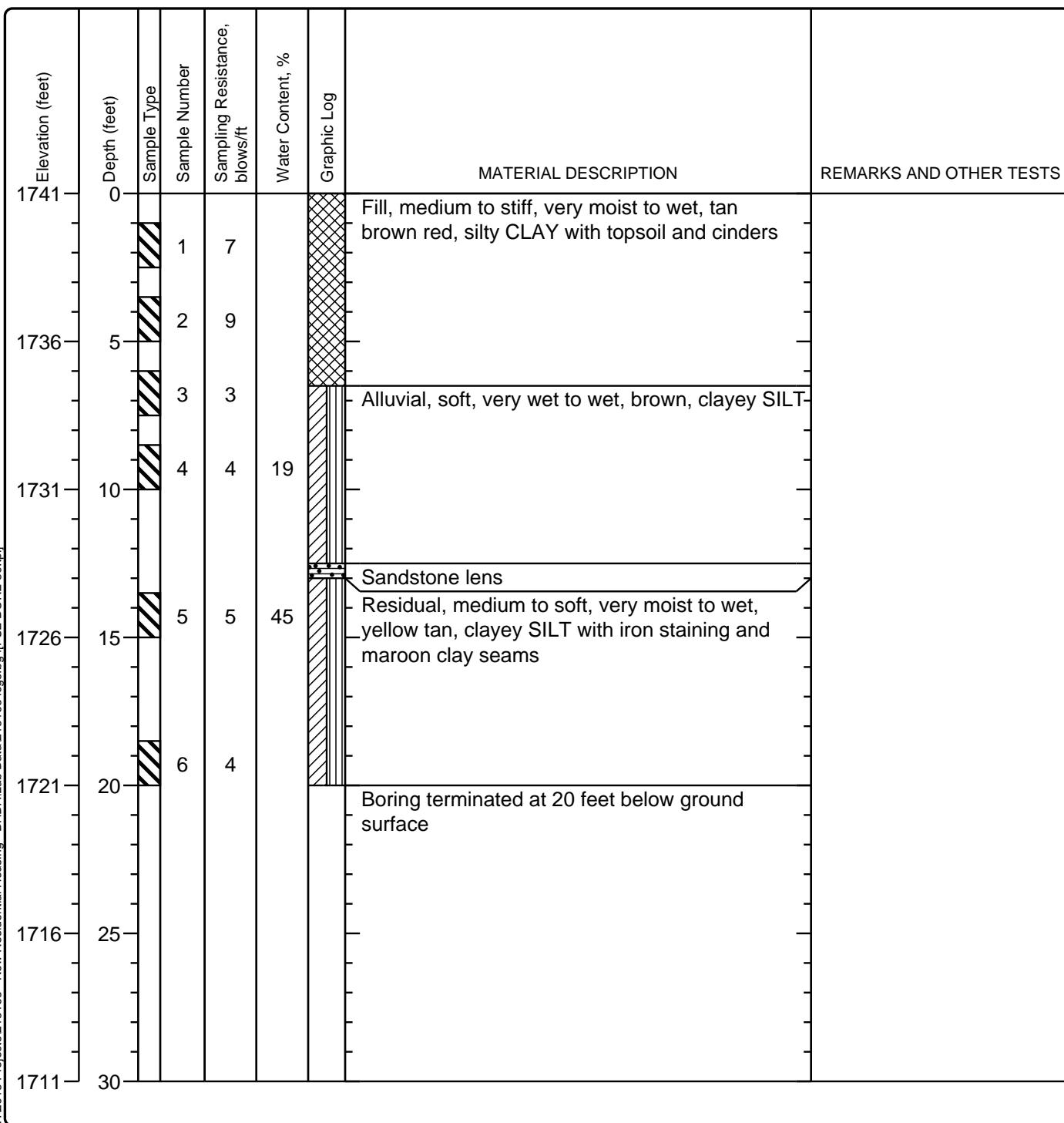
Project Location: Bristol, Virginia

Project Number: 215163

## Log of Boring B-04

Sheet 1 of 1

Date(s) Drilled 5/8/2015	Logged By Joe Martin	Checked By Wes Iorger
Drilling Method Hollow Stem Rotary	Drill Bit Size/Type 6" Bullet Point	Total Depth of Borehole 20 feet bgs
Drill Rig Type CME 75	Drilling Contractor CML	Approximate Surface Elevation 1741
Groundwater Level and Date Measured	Sampling Method(s) SPT	Hammer Data Manual drop hammer
Borehole Backfill Cuttings	Comments Elevations derived by interpreting the pre-demolition topographic survey and should be considered approximate.	



Project: **Bonham Circle Redevelopment**

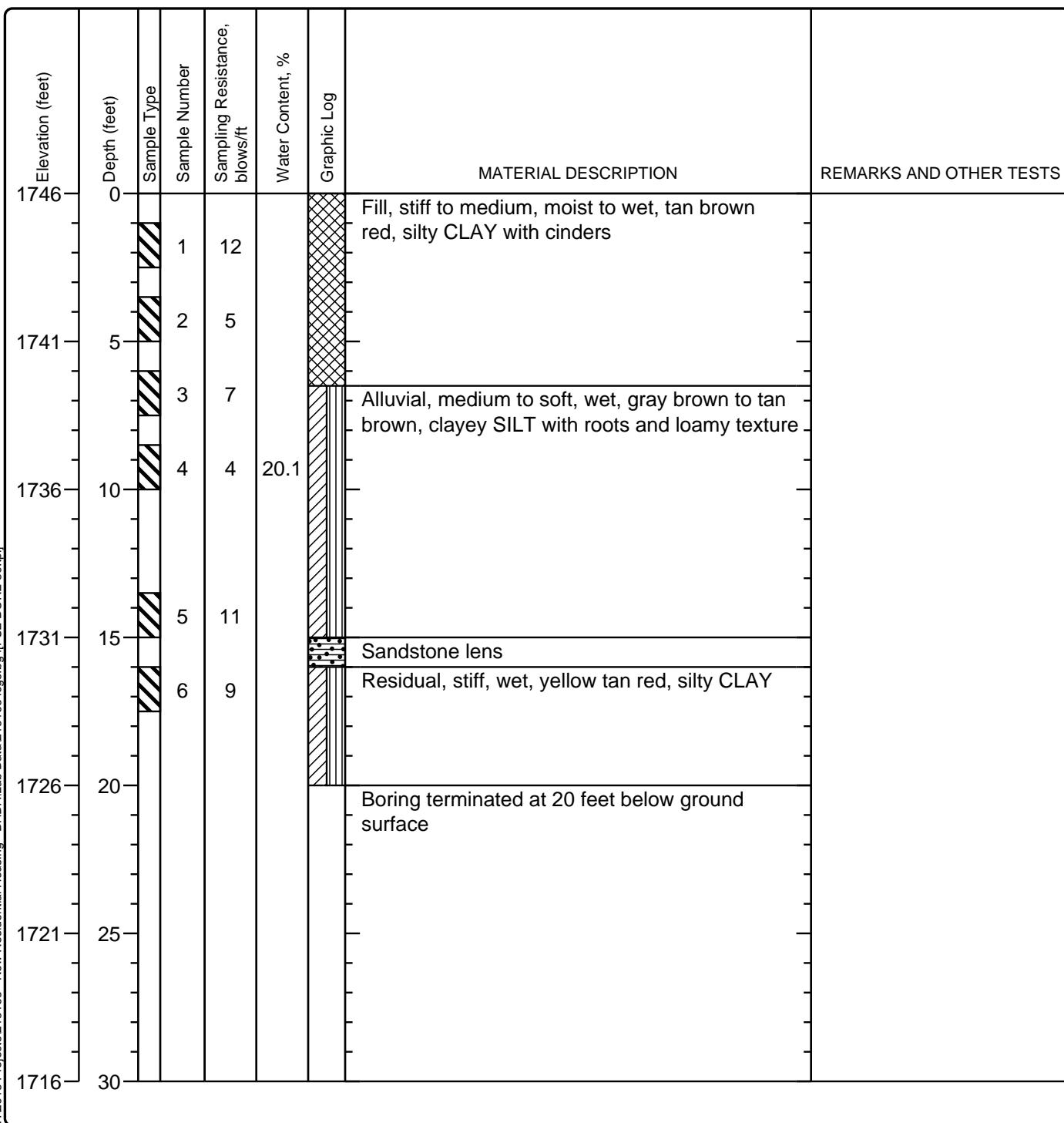
Project Location: **Bristol, Virginia**

Project Number: **215163**

## Log of Boring B-05

**Sheet 1 of 1**

Date(s) Drilled 5/8/2015	Logged By <b>Joe Martin</b>	Checked By <b>Wes Iorger</b>
Drilling Method <b>Hollow Stem Rotary</b>	Drill Bit Size/Type <b>6" Bullet Point</b>	Total Depth of Borehole <b>20 feet bgs</b>
Drill Rig Type <b>CME 75</b>	Drilling Contractor <b>CML</b>	Approximate Surface Elevation <b>1746</b>
Groundwater Level and Date Measured	Sampling Method(s) <b>SPT</b>	Hammer Data <b>Manual drop hammer</b>
Borehole Backfill <b>Cuttings</b>	Comments <b>Elevations derived by interpreting the pre-demolition topographic survey and should be considered approximate.</b>	



Project: Bonham Circle Redevelopment

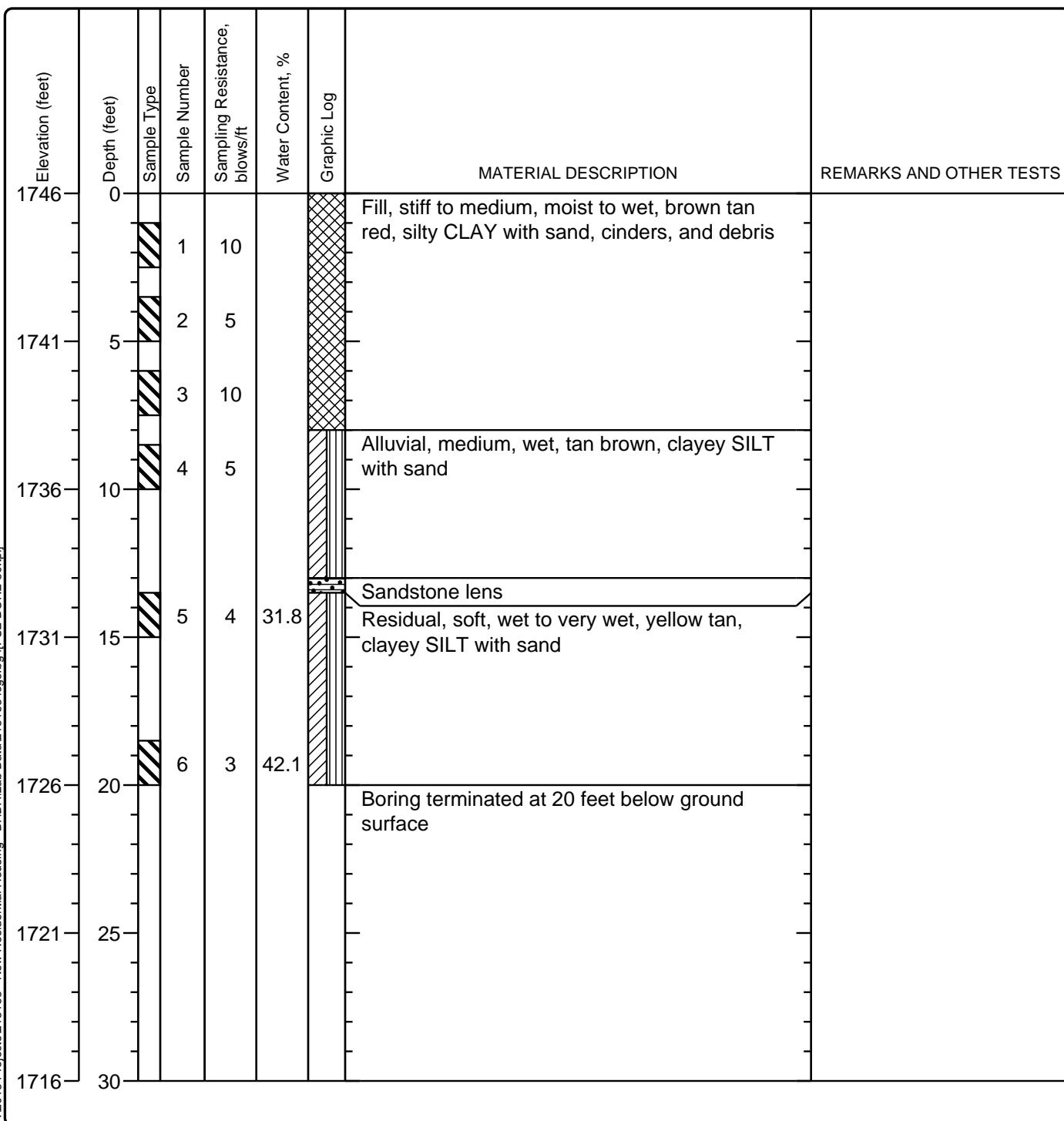
Project Location: Bristol, Virginia

Project Number: 215163

## Log of Boring B-06

Sheet 1 of 1

Date(s) Drilled	5/11/2015	Logged By Joe Martin	Checked By Wes Iorger
Drilling Method	Hollow Stem Rotary	Drill Bit Size/Type	Total Depth of Borehole 20 feet bgs
Drill Rig Type	CME 75	Drilling Contractor	Approximate Surface Elevation 1746
Groundwater Level and Date Measured		Sampling Method(s)	Hammer Data Manual drop hammer
Borehole Backfill	Cuttings	Comments Elevations derived by interpreting the pre-demolition topographic survey and should be considered approximate.	



Project: Bonham Circle Redevelopment

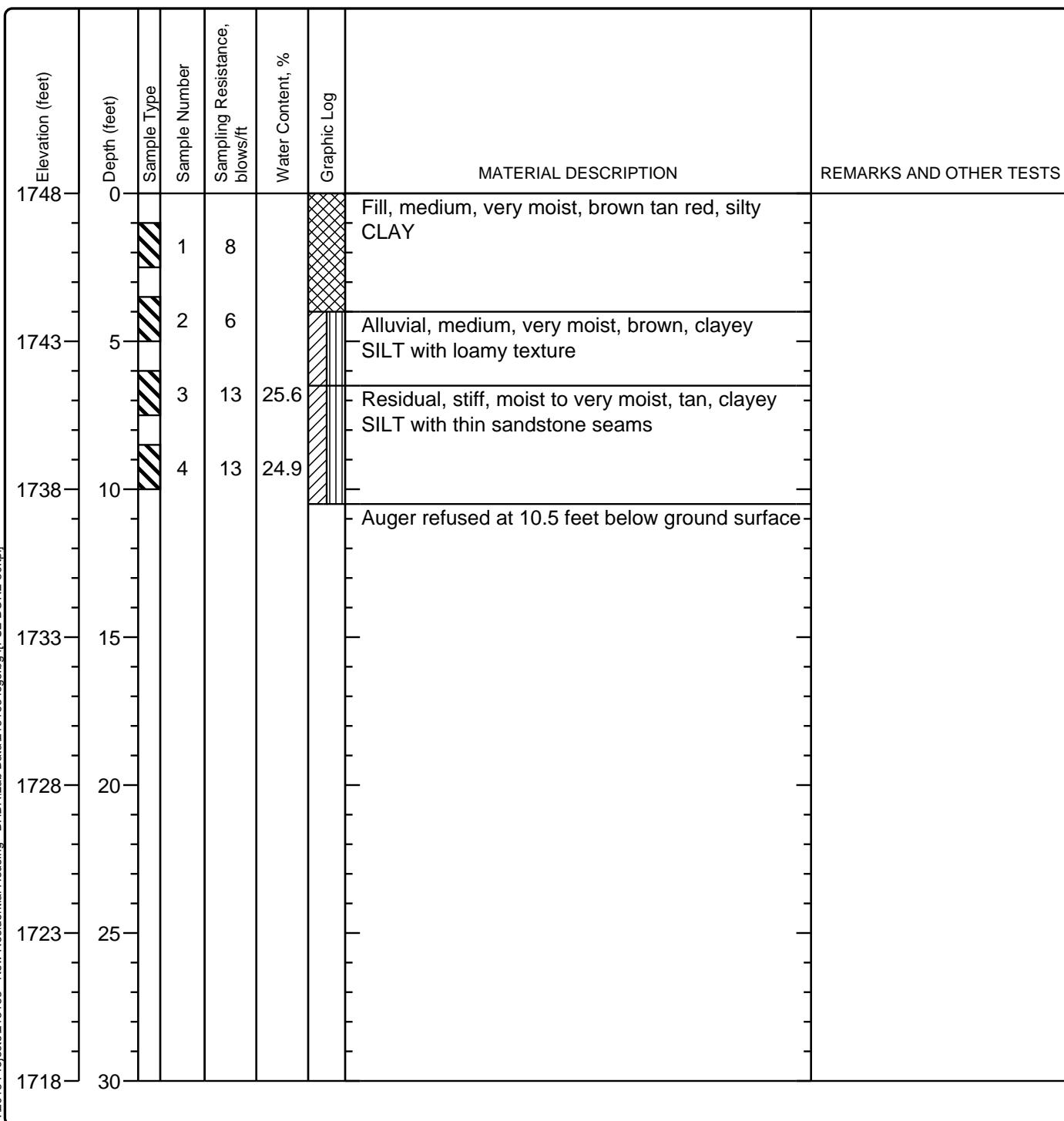
Project Location: Bristol, Virginia

Project Number: 215163

## Log of Boring B-07

Sheet 1 of 1

Date(s) Drilled 5/11/2015	Logged By Joe Martin	Checked By Wes Iorger
Drilling Method Hollow Stem Rotary	Drill Bit Size/Type 6" Bullet Point	Total Depth of Borehole 10.5 feet bgs
Drill Rig Type CME 75	Drilling Contractor CML	Approximate Surface Elevation 1748
Groundwater Level and Date Measured	Sampling Method(s) SPT	Hammer Data Manual drop hammer
Borehole Backfill Cuttings	Comments Elevations derived by interpreting the pre-demolition topographic survey and should be considered approximate.	



Project: Bonham Circle Redevelopment

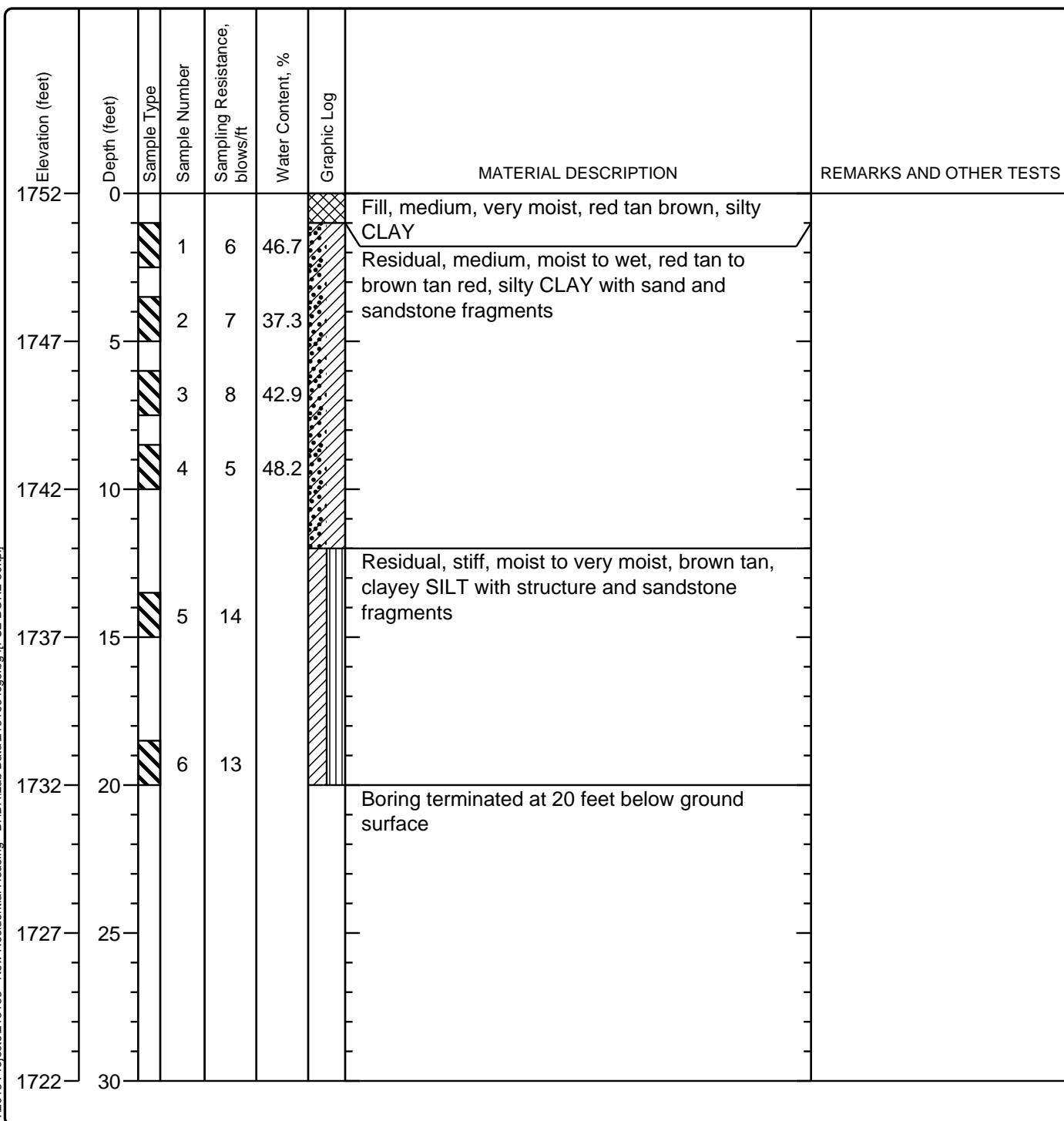
Project Location: Bristol, Virginia

Project Number: 215163

## Log of Boring B-08

Sheet 1 of 1

Date(s) Drilled 5/11/2015	Logged By Joe Martin	Checked By Wes Iorger
Drilling Method Hollow Stem Rotary	Drill Bit Size/Type 6" Bullet Point	Total Depth of Borehole 20 feet bgs
Drill Rig Type CME 75	Drilling Contractor CML	Approximate Surface Elevation 1752
Groundwater Level and Date Measured	Sampling Method(s) SPT	Hammer Data Manual drop hammer
Borehole Backfill Cuttings	Comments Elevations derived by interpreting the pre-demolition topographic survey and should be considered approximate.	



Project: **Bonham Circle Redevelopment**

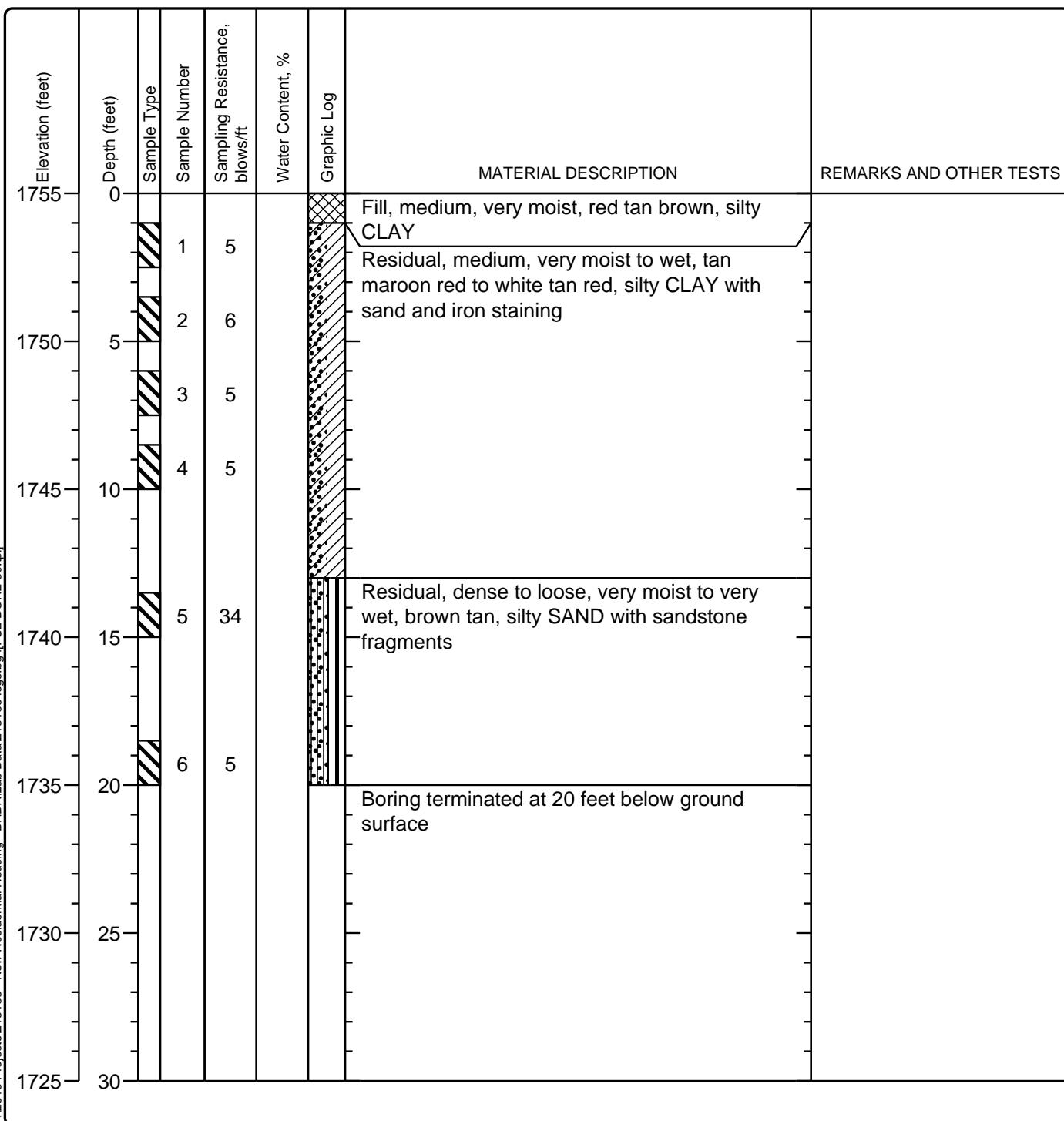
Project Location: **Bristol, Virginia**

Project Number: **215163**

## Log of Boring B-09

**Sheet 1 of 1**

Date(s) Drilled 5/11/2015	Logged By <b>Joe Martin</b>	Checked By <b>Wes Iorger</b>
Drilling Method <b>Hollow Stem Rotary</b>	Drill Bit Size/Type <b>6" Bullet Point</b>	Total Depth of Borehole <b>20 feet bgs</b>
Drill Rig Type <b>CME 75</b>	Drilling Contractor <b>CML</b>	Approximate Surface Elevation <b>1755</b>
Groundwater Level and Date Measured	Sampling Method(s) <b>SPT</b>	Hammer Data <b>Manual drop hammer</b>
Borehole Backfill <b>Cuttings</b>	Comments <b>Elevations derived by interpreting the pre-demolition topographic survey and should be considered approximate.</b>	



Project: Bonham Circle Redevelopment

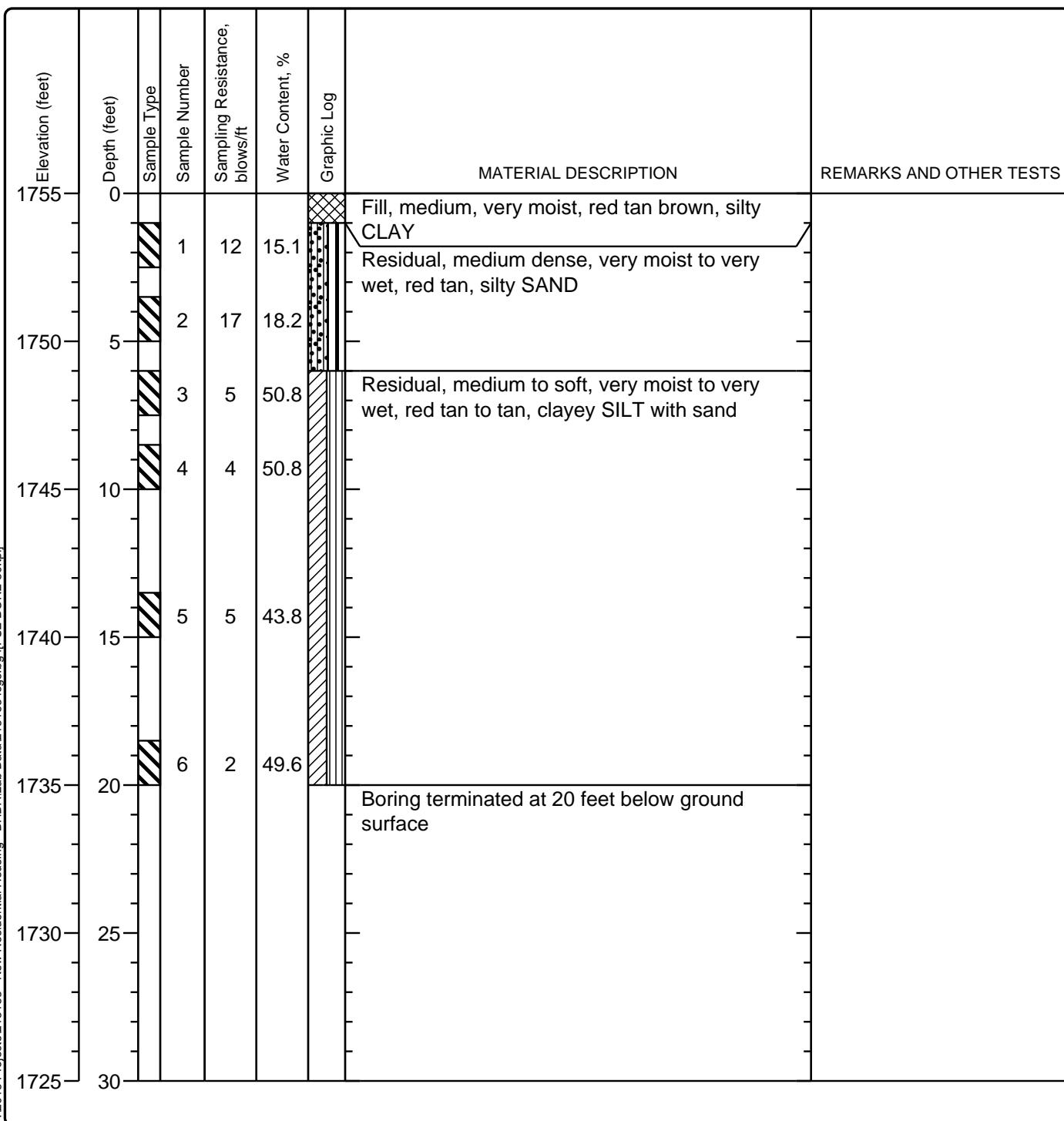
Project Location: Bristol, Virginia

Project Number: 215163

## Log of Boring B-10

Sheet 1 of 1

Date(s) Drilled 5/11/2015	Logged By Joe Martin	Checked By Wes Iorger
Drilling Method Hollow Stem Rotary	Drill Bit Size/Type 6" Bullet Point	Total Depth of Borehole 20 feet bgs
Drill Rig Type CME 75	Drilling Contractor CML	Approximate Surface Elevation 1755
Groundwater Level and Date Measured	Sampling Method(s) SPT	Hammer Data Manual drop hammer
Borehole Backfill Cuttings	Comments Elevations derived by interpreting the pre-demolition topographic survey and should be considered approximate.	



Project: **Bonham Circle Redevelopment**

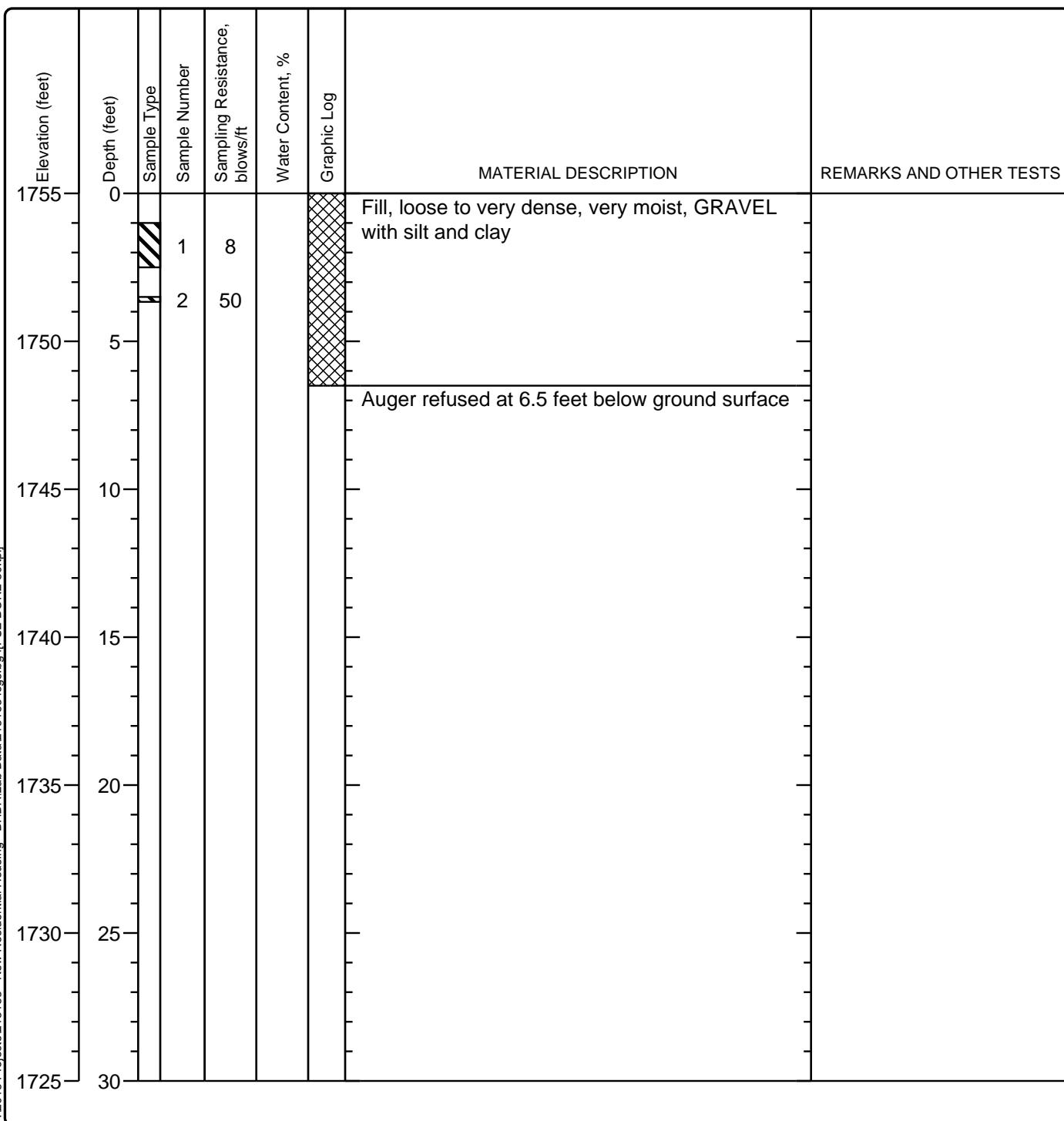
Project Location: **Bristol, Virginia**

Project Number: **215163**

## Log of Boring B-11

### Sheet 1 of 1

Date(s) Drilled 5/11/2015	Logged By <b>Joe Martin</b>	Checked By <b>Wes Iorger</b>
Drilling Method <b>Hollow Stem Rotary</b>	Drill Bit Size/Type <b>6" Bullet Point</b>	Total Depth of Borehole <b>6.5 feet bgs</b>
Drill Rig Type <b>CME 75</b>	Drilling Contractor <b>CML</b>	Approximate Surface Elevation <b>1755</b>
Groundwater Level and Date Measured	Sampling Method(s) <b>SPT</b>	Hammer Data <b>Manual drop hammer</b>
Borehole Backfill <b>Cuttings</b>	Comments <b>Elevations derived by interpreting the pre-demolition topographic survey and should be considered approximate.</b>	



Project: **Bonham Circle Redevelopment**

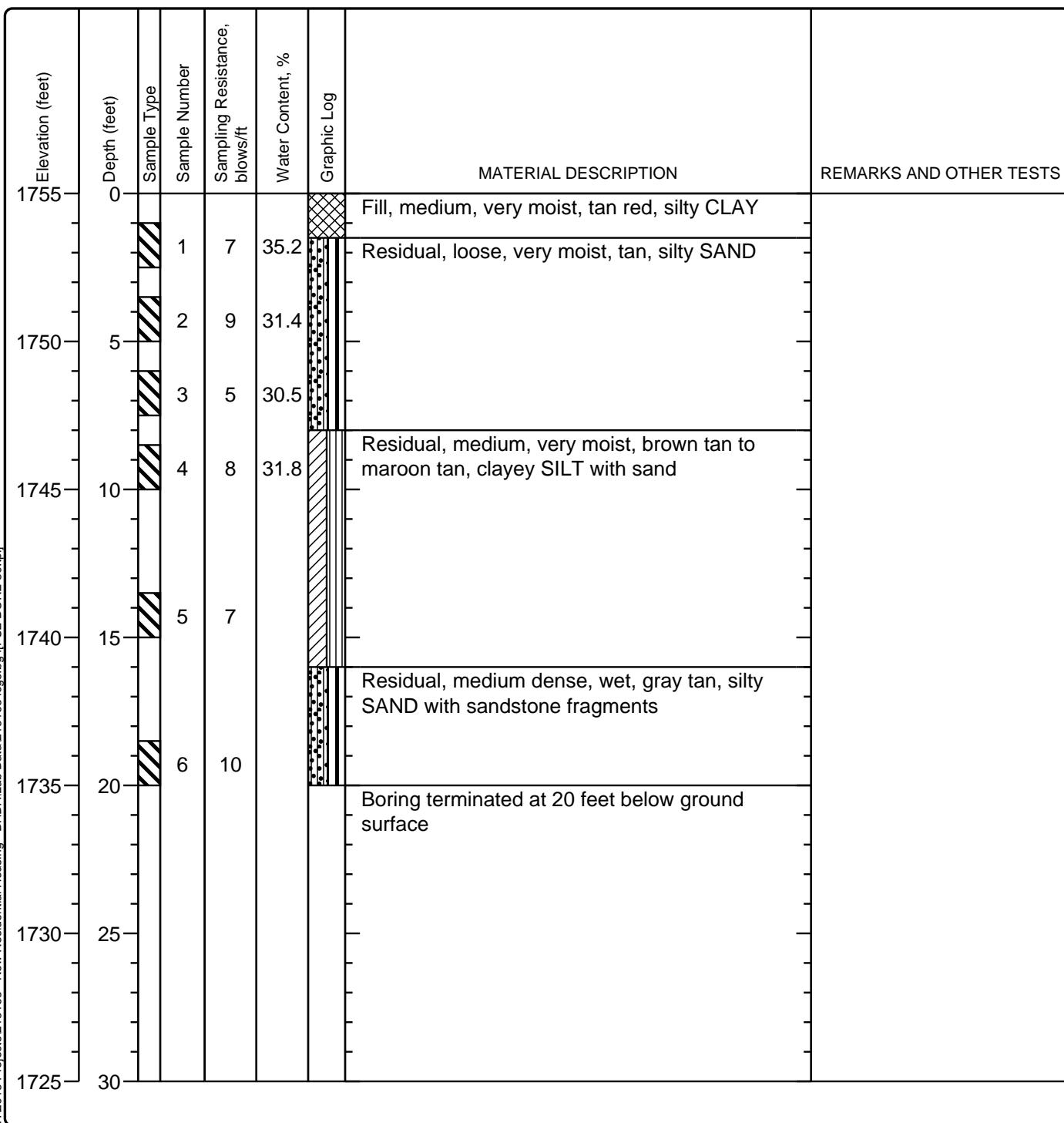
Project Location: **Bristol, Virginia**

Project Number: **215163**

## Log of Boring B-12

**Sheet 1 of 1**

Date(s) Drilled 5/11/2015	Logged By <b>Joe Martin</b>	Checked By <b>Wes Iorger</b>
Drilling Method <b>Hollow Stem Rotary</b>	Drill Bit Size/Type <b>6" Bullet Point</b>	Total Depth of Borehole <b>20 feet bgs</b>
Drill Rig Type <b>CME 75</b>	Drilling Contractor <b>CML</b>	Approximate Surface Elevation <b>1755</b>
Groundwater Level and Date Measured	Sampling Method(s) <b>SPT</b>	Hammer Data <b>Manual drop hammer</b>
Borehole Backfill <b>Cuttings</b>	Comments <b>Elevations derived by interpreting the pre-demolition topographic survey and should be considered approximate.</b>	



Project: **Bonham Circle Redevelopment**

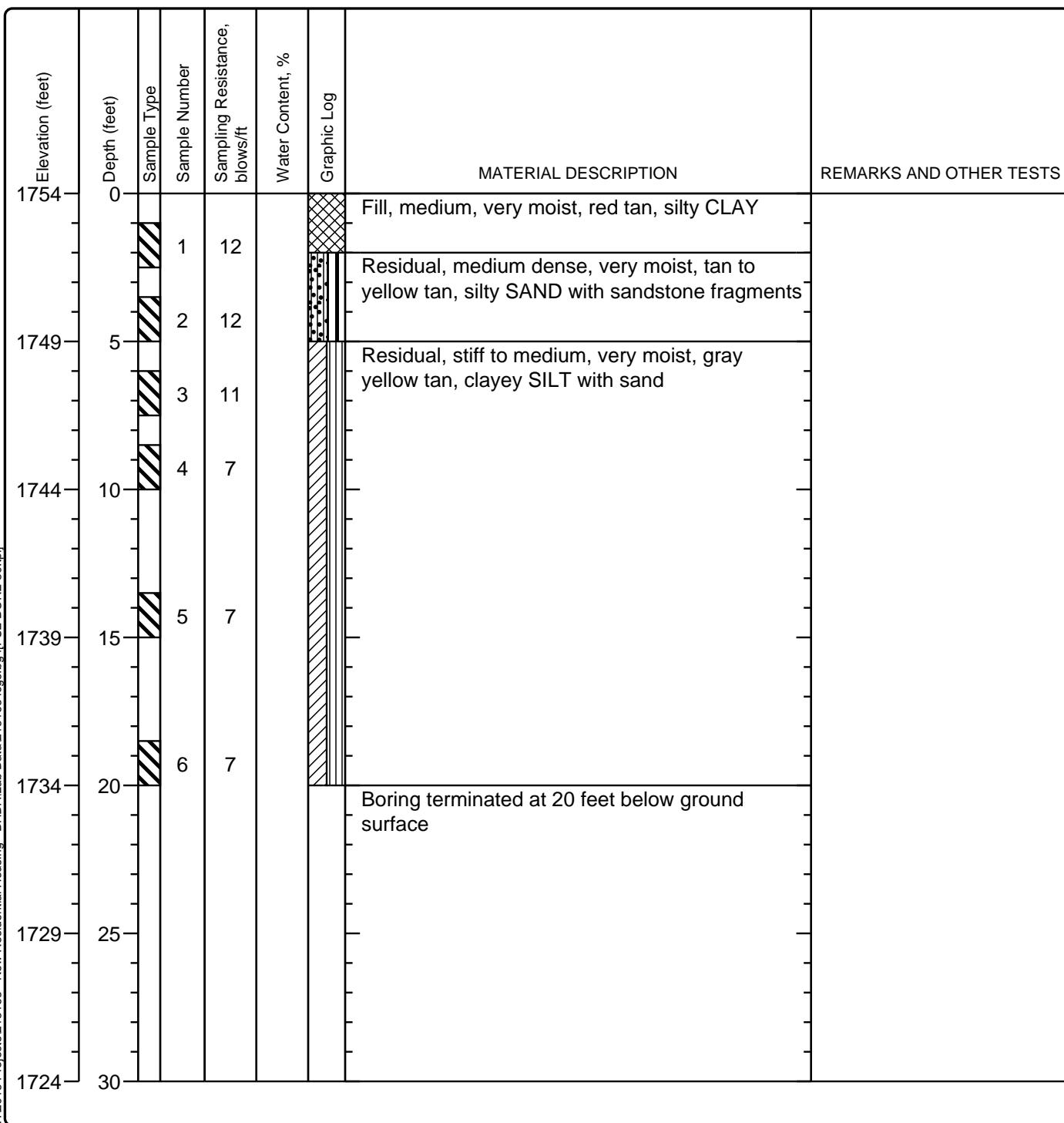
Project Location: **Bristol, Virginia**

Project Number: **215163**

## Log of Boring B-13

**Sheet 1 of 1**

Date(s) Drilled 5/11/2015	Logged By <b>Joe Martin</b>	Checked By <b>Wes Iorger</b>
Drilling Method <b>Hollow Stem Rotary</b>	Drill Bit Size/Type <b>6" Bullet Point</b>	Total Depth of Borehole <b>20 feet bgs</b>
Drill Rig Type <b>CME 75</b>	Drilling Contractor <b>CML</b>	Approximate Surface Elevation <b>1754</b>
Groundwater Level and Date Measured	Sampling Method(s) <b>SPT</b>	Hammer Data <b>Manual drop hammer</b>
Borehole Backfill <b>Cuttings</b>	Comments <b>Elevations derived by interpreting the pre-demolition topographic survey and should be considered approximate.</b>	



Project: **Bonham Circle Redevelopment**

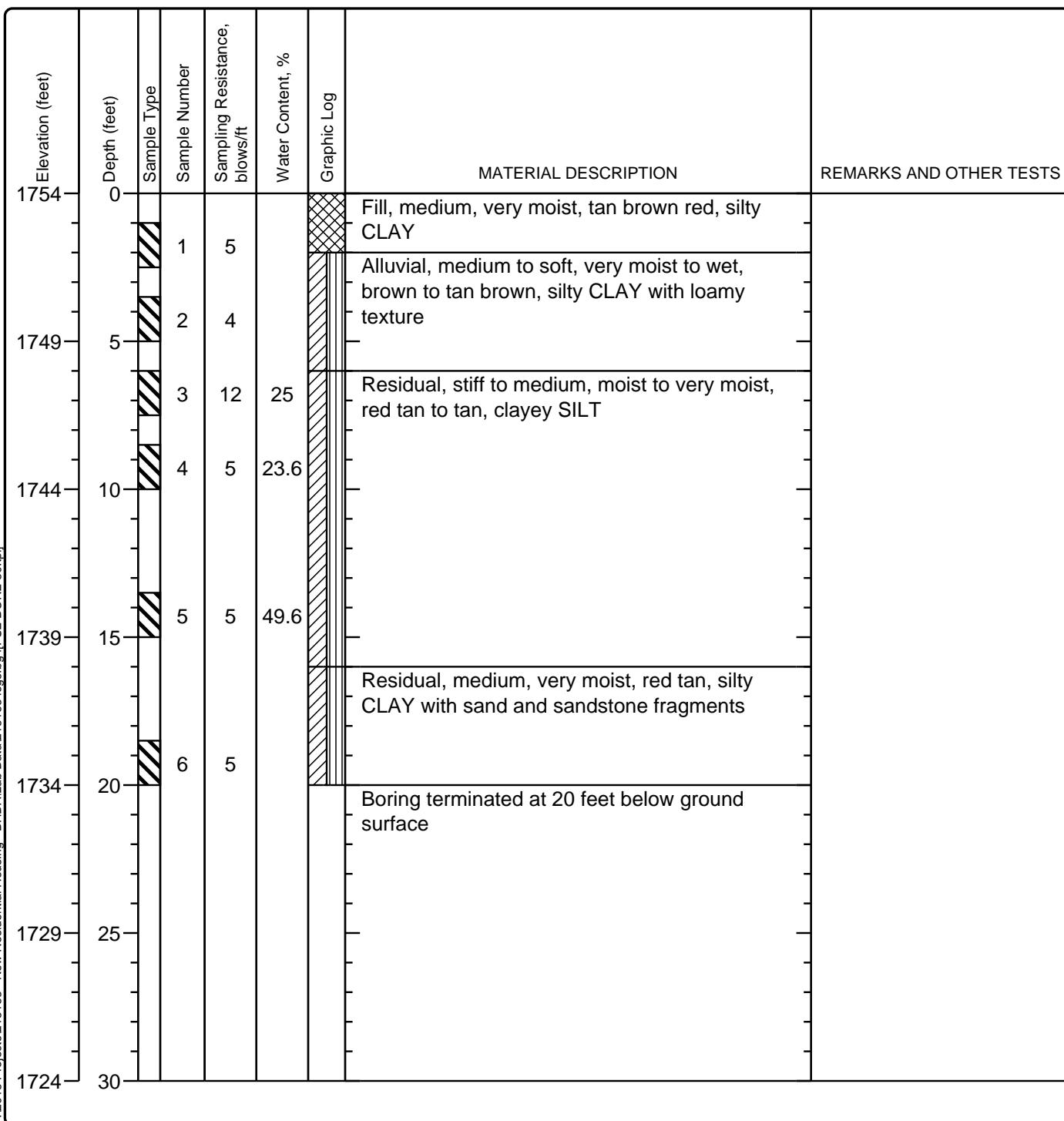
Project Location: **Bristol, Virginia**

Project Number: **215163**

## Log of Boring B-14

**Sheet 1 of 1**

Date(s) Drilled 5/11/2015	Logged By <b>Joe Martin</b>	Checked By <b>Wes Iorger</b>
Drilling Method <b>Hollow Stem Rotary</b>	Drill Bit Size/Type <b>6" Bullet Point</b>	Total Depth of Borehole <b>20 feet bgs</b>
Drill Rig Type <b>CME 75</b>	Drilling Contractor <b>CML</b>	Approximate Surface Elevation <b>1754</b>
Groundwater Level and Date Measured	Sampling Method(s) <b>SPT</b>	Hammer Data <b>Manual drop hammer</b>
Borehole Backfill <b>Cuttings</b>	Comments <b>Elevations derived by interpreting the pre-demolition topographic survey and should be considered approximate.</b>	



Project: Bonham Circle Redevelopment

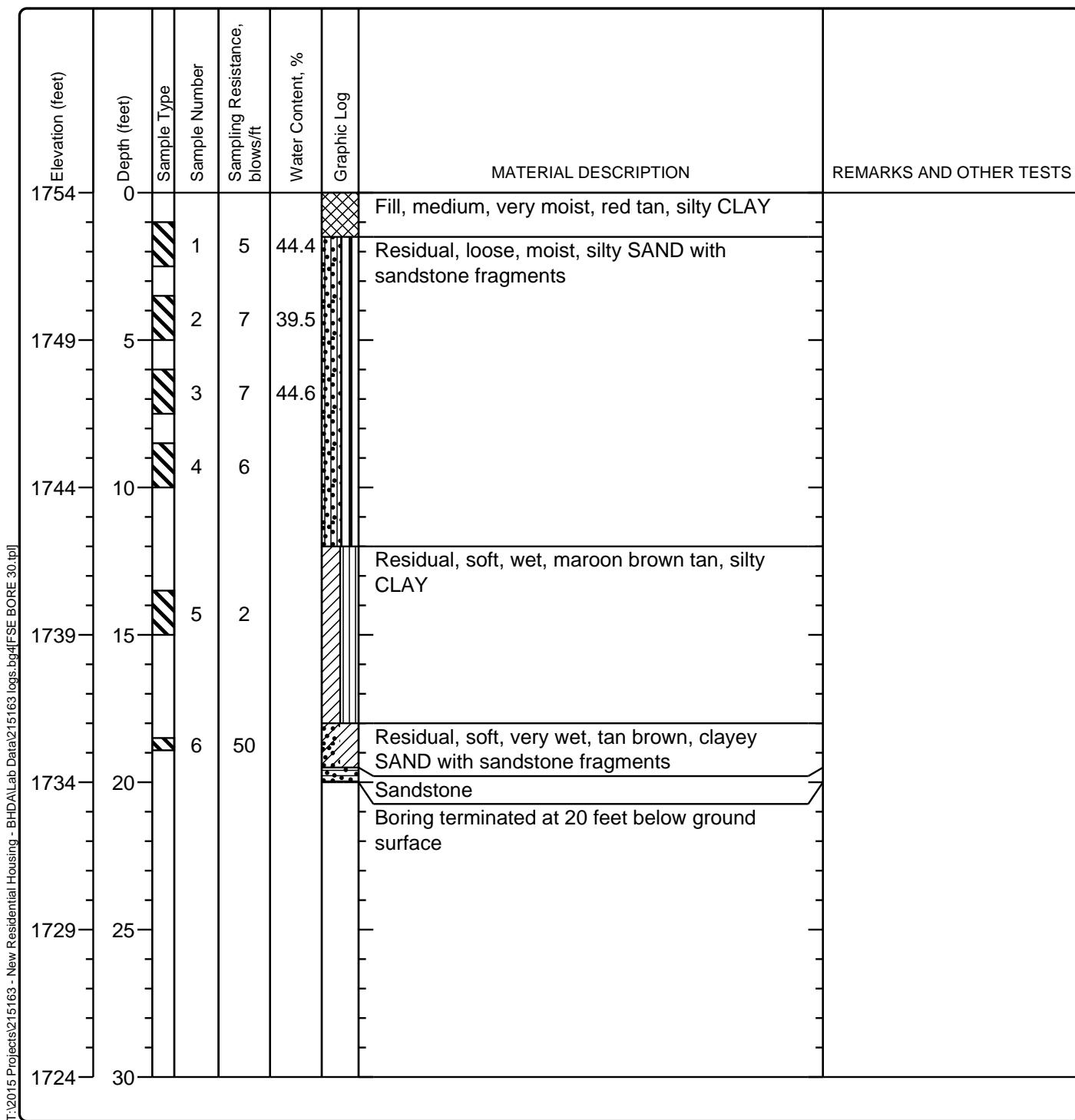
Project Location: Bristol, Virginia

Project Number: 215163

## Log of Boring B-15

Sheet 1 of 1

Date(s) Drilled	5/11/2015	Logged By Joe Martin	Checked By Wes Iorger
Drilling Method	Hollow Stem Rotary	Drill Bit Size/Type	Total Depth of Borehole 20 feet bgs
Drill Rig Type	CME 75	Drilling Contractor	Approximate Surface Elevation 1754
Groundwater Level and Date Measured		Sampling Method(s)	Hammer Data Manual drop hammer
Borehole Backfill	Cuttings	Comments Elevations derived by interpreting the pre-demolition topographic survey and should be considered approximate.	



Project: Bonham Circle Redevelopment

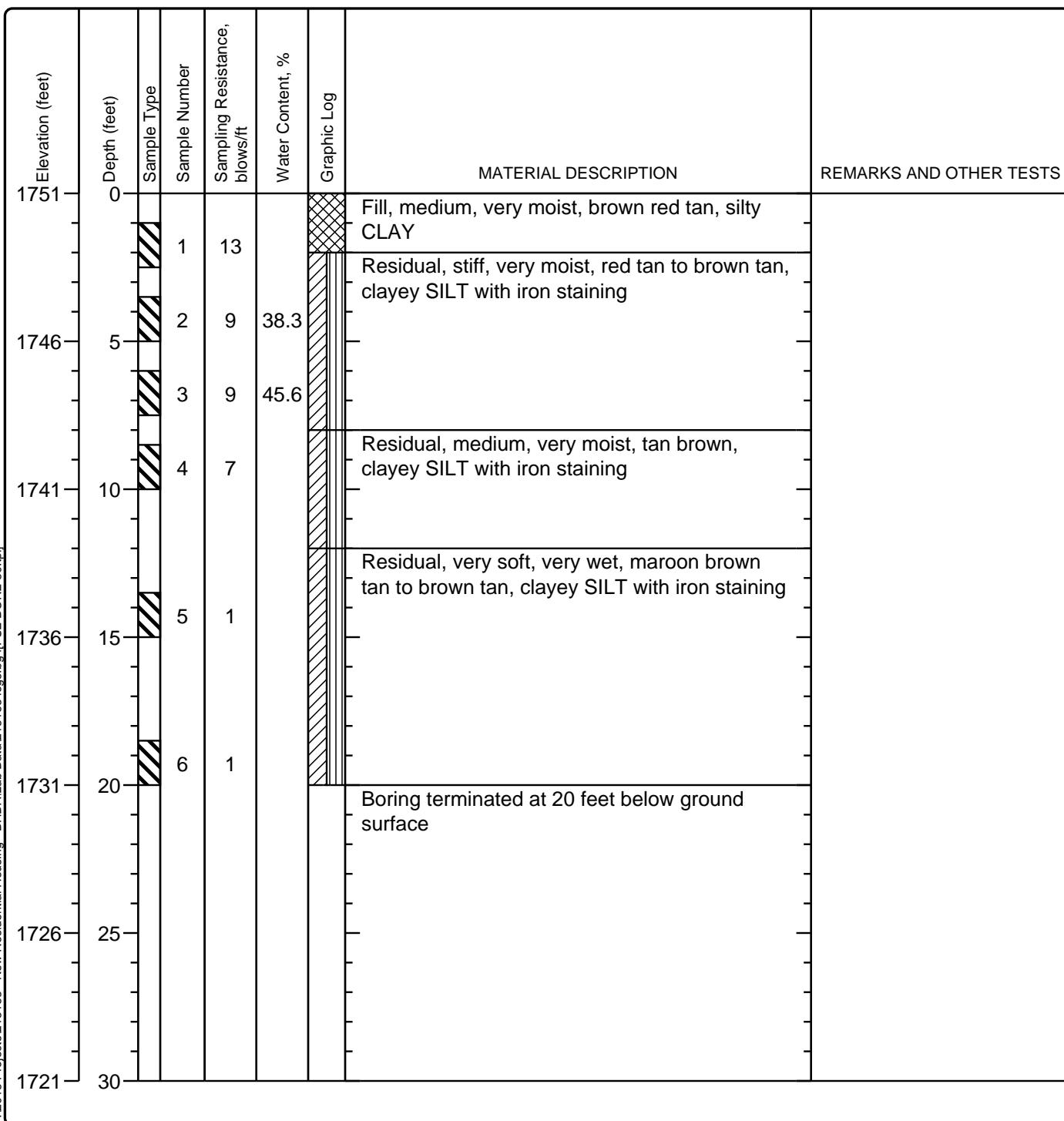
Project Location: Bristol, Virginia

Project Number: 215163

## Log of Boring B-16

Sheet 1 of 1

Date(s) Drilled	5/11/2015	Logged By <b>Joe Martin</b>	Checked By <b>Wes Iorger</b>
Drilling Method	<b>Hollow Stem Rotary</b>	Drill Bit Size/Type <b>6" Bullet Point</b>	Total Depth of Borehole <b>20 feet bgs</b>
Drill Rig Type	<b>CME 75</b>	Drilling Contractor <b>CML</b>	Approximate Surface Elevation <b>1751</b>
Groundwater Level and Date Measured		Sampling Method(s) <b>SPT</b>	Hammer Data <b>Manual drop hammer</b>
Borehole Backfill	<b>Cuttings</b>	Comments	<b>Elevations derived by interpreting the pre-demolition topographic survey and should be considered approximate.</b>



Project: Bonham Circle Redevelopment

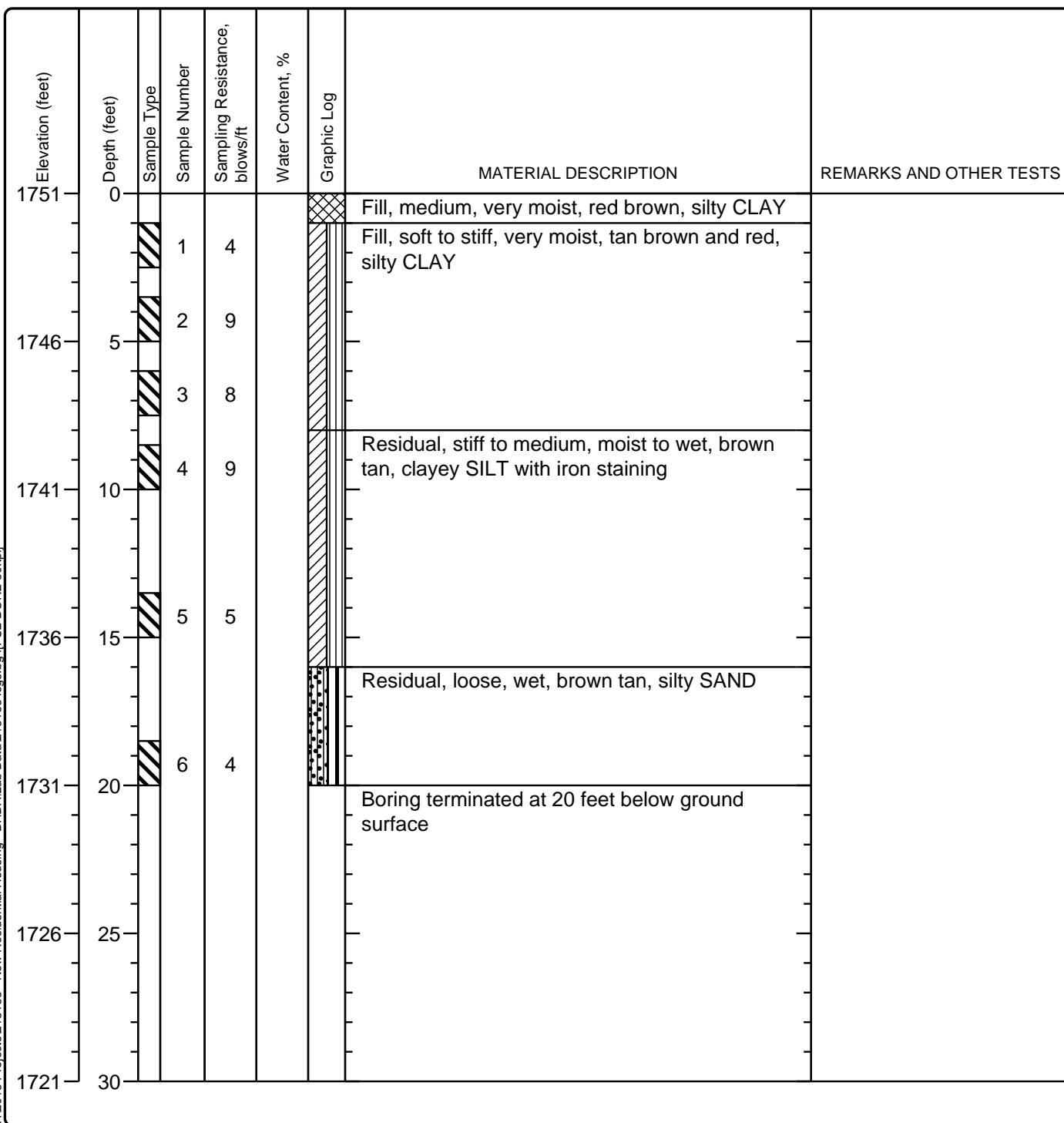
Project Location: Bristol, Virginia

Project Number: 215163

## Log of Boring B-17

Sheet 1 of 1

Date(s) Drilled 5/18/2015	Logged By Joe Martin	Checked By Wes Iorger
Drilling Method Hollow Stem Rotary	Drill Bit Size/Type 6" Bullet Point	Total Depth of Borehole 20 feet bgs
Drill Rig Type CME 75	Drilling Contractor CML	Approximate Surface Elevation 1751
Groundwater Level and Date Measured	Sampling Method(s) SPT	Hammer Data Manual drop hammer
Borehole Backfill Cuttings	Comments Elevations derived by interpreting the pre-demolition topographic survey and should be considered approximate.	



Project: **Bonham Circle Redevelopment**

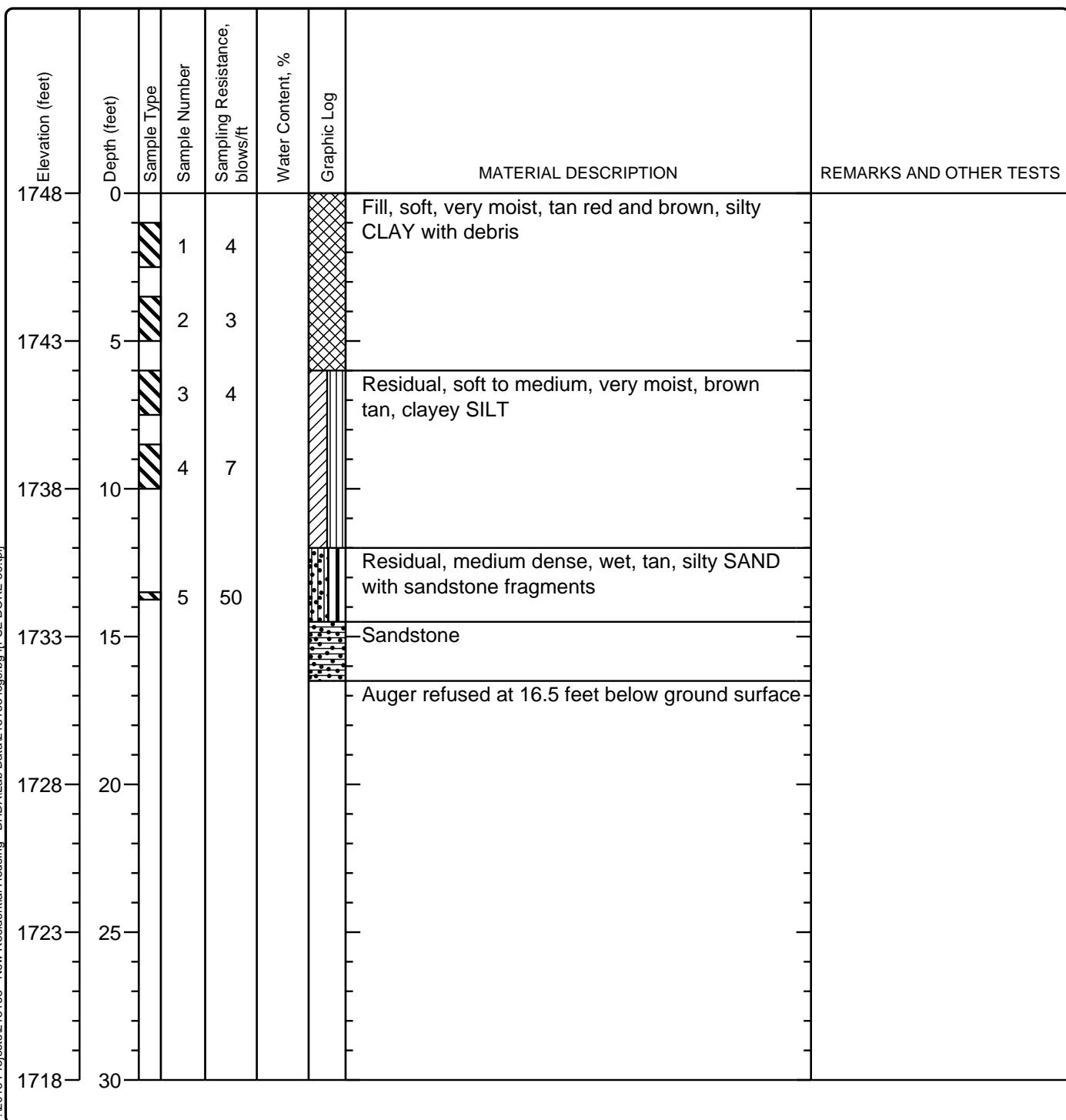
Project Location: **Bristol, Virginia**

Project Number: **215163**

## Log of Boring B-18

**Sheet 1 of 1**

Date(s) Drilled 5/18/2015	Logged By <b>Joe Martin</b>	Checked By <b>Wes Iorger</b>
Drilling Method <b>Hollow Stem Rotary</b>	Drill Bit Size/Type <b>6" Bullet Point</b>	Total Depth of Borehole <b>16.5 feet bgs</b>
Drill Rig Type <b>CME 75</b>	Drilling Contractor <b>CML</b>	Approximate Surface Elevation <b>1748</b>
Groundwater Level and Date Measured	Sampling Method(s) <b>SPT</b>	Hammer Data <b>Manual drop hammer</b>
Borehole Backfill <b>Cuttings</b>	Comments	Elevations derived by interpreting the pre-demolition topographic survey and should be considered approximate. Boring collapsed to 8 feet below ground surface.



**Project: Bonham Circle Redevelopment**

**Project Location: Bristol, Virginia**

**Project Number: 215163**

**Key to Log of Boring**

**Sheet 1 of 1**

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	Sampling Resistance, blows/ft	Water Content, %	Graphic Log	MATERIAL DESCRIPTION	REMARKS AND OTHER TESTS
1	2	3	4	5	6	7	8	9

**COLUMN DESCRIPTIONS**

- 1** Elevation (feet): Elevation (MSL, feet).
- 2** Depth (feet): Depth in feet below the ground surface.
- 3** Sample Type: Type of soil sample collected at the depth interval shown.
- 4** Sample Number: Sample identification number.
- 5** Sampling Resistance, blows/ft: Number of blows to advance driven sampler one foot (or distance shown) beyond seating interval using the hammer identified on the boring log.
- 6** Water Content, %: Water content of the soil sample, expressed as percentage of dry weight of sample.
- 7** Graphic Log: Graphic depiction of the subsurface material encountered.
- 8** MATERIAL DESCRIPTION: Description of material encountered. May include consistency, moisture, color, and other descriptive text.
- 9** REMARKS AND OTHER TESTS: Comments and observations regarding drilling or sampling made by driller or field personnel.

**FIELD AND LABORATORY TEST ABBREVIATIONS**

NMC: Natural Moisture Content, percent

LL: Liquid Limit, percent

PI: Plasticity Index, percent

SA: Sieve analysis (percent passing No. 200 Sieve)

UC: Unconfined compressive strength test, Qu, in ksf

**MATERIAL GRAPHIC SYMBOLS**

Asphaltic Concrete (AC)	Portland Cement Concrete	Gravel	Clayey SAND (SC)
Bentonite	Cuttings	Grout	Clayey SAND to Sandy CLAY (SC-CH)
Bentonite chips	AF	Well graded GRAVEL (GW)	Clayey SAND to Sandy CLAY (SC-CL)
Bentonite powder	Clayey GRAVEL (GC)	Well graded GRAVEL with Silt (GW-GM)	Shale
Bentonite plug	Clayey GRAVEL to Gravely CLAY (GC-CH)	Poorly to Well graded GRAVEL (GW-GP)	Silt
Boulders	Clayey GRAVEL to Gravely CLAY (GC-CL)	Limestone	Siltstone
Fat CLAY, CLAY w/SAND, SANDY CLAY (CH)	Silty GRAVEL (GM)	Artificial Fill	Silty SAND (SM)
Fat CLAY/SILT (CH-MH)	Silty GRAVEL to Clayey GRAVEL (GM-GC)	SILT, SILT w/SAND, SANDY SILT (MH)	Silty SAND to Sandy SILT (SM-MH)
Fat CLAY/PEAT (CH-OH)	Silty GRAVEL to Gravely SILT (GM-MH)	SILT, SILT w/SAND, SANDY SILT (ML)	Silty SAND to Sandy SILT (SM-ML)
Lean CLAY, CLAY w/SAND, SANDY CLAY (CL)	Silty GRAVEL to Gravely SILT (GM-ML)	SILT, SILT with SAND, SANDY SILT (ML-MH)	Silty to Clayey SAND (SM-SC)
Lean-Fat CLAY, CLAY w/SAND, SANDY CLAY (CL-CH)	Poorly graded GRAVEL (GP)	High plasticity PEAT (OH)	Poorly graded SAND (SP)
SILTY CLAY (CL-ML)	Poorly graded GRAVEL with Silt (GP-GM)	Low plasticity PEAT (OL)	Poorly graded SAND with Clay (SP-SC)
Lean CLAY/PEAT (CL-OL)	Granite	Low to High plasticity PEAT (OL-OH)	Poorly graded SAND with Silt (SP-SM)
Claystone	Grass and/or topsoil	Sandstone	Well graded SAND (SW)
			Well graded SAND with Clay (SW-SC)
			Well graded SAND with Silt (SW-SM)

**TYPICAL SAMPLER GRAPHIC SYMBOLS**

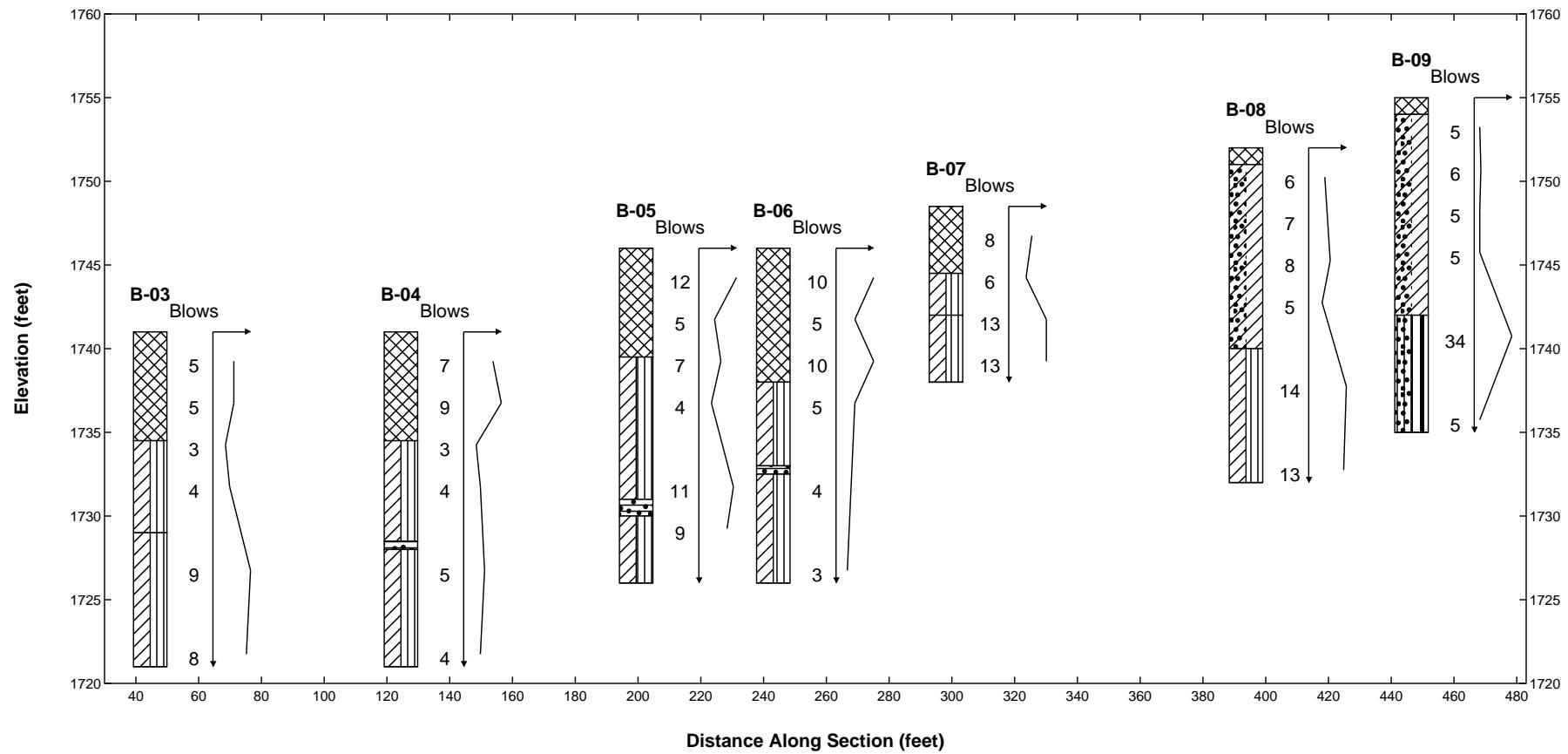
Auger sampler	CME Sampler	Pitcher Sample
Bulk Sample	Grab Sample	2-inch-OD unlined split spoon (SPT)
3-inch-OD California w/ brass rings	2.5-inch-OD Modified California w/ brass liners	Shelby Tube (Thin-walled, fixed head)

**OTHER GRAPHIC SYMBOLS**

—▽—	Water level (at time of drilling, ATD)
—▼—	Water level (after waiting)
—△—	Minor change in material properties within a stratum
——	Inferred/gradational contact between strata
—?—	Queried contact between strata

**GENERAL NOTES**

- 1: Soil classifications are based on the Unified Soil Classification System. Descriptions and stratum lines are interpretive, and actual lithologic changes may be gradual. Field descriptions may have been modified to reflect results of lab tests.
- 2: Descriptions on these logs apply only at the specific boring locations and at the time the borings were advanced. They are not warranted to be representative of subsurface conditions at other locations or times.



#### MATERIAL GRAPHIC SYMBOLS



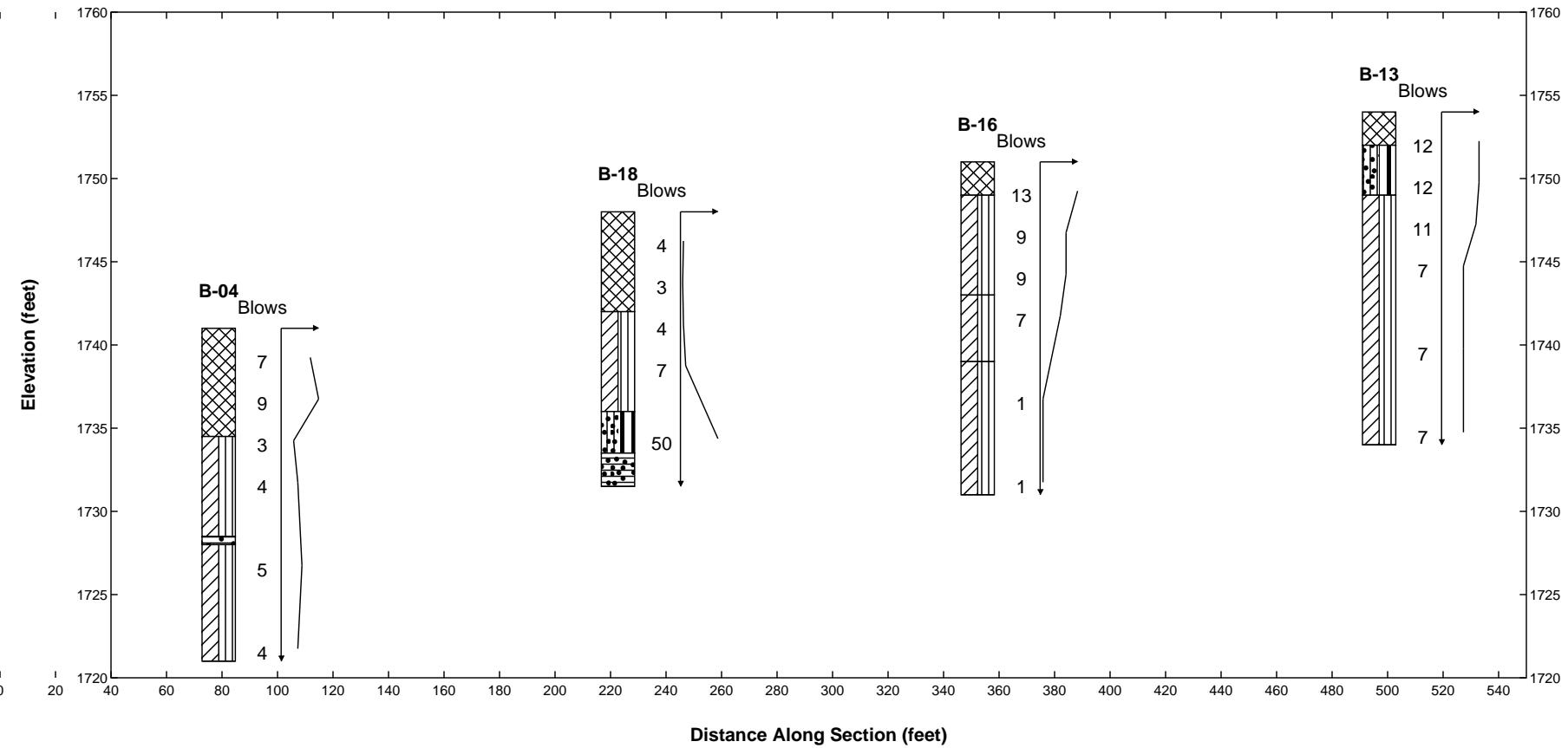
Clayey SAND to Sandy CLAY (SC-CL)

Silty SAND to Sandy SILT (SM-MH)

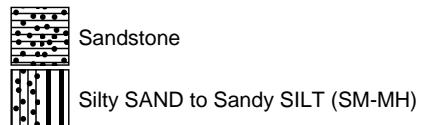
**Foundation Systems  
Engineering, PC**

**BONHAM CIRCLE  
REDEVELOPMENT**

Project No.	Fence No.
215163	A



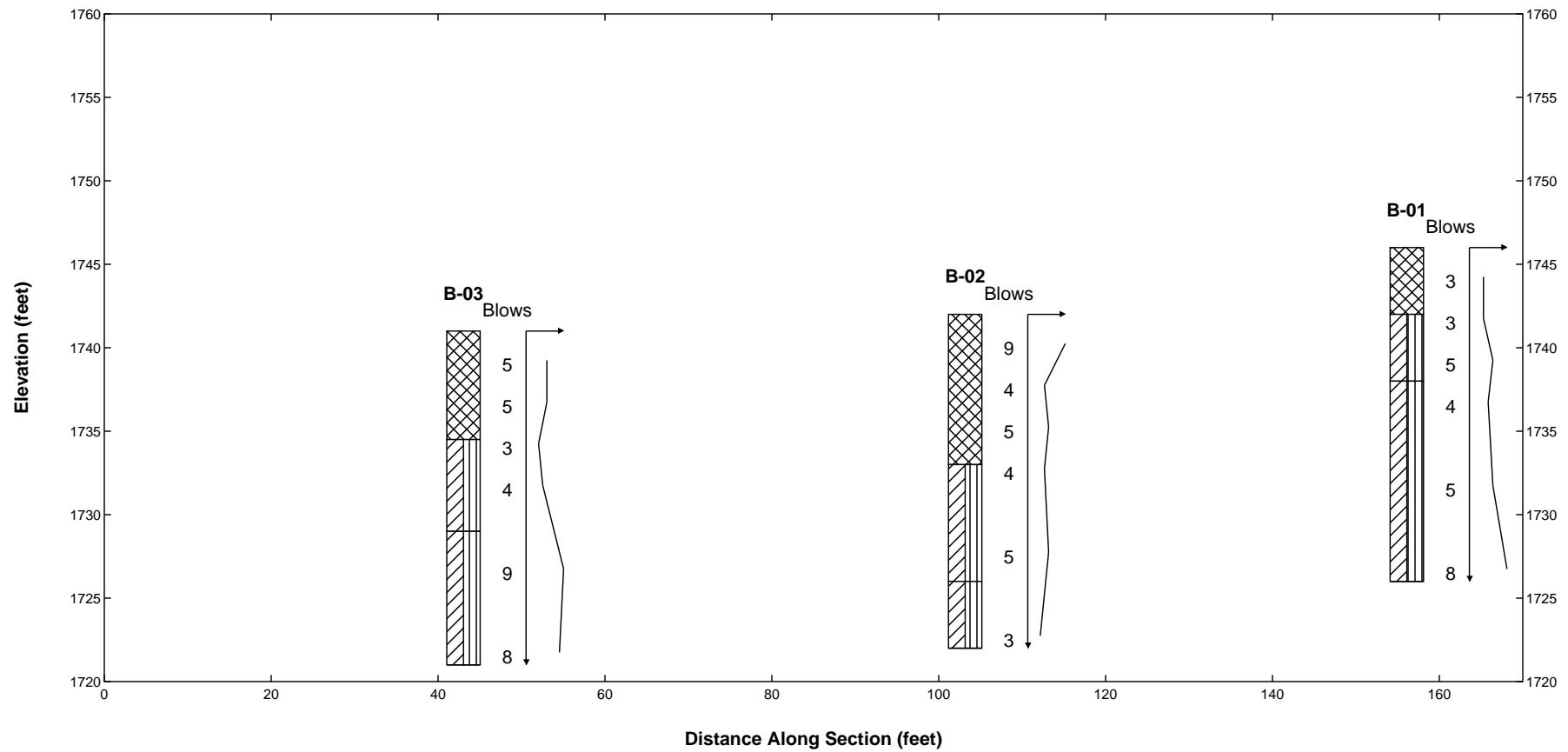
**MATERIAL GRAPHIC SYMBOLS**



**Foundation Systems  
Engineering, PC**

**BONHAM CIRCLE  
REDEVELOPMENT**

Project No.	Fence No.
215163	B



#### MATERIAL GRAPHIC SYMBOLS



SILTY CLAY (CL-ML)



Artificial Fill

**Foundation Systems  
Engineering, PC**

**BONHAM CIRCLE  
REDEVELOPMENT**

Project No.	Fence No.
215163	C

# TEST PIT OBSERVATION RECORD



TEST PIT NO:	1	PROJECT NAME:	Bristol Housing
EXCAVATOR:	Mini Excavator	PROJECT LOCATION:	Oakview Avenue, Bristol Virginia
OBSERVED BY:	Wes Loerger, P.E.	FSE PROJECT NO:	215163
DATE EXCAVATED :	5/15/2015	ELEVATION (FT):	1755
DEPTH (FEET)	MATERIAL DESCRIPTION	Note: Test pit terminated at 5.0 feet. No water encountered.	
0 – 1.0	Topsoil		
1.0 – 2.5	Fill, medium, very moist, tan red, silty CLAY with debris		
2.5 – 5.0	Residual, medium, very moist, tan, sandy clayey SILT with sandstone seams		



# TEST PIT OBSERVATION RECORD



TEST PIT NO:	2	PROJECT NAME:	Bristol Housing
EXCAVATOR:	Mini Excavator	PROJECT LOCATION:	Oakview Avenue, Bristol Virginia
OBSERVED BY:	Wes Loerger, P.E.	FSE PROJECT NO:	215163
DATE EXCAVATED :	5/15/2015	ELEVATION (FT):	1754
DEPTH (FEET)	MATERIAL DESCRIPTION	Note: Test pit terminated at 2.5 feet. No water encountered.	
0 - 0.5	Pavement base		
0.5 - 2.5	Residual, medium to stiff, very moist, gray tan silty CLAY		



# TEST PIT OBSERVATION RECORD



TEST PIT NO:	<b>3</b>	PROJECT NAME:	Bristol Housing
EXCAVATOR:	Mini Excavator	PROJECT LOCATION:	Oakview Avenue, Bristol Virginia
OBSERVED BY:	Wes Loerger, P.E.	FSE PROJECT NO:	215163
DATE EXCAVATED :	5/15/2015	ELEVATION (FT):	1754
<b>DEPTH (FEET)</b>	<b>MATERIAL DESCRIPTION</b>		
0 – 0.7	Topsoil		
0.7 – 6.0	Fill, medium, very moist to wet, tan brown, silty CLAY with debris		
6.0 – 9.0	Fill, medium, very moist, soil and debris including steel, brick, block, and charred wood		
9.0 – 10.5	Alluvial, medium, wet, gray, clayey SILT with organic odor		

**Note: Test pit terminated at 10.5 feet. No water encountered.**



# TEST PIT OBSERVATION RECORD



TEST PIT NO:	4	PROJECT NAME:	Bristol Housing
EXCAVATOR:	Mini Excavator	PROJECT LOCATION:	Oakview Avenue, Bristol Virginia
OBSERVED BY:	Wes Loerger, P.E.	FSE PROJECT NO:	215163
DATE EXCAVATED :	5/15/2015	ELEVATION (FT):	1747
DEPTH (FEET)	MATERIAL DESCRIPTION		
0 - 0.5	Topsoil		
0.5 - 8.0	Fill, medium, very moist to wet, gray brown to red tan, silty CLAY with debris		
8.0 - 9.0	Residual, medium, very moist, red tan, silty CLAY		
Note: Test pit terminated at 9.0 feet. No water encountered.			



# TEST PIT OBSERVATION RECORD



TEST PIT NO:	5	PROJECT NAME:	Bristol Housing
EXCAVATOR:	Mini Excavator	PROJECT LOCATION:	Oakview Avenue, Bristol Virginia
OBSERVED BY:	Wes Loerger, P.E.	FSE PROJECT NO:	215163
DATE EXCAVATED :	5/15/2015	ELEVATION (FT):	1764
DEPTH (FEET)	MATERIAL DESCRIPTION		
0 - 1.0	Topsoil, loamy, black		
1.0 - 4.0	Residual, medium, very moist, reddish tan, silty CLAY		

Note: Test pit terminated at 5.0 feet. No water encountered.



# TEST PIT OBSERVATION RECORD



TEST PIT NO:	6	PROJECT NAME:	Bristol Housing
EXCAVATOR:	Mini Excavator	PROJECT LOCATION:	Oakview Avenue, Bristol Virginia
OBSERVED BY:	Wes Loerger, P.E.	FSE PROJECT NO:	215163
DATE EXCAVATED :	5/15/2015	ELEVATION (FT):	1769
DEPTH (FEET)	MATERIAL DESCRIPTION	Note: Test pit terminated at 2.5 feet. No water encountered.	
0 - 0.7	Topsoil, loamy, black		
0.7 - 2.5	Residual, medium, very moist, tan red, silty CLAY		

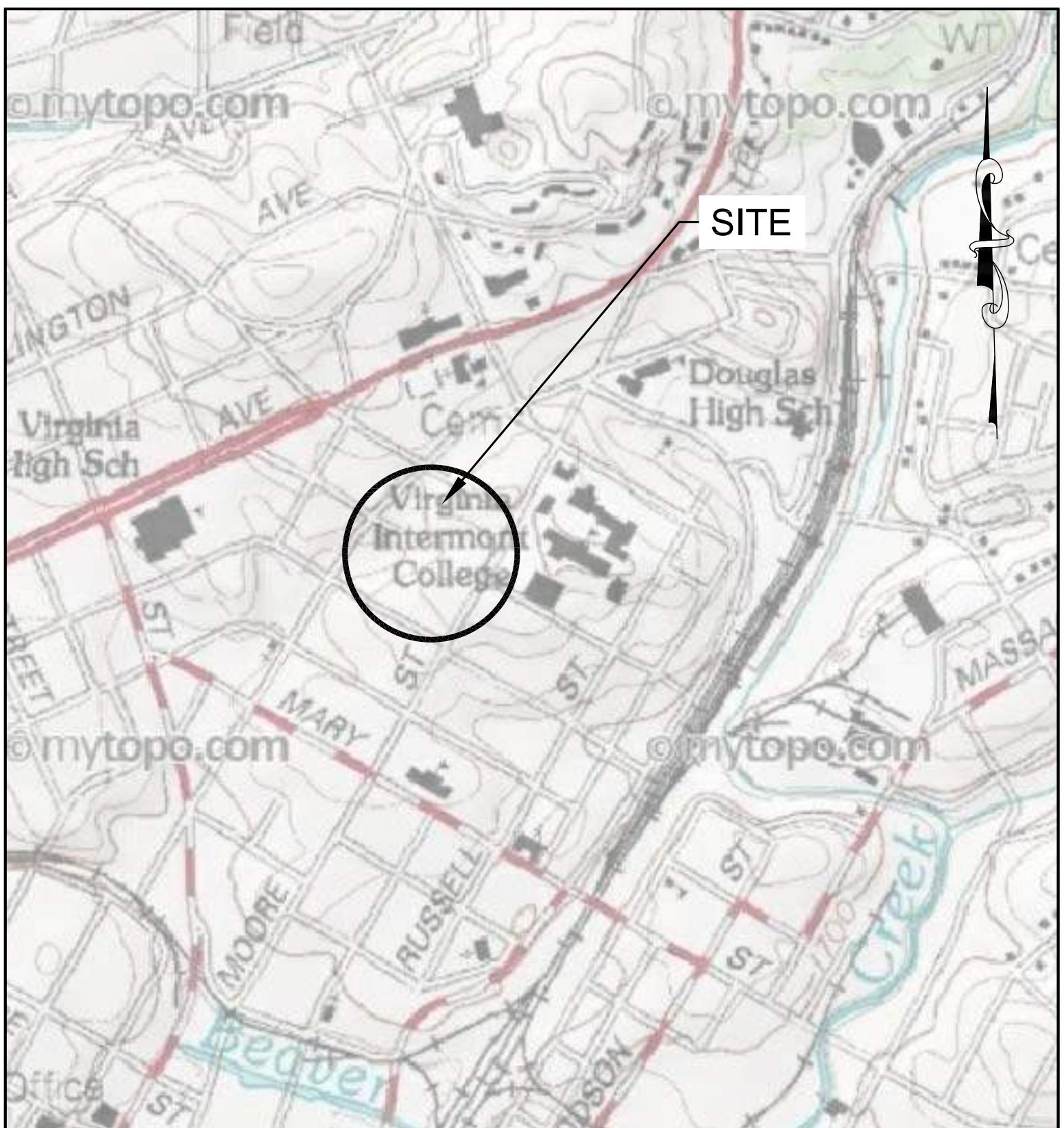


# TEST PIT OBSERVATION RECORD



TEST PIT NO:	7	PROJECT NAME:	Bristol Housing
EXCAVATOR:	Mini Excavator	PROJECT LOCATION:	Oakview Avenue, Bristol Virginia
OBSERVED BY:	Wes Loerger, P.E.	FSE PROJECT NO:	215163
DATE EXCAVATED :	5/15/2015	ELEVATION (FT):	1769
DEPTH (FEET)	MATERIAL DESCRIPTION	Note: Test pit terminated at 3.0 feet. No water encountered.	
0 - 0.5	Topsoil, loamy, black		
0.5 - 3.0	Residual, medium, very moist, tan red, silty CLAY		





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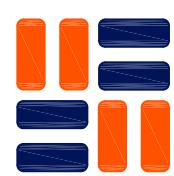
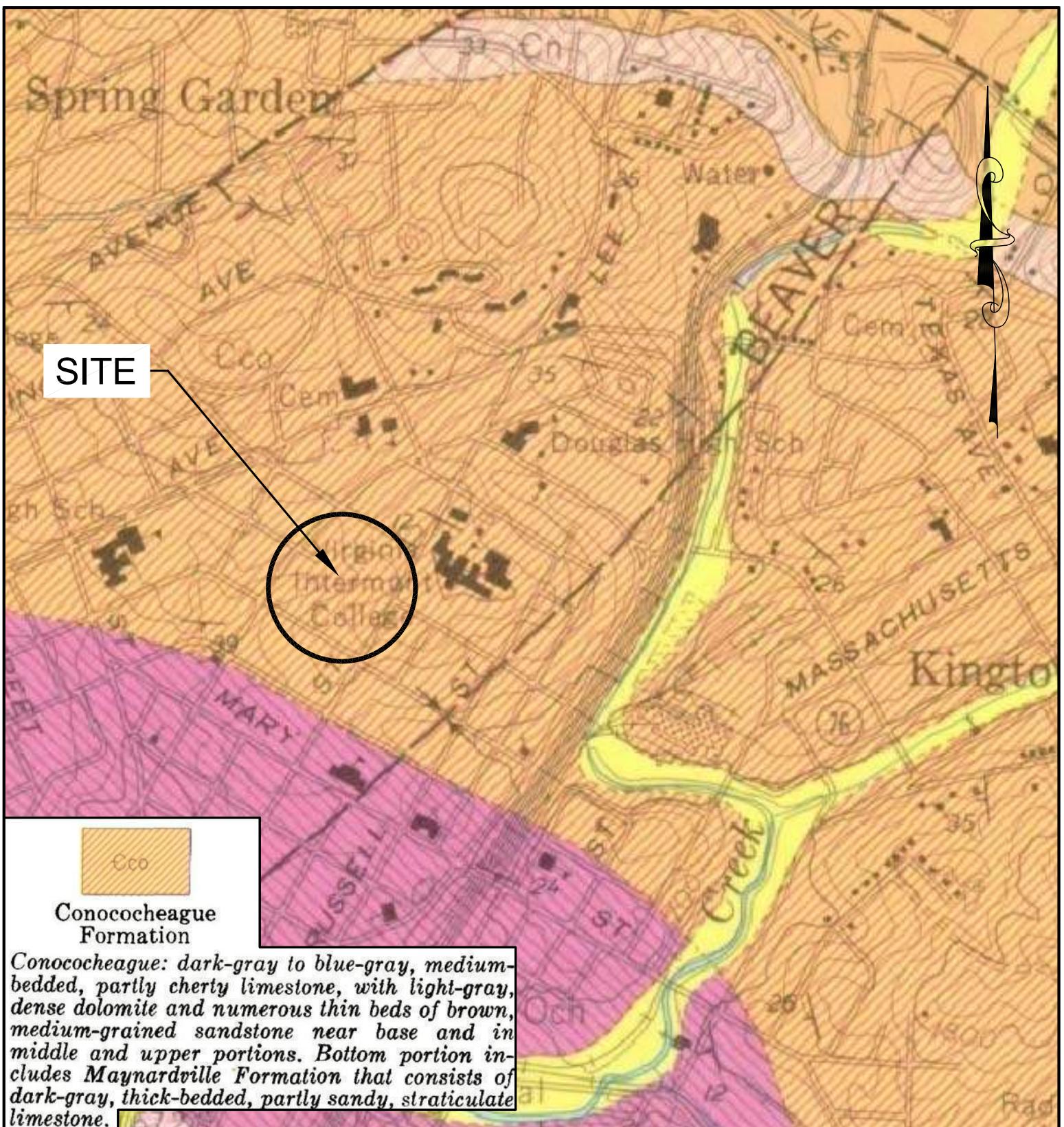
[www.fsepc.com](http://www.fsepc.com)

423-239-9226  
FAX 239-8677

**SITE LOCATION PLAN  
BRISTOL REDEVELOPMENT  
AND HOUSING AUTHORITY PROPERTY  
BRISTOL, VIRGINIA**

**FOR: THOMPSON AND LITTON**

DRAWN BY: HWI	NOTES:
PROJ #: 214163	ADAPTED FROM USGS MAPPING
SCALE: NONE	DATE: 05/27/2015
	DWG #: SLP



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**AREA GEOLOGY MAP  
BRISTOL REDEVELOPMENT  
AND HOUSING AUTHORITY PROPERTY  
BRISTOL, VIRGINIA**

**FOR: THOMPSON AND LITTON**

DRAWN BY: HWI	NOTES:
PROJ #: 214163	SOURCE:
SCALE: NONE	DATE: 05/27/2015 DWG #: GEO



SITE



1997

Imagery Date: 4/12/2012



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AERIAL PHOTOGRAPH  
BRISTOL REDEVELOPMENT  
AND HOUSING AUTHORITY PROPERTY  
BRISTOL, VIRGINIA

FOR: THOMPSON AND LITTON

DRAWN BY: HWI NOTES:

PROJ #: 214163

SCALE: NONE

DATE: 05/27/2015

DWG #: AERIAL



FSE File #: 215163  
Project : New Residential Housing  
Date: 5/15/2015  
Lab. No: JC-151844

## SOIL DATA SUMMARY

BORING NUMBER	SAMPLE DEPTH	MOISTURE CONTENT	LIQUID LIMIT	PLASTIC LIMIT	PLASTIC INDEX	UNIFIED SOIL CLASSIFICATION
B - 1	8.5' - 10.0'	57.3	63	34	29	MH
B - 1	13.5' - 15.0'	44.0				
B - 3	6.0' - 7.5'	29.5				
B - 3	8.5' - 10.0'	28.0				
B - 4	8.5' - 10.0'	19.0				
B - 4	13.5' - 15.0'	45.0				
B - 5	8.5' - 10.0'	20.1				
B - 6	13.5' - 15.0'	31.8				
B - 6	18.5' - 20.0'	42.1				
B - 7	6.0' - 7.5'	25.6				
B - 7	8.5' - 10.0'	24.9				
B - 8	1.0' - 2.5'	46.7				
B - 8	3.0' - 4.5'	37.3				
B - 8	6.0' - 7.5'	42.9				
B - 8	8.5' - 10.0'	48.2	54	32	22	MH



FSE File #: 215163

Project : New Residential Housing

Date: 5/15/2015

Lab. No: JC-151844

## SOIL DATA SUMMARY

BORING NUMBER	SAMPLE DEPTH	MOISTURE CONTENT	LIQUID LIMIT	PLASTIC LIMIT	PLASTIC INDEX	UNIFIED SOIL CLASSIFICATION
B - 10	1.0' - 2.5'	15.1				
B - 10	3.0' - 4.5'	18.2				
B - 10	6.0' - 7.5'	50.8				
B - 10	8.5' - 10.0'	50.8				
B - 10	13.5' - 15.0'	43.8				
B - 10	18.5' - 20.0'	49.6				
B - 12	1.0' - 2.5'	35.2				
B - 12	3.0' - 4.5'	31.4				
B - 12	6.0' - 7.5'	30.5				
B - 12	8.5' - 10.0'	31.8	43	24	19	CL
B - 14	6.0' - 7.5'	25.0				
B - 14	8.5' - 10.0'	23.6				
B - 14	13.5' - 15.0'	49.6				
B - 15	1.0' - 2.5'	44.4				
B - 15	3.0' - 4.5'	39.5				



FSE File #: 215163

Project : New Residential Housing

Date: 5/15/2015

Lab. No: JC-151844

## SOIL DATA SUMMARY

BORING NUMBER	SAMPLE DEPTH	MOISTURE CONTENT	LIQUID LIMIT	PLASTIC LIMIT	PLASTIC INDEX	UNIFIED SOIL CLASSIFICATION
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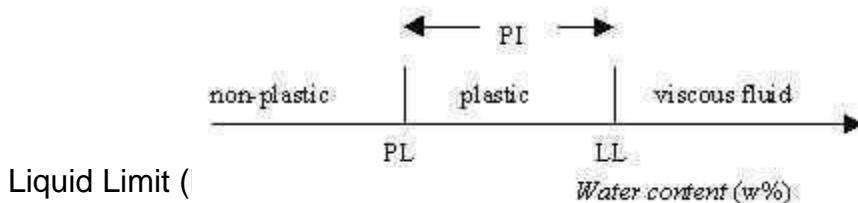
B - 15	6.0' - 7.5'	44.6				
B - 16	3.0' - 4.5'	38.3				
B - 16	6.0' - 7.5'	45.6				

The objective of the Atterberg limits test is to obtain basic index information about the soil used to estimate strength and settlement characteristics. It is the primary form of classification for cohesive soils.

Fine-grained soil is tested to determine the liquid and plastic limits, which are moisture contents that define boundaries between material consistency states. These standardized tests produce comparable numbers used for soil identification, classification and correlations to strength.

The liquid (LL) and plastic (PL) limits define the water content boundaries between non-plastic, plastic and viscous fluid states. The plasticity index (PI) defines the complete range of plastic state. Figure 1 illustrates it nicely.

Figure 1: Atterberg limits illustration.



Liquid Limit (

The liquid limit defines the boundary between plastic and viscous fluid states. It is determined using a standard "Liquid Limit Device," which drops a shallow cupfull of soil 1 cm consistently. When a groove cut through the sample closes 1/2", the number of drops is recorded and a moisture content sample processed.

Repeating the procedure for a total of four drop-count ranges provides enough data to plot on a semi-log scale. From the plot, the moisture content at 25 drops defines the Liquid Limit.

#### Plastic Limit (PL)

The plastic limit defines the boundary between non-plastic and plastic states. It is determined simply by rolling a thread of soil and adjusting the moisture content until it breaks at 1/8 inch diameter.

This test uses a thick-walled sample tube, with an outside diameter of 2 inches, an inside diameter of 1 3/8 inches, and a length of around 32 inches. This tube is driven into the ground at the bottom of a borehole by blows from a slide hammer with a weight of 140 lb falling through a distance of 30 in. The sample tube is driven into the ground and then the number of blows needed for the tube to penetrate each 6 inch increment up to a depth of 18 inches is recorded. The sum of the number of blows required for the second and third 6 inches of penetration is termed the "standard penetration resistance" or the "N-value".

In cases where 50 blows are insufficient to advance it through a 6 inch interval the penetration after 50 blows is recorded. The blow count provides an indication of the soil consistency and can be correlated to the bearing capacity of the soil.

The Unified Soil Classification System (USCS) is a nationally recognized standard for classifying soils in accordance with their engineering properties. The parameters considered in this system are:

- Particle Size
- Water Holding and Plasticity
- Organic Content

The system identifies three major soil divisions; coarse-grained soils, fine-grained soils, and highly organic soils. These three divisions are further subdivided into a total of 15 basic soil groups. Based on the results of visual observations and prescribed laboratory tests, the soil is cataloged into basic soil groups, which include variations of gravel, sands, silty, clays and highly organic soils.

# GENERAL NOTES



## **WATER LEVEL MEASUREMENT:**

Water levels indicated on the boring logs are the levels measured in the borings at the times indicated. Groundwater levels at other times and other locations across the site could vary. In pervious soils, the indicated levels may reflect the location of groundwater. In low permeability soil, the accurate determination of groundwater levels may not be suitable with only short-term observations.

## **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.

<u>CONSISTENCY OF FINE-GRAINED SOILS</u>		
<u>Unconfined Compressive Strength, Qu, psf</u>	<u>Standard Penetration or N-value (55) Blows/Ft.</u>	<u>Consistency</u>
< 500	0 - 1	Very Soft
500-1,000	2 - 4	Soft
1,000 - 2,000	4 - 8	Medium Stiff
2,000 - 4,000	8 - 15	Stiff
4,000 - 8,000	15 - 30	Very Stiff
8,000+	> 30	Hard

<u>RELATIVE DENSITY OF COARSE-GRAINED SOILS</u>	
<u>Standard Penetration or N-value (SS) Blows/Ft.</u>	<u>Relative Density</u>
0 - 3	Very Loose
4 - 9	Loose
10 - 29	Medium Dense
30 - 50	Dense
>50	Very Dense

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

<u>GRAIN SIZE TERMINOLOGY</u>	
<u>Major Component of Sample</u>	<u>Particle Size</u>
Boulders	Over 12 in. (300mm)
Cobbles	12 in. to 3 in. (300mm to 75mm)
Gravel	3 in. to #4 sieve (75mm to 4.75mm)
Sand	#4 to #200 sieve (4.75 to 0.075mm)
Silt or Clay	Passing #200 Sieve (0.075mm)

<u>RELATIVE PROPORTION OF FINE S</u>	
<u>Descriptive Term(s) of other constituents</u>	<u>Percent of Dry Weight</u>
Trace	<5
With	5 - 12
Modifier	> 12

<u>PLASTICITY DESCRIPTION</u>	
<u>Term</u>	<u>Plasticity Index</u>
Non-plastic	0
Low	1 - 10
Medium	11 - 30
High	> 30