

# Specifications for the F-35: ADAL SQUADRON OPERATIONS BUILDING 1303

187th Fighter Wing Dannelly Field - AL ANG  
Montgomery, AL

# SSL&L

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## VOLUME II

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MANAGEMENT OF SENSITIVE COMPARTMENTED INFORMATION FACILITIES  
(ICD TECH SPEC FOR IC/ICS705)**

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CF-35 ADAL Squadron Operations Building  
187th Fighter Wing, Dannelly Field, ANG  
Montgomery, AL

FAKZ189102

November 2022

Type B3 (100%) Submittal

**DIVISION 21 0000, 22 0000, AND 23 0000**

**ENGINEER SEAL SHEET**



Prepared by: Tom Hattemer

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## **SECTION 211313 - WET-PIPE SPRINKLER SYSTEMS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including Requirements of the Government's Solicitation and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes
  - 1. Extension of the existing hydraulic based sprinkler system to building additions
  - 2. Alteration to the existing interior sprinkler system:
  - 3. Alterations to the fire water service
  - 4. Pipes, fittings, and specialties.
  - 5. Sprinklers.

#### **1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For wet-pipe sprinkler systems.
  - 1. Include plans and attachment details.

#### **1.4 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved.
- B. Qualification Data: For qualified Installer.
- C. Design Data:

1. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.
- D. Welding certificates.
- E. Field Test Reports:
  1. Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."
  2. Fire-hydrant flow test report.
- F. Field quality-control reports.

## **1.5 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For wet-pipe sprinkler systems and specialties to include in emergency, operation, and maintenance manuals.

## **1.6 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. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

## **1.7 QUALITY ASSURANCE**

- A. Installer Qualifications:
  1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
    - a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.
- B. Welding Qualifications: Qualify procedures and operators according to 2010 ASME Boiler and Pressure Vessel Code.



## **PART 2 - PRODUCTS**

### **2.1 PERFORMANCE REQUIREMENTS**

- A. Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with NFPA 13.
- B. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.

### **2.2 STEEL PIPE AND FITTINGS**

- A. Standard-Weight, Black-Steel Pipe: ASTM A53/A53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.
- B. Thinwall Black-Steel Pipe: ASTM A135/A135M or ASTM A795/A795M, threadable, with wall thickness less than Schedule 30 and equal to or greater than Schedule 10. Pipe ends may be factory or field formed to match joining method.
- C. Black-Steel Pipe Nipples: ASTM A733, made of ASTM A53/A53M, standard-weight, seamless steel pipe with threaded ends.
- D. Uncoated-Steel Couplings: ASTM A865/A865M, threaded.
- E. Uncoated, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
- F. Malleable- or Ductile-Iron Unions: UL 860.
- G. Cast-Iron Flanges: ASME 16.1, Class 125.
- H. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
  - 1. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or EPDM rubber gasket.
    - a. Class 125 and Class 250, Cast-Iron, Flat-Face Flanges: Full-face gaskets.
    - b. Class 150 and Class 300, Ductile-Iron or -Steel, Raised-Face Flanges: Ring-type gaskets.
  - 2. Metal, Pipe-Flange Bolts and Nuts: Carbon steel unless otherwise indicated.
- I. Steel Welding Fittings: ASTM A234/A234M and ASME B16.9.

1. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- J. Grooved-Joint, Steel-Pipe Appurtenances:
  1. Pressure Rating: 175-psig minimum.
  2. Painted Grooved-End Fittings for Steel Piping: ASTM A47/A47M, malleable-iron casting or ASTM A536, ductile-iron casting, with dimensions matching steel pipe.
  3. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213 rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

## 2.3 SPRINKLER PIPING SPECIALTIES

- A. Branch Outlet Fittings:
  1. Standard: UL 213.
  2. Pressure Rating: **175-psig minimum.**
  3. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
  4. Type: Mechanical-tee and -cross fittings.
  5. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
  6. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
  7. Branch Outlets: Grooved, plain-end pipe, or threaded.
- B. Flexible Sprinkler Hose Fittings:
  1. Standard: UL 1474.
  2. Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
  3. Pressure Rating: **175-psig minimum.**
  4. Size: Same as connected piping, for sprinkler.

## 2.4 SPRINKLERS

- A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
- B. Pressure Rating for Automatic Sprinklers: 175-psig minimum.
- C. Automatic Sprinklers with Heat-Responsive Element:
  1. Early-Suppression, Fast-Response Applications: UL 1767.
  2. Nonresidential Applications: UL 199.

3. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.
- D. Sprinkler Finishes: Chrome plated.
- E. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
  1. Ceiling Mounting: Plastic, white finish, one piece, flat.
  2. Sidewall Mounting: Chrome-plated steel, one piece, flat.
- F. Sprinkler Guards:
  1. Standard: UL 199.
  2. Type: Wire cage with fastening device for attaching to sprinkler.

### **PART 3 - EXECUTION**

#### **3.1 WATER-SUPPLY CONNECTIONS**

- A. Connect sprinkler piping to existing interior water-distribution piping.

#### **3.2 PIPING INSTALLATION**

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated on approved working plans.
  1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
  2. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.
- B. Piping Standard: Comply with NFPA 13 requirements for installation of sprinkler piping.
- C. Install seismic restraints on piping. Comply with NFPA 13 requirements for seismic-restraint device materials and installation.
- D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

- E. Install sprinkler piping with drains for complete system drainage.
- F. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.
- G. Fill sprinkler system piping with water.
- H. Install escutcheons for piping penetrations of walls, ceilings, and floors.

### **3.3 JOINT CONSTRUCTION**

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- D. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.
- E. Threaded Joints: Thread 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.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- F. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
  - 1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.
- G. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.
- H. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

### **3.4 VALVE AND SPECIALTIES INSTALLATION**

- A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
- B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

### **3.5 SPRINKLER INSTALLATION**

- A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels.

### **3.6 IDENTIFICATION**

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

### **3.7 FIELD QUALITY CONTROL**

- A. Perform the following tests and inspections:
  - 1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
  - 3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
- B. Sprinkler piping system will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

### **3.8 CLEANING**

- A. Clean dirt and debris from sprinklers.
- B. Only sprinklers with their original factory finish are acceptable. Remove and replace any sprinklers that are painted or have any other finish than their original factory finish.

### **3.9 PIPING SCHEDULE**

- A. Standard-pressure, wet-pipe sprinkler system, NPS 2 and smaller, shall be the following:
  - 1. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
- B. Standard-pressure, wet-pipe sprinkler system, NPS 2-1/2 to NPS 4, shall be the following:
  - 1. Thinwall black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

### **3.10 SPRINKLER SCHEDULE**

- A. Use sprinkler types in subparagraphs below for the following applications:
  - 1. Rooms without Ceilings: Upright sprinklers.
  - 2. Rooms with Suspended Ceilings: Concealed sprinklers.
  - 3. Wall Mounting: Sidewall sprinklers.
- B. Provide sprinkler types in subparagraphs below with finishes indicated.
  - 1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
  - 2. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
  - 3. Upright Pendent and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

**END OF SECTION 211313**

## **SECTION 220000 - PLUMBING**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. General Provisions of the Contract, including Requirements of the Government's Solicitation, and Division 1 - General Requirements, apply to the work specified in this Section.
- B. Excavation and backfill, DIVISION 2.
- C. Painting, DIVISION 9.
- D. Electrical, DIVISION 26.
- E. All parts of this Section of the Specification take precedence over other sections of Division 22 and 23 (in connection with Plumbing work) unless noted otherwise.
- F. Comply with Section 230000 with it in its entirety, including "PRIOR APPROVAL" requirements.
- G. Insulation, Section 230719.

#### **1.2 DESCRIPTION OF WORK**

- A. The work to be performed under this Section of the work shall consist of but is not limited to the following general categories.
  - 1. Provide complete and operable plumbing systems to serve all plumbing fixtures, equipment, hose bibbs, air conditioning equipment, etc.

#### **1.3 SCOPE**

- A. The plumbing system for this work includes all cold water distribution, domestic water heating and distribution, vents and wastes, floor drainage, natural gas distribution, plumbing fixtures and trim, connection of equipment furnished by others, assisting the other trades in the connection of the gas equipment to the gas supply and the fuel oil storage system. All other items indicated on drawings or described in these specifications, and all other plumbing items needed for a complete and proper installation.

(See "General Conditions" and "Scope of Work", and "Mechanical General Provisions" which is a part of this contract.)

#### **1.4 QUALITY ASSURANCE**

- A. General: Provide all new materials, labor, tools, equipment, transportation, incidentals and services necessary for the complete installation in every respect and the satisfactory operation of the plumbing systems as specified below and as shown on the drawings.
- B. Contractor shall verify conditions and check all measurements at job site.
- C. Wherever the word "supply", "provide" or similar term is used in the sense of providing apparatus or materials, it shall mean that Contractor shall furnish and connect such apparatus or materials referred to, unless otherwise specifically called for, at no additional cost to The Government.
- D. All statements made throughout these Specifications shall be considered as orders, directives, instructions, etc., to the Contractor to whom this Contract is awarded whether the word "Contractor" is used or not, unless otherwise noted.
- E. Insulation of piping does not protect pipe against freezing. All water bearing pipe must be run on the heated side of the building insulated envelope or provided with heat trace. If heat trace is required, and none is shown, the contractor shall provide heat trace, as well as all power circuits and controls, as work of this project and without additional expense or change order to the contract.
- F. Codes, Permits:
  - 1. Obtain and pay for all permits and inspections required by all laws, ordinances, regulations, and public authority having jurisdiction. The following codes, standards and regulations in effect on the date of bid invitation shall be considered a part of this specification:
    - a. State Public Health Department Regulations
    - b. International Code Congress (ICC) Codes
    - c. Local and State Plumbing Codes
    - d. National Fire Protection Association
    - e. American Society of Mechanical Engineers
    - f. American Society for Testing Materials
    - g. Underwriters' Laboratories'
    - h. National Electrical Manufacturers Association
    - i. OSHA - Occupational Safety and Health Standards
    - j. Local Utilities' Requirements



2. All material and workmanship shall comply with all latest applicable sections of local, municipal, parish or county, state, federal, industry and utilities company's rules, regulations, codes, ordinances and standards. Pipe sizes shown are minimum that will be allowed.
3. Should the Contractor perform any work that does not comply with the requirements of the applicable codes, standards and regulations, he shall bear all costs arising from the deficiencies.
4. Deliver copies of all certificates of inspection to Contracting Officer for delivery to The Government upon completion of the work.
5. Do not conceal any work until it has been inspected and tested.
6. Terminology used in these specifications is that of the ICC International Plumbing Code (IPC).
7. Should work shown on these drawings and specifications be located in any area which levies a SEWER USE FEE or surcharge, this cost shall be included in the Contractor's bid unless specifically omitted by instructions in the General or Special Conditions.
8. Should local utility require any payment or fee for providing water or gas service to the facility, the cost shall be included in Bid.
9. All applications required shall be filled in the Government's name.
10. Should work shown on the Contract Documents not be as strict as "local interpretations" of the local code, the Contractor shall make his bid in accordance with the local requirements and shall call the Contracting Officer's attention to the changes required to comply with the above.
11. Inspections: Obtain and pay for all inspections, required by all laws, ordinances, rules, regulations, or public authorities having jurisdiction. This Contractor shall obtain and pay for all certificates of such inspections, and file such certificates with the The Government.
12. Contractor shall be a licensed plumbing locally.

**G. Drawings and Specifications:**

1. Drawings and Specification are complementary to each other. What is called by one shall be binding as if called for by both.
2. All methods of construction, details of workmanship and detailed arrangement of all work where not specifically described herein or indicated on the drawings, shall be subject to the control and approval of the Contracting Officer.
3. Contracting Officer shall render a decision in writing as to the space allotment in congested areas, which decision shall be binding on all. No claims for "extras" due to such decisions will be allowed, even though the work has already been installed.
4. Submit shop drawings for review on all fixtures, equipment and accessories.
5. It shall be the responsibility of the Contractor to use the Contract Document Drawings and these Specifications for a basic layout of the Plumbing Systems. Contractor shall not be permitted to change this basic method of distribution of the

system details without submitting drawings for review and acceptance before fabrication and installation, and in particular with reference to exposed piping.

6. Plumbing drawings are diagrammatic; see Architectural drawings and building for dimensions and conditions not shown. Drawings do not show all fittings or details, but must be followed generally. Changes must be approved in writing. Obtain Contracting Officer's written decision in case of doubt as to intent of drawings or specifications. Failure to obtain written decision will leave this contractor liable for damage to work of other trades and responsible for corrections required by Contracting Officer.
7. Plans and Riser Diagrams (Risers): Plumbing Plans and Risers are complementary to each other. What is called for by one shall be binding as if called for by both. Where pipe sizes differ from the plans to the risers, it shall be considered as a drafting inaccuracy and the larger of the sizes shall be provided.

## **1.5 RESPONSIBILITY OF THE CONTRACTOR**

- A. Contractor shall examine all drawings, specifications, addendums, and the Site of the work. He should familiarize himself with the character of work, coordination required with other trades, and any conditions that affect the completion of this work. No consideration will be given at a later date for any alleged misunderstanding as to the requirements, materials to be furnished, or any special requirements due to the nature of the job site or local conditions.
- B. Items obviously omitted from the plans and specifications shall be called to the attention of the Contracting Officer before bidding. After the award of the contract, any changes, additions, or rearrangements necessary to complete the work as outlined shall be at this Contractor's expense.
- C. The utilities shown are based on the best information available to the Designers and is for Bidding purposes and indication of desired routing only. The Contractor is required to coordinate with the required utilities prior to entering Bid, and Bid so as to include all costs of obtaining utilities as required by the drawings.

## **1.6 SUBMITTALS**

- A. See paragraph on Submittals in Section 230000.
- B. Submit for review not less than five (5) copies of complete data, cuts, capacities, type, and grade for review of fixtures, trim, pipe, insulation (jackets and fittings), and all other major components. Submit within 30 days of signing of general contract. Submit all items at one time in a bound submittal package with a cover sheet identifying all items submitted. Partial submittals will be rejected.

- C. Where plumbing fixtures are specified by manufacturer name and model, and a substitution manufacturer and model fixture is proposed, the submittal shall include a cross reference guide published by the manufacturer actually specified indicating that the proposed fixture and manufacturer is an appropriate substitution. In such cases where no such cross reference is published, provide cut sheets for both the specified fixture and the proposed fixture to facilitate evaluation by the Engineer.
- D. Three (3) copies will be returned to the general contractor with comments, or reason for rejection. Resubmit at once on rejected items.
- E. Materials, fixtures, or equipment installed without review or after rejections shall be replaced by this contractor with acceptable items at Contracting Officer's direction.
- F. The supplier, by submitting, certifies that his materials and/or equipment are satisfactory for the application for which they are proposed.
- G. Contractor agrees that submittals processed by the Engineer are not change orders; that the purpose of submittal by the contractor is to demonstrate to the Engineer that the contractor understands the design concept, that he demonstrates his understanding by indicating which equipment and materials he intends to furnish and install and by detailing the fabrication and installation methods he intends to use.
- H. Contractor further agrees that if deviations, discrepancies or conflicts between submittals and specifications are discovered either prior to or after submittals are processed by the Engineer, the design drawings and specifications shall be followed.

## **1.7 WORKMANSHIP**

- A. Work to be orderly, neat, workmanlike in appearance, done by skilled craftsmen. Any work not so installed shall be removed and replaced without additional cost to the Government or Design Professionals.
- B. Work shall be first class and in accordance with best practice. Pipe shall be cut clean, properly reamed, threaded or soldered, erected plumb and secure. Make changes in pipe size with reducing fittings.
- C. At all stages of installation, protect pipe openings, fixtures, and equipment against the entrance of foreign materials.

**1.8 SAFETY**

- A. Perform all work in a safe manner. Protect all workmen and others on site. Barricade (light if necessary) all ditches, holes, openings through floors and other hazards. Comply with all health and safety regulations. Contractor is solely responsible for job site safety.

**1.9 COOPERATION**

- A. Cooperate with all crafts; schedule work as needed; do not delay other trades; maintain necessary competent mechanics and supervision on the job at all times.

**1.10 INCIDENTAL WORK INCLUDED**

- A. Cutting of structure (patching to be done by the affected trade at this contractor's expense). Secure Contracting Officer's approval where strength or appearance is affected.
- B. Necessary foundations not shown on Architectural or Structural plans.
- C. Motors, controls, control devices, control wiring, all as required for a complete system shall be by this contractor unless shown on the electrical drawings and included in that section. All electrical work shall comply with the Division 26 Electrical sections of the specifications.
- D. All ferrous metal exposed to weather shall be prime coated with a primer to match the metal and finished with a two coat application of finish paint of color and type selected by the Contracting Officer. Where the finish painting is specified in the section on painting, the two final coats may be omitted, but the metal shall be prime coated before rusts starts to form.

**1.11 QUESTIONS AND CLARIFICATIONS**

- A. Contractor shall not rely on any verbal clarification of the drawings and specifications. Any questions shall be referred to the Contracting Officer at least seven (7) working days prior to the bid date to allow clarification by addendum.

**1.12 QUALIFICATIONS**

- A. Contractor shall have at least three (3) years of successful installation experience on plumbing work similar in size and scope to this project.

### **1.13 CHANGES**

- A. If during construction desirable or necessary changes become apparent, advise the Contracting Officer and secure his decision in writing; otherwise make no deviation from the system as detailed.

### **1.14 CLEARING AND ADJUSTING**

- A. Upon completion of work, clear all drains, traps, pipe lines, and plumbing fixtures. Adjust all valves, pack stuffing boxes, remove rubbish and leave work in clean and operating condition.

### **1.15 FOUNDATIONS**

- A. Provide foundations, supports, etc., not specified under other sections and as required to mount equipment in a workmanlike and structurally sound manner. Consult drawings pertinent to other trades to determine extent of their work.

### **1.16 SYSTEM IDENTIFICATION**

- A. Comply with 230553. ELECTRICAL PROVISIONS OF PLUMBING WORK
- B. All electrical work required in association with the Plumbing work (in order to provide complete operating systems) shall generally be a part of the Division 26 work. However, there are certain portions of the electrical requirements which shall be a responsibility of the Division 22 work, which shall be executed in accordance with applicable Division 26 Specification requirements. Refer to 23 01 00 Paragraph 2.4 for additional requirements related to electrical work integral to the Plumbing work. The electrical provisions of Plumbing work, where it may be furnished integrally with mechanical work, can be summarized (but not by way of limitation) to include the following:
  - 1. Control cabling and raceways associated with the hot water heater system. Provide all required sensor cable from tank to water heater master controller and between the two water heaters. Sensor cables must be installed in raceway with appropriate junction boxes for final sensor cable terminations.
  - 2. Low voltage interlock wiring from each water heater to its associated pump.
  - 3. Motor starters for water heater pumps, comply with 21 01 00 paragraph 2.4.
  - 4. Electric heat tracing cable with terminations at heat trace controller. Coordinate power circuit to controller with Division 26 contractor.
  - 5. Sump pump control cables and terminations at control panel.
  - 6. Coordinate power location for Digital Recirculation Mixing Valve.

- C. Responsibility: It is the sole responsibility of the Contractor to coordinate the electrical requirements of each item of equipment provided with the electrical circuits required and to insure their compatibility and compliance with the N.E.C.

#### **1.17 GUARANTY**

- A. All piping, equipment, fixtures, and related material shall be guaranteed in writing against defective materials and workmanship for a period of one year from date of acceptance. After notification, corrections shall be made promptly at no cost to the Government. Any defects due to faulty materials, equipment, method of installation or workmanship, and consequent damage resulting from such defects within the one-year guaranty period, shall be repaired or replaced promptly upon notice and without any expense to the Government.

### **PART 2 - PRODUCTS**

#### **2.1 GENERAL**

- A. All products shall comply with the applicable sections of the Plumbing Code in effect in the building location. Where bidder is not sure, he is advised to determine what limitations, if any, are imposed at the site. All bids are assumed to be on approved material. Bidders/Contractors shall not use a lesser material than that specified even if allowed by code at the building site.
- B. Lead-Free Requirements:
  - 1. Any product designed for dispensing potable water must meet both the NSF 61 and NSF 372 test standards via third-party testing and certification.
  - 2. This requirement supersedes specific model numbers stated either in these specifications or on the drawings, should a non lead-free model number be specified for products designed for dispensing potable water.
- C. For ease of maintenance and part replacement, and to the maximum extent possible, use equipment of a single manufacturer. The Contracting Officer reserves the right to reject any materials list which contains equipment from various manufacturers if suitable equipment can be obtained from fewer manufacturers, and to require source of materials to be unified to the maximum extent possible.
- D. All materials and equipment installed in HVAC return air plenums shall have a 25/50 flame spread/smoke developed index maximum when tested in accordance with ASTM E 84.

- E. All products shall be new, of first line quality of grade and type shown on the drawings and specified, or equals accepted by the Contracting Officer in writing.
- F. All products shall be in current production with no notice having been given that such product is to be drastically changed, modified, or discontinued from production.
- G. The supplier, by submitting, certifies that equipment being processed is proper for the application intended and that it has the capacity specified.

## **2.2 MATERIALS**

### **A. Building Soil, Waste, Storm and Vent Piping:**

- 1. Underground: service weight cast iron, bell and spigot, conforming to ASTM A74 as manufactured by AB&I, Charlotte, or Tyler, with lubricated rubber compression joints conforming to ASTM C1563 or lead and oakum.
- 2. Above ground: Cast iron no-hub system, manufactured by AB&I, Charlotte, or Tyler, with neoprene gasket conforming to ASM C564, type 302 stainless steel shield and four clamp (pipe sizes 4" or less) or six clamp (pipe sizes larger than 4") heavy-duty stainless steel clamps, equal to Anaco Husky SD 4000.
- 3. All cast iron soil pipe, fittings and clamps shall conform to the requirements of CISPI Standard 301, ASTM A-888 or ASTM A-74 and be marked with the collective trademark of the Cast Iron Soil Pipe Institute. All pipe and fittings shall be certified and marked NSF.
- 4. Stub-out to fixtures shall be made with Schedule 80 galvanized steel pipe for urinals and DWV copper tubing and fittings or Schedule 80 galvanized steel for other fixtures.

### **B. Hot and Cold Piping (Inside Building):**

- 1. Underground: Use Type "K" copper, soft drawn; in tunnels: use Type "K" hard drawn; ASTM B-88, with wrought copper fittings ANSI B16.22. Join underground or in tunnel fittings with silver solder AWS-ASTM BCUP-5. Pipe below floor slabs shall have joints made by looping up in wall out of the slab, no joints under the slab will be permitted.
- 2. Above ground: Use Type "L" copper tubing, hard drawn, with same fittings as specified above, joined with lead free 95-5 solder, ASTM B32 alloy, Grade 5A except for any special systems requiring temperatures higher than 250 degree F or pressures above 125 psi for which alloy E, alloy HB, or brazing materials shall be used.
- 3. Nominal pipe sizes are shown on the Drawings.

4. Copper tubing air chambers shall be provided at each fixture supply and piece of equipment and shall be line size and 18 inches in length. Provide manufactured water hammer arrestors where shown.
5. Use dielectric fittings at all dissimilar pipe connections.

## 2.3 VALVES AND COCKS

- A. Bronze Ball Valves, Two-Piece with Full Port and Stainless-Steel Trim, Threaded Ends:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Apollo Flow Controls; Conbraco Industries, Inc.
    - b. Jomar Valve.
    - c. KITZ Corporation.
    - d. Milwaukee Valve Company.
    - e. NIBCO INC.
  2. Description:
    - a. Standard: MSS SP-110 or MSS SP-145.
    - b. CWP Rating: 600 psig (4140 kPa).
    - c. Body Design: Two piece.
    - d. Body Material: Bronze.
    - e. Ends: Threaded.
    - f. Seats: PTFE.
    - g. Stem: Stainless steel.
    - h. Ball: Stainless steel, vented.
    - i. Port: Full.
- B. Drain valves shall be "NIBCO", #763, 3/4" size, with approved anchors from flange to walls or columns. Provide screw-on type backflow preventers.
- C. Wall hydrants shall be as specified scheduled on the Drawings.
- D. Valve boxes for valves in underground pipelines shall be cast iron type with removable cast iron lid cast with the service designation in it (example: "water", "gas", etc.).



## **2.4 UNIONS**

- A. Use a union in the connection to each valve and each piece of apparatus equipment, so that it may be readily removable. In copper lines, up to and including 4" sizes, use cast brass or bronze unions, with copper soldered connections and ground joints.
- B. Unions in drainage pipes on fixture side of traps may be slip or flanged joints with soft rubber or leather gaskets.
- C. Unions 2" and smaller shall be ground joint type with flanges being used in pipes larger than 2".

## **2.5 CLEANOUTS AND EXTENSIONS**

- A. Cleanouts shall be cast iron bodies with brass plugs. They shall be extended full size to floors and wall faces, but shall not be larger than 4". Extension to floor shall be made with combination "Y" and eighth bends.
- B. Provide cleanouts in sanitary, waste and drain lines as shown, as required by local Code, and as follows:
  - 1. At the bottom of each exposed fixture trap which is not integral with the fixture.
  - 2. At the end of each branch drainage line.
  - 3. At each change of horizontal direction greater than 45 degrees.
  - 4. At the base of each stack and in horizontal drain lines at intervals of not more than 50 feet apart in lines smaller than 4", 75 feet apart in lines of 4" nominal size, and 100 feet apart in lines larger than 4".
- C. Install cleanouts so that they are readily accessible.
- D. Cleanouts in interior floor construction shall be equal to Smith 4020 or 4040 (for floors with square tile), with scoriated cover, nickel-bronze finish. Cleanouts in walls and ceilings shall be as specified under "Access Panels".
- E. Cleanouts at grade shall be provided with a 12" diameter by 4" thick monument to allow for locating and turf grooming.

## **2.6 TRAPS**

- A. Traps for floor drains, hub drains, etc., shall be standard C.I.S.P.I. cast iron P-traps, with hub and spigot joints for lead caulking or no-hub systems coated with Coal Tar Varnish while hot, except traps for drains used in fan rooms, which shall be of similar type cast iron but deep seal P-traps having a minimum 4.75 inch seal.

- B. Traps for all floor drains, whether indicated or specified elsewhere or not, shall have approved trap primers installed and connected. Install ProSet Trap Guard or Jay R. Smith Quad Close Trap Seal devices in Mechanical Room, Fan Room, and similar spaces where drains accept condensation drainage, in addition to priming the traps.
- C. Comply with trap requirements as specified for individual fixture type, in lieu as specified here, when specified differently for fixture type.

## **2.7 FLASHING**

- A. Flashing for soil and vent stacks passing thru roof shall be furnished under this Section of the Specifications.
  - 1. Flashing for bituminous roofs shall be formed of minimum 4-pound sheet lead and shall be of thimble and counterflashing type. Base shall be made so that coverage of 12" plus the diameter of the boot is obtained. Height of flashing shall be sufficient to allow for ample turn-down into pipe.
  - 2. Flashing for membrane roof and metallic roofs shall be in accordance with the roofing manufacturer's recommendations.

## **2.8 SLEEVES AND ESCUTCHEONS**

- A. Provide galvanized sheet metal sleeve for all pipes at floors, ceilings, partitions; steel pipe sleeve two pipe sizes larger than pipe at walls and footings.
- B. Sleeves in structural beams to be furnished by General Contractor at location set by this contractor.
- C. Provide nickel plated escutcheons with spring lock or set screw at ceilings, floors, and walls for all pipes.

## **2.9 SUPPORTS, ANCHORS, AND SEALS**

- A. Types of supports, anchors, and seals specified in this article include the following:
  - 1. Horizontal-Piping Hangers and Supports.
  - 2. Vertical-Piping Clamps.
  - 3. Hanger-Rod Attachments.
  - 4. Building Attachments.
  - 5. Saddles and Shields.
  - 6. Miscellaneous Materials.

B. QUALITY ASSURANCE:

1. MSS Standard Compliance:

- a. Provide pipe hangers and supports of which materials, design and manufacture comply with ANSI/MSS SP-58.
- b. Select and apply pipe hangers and supports, complying with MSS SP-69.
- c. Fabricate and install pipe hangers and supports, complying with MSS SP-89.
- d. Terminology used in this article is defined in MSS SP-90.

C. SUBMITTALS:

1. Product Data: Submit catalog cuts, specifications, installation instructions, and dimensioned drawings for each type of support, anchor, and seal. Submit pipe hanger and support schedule showing Manufacturer's figure number, size, location, and features for each required pipe hanger and support.

D. HORIZONTAL-PIPING HANGERS AND SUPPORTS:

1. General: Except as otherwise indicated, provide factory-fabricated horizontal-piping hangers and supports complying with ANSI-MSS SP-58, of one of the following MSS types listed, selected by Installer to suit horizontal-piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Select only one type by one manufacturer for each piping service. Select size of hangers and supports to exactly fit pipe size for bare piping, and to exactly fit around piping insulation with saddle or shield for insulated piping. Provide copper-plated hangers and supports for copper-piping systems.
2. Adjustable Steel Clevises: MSS Type 1.
3. Pipe Slides and Slide Plates: MSS Type 35, including one of the following plate types:
  - a. Plate: Unguided type.
  - b. Plate: Guided type.
  - c. Plate: Hold-down clamp type.

E. VERTICAL-PIPING CLAMPS:

1. General: Except as otherwise indicated, provide factory-fabricated vertical-piping clamps complying with ANSI/MSS SP-58, of one of the following types listed, selected by Installer to suit vertical piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Select size of vertical piping clamps to exactly fit pipe size of bare pipe. Provide copper-plated clamps for copper-piping systems.
2. Four-Bolt Riser Clamps: MSS Type 42.

F. HANGER-ROD ATTACHMENTS:

1. General: Except as otherwise indicated, provide factory-fabricated hanger-rod attachments complying with ANSI/MSS SP-58, of one of the following MSS types listed, selected by Installer to suit horizontal-piping hangers and building attachments, in accordance with MSS SP-69 and manufacturer's published product information. Select only one type by one manufacturer for each piping service. Select size of hanger-rod attachments to suit hanger rods. Provide copper-plated hanger-rod attachments for copper-piping systems.
2. Swivel Turnbuckles: MSS Type 15.

G. BUILDING ATTACHMENTS:

1. General: Except as otherwise indicated, provide factory-fabricated building attachments complying with ANSI/MSS SP-58, of one of the following MSS types listed, selected by Installer to suit building substrate conditions, in accordance with MSS SP-69 and manufacturer's published product information. Select size of building attachments to suit hanger rods. Provide copper-plated building attachments for copper-piping systems.
2. Concrete Inserts: MSS Type 18.
3. Side Beam or Channel Clamps: MSS Type 20.
4. C-Clamps: MSS Type 23.
5. Side Beam Brackets: MSS Type 34.
6. Manufacturer: Subject to compliance with requirements, provide hangers and supports of one of the following:
  - a. Fee & Mason Mfg. Co., Div. of A-T- Inc.
  - b. ITT Grinnel Corp.

H. SADDLES AND SHIELDS:

1. General: Except as otherwise indicated, provide saddles or shields under piping hangers and supports, factory-fabricated, for all insulated piping. Size saddles and shields for exact fit to mate with pipe insulation.
2. Protection Saddles: MSS Type 39; fill interior voids with segments of insulation matching adjoining insulation.
3. Protection Shields: MSS Type 40; of length recommended by manufacturer to prevent crushing of insulation.
4. Thermal Hanger Shields: Constructed of 360° insert of high density, 100 psi, and waterproof calcium silicate, encased in 360° sheet metal shield. Provide assembly of same thickness as adjoining insulation.
5. Manufacturer: Subject to compliance with requirements, provide thermal hanger shields of one of the following:

- a. Elcen Metal Products Co.
- b. Pipe Shields, Inc.

**I. HANGER RODS**

1. Hanger Rods: Shall be all threaded rod and shall have the following diameters:
  - a. 3/8" for up to 2" diameter pipe.
  - b. 1/2" for 2-1/2" to 4" pipe.
  - c. 5/8" for 5" and 6" pipe.
  - d. 3/4" for 6" and 8" pipe.
2. Hanger Spacing: Shall be as followed (except not less than two hangers per length of pipe):
  - a. Cast Iron pipe: 5'-0" spacing maximum and at each hub, on both sides of horizontal no-hub fittings, and at each trap.
  - b. Steel Pipe: 6'-0" spacing up to 2" diameter and 10'-0" for 2-1/2" diameter and larger.
  - c. Copper pipe: 6'-0" spacing up 2" diameter and 10'-0" for 2-1/2" diameter and larger.
  - d. Plastic pipe: 4'0" for up to 2" diameter and 6'0" for 2-1/2" to 6" diameter, 10'0" for pipes larger than 6" diameter.
3. Hanger Locations in wood and light gage structures: No multiple hangers shall be permitted on a single building wooden or light gage steel member. Hangers shall be staggered to distribute loads evenly over the structure and additional longitudinal structural members provided to evenly distribute loads. Provide hanger locations as part of the required piping shop drawings.

**J. MISCELLANEOUS MATERIALS:**

1. Metal Framing: Provide products complying with NEMA STD ML 1.
2. Steel Plates, Shapes and Bars: Provide products complying with ANSI/ASTM A 36.
3. Heavy-Duty Steel Trapezes: Fabricate from steel shapes selected for loads required; weld steel in accordance with AWS standards.
4. Pipe Guides: Provide factory-fabricated guides, of cast semi-steel or heavy fabricated steel, consisting of a bolted two-section outer cylinder and base with a two-section guiding spider bolted tight to pipe. Size guide and spiders to clear pipe and insulation (if any), and cylinder. Provide guides of length recommended by manufacturer to allow indicated travel.

## **2.10 BACKFLOW PREVENTERS**

- A. Hose-Connection Vacuum Breakers:
  - 1. Standard: ASSE 1011.
  - 2. Body: Bronze, nonremovable, with manual drain.
  - 3. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
  - 4. Finish: Chrome or nickel plated.

## **2.11 WATER SYSTEM ACCESSORIES**

- A. Trap primers shall be installed to prime the traps indicated. Primer shall be cast brass with integral air ports to prevent back siphonage of trap water. Primer to be installed behind an access door and to be Precision Plumbing Products, Inc. models P-1 or P-2 as appropriate.
- B. Wall Hydrant, non-freeze types:
  - 1. Standard: ASSE 1019, Type A or Type B.
  - 2. Type: Automatic draining with integral air-inlet valve.
  - 3. Classification: Type B, for automatic draining with hose removed or with hose attached and nozzle closed.
  - 4. Pressure Rating: 125 psig .
  - 5. Operation: wheel handle.
  - 6. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
  - 7. Inlet: NPS 1/2 or NPS 3/4 .
  - 8. Outlet: Exposed with garden-hose thread complying with ASME B1.20.7.

## **2.12 FLOOR DRAINS**

- A. Floor drains shall be the size of the pipe to which they are connected. Install temporary closures during construction. Each drain shall have deep seal P-trap.
- B. Floor drains shall be equal to the J. R. Smith figure numbers as scheduled below by location:
  - 1. Restrooms and typical floor drains: 2010-B, square adjustable nickel bronze strainer. 3" and smaller drains to have 6" x 6" grate, 4" drains to have 8" x 8" grate.
- C. All floor drains, regardless of location or application (except where used as shower drains), shall have a trap primer connection, a Precision Plumbing Products, Inc. Model P-1 or P-2 (as appropriate) trap primer (behind access panel) connected to the nearest 1-1/2" (or less) domestic cold water line and a 1/2" copper tube from trap primer to drain.

Trap primer alternatives, such as “Trap Guard” devices as manufactured by ProSet Systems, Inc., or Jay R. Smith Quad Close Trap Seal may be considered if allowed by all authorities having jurisdiction, or, required in addition to trap priming where specified.

## **2.13 ROOF DRAINS:**

- A. Cast Iron with underdeck clamp and 4” cast iron dome.
- B. Cast Iron with underdeck clamp , cast iron standpipe, and cast iron dome.
- C. Down Spout nozzle: nickel-bronze, suitable for wall mounting.

## **PART 3 - EXECUTION**

### **3.1 GENERAL**

- A. All work shall be done in accordance with the best practices and al products installed as directed by the manufacturer through his written instructions.
- B. Utility connections:
  - 1. It is intended that new domestic water, sanitary soil, waste and vent systems shall be connected into existing building systems of sufficient sizes.
  - 2. All existing underground utilities have not been shown. All piping, cleanouts, catch basins, etc., that are in the way of new construction and no longer required shall be removed. Ends of lines that do not have to be removed but have been cut shall be flooded completely with clean sand and the ends sealed.
- C. Excavations and Backfill
  - 1. Do all excavation and backfilling required. Trenches shall be wide enough for proper installation of the pipe. Grade the ditch bottom for proper slope and provide bell holes to allow the full bearing of the pipe barrel. Comply with all health and safety regulations relating to the work.
  - 2. No excavation shall be done under or near footings without approval of the Contracting Officer.
- D. Pipe and Fittings
  - 1. Install all domestic water soil, waste and vent, and storm piping generally as shown on drawings, with no deviation from diagrammed arrangements. If in any instance it is impractical to install piping as shown, or should approving agencies demand

other arrangement, notify Contracting Officer in writing along with a diagram of proposed changes for Contracting Officer's approval, and said agencies' approval, all at no additional cost to The Government.

2. Carefully plan work to avoid existing utilities and other interferences. Contracting Officer and his Consulting Engineers have not attempted to indicate all existing utilities and other interferences. Prior to doing any plumbing work, carefully investigate and locate all existing conduits, pipes, and other utilities

### **3.2 WATER DISTRIBUTION PIPING**

- A. Extend from the termination of the water service to every fixture, water heater, or outlet requiring hot or cold water. Provide stop valve and a drain for the system. Every low point shall be drained with a drain valve.
- B. Every fixture connection shall be provided with a stop valve.

### **3.3 BUILDING SEWER**

- A. Building sewer starts with the termination of the building drain, approximately five feet outside the building.
- B. Sewer Pipe Laying: Commence at the lowest point in the system and lay the pipe with bell or groove-end upgrade. Test pipe for soundness and clean interior and joint surfaces before lowering the pipe into the trench. Lay pipe in straight lines and on uniform grades between points where changes in alignment or grade are shown. Bed the pipe barrel firmly and uniformly (see "Grading Trench Bottom" above). Check the line and invert grade of each pipe from a top line carried on batter boards not over 50 feet apart, or by other acceptable methods. Fit the pipes to form close concentric joints. Perform pumping or bailing as necessary to avoid laying the pipe in water and to protect joints. Keep a stopper in the pipe mouth when pipe laying is not in progress.
- C. Excavation and Backfill: Provide all excavation of any materials encountered. Backfill and tamp with suitable materials as approved by Contracting Officer. Restore all surfaces equal to or better than that existing as approved by the Contracting Officer.
- D. Sewer Pipe Jointing: Factory made, compression-type joints and solvent cement welded joints shall be jointed in accordance with the manufacturer's instructions.
- E. Flushing Sewers: Flush all sanitary sewers with water in sufficient volume to obtain free flow through each line. Remove all obstructions and correct all defect discovered. Remove all silt and trash from inlets just prior to final acceptance of the work.



### **3.4 BUILDING DRAIN, WASTE, AND VENTS**

- A. Building drain terminates into the building sewer shown above approximately five feet outside the building line.
- B. The Waste and Vent system shall be generally as shown on the drawings with changes on the job as required to meet the job conditions. Any major change from that shown on the drawings shall be approved by the Contracting Officer.
- C. All pipe shall be supported in a manner such as to prevent excessive stress
- D. The bottom of all stacks shall be washed by a fixture whether required by local code or not.
- E. Extend vent stacks 12" above the roof and flash with lead flashing furnished by this contractor and installed into the roof by the roofer. Top of flashing turned into the stack by this contractor.
- F. There shall be no horizontal offset in vents less than 6" above the flood rim of the highest fixture in the group.

### **3.5 TESTING**

- A. Notify Contracting Officer, Engineer and local authorities three working days before test are to be made. No joints or fittings are to be concealed until tested, and any defects shall be corrected by replacement with new materials. Retest until satisfactory.
- B. Follow test as described in the 2009 edition of the ICC International Plumbing Code or as follows (whichever is most stringent):
  - 1. Sewer System:
    - a. Water Test - fill system with water (minimum of 10' head) and hold for 45 minutes without drop in water.
    - b. Sewer Ball - pass wooden sewer ball through system using only water to wash through. Ball shall pass freely.
    - c. Peppermint Test - seal all traps of fixtures and introduce peppermint into vent from roof. There shall be no odor in building.
  - 2. Water System:
    - a. Impose pressure of 150 psi; with system full of water, hold for 4 hours without pressure drop. If air pressure is used, hold pressure for 8 hours without drop except as temperature drops. Provide pressure gauge and leave in place.

### **3.6 CAST IRON PIPE SYSTEMS**

- A. Fittings of the no-hub, push type, or lead and oakum shall be installed as recommended by the manufacturer using tools as recommended by them. Take care to prevent shifting or settling of pipe.

### **3.7 SOLDER TYPE FITTINGS**

- A. Solder type fittings below a slab are prohibited. Loop pipe up in wall and make soldered joint or fitting.
- B. All solder type fittings shall be made up using specified solder except for any special systems requiring temperatures higher than 250 degree F or pressures above 125 psi for which alloy E, alloy HB, or brazing materials shall be used. Clean pipe and fittings bright with sand paper or wire brush and apply paste flux (liquid flux is not acceptable) and assemble joint. Apply heat evenly to the pipe and fittings and apply solder to fill the joint by capillary action. Clean joint of excess solder before it cools. Fittings discolored by heat shall be removed and the joint remade.
- C. The Contracting Officer may require the cutting out and destructive testing of up to five joints of their own selection to determine the type of workmanship being performed and the 'fullness' of the solder in the joint. Such joints shall be remade by the contractor at his expense. Should the joints tested show large voids or other indication of poor joints, the workman making the joints shall be replaced and other joints tested to determine the extent of such problems.
- D. Every connection between ferrous and non-ferrous metals in pipe, tanks, etc. shall be separated by a dielectric union or flange equal to Wedge Seal

### **3.8 LAYOUT**

- A. This contractors responsibility includes:
  - 1. Setting of floor and wall sleeves in proper locations.
  - 2. Informing other trades of location of and size of chases, stacks, cleanouts, etc., that will later relate to their work.
  - 3. Providing access to all items requiring routine service.
  - 4. Setting the elevation of the floor drain tops to provide for a slope of 1/16" per foot toward the drain. This requires coordination with the concrete subcontractor, the General Contractor and rechecking at the time the pour is being made.
  - 5. Coordinating with the HVAC Contractor to insure that the actual equipment installation will not interfere with the mechanical room floor drain locations shown

and that adequate clearance is provided for the routing of condensate drains to these floor drains.

### **3.9 HANGARS AND SUPPORTS**

- A. All pipe shall be supported in a manner such as to prevent excessive stress and variations in supporting forces onto the supporting structures. Anchor and hang in such a way as not to interfere with natural expansions and contraction and the anchors and guides shall be capable of withstanding such forces imposed on them by the expansion and contraction of piping.
- B. All vertical piping extending from floor to floor shall be supported vertically at each floor with approved riser clamps and secured horizontally.
- C. All pipe hangers shall be of sufficient size to allow for pipe insulation.
- D. All insulated lines shall have supports for piping placed on outside of insulation at every support anchor or guide. Hangers shall not be in contact with the pipe. Saddles between hangers and insulation shall be galvanized iron shields.

### **3.10 GRADES**

- A. Pipe shall grade in direction of flow not less than the following
  - 1. Building Sewer and Building Drain - 1/8" per foot.
  - 2. Waste and Vent 2-1/2" and smaller - 1/4" per foot.
  - 3. Waste and Vent 3" and larger - 1/8" per foot.
  - 4. Gas - 1/8" per foot.
  - 5. Water piping shall be pitched to allow complete draining.

### **3.11 INSTALLATION OF PIPES**

- A. All threaded pipes shall be reamed to remove all cutting lips from the inside edge and shall be threaded with clean dies to the proper depth. Cuts shall be clean and not gouged or rough. Apply lubricant to male thread only.
- B. All buried thermoplastic piping shall be installed per ASTM D2321.
- C. All copper pipes shall be reamed to remove all cutting lips from the inside edge.
- D. Pipe shall be laid or supported in a straight and true manner with fittings used to make all changes in direction.

**E. Cutting and Patching:**

1. No reinforcing steel in slabs, ceilings, roof, etc., shall be shifted or cut, nor will any structural members be cut or altered, without the specific approval of Contracting Officer unless the Contract Drawings show exact details for same. Do not make deep cuts into building framing without the specific approval of the Contracting Officer. Provide metal and/or timber reinforcing of joist, studs, plates, etc., where such cuts are made, as directed by the Contracting Officer.
2. Provide basic patching between masonry openings and sleeves, drains, cleanouts, etc., up to the finished surfaces, by sealing these openings with an approved non-shrinking grout, installed according to manufacturer's written instructions. The surface patching and finishing shall also be done under this section of the work in a manner as approved by Contracting Officer.
3. Where holes or cut-outs are made in flooring for the installation of drains, vents, etc., remove only enough concrete and reinforcing to install piping, etc. Preserve as much reinforcing steel as possible. Do not cut into grade beams or footings. Restore and add to floor reinforcing steel as directed by the Contracting Officer. Rebuild floor to original thickness and finish with non-shrinking 3,000 P.S.I. concrete.

**F. Pipe Sleeves:**

1. Each pipe passing through masonry and/or concrete construction shall be free from the structure and shall pass through a sleeve.
2. Each sleeve shall extend through its respective floor, wall, etc., and shall be cut to be flush with each outer finished surface, except sleeves in floors, which shall extend one inch above finished floor unless noted otherwise. Sleeves shall be Schedule 40 galvanized steel pipe.
3. Unless otherwise noted, the inside diameter of all sleeves shall be a minimum of one inch larger than the outside diameter of the pipe or conduit it serves, or a minimum of one inch in diameter larger than the outside diameter of the insulation on insulated lines.
4. All holes required in concrete or masonry structures shall be cored with a diamond bit core drilling machine. No holes shall be cored through beams, joists or columns. Every safety precaution shall be taken in coring holes to prevent electric shock should any energized circuits be encountered.
5. Caulk space full between sleeves and pipe or conduit, insulated or plain, above grade, to provide a positive smoke seal. Where holes have been cut in masonry for placing sleeves, the space between cut openings and sleeves shall be sealed as called for above under Paragraph "Cutting and Patching".
6. Where exposed piping passes through walls, ceilings, floors or partitions, provide chromium plated, pressed steel escutcheons, Crane 10B and C, or approved equal.

**3.12 PLUMBING FIXTURES**

- A. Exact location of fixtures or equipment shall be as shown on Architectural drawings, as scheduled on the Plumbing drawings and as approved by Contracting Officer. Check Manufacturer's details of all roughing in.
- B. Provide all necessary supports in connection with all fixtures to be installed. Fixtures shall not be supported by piping connections.
- C. Install wall hangers and carriers by means of through bolts.
- D. Caulk all around fixtures which mount tight to walls, floors or counter tops with "Dow Corning" No. 780 or General Electric "RTC" Silicon sealant.

**3.13 CLEANING AND DISINFECTING**

- A. All potable water piping shall be flushed and disinfected prior to connection to domestic water supply. Disinfecting shall be carried out in accordance with State Sanitary Code and local regulations

**3.14 BALANCING**

- A. Before final acceptance, fully balance all systems furnished under this Section to achieve optimum performance. Systems shall be free from water hammer

**3.15 TESTS:**

- A. Make tight and test all piping, valves, fittings, specialties and equipment required by regulatory authorities.
- B. Do not conceal any work until it has been tested and inspected. Notify Contracting Officer and proper authorities in ample time when any work is ready for inspection and testing.

**3.16 ELECTRICAL:**

- A. All electrical work shown, noted and required to provide completely operating facilities shall be included as part of contract work.
- B. Refer to DIVISION 26 - ELECTRICAL for materials and methods.

**3.17 PROTECTION DURING CONSTRUCTION:**

- A. Install test plugs, wood plugs or caps in all open pipes at time of installation and do not remove until pipe is connected.
- B. Maintain pressure and pressure gauge on all water lines during construction. Use water except in cold weather.
- C. Drain all water from lines to prevent freezing.
- D. Protect all finished surfaces of fixtures and brass from any damage. Fixtures or brass of any type that is damaged, scratched, discolored shall be removed and replaced at this contractor's expense.

**3.18 VACUUM BREAKERS AND BACK FLOW PREVENTERS:**

- A. Install vacuum breakers above the highest piece of equipment to be protected. Location must be in area with floor drain, or provide other means of disposing of water that might drip out of vent opening. Vent may be piped to drain with use of air gap.

**PART 4 - FIXTURES AND EQUIPMENT**

**4.1 GENERAL REQUIREMENTS**

- A. Furnish all plumbing fixtures, drains, and equipment as shown on the Architectural drawings. If architectural drawings differ from plumbing drawings, this shall be called to the Contracting Officer's attention before bidding.
- B. Fixtures and other equipment shall be furnished complete with all trim, fittings, and other devices which are generally considered necessary by trade, by craft standards and/or the Contracting Officer.
- C. Fixtures and equipment shall have the manufacturer's name or trademark imprinted on or attached by metallic name plate.
- D. All exposed trim shall be chrome plated. Tops of all floor drains shall be chrome or nickel bronze unless otherwise noted

**END OF SECTION 220000**

## **SECTION 230100 - MECHANICAL GENERAL PROVISIONS**

### **PART 1. GENERAL**

#### **1.1. RELATED DOCUMENTS:**

- A. The general provisions of the Contract, including Requirements of the Government's Solicitation and General Requirements, apply to the work specified in this section.

#### **1.2. DESCRIPTION OF WORK:**

- A. General: This section specifies several categories of provisions for mechanical work, including: 1) Certain adaptive expansions of requirements specified in Division 1, as uniquely applicable to mechanical work, 2) General performance requirements within the mechanical work as a whole, and 3) General work to be performed as mechanical work, because of its close association with mechanical work.

#### **1.3. SUMMARY OF MECHANICAL WORK:**

- A. Drawings: Refer to the drawings for graphic representations, schedules and notations showing mechanical work.
- B. Specifications: Refer to Divisions-23 sections for the primary technical specifications of mechanical work.
- C. General Outline: The facilities and systems of the mechanical work can be described (but not by way of limitation) as follows: 1) Plumbing systems; 2) Heating and air conditioning system; 3) HVAC control system; and 4) Testing, Adjusting and Balancing.

#### **1.4. SCOPE:**

- A. This section shall consist of providing all materials, labor, tools, plant and incidentals necessary to install and make ready for Government's beneficial use, complete mechanical systems including a system of air tempering for the proposed building as shown on the Drawings and called for in the Specifications. Completed Mechanical Systems means ready for operation, and that items omitted from drawings that are required for a complete and operational system will be furnished by the Contractor at no additional cost to the Government.
- B. It is understood that the responsibility for the work of the entire project falls upon one Contractor (sometimes, herein referred to as the General Contractor). The Designers, however, understand the relationship between the Contractor and other organizations,

outside of his, which the Contractor employs to assist him with this work. The Division 23 Specifications are addressed to the Contractor and it is his responsibility to perform the work (regardless of whom he may employ for assistance). The Division 23 Specifications are written, however, in an effort to assist the Contractor with subcontract employment (herein referred to as "This Contractor", "Mechanical Contractor", "Electrical Contractor", "Plumbing Contractor", "Control Contractor", etc., or above listed as "SubContractor" in lieu of "Contractor"). This shall not be construed by the Contractor to alleviate him of any responsibility for the work, including it's coordination amongst various trades, and placement of the same on others, nor shall this be construed to direct the Contractor to the employment of Subcontractors (with the exception of Testing Agencies).

- C. All references to "Contractor(s)" or "Subcontractor(s)" are referring to the Contractor and his coordination of responsibilities within the work of the Contract.
- D. See the Architectural Plans and visit the site of work to observe dimensions, construction and details not shown on these Drawings.
- E. Wherever the word "supply", "provide" or similar term is used in the sense of providing apparatus or materials, it shall mean that Contractor shall furnish and connect such apparatus or materials referred to, unless otherwise specifically called for, at no additional cost to Government.

#### **1.5. DRAWINGS AND SPECIFICATIONS:**

- A. Consider as complementary each to the other. What is called for by one shall be binding as if called for by both. Where conflicts occur, obtain written clarification; otherwise provide the more expensive quality or quantity.

#### **1.6. COORDINATION OF MECHANICAL WORK:**

- A. General: Refer to the Division 1 sections for general coordination requirements applicable to the entire work. It is recognized that the contract documents are diagrammatic in showing certain physical relationships which must be established within the mechanical work, and in its interface with other work including utilities and electrical work, and that such establishment is the exclusive responsibility of the Contractor.
- B. Arrange mechanical work in a neat, well organized manner with piping and similar services running parallel with primary lines of the building construction, and with a minimum of 7'0" overhead clearance where possible.
- C. Locate operating and control equipment properly to provide easy access, and arrange entire mechanical work with adequate access for operation and maintenance.



- D. Give right-of-way to piping which must slope for drainage.
- E. Advise other trades of openings required in their work for the subsequent move-in of large units of mechanical work (equipment).
- F. Coordination Drawings: For locations where several elements of mechanical (or combined mechanical and electrical) work must be sequenced and positioned with precision in order to fit into the available space, prepare coordination drawings (shop drawings) showing the actual physical dimensions (at accurate scale) required for the installation. Prepare and submit coordination drawings prior to purchase, fabrication, or installation of any of the elements involved in the coordination. Coordination drawings at 1/4-inch scale will be required for all mechanical rooms.
- G. Work for Other Trades: Refer to, read and study, all of the General and Technical specification sections in all Divisions for this project and provide all work required of the Division 23 trades which may be required therein or thereby including, but not by way of limitation, connection of utilities to equipment provided under other Divisions, providing and/or installing ducts, louvers and fans in connection with equipment provided under other Divisions (eg: kitchen exhaust hoods, emergency generator radiators, etc.), providing gas vents for equipment provided under other Divisions, etc.
- H. Coordinate ductwork and fire damper installation with Architectural Drawings and Specifications indicating and/or describing fire rated construction and provide properly rated fire dampers in all penetrations of duct and duct devices through fire rated construction. In some cases fire dampers are indicated on the Drawings, in other instances they are not. It is fully the responsibility of the Contractor to coordinate the requirements of fire rated construction as indicated and/or specified and provide fire dampers in ducts where required whether indicated on the duct drawings or not.

**1.7. MECHANICAL PLANS:**

- A. The mechanical plans are intended to be diagrammatic based on one manufacturer's equipment. The plans are not intended to show every item in its exact location, the exact dimensions, or all the details of the equipment. Verify the exact dimensions of the equipment proposed.
- B. Installation shall be within the limitations imposed by the architectural, structural, electrical and plumbing, and fire protection (sprinkler) requirements with adequate space for maintenance.

**1.8. QUALITY ASSURANCE, STANDARDS AND SYMBOLS:**

- A. Contractor for this DIVISION must have installed at least three (3) similar type and size jobs and mechanical contracting shall be their primary business.

- B. Qualifications of Subcontractors: Must be properly licensed and established as a General Contractor and as an HVAC Contractor and as a Master Plumber at location of the work and shall maintain locally adequate service facilities. They shall have had previous experience in the satisfactory installation of at least three systems of this type and size.
- C. General: Refer to the technical sections for general administrative/procedural requirements related to compliance with codes and standards. Specifically, for the mechanical work (in addition to standards specified in individual work sections), the following standards are imposed, as applicable to the work in each instance:
  - 1. AWS standards for welding.
- D. All work shall be in accordance with the latest editions adopted of following codes and regulations:
  - 1. National Fire Protection Agency
  - 2. Occupational Safety and Health Administration
  - 3. International Code Council, Inc. Codes
  - 4. State Building Code
  - 5. Local Building Codes
- E. Where any of the above are at variance with the drawings and specifications, the requirements of the above codes and regulations shall take precedence and the costs necessary to meet these shall be included in the bid price.
- F. The contractor is solely responsible for meeting all OSHA regulations and insuring job site safety.
- G. Symbols: Except as otherwise indicated, refer to the "ASHRAE Handbook of Fundamentals" for definitions of symbols used on the drawings to show mechanical work.

**1.9. QUESTIONS AND CLARIFICATIONS OF BID DOCUMENTS:**

- A. Bidders shall not rely on any verbal clarification of the drawings or specifications. Any questions or clarifications shall be referred to the Contracting Officer at least five (5) working days prior to bidding to allow for issuance of an addendum. After the five (5) day deadline, the bidder shall make his own decision and qualify his bid if he feels it necessary.

**1.10. PRIOR APPROVAL:**

- A. Substitutions require prior approval from the Contracting Officer and shall be submitted in accordance with the Solicitation for Bidders.

**1.11. GUARANTEES:**

- A. All equipment, materials and workmanship shall be guaranteed in writing for a period of one (1) year beginning with the date of acceptance. Special warranties will be called for under some sections of equipment. This warranty shall be in writing and shall include written copies of the factory warranties with expiration dates on items of equipment where the warranty date may differ from the acceptance date. No warranty shall start before the acceptance date.
- B. The contractor's warranty shall include at least two (2) inspections of the system to repair and/or replace any items found defective during this warranty period.
- C. After completion of the work, the Contractor shall operate the equipment he installs for a period of five (5) days, after which time it shall be considered as a test of satisfactory operation. During this time, he shall instruct the Government's operating personnel in the correct operation of the equipment.
- D. Contractor shall provide the Government with two (2) sets of manufacturer's operating and maintenance manuals and parts list for all equipment and materials furnished by him. In addition to the manufacturer's data, contractor shall provide a maintenance schedule listing routine maintenance operations and the frequency thereof.

**1.12. SUBMITTALS:**

- A. General: The Drawings and Specifications may make mention to specific Manufacturer's model numbers. It is understood that these model numbers direct the Contractor to a "Type" or "Series", and are not intended to indicate all suffix designations, prefix designations, or variations of types and models. The type, series, or variation of the model number given must be determined by including all specified items, performance, etc. specified, indicated, and/or detailed. Refer to the Division 1 sections for general requirements concerning work-related submittals (refer to other Divisions 1 sections for administrative submittals).
- B. Submittals:
  - 1. Submittals shall be bound under one cover and submitted all at one time. Partial submittals or unbound submittals will not be accepted. Any item not submitted with this required bound submittal shall be provided as specified or indicated. Subsequent submittals for additional specific items shall not be accepted.

2. If electronic submittals are used, the submittal shall be in Adobe. PDF format with each individual specification section bookmarked to allow for easy access to specific items. Specification sections to have nested bookmarks for each item covered by that specification.
3. The Contractor, by submitting, certifies that those submitted items, materials, equipment, etc., are those that, if not “rejected” or “returned for correction”, shall actually be installed, without exception, addition or substitution, as work of the project.
4. By submitting the required submittals, the Contractor certifies that the Electrical Installer has reviewed all electric power using equipment has been reviewed by the Electrical Installer and that any and/or all power circuits have been coordinated and that all power circuits shall match the equipment provided, whether properly indicated on the Electrical Drawings or not. See also Paragraph 2.4.
5. Any equipment installed without prior (review) acceptance shall be subject to rejection and replacement unless such items were identified by name on the bid documents.
6. The supplier, by submitting, certifies that the materials or equipment proposed is satisfactory for the application intended and that the materials and equipment are in current production with no anticipated plans to cease production.
7. Contractor agrees that submittals processed by the Contracting Officer are not change orders; that the purpose of submittals by the contractor is to demonstrate to the Contracting Officer that the contractor understands the design and specification concept, and that he demonstrates this understanding by indicating which equipment and materials he intends to furnish and install with the fabrication and installation methods he intends to use.
8. Contractor further agrees that if deviations, discrepancies or conflicts between submittals and contract documents are discovered either prior to or after submittals are processed by the Contracting Officer, the contract documents shall control and shall be followed.
9. Submittals shall include:
  - a. 1/4 scale shop drawings of equipment.
  - b. Power and fuel consumption, voltage and ampere rating.
  - c. Capacity and conditions at which rated.
  - d. 1/8 scale shop drawings of VRF system showing factory approved pipe diameters.

- e. Volts, phase and full load amps of each electrical item.
- C. When major items of equipment or systems are submitted as substitution for that which is called for by the contract documents, and significantly different dimensions or concepts are encountered in such proposal, the submittals shall include 1/4" scale drawings of proposed equipment and system layout with sections. These drawings shall indicate all spacial relationships between equipment, piping, duct, electrical work, building and space constraints, etc.

**1.13. CONFLICTS:**

- A. Where any conflict between the requirements of these specifications and the requirements of the associated drawings occur, the more stringent requirements shall govern unless approval is obtained through the Contracting Officer. All such conflicts shall be brought to the Contracting Officer's attention.
- B. Where technical specifications include installation instructions, in their "Part 3 – Execution" paragraph, for materials, items, equipment, etc. which are not mentioned in their "Part 2 – Products" paragraph, it shall be considered as an editing inaccuracy and shall not be construed as Part 3 allowing the use of products not mentioned in Part 2

**PART 2 PRODUCTS**

**2.1. GENERAL:**

- A. All products, materials, equipment, etc. shall be domestically produced and shall fully comply with the Buy American Act.
- B. All products shall be new, of first line quality of grade and type shown on the drawings and specified, or equals accepted by the Contracting Officer in writing.
- C. All products shall be in current production with no notice having been given that such product is to be drastically changed, modified, or discontinued from production.
- D. The supplier, by submitting, certifies that equipment being processed is proper for the application intended and that it has the capacity specified.

**2.2. COMPLETE SYSTEM:**

- A. All products, materials and accessories shall be furnished and installed as required for a complete system ready for Government's beneficial use.

**2.3 PRODUCTS, MECHANICAL WORK:**

- A. General: Refer to Division 1 sections for general requirements on products, materials and equipment. The following provisions expand or modify the requirements as applicable to mechanical work:
- B. For principal equipment item, list the power and fuel consumption ratings, and the primary ratings.
- C. Compatibility: Provide products which are compatible with other products of the mechanical work, and with other work requiring interface with the mechanical work. Provide products with the proper or correct power characteristics, fuel-burning characteristics and similar adaptations for the project. Coordinate the selections from among options (if any) for compatibility of products.
- D. Equipment and Material Deviations: When any material or piece of equipment is specified on the plans or in the specification by reference to one manufacturer's name or model number, it is intended to establish the required standard of design and quality, and it is understood that the phrase "or approved equal" is hereby inserted following the one manufacturer's name, whether such phrase occurs or not.
- E. When the drawings and/or specifications indicate one or two manufacturer's names for materials and equipment, the bidder may submit his bid based on material or equipment of manufacturers not named but considered by the bidder to be equal to the standard of quality and design specified. However, such substitutions must be accepted by the Contracting Officer as equal. If the bidder elects to bid on a substitution without obtaining the written consent of the Contracting Officer prior to receipt of bids, then it will be understood that proof of compliance with specified requirements is the direct responsibility of the bidder and no such materials and/or equipment may be purchased or installed without written acceptance of the Contracting Officer.

#### **2.4. ELECTRICAL PROVISIONS OF MECHANICAL WORK:**

- A. All electrical work required in association with the HVAC work (in order to provide complete operating systems of Fire Suppression, Plumbing, HVAC and HVAC controls) shall generally be a part of the Division 26 work. However, there are certain portions of the electrical requirements which shall be a responsibility of the Division 23 work, which shall be executed in accordance with applicable Division 26 Specification requirements. The electrical provisions of mechanical work, where it may be furnished integrally with mechanical work, can be summarized (but not by way of limitation) to include the following: 1) Motors, 2) Motor starters, 3) Wiring from mechanical equipment to electrical work termination (junction box or disconnect switch), 4) Control switch, pilot lights, interlocks, control transformers and similar devices, 5) Variable Frequency/Variable Speed Drives with Isolation Transformers where so required, 6)

Electrical heating coils and similar elements in mechanical equipment, 7) Electrical work specified as mechanical work in the HVAC control system, 8) Drip pans to protect electrical work, and 9) Work specified elsewhere and/or in other sections as part of the Mechanical Work Requirements.

- B. Responsibility: It is the sole responsibility of the Contractor to coordinate the electrical requirements of each item of equipment provided with the electrical circuits required and to insure their compatibility and compliance with the N.E.C.
- C. For the purposes of these Specifications, the term “single point power connection” (SPPC) shall mean explicitly that. A single point power connection shall require no other circuits to complete the system. If an item of equipment is provided which is scheduled and/or specified for SPPC but requires additional circuits, the Contractor shall be responsible for the additional circuits, transformers, circuit protection, sub-fusing, etc. in accordance with the NEC and/or the Division 26 specifications for this project.
- D. If such an instance occurs where an item of equipment, heat trace, control element, etc., is shown or required, and no electrical provisions are elsewhere specified, shown or indicated, the Contractor shall provide a properly sized and protected power circuit for it (them) as part of the Division 23 work in accordance with the Division 26 sections of these specifications and the N.E.C.
- E. If such an instance occurs where the electrical characteristics of an item of equipment indicated in/on Mechanical Drawings do not match those indicated in/on the Electrical Drawings, it shall be considered as a drafting inconsistency and the Contractor shall be required to provide equipment which is properly matched to the circuits and circuit protection provided.
- F. Where mechanical devices are to be incorporated into fabricated electrical units at the factory, furnish devices to the designated factory well in advance of time units are needed at the project.
- G. Where control transformers are provided, insure that they are compatible with the electrical circuits provided (example: if a 480volt/3phase/60 hz, 3-wire power circuit serves a mechanical item of equipment, provide 480 volt to low voltage transformer(s) for controls, if low voltage controls so require, not 277 volt transformers).
- H. Standards: Where not otherwise indicated, comply with applicable provisions of the National Electrical Code, NEMA standards, and sections of Division 26 of these specifications. All wiring, including controls, shall be installed in conduit with wire sizes according to NFPA 70 unless shown on the plans.
- I. Motors:

1. Temperature Rating Class B insulation, or Class F when used with variable Frequency (Variable Speed) Drive(s), or as otherwise indicated or required for service indicated.
2. Starting Capability: As required for service indicated, but not less than 5 starts per hour.
3. Phases and Current: Refer to project drawings.
4. Service Factor: 1.15 for polyphase; 1.35 for single-phase.
5. Construction: General purpose, continuous duty; Design "B", except "C" for high starting torque applications.
6. Frames: NEMA No. 48, except 56 for heavy-duty applications.
7. Bearings: Ball or roller designed for thrust where applicable; shaft seals and regreasable, except provide permanently sealed where not accessible for greasing. Sleeve-type bearings permitted only where indicated for light-duty fractional hp motors.
8. Enclosure Type: Open drip-proof for normal concealed indoor use, guarded where exposed to employees or occupants. Type II for outdoor use, except weather-protected Type I where adequately housed. Totally Enclosed Fan Cooled (TEFC) motors shall include a rain cap if required for protection when mounted in a vertical configuration.
9. Overload Protection: Built-in thermal; with internal sensing device for stopping motor, and for signaling where indicated.
10. Noise Rating: "Quiet", except where otherwise indicated. Motors used with variable frequency/speed drives shall be selected such that neither the motor nor the drive whines or makes any objectionable noise.
11. All electric motors shall operate at a maximum of 1750 rpm and have open drip proof enclosures for dry indoor applications and totally enclosed fan cooled or air over motors for outdoor applications. Motors located on air handling units shall be mounted in rubber supports or the fan shall be independently supported on springs isolators. Motors located in the conditioned space shall be selected for quiet operation and shall not produce objectionable "motor noise" in the space.
12. All motors shall be premium efficiency (or inverter duty where used with variable speed (frequency) drive(s)).



13. Electrical characteristics shall be verified from the Electrical drawings, prior to bidding, and verified on the job by the Electrical Contractor (prior to ordering by the Electrical Installer).

**J. Starters, Switches:**

1. Motor starters shall be sized in accordance with the National Electrical Code and proper heater elements shall be provided and installed.
2. Starter Characteristics: Type I general purpose enclosure with padlock ears and supports for mounting as indicated. Starter type and size as recommended by motor manufacturer. Locate disconnect switch within sight of motor.
3. Manual Switches: Provide on motors 1/3 hp and smaller, except where automatic control or interlock is indicated; include pilot light. Provide overload protection where not protected by panelboard circuit breaker or fused disconnect switch.
4. Magnetic Starters: Provide for 1/2 hp and larger motors, and for smaller motors on automatic control or with interlock switch. Include push buttons, pilot lights, reset, trip-free relay on each phase, undervoltage release, and devices for coordination with control system (including 120-volt transformer for control circuit where service exceeds 240-volts). Starters shall be provided with hand-off-auto switches and phase loss and phase reversal relays.
5. Starters shall consist of a horsepower rated magnetic contactor with a minimum of 1NO and 1NC auxiliary contacts and solid state electronic overload relay. Overload relay shall protect all three phases with a wide range current setting and trip class to allow field adjustment for specific motor FLA. Interchangeable heater elements are not acceptable. Overload relay shall provide phase failure, phase loss, locked rotor and stall protection
6. Provide a manual reset pushbutton on the starter cover to restore normal operation after a trip or fault condition.
7. Ventilation OFF switch: Existing..

**K. Wiring, Connections:**

1. Motors: Wire connections in flexible conduit, except where plug-in electrical cords are indicated and permitted by governing regulations.
2. General Wiring: Comply with applicable provisions of Division 26 sections.

**PART 3. EXECUTION**

**3.1. WORKMANSHIP:**

- A. All work shall be performed by competent mechanics using proper tools and equipment to produce first quality work. All work shall be neatly installed, accessible for maintenance and complete with all accessories required.

**3.2. CEILING RETURN AIR PLENUMS:**

- A. In instances where the cavity spaces above ceilings are used as return air plenums, the contractor shall insure that adequate return air path(s) above the ceiling(s) are provided (whether shown or indicated or not) from each occupied room or space into the ceiling cavity and then from the ceiling cavity above each room or space back to the appropriate air handling/blower coil unit(s).
- B. Providing return air paths as required by this paragraph may require providing openings (which are not shown or indicated) in walls which extend above the ceiling(s) and are tight to the structure above.
- C. Providing return air paths as required by this paragraph may also require providing ceiling mounted return air grilles (which are not shown or indicated) where return air type light fixtures are either not present or not present in large enough numbers to provide an adequate return air path.
- D. Return air paths provided through fire rated walls above ceilings shall be provided with appropriately rated and/or classified fire dampers.
- E. All materials and equipment installed in HVAC return air plenums shall have a 25/50 flame spread/smoke developed index maximum when tested in accordance with ASTM E 84.

**3.3. ACCESSIBLE PROVISIONS:**

- A. The Contractor shall comply with all provisions of the "Americans with Disabilities Act" (ADA), whether indicated or specified elsewhere or not.
- B. Thermostats shall be mounted at 54" above the floor where side reach is possible and at 48" where only forward reach as possible.

**3.4. MECHANICAL SYSTEM IDENTIFICATION:**

- A. Piping System: Provide adequate marking of piping which is exposed, including that which is concealed in accessible spaces. Provide either pre-printed color-coded plastic pipe markers or color-coded stencil painted markers. Indicate each pipe system by its generic name (abbreviated) as shown/scheduled/specified; except drainage and vent piping may be indicated by color-coding only. Comply with ANSI A13.1 for colors. Include arrows to show direction of flow. Locate markers at terminations of lines and near major branches; near control valves and at equipment connections; where lines pass through walls, floors and ceilings; at access doors where piping is in concealed spaces; and at spacing of not more than 20' along each line for exposed piping, 10' for concealed piping.

Plastic Pipe Markers: Provide manufacturer's standard pre-printed flexible or semi-rigid, permanent, color-coded, plastic-sheet pipe markers, complying with ANSI A13.1.

Small Pipes: For external diameters less than 6" (including insulation if any), provide full-band pipe markers, extending 360 degrees around pipe at each location, fastened by one of the following methods:

1. Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
2. Adhesive lap joint in pipe marker overlap.
3. Elastic or stainless steel bands.

Large Pipes: For external diameters of 6" and larger (including insulation if any), provide either full-band or strip-type pipe markers, but not narrower than 3 times letter height (and of required length), fastened by one of the following methods:

Strapped-to-pipe (or insulation) application of semi-rigid type, with manufacturer's standard stainless steel bands.

Arrows: Print each pipe marker with arrows indicating the direction of flow, either integrally with piping system service lettering or as a separate unit.

Piping to be Identified:

1. Domestic Cold water
2. Domestic Hot water
3. Domestic Hot water – heat traced

Valve Identification:

1. Brass Valve Tags: Provide 19-gauge polished brass valve tags with stamp-engraved piping system abbreviations in 1/4" high letters and sequenced valve numbers 1/2" high, and with 5/32" hole for fastener.

2. Provide 1-1/2" diameter tags, except as otherwise indicated.
3. Fill tag engraving with black enamel.
4. Valve Tag Fasteners: Manufacturer's standard solid brass chain (wire link or beaded type), or solid brass S-hooks of the sizes required for proper attachment of tags to valves, and manufactured specifically for that purpose.
5. Valve Schedule Frames: For each page of the valve schedule, provide a glazed display frame, with screws for removable mounting on masonry walls. Provide frames of finished hardwood or extruded aluminum, with SSB-grade sheet glass.

Valve Schedule: Prepare and submit valve tag schedule (in duplicate), listing each tagged valve by location, service, and tag description. Install each page of one copy of the valve schedule in glazed frames, and mount where directed.

**B. Equipment:**

1. Signs: Provide engraved plastic-laminate signs at locations of major equipment units, primary control devices, emergency equipment, dangerous elements of the mechanical work and similar places. Provide text of sufficient clarity and lettering, of sufficient size to convey adequate information at each location, and mount permanently in an appropriate and effective location. Comply with recognized industry standards for color and design.
2. Selection: Refer to instances where either a plastic-laminate sign or plasticized tag might be appropriate, to the Contracting Officer for resolution.

**3.6. ACCESS:**

- A. Access Units: The work of this article is limited to the provisions for access through other work for access to mechanical work, and does not include internal access provisions (within the mechanical work). In general and where possible, furnish or furnish-and-mount required access units in other trades' work prior to their work, so that cutting and patching for the subsequent installation of such access units will not be required. In occupied spaces, provide finished access units of the maximum concealment type, including locks where appropriate, and matching access units provided in the same expanse of finish (for non-mechanical access, if any). Access units shall meet the fire and/or smoke rating of the construction in which installed.
- B. Scope: The scope of access units to be furnished or provided as indicated on mechanical drawings or specified in Division 23 sections, and those additional units required for adequate access to mechanical work and not shown or specified individually.

- C. Access Doors: Standard welded-steel construction, 16 gauge frames and 14 gauge door panels, 175° concealed spring hinges, rust-inhibitive prime coat, flush cam lock (for screw-driver operation where keyed lock is not required), recessed to receive applied finish where applicable, 5-pin/disk tumbler lock where indicated.

### **3.7. CUTTING AND PATCHING**

- A. Cutting and Patching Requirements: Comply with the requirements of other Divisions for the cutting and patching of other work to accommodate the installation of mechanical work. Except as individually authorized by the Contracting Officer, cutting-and-patching of mechanical work to accommodate the installation of other work is not permitted, other than necessary penetrations of mechanical sheet metal work for electrical conduit and similar purposes.

### **3.8. WORK BY OTHER TRADES**

- A. Cutting, patching, furring or painting shall be done by the affected trade at this contractor's expense for changes required in the finish work.
- B. Openings in walls, floors and roof to be furnished by the General Contractor. This contractor shall furnish the General Contractor with the location and size required. This contractor shall furnish all sleeves, frames including framing between joist (unless shown on the Structural plans), access doors, prefabricated curbs, roof flashing, counter flashing and other accessories necessary for a complete installation. Only those items specifically shown and/or specified in other sections are excluded.
- C. Power wiring, including final connections, is by the Electrical Contractor (However, this contractor is in some cases made responsible for power wiring by these specifications. It is in these cases that this contractor must arrange for and bear the cost of power wiring such as that associated with equipment auxiliaries, power for control circuits, etc.) This contractor shall install all motors and furnish all starting equipment to the Electrical Contractor for installation. Control wiring, including conduit, switches, thermostats, interlocks, etc...shall be furnished by this contractor unless specifically shown on the Electrical drawings. This contractor shall see that the electrical components mounted on the equipment do not block access to service areas of the equipment (such as disconnects switches mounted on the equipment).
- D. Power and fuel for testing shall be by the General Contractor.
- E. Floor drains and hub drains shall be the responsibility of the Plumbing Contractor. This contractor shall connect drains from his equipment to these drains with an open site drain

connection or air gap. This contractor shall review the drain locations and insure that mechanical equipment will not interfere with drain location. If a conflict is noted, notify the Contracting Officer and coordinate drain location.

### **3.9. FOUNDATIONS AND SPECIAL SUPPORTS**

- A. Furnish and install all special foundations and supports required for equipment installed under this Section, unless they are a part of the building structure and are shown in other sections.
- B. All floor mounted shall be mounted on inertial bases or 4" minimum thick housekeeping pads which have are a minimum 4" higher than surrounding floor, grade, or surface and which are 12" larger in each plan dimension that the equipment installed thereon.

### **3.10. EXCAVATING FOR MECHANICAL WORK:**

- A. General: The work of this article is defined to include whatever excavating and backfilling is necessary to install the mechanical work. Coordinate the work with other excavating and backfilling in the same area, including dewatering, flood protection provision, and other temporary facilities. Coordinate the work with other work in the same area, including other underground services (existing and new), landscape development, paving, and floor slabs on grade. Coordinate with weather conditions and provide temporary facilities needed for protection and proper performances of excavating and backfilling.
- B. General Standards: Except as otherwise indicated, comply with the applicable provisions of the Division 2 sections for mechanical-work excavating and backfilling. Refer instances of uncertain applicability to the Contracting Officer for resolution before proceeding.
- C. Piping Support: Support pipe 5" and smaller directly on undistributed soil. Support pipe 6" and larger, and tanks/vessels, on compacted and shaped subbase material of depth shown but not less than 6" deep. Compact previously disturbed and unsatisfactory subsoil to provide adequate, uniform support for mechanical work; or excavate and replace with stable subbase material or lean concrete.
- D. Water-Bearing Pipe: Except as otherwise specifically indicated, place exterior underground water-bearing pipe (including drainage lines) a minimum of 3'-6" below grade (measured to top of pipe).
- E. Sequencing: Delay backfill and encasement of piping until testing of piping system has been completed.

- F. Backfill first two feet minimum of piping trench (but no less than 6" cover over piping) with backfill class concrete. Backfill balance with clean dirt or sand, no rocks, clods or trash with a minimum of 8" of clean top soil at grade. Take care not to disturb the pipe grade or alignment. Compact around and under the pipe carefully. Finish all backfill with approved material and leave slightly mounded. Clean up around the ditch area to remove trash and any excess dirt.
- G. Replacement of Other Work: Where it is necessary to remove and replace landscape work, pavement, flooring and similar exposed finish work, engage the original installer to install the replacement work; except where the work existed prior to the work of this Contract, engage only experienced and expert firms and trades persons to replace the work.

### **3.11. CONCRETE FOR MECHANICAL WORK:**

- A. General: The work of this article is defined to include whatever concrete work is necessary or shown specifically for installation of the mechanical work. Coordinate the work with other work, particularly other concrete work and accessories.
- B. General Standards: Except as otherwise indicated, comply with applicable provision of Division 3 Sections for mechanical-work concrete, including formwork, reinforcement, mix design, material (use mix designs and materials accepted for Division-3 work where possible), admixtures, accessories (including waterstops), placing of wet concrete, finishing, curing, protecting, testing, submittals, and other requirements of the concrete work. Refer instances of uncertain applicability to the Contracting Officer for resolution before proceeding.
- C. Associated Work: Where expansion joint fillers and sealants are required, provide the types indicated and comply with applicable provisions of the other sections. Where a moisture or vapor barrier is indicated, under or behind concrete work, provide fiber-reinforced, plastic-core, asphalt-saturated felt-laminate sheets, 1/8" thick, 70 lbs. per 100 sq. ft., 0.005 perm rating.
- D. Classes and Applications: Except as otherwise indicated, provide strength classes as follows, with the following cement content and water/cement ratios (for the indicated applications and similar required applications):
  - 1. 4000 psi Class: 565 lbs. cement/yd. (6.0 sacks); 0.57 water/cement ratio. Provide 4000 Class for tanks, vaults, beam-type foundations and similar structures.
  - 2. 3000 psi Class: 500 lbs. cement/yd. (5.25 sacks); 0.68 water/cement ratio. Provide 3000 Class for miscellaneous underground structural concrete, reinforced encasement, block-type foundations (with smallest dimension at least 0.2 x largest

dimension), curbs, pads, inertia blocks (unframed type), and similar structural support work, and whenever otherwise unspecified or not indicated by class.

3. 2500 psi Class: 450 lbs. cement/yd. (4.75 sacks); 0.75 water/cement ratio. Provide 2500 Class for plain encasement, filling steel-framed units, and similar work.
4. Rough Grouting Class: 565 lbs. cement/yd (6.0 sacks); 0.75 water/cement ratio; adjust aggregate sizes to facilitate placement. Use for rough grouting, not for setting equipment bases.
5. Backfill Class (Lean Concrete): 375 lbs. cement/yd. (4.0 sacks); 0.87 water/cement ratio. Use for backfilling where piping is installed in trenches below grade.

### **3.12. PAINTING MECHANICAL WORK:**

- A. General: The work of this article is defined to include general painting of mechanical work at the project site. Coordinate the painting with the painting of other work of a similar nature, and comply with indicated color and color matching requirements. Except as otherwise indicated, paint surfaces of mechanical work which would normally be painted in the application and exposure indicated.
- B. General Standards: Except as otherwise indicated, comply with applicable provisions of other Sections for mechanical-work painting. Refer instances of uncertain applicability to the Contracting Officer for resolution before proceeding.
- C. Paint the following categories of mechanical work which have not been fully factory-finished, except paint over factory finish which is not an acceptable color:
  1. Exterior ferrous metal (does not include stainless steel).
  2. Inside of return air ductwork where visible through return grille.

### **3.13. NOISE AND VIBRATION:**

- A. Install vibration isolators, flexible connectors, expansion joints and other safety measures to prevent noise and vibration from being transmitted to occupied areas. Equipment shall be selected to operate within the noise level recommended for the particular type installation in relation to its location.
- B. After installation, make proper adjustments to eliminate excessive noise and vibration.

### **3.14. CONDENSATE DRAINS:**



- A. Provide insulated type M copper condensate drain for all air handling units. Drains shall have a slope of not less than 1" in 40 feet and if possible, 1/4" per foot. Do not allow any sags or low points for water to collect. Provide trap of size equal to drain connection at unit and air gap at floor drain. Drain shall have a trap depth 1" greater than to the total fan static pressure, inches water column, or as detailed. Minimum size for VRF system is 1". Provide union at each equipment connection.

**3.15 CLEANING AND PAINTING:**

- A. Thoroughly clean all equipment and remove all trash, cartons, etc...Make any necessary corrections or repair/replace any damaged materials or equipment. Leave the entire system in a thoroughly clean and orderly manner.
- B. Any finished surfaces that have been scratched or discolored shall be touched-up or repainted to match the original color.
- C. All metal items subject to rusting, inside or exposed to the weather, shall be given one coat of proper type rust preventive type primer as soon as installed. If final paint finish is not specified in other sections, then this contractor shall apply two (2) finish coats with color to be selected by the Contracting Officer.

**3.16. DUCTWORK AND EQUIPMENT CLEANLINESS DURING CONSTRUCTION:**

- A. HVAC equipment and ductwork will be protected from dust and other pollutants during installation and during initial equipment operation.
- B. All air handling unit casings shall be hand-wiped clean prior to final test and balance.
- C. Openings into installed ductwork and air-handling equipment not in active use will be sealed using taped plastic, taped cardboard, or other reasonably air-tight coverings. Ductwork delivered to job site will be protected prior to leaving fabrication shop. Sealing will occur prior to, or immediately upon installation of the ductwork or equipment. Regular inspections will be conducted by the Mechanical Contractor Superintendent to check for damaged or displaced coverings. Repair or replacement of damaged or displaced coverings will occur immediately upon discovery.
- D. Construction work that generates air pollution will be avoided where ductwork or air handling equipment is being installed. If visible air pollutants are present in a space where ductwork is to be installed, spot cleaning or other measures will be used to prevent ductwork or equipment contamination.
- E. Use of mechanical systems during construction:
  - 1. Air handling Units will be protected with a temporary filter having a minimum rating of MERV 8 per ASHRAE 52.2-1999.

2. Distribution elements needing filters, including all return air ductwork, will be protected with temporary filters having a minimum rating of MERV 8 per ASHRAE 52.2-1999 unless otherwise noted. If used for prolonged periods, filters will be periodically inspected and replaced if dirty. All components of the distribution on the return side will be protected.

**END OF SECTION 230100**

## **SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Balancing Air Systems:
    - a. Outside air with exhaust/relief air
    - b. VRF and split-system heat pumps Systems.

#### **1.3 DEFINITIONS**

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An entity engaged to perform TAB Work.

#### **1.4 SUBMITTALS**

- A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB contractor and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Contract Documents Examination Report: Within 60 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.

- C. Strategies and Procedures Plan: Within 90 of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.
- D. Certified TAB reports.
- E. Sample report forms.
- F. Instrument calibration reports, to include the following:
  - 1. Instrument type and make.
  - 2. Serial number.
  - 3. Application.
  - 4. Dates of use.
  - 5. Dates of calibration.
  - 6. QUALITY ASSURANCE
- G. TAB Contractor Qualifications: Engage a TAB entity certified by AABC or NEBB.
  - 1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC or NEBB.
  - 2. TAB Technician: Employee of the TAB contractor and who is certified by AABC or NEBB as a TAB technician.
- H. TAB Conference: Meet with Contracting Officer on approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Require the participation of the TAB field supervisor and technicians. Provide seven days' advance notice of scheduled meeting time and location.
  - 1. Agenda Items:
    - a. The Contract Documents examination report.
    - b. The TAB plan.
    - c. Coordination and cooperation of trades and subcontractors.
    - d. Coordination of documentation and communication flow.
    - e. Certify TAB field data reports and perform the following:
  - 2. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
  - 3. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.
- I. TAB Report Forms: Use standard TAB contractor's forms approved by Contracting Officer.

- J. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

## **1.5 PROJECT CONDITIONS**

- A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.
- B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

## **1.6 COORDINATION**

- A. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.
- B. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

## **PART 2 - PRODUCTS (Not Applicable)**

## **PART 3 - EXECUTION**

### **3.1 TAB SPECIALISTS**

- A. Subject to compliance with requirements, engage one of the following:

### **3.2 EXAMINATION**

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
- B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.

- D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they meet the leakage class of connected ducts as specified in Division 23 Section "Metal Ducts" and are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.
- F. Examine equipment performance data including fan and pump curves.
  - 1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
  - 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.
- G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- H. Examine test reports specified in individual system and equipment Sections.
- I. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.
- K. Examine operating safety interlocks and controls on HVAC equipment.
- L. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

### **3.3 PREPARATION**

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system-readiness checks and prepare reports. Verify the following:

1. Permanent electrical-power wiring is complete.
  2. Automatic temperature-control systems are operational.
  3. Equipment and duct access doors are securely closed.
  4. Balance, smoke, and fire dampers are open.
  5. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
  6. Windows and doors can be closed so indicated conditions for system operations can be met.
  7. **GENERAL PROCEDURES FOR TESTING AND BALANCING**
- C. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.
1. Comply with requirements in ASHRAE 62.1-2010, Section 7.2.2, "Air Balancing."
- D. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
  2. After testing and balancing, install test ports and duct access doors that comply with requirements in Division 23 Section "Air Duct Accessories."
  3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Division 23 Section "HVAC Insulation."
- E. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- F. Take and report testing and balancing measurements in inch-pound (IP) units.

### **3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS**

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. For variable-air-volume systems, develop a plan to simulate diversity.

- D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.
- I. Check for airflow blockages.
- J. Check condensate drains for proper connections and functioning.
- K. Check for proper sealing of air-handling-unit components.
- L. Verify that air duct system is sealed as specified in Division 23 Section "Metal Ducts."

### **3.5 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS**

- A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a minimum set-point airflow with the remainder at maximum-airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.
- B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
  - 1. Set outdoor-air dampers at minimum, and set return- and exhaust-air dampers at a position that simulates full-cooling load.
  - 2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
  - 3. Measure total system airflow. Adjust to within indicated airflow.
  - 4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.



5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.
    - a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.
  6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
    - a. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.
  7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
  8. Record final fan-performance data.
  9. GENERAL PROCEDURES FOR BALANCING VRF SYSTEMS
- C. For ducted units, prepare test reports for outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes. Record entering and leaving dry bulb and wet bulb temperatures. Adjust thermostat to record data in cooling and heating mode.
- D. For ductless units, Record entering and leaving dry bulb and wet bulb temperatures. Adjust thermostat to record data in cooling and heating mode.

### **3.6 PROCEDURES FOR MOTORS**

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
1. Manufacturer's name, model number, and serial number.
  2. Motor horsepower rating.
  3. Motor rpm.
  4. Efficiency rating.
  5. Nameplate and measured voltage, each phase.
  6. Nameplate and measured amperage, each phase.
  7. Starter thermal-protection-element rating.
- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

### **3.7 PROCEDURES FOR CONDENSING UNITS**

- A. Verify proper rotation of fans.
- B. Measure entering- and leaving-air temperatures.
- C. Record compressor data.

### **3.8 TOLERANCES**

- A. Set HVAC system's air flow rates and water flow rates within the following tolerances:
  - 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
  - 2. Air Outlets and Inlets: Plus or minus 10 percent.
  - 3. FINAL REPORT
- B. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
  - 1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
  - 2. Include a list of instruments used for procedures, along with proof of calibration.
- C. Final Report Contents: In addition to certified field-report data, include the following:
  - 1. Manufacturers' test data.
  - 2. Field test reports prepared by system and equipment installers.
  - 3. Other information relative to equipment performance; do not include Shop Drawings and product data.
- D. General Report Data: In addition to form titles and entries, include the following data:
  - 1. Title page.
  - 2. Name and address of the TAB contractor.
  - 3. Project name.
  - 4. Project location.
  - 5. Architect's name and address.
  - 6. Engineer's name and address.
  - 7. Contractor's name and address.
  - 8. Report date.
  - 9. Signature of TAB supervisor who certifies the report.
  - 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
  - 11. Summary of contents including the following:

- a. Indicated versus final performance.
  - b. Notable characteristics of systems.
  - c. Description of system operation sequence if it varies from the Contract Documents.
12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans and pump performance forms including the following:
  - a. Settings for outdoor-, return-, and exhaust-air dampers.
  - b. Conditions of filters.
  - c. Cooling coil, wet- and dry-bulb conditions.
  - d. Face and bypass damper settings at coils.
  - e. Fan drive settings including settings and percentage of maximum pitch diameter.
  - f. Inlet vane settings for variable-air-volume systems.
  - g. Settings for supply-air, static-pressure controller.
  - h. Other system operating conditions that affect performance.
  - i. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
16. Quantities of outdoor, supply, return, and exhaust airflows.
17. Duct, outlet, and inlet sizes.
18. Terminal units.
- E. Equipment Test Reports: Use AABC or NEBB equipment reporting forms.:
- F. Instrument Calibration Reports:
  1. Report Data:
    - a. Instrument type and make.
    - b. Serial number.
    - c. Application.
    - d. Dates of use.
    - e. Dates of calibration.

**END OF SECTION 230593**

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## **SECTION 230713 - DUCT INSULATION**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section includes insulating the following duct services:
  - 1. Indoor, concealed supply and outdoor air.
  - 2. Indoor, exposed supply and outdoor air.
  - 3. Indoor, concealed return located in unconditioned space and mechanical rooms.
  - 4. Indoor, exposed return located in unconditioned space and mechanical rooms.
- B. Related Sections:
  - 1. Division 23 Section "HVAC Piping Insulation."
  - 2. SUBMITTALS
- C. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).
- D. LEED Submittals:
  - 1. Product Data for Credit EQ 4.1: For adhesives and sealants, documentation including printed statement of VOC content and chemical components.
  - 2. Laboratory Test Reports for Credit EQ 4: For adhesives and sealants, documentation indicating that product complies 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," including 2004 Addenda.
- E. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.

2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
  3. Detail application of field-applied jackets.
  4. Detail application at linkages of control devices.
- F. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:
1. Sheet Form Insulation Materials: 12 inches (300 mm) square.
  2. Sheet Jacket Materials: 12 inches (300 mm) square.
  3. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.
- G. Qualification Data: For qualified Installer.
- H. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- I. Field quality-control reports.

### 1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
  2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

## **1.5 COORDINATION**

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

## **1.6 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.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

## **PART 2 - PRODUCTS**

### **2.1 INSULATION MATERIALS**

- A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - 1. Products: Subject to compliance with requirements, provide one of the following:

- a. CertainTeed Corp.; SoftTouch Duct Wrap.
  - b. Johns Manville; Microlite.
  - c. Knauf Insulation; Friendly Feel Duct Wrap.
  - d. Manson Insulation Inc.; Alley Wrap.
  - e. Owens Corning; SOFTR All-Service Duct Wrap.
- F. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. CertainTeed Corp.; Commercial Board.
    - b. Fibrex Insulations Inc.; FBX.
    - c. Johns Manville; 800 Series Spin-Glas.
    - d. Knauf Insulation; Insulation Board.
    - e. Manson Insulation Inc.; AK Board.
    - f. Owens Corning; Fiberglas 700 Series.
- G. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. (40 kg/cu. m) or more. Thermal conductivity (k-value) at 100 deg F (55 deg C) is 0.29 Btu x in./h x sq. ft. x deg F (0.042 W/m x K) or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. CertainTeed Corp.; CrimpWrap.
    - b. Johns Manville; MicroFlex.
    - c. Knauf Insulation; Pipe and Tank Insulation.
    - d. Manson Insulation Inc.; AK Flex.
    - e. Owens Corning; Fiberglas Pipe and Tank Insulation.

## 2.2 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. Products: Subject to compliance with requirements, provide one of the following:



- a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
    - b. Eagle Bridges - Marathon Industries; 225.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
    - d. Mon-Eco Industries, Inc.; 22-25.
  2. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  3. Use adhesive that complies 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," including 2004 Addenda.
- 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: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
    - b. Eagle Bridges - Marathon Industries; 225.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.
    - d. Mon-Eco Industries, Inc.; 22-25.
  2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  3. Use adhesive that complies 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," including 2004 Addenda.
  4. MASTICS
- D. 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).
- E. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.
  1. Products: Subject to compliance with requirements, provide one of the following:

- a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
    - b. Vimasco Corporation; 749.
  2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, **0.013 perm** (**0.009 metric perm**) at **43-mil** (**1.09-mm**) dry film thickness.
  3. Service Temperature Range: **Minus 20 to plus 180 deg F** (**Minus 29 to plus 82 deg C**).
  4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
  5. Color: White.
- F. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Encacel.
    - b. Eagle Bridges - Marathon Industries; 570.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 60-95/60-96.
  2. Water-Vapor Permeance: ASTM F 1249, **0.05 perm** (**0.033 metric perm**) at **30-mil** (**0.8-mm**) dry film thickness.
  3. Service Temperature Range: **Minus 50 to plus 220 deg F** (**Minus 46 to plus 104 deg C**).
  4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
  5. Color: White.
  6. LAGGING ADHESIVES
- G. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  2. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-50 AHV2.
    - b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.
    - c. Vimasco Corporation; 713 and 714.
  3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.
  4. Service Temperature Range: **0 to plus 180 deg F** (**Minus 18 to plus 82 deg C**).

5. Color: White.
6. SEALANTS

H. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
  - b. Eagle Bridges - Marathon Industries; 405.
  - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
  - d. Mon-Eco Industries, Inc.; 44-05.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: **Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).**
5. Color: Aluminum.
6. For indoor applications, use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Use sealants that 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," including 2004 Addenda.

I. ASJ Flashing Sealants, and Vinyl and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: **Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).**
5. Color: White.
6. For indoor applications, use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Use sealants that 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," including 2004 Addenda.
8. FACTORY-APPLIED JACKETS

- J. 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 (0.86 metric perm) when tested according to ASTM E 96/E 96M, Procedure A, and complying with NFPA 90A and NFPA 90B.
  6. FIELD-APPLIED FABRIC-REINFORCING MESH
- K. Woven Glass-Fiber Fabric: Approximately 6 oz./sq. yd. (203 g/sq. m) with a thread count of 5 strands by 5 strands/sq. in. (2 strands by 2 strands/sq. mm) for covering ducts.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Chil-Glas No. 5.
    - b. Woven Polyester Fabric: Approximately 1 oz./sq. yd. (34 g/sq. m) with a thread count of 10 strands by 10 strands/sq. in. (4 strands by 4 strands/sq. mm), in a Leno weave, for ducts.
  2. Products: Subject to compliance with requirements, provide one of the following:
    - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Mast-A-Fab.
    - b. Vimasco Corporation; Elastafab 894.

## 2.3 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

## 2.4 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:
    - a. ABI, Ideal Tape Division; 428 AWF ASJ.
    - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
    - c. Compac Corporation; 104 and 105.
    - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
  2. Width: 3 inches (75 mm).
  3. Thickness: 11.5 mils (0.29 mm).
  4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
  5. Elongation: 2 percent.
  6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
  7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. ABI, Ideal Tape Division; 491 AWF FSK.
    - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
    - c. Compac Corporation; 110 and 111.
    - d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.
  2. Width: 3 inches (75 mm).
  3. Thickness: 6.5 mils (0.16 mm).
  4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
  5. Elongation: 2 percent.
  6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
  7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. ABI, Ideal Tape Division; 488 AWF.
    - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
    - c. Compac Corporation; 120.
    - d. Venture Tape; 3520 CW.
  2. Width: 2 inches (50 mm).
  3. Thickness: 3.7 mils (0.093 mm).
  4. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.
  5. Elongation: 5 percent.

6. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.
7. SECUREMENTS

D. Bands:

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. ITW Insulation Systems; Gerrard Strapping and Seals.
  - b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.
2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch (0.38 mm) thick, 1/2 inch (13 mm) wide with wing seal or closed seal.
3. Aluminum: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, 1/2 inch (13 mm) wide with wing seal or closed seal.
4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

E. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- (3.5-mm-) diameter shank, length to suit depth of insulation indicated.
  - a. Products: Subject to compliance with requirements, provide one of the following:
    - 1) AGM Industries, Inc.; CWP-1.
    - 2) GEMCO; CD.
    - 3) Midwest Fasteners, Inc.; CD.
    - 4) Nelson Stud Welding; TPA, TPC, and TPS.
    - 5) Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
  - b. Products: Subject to compliance with requirements, provide one of the following:
    - 1) AGM Industries, Inc.; Tactoo Perforated Base Insul-Hangers.
    - 2) GEMCO; Perforated Base.
    - 3) Midwest Fasteners, Inc.; Spindle.

- c. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.
  - d. Spindle: Aluminum, fully annealed, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
  - e. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick, aluminum sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.
- a. Products: Subject to compliance with requirements, provide one of the following:
    - 1) AGM Industries, Inc.; RC-150.
    - 2) GEMCO; R-150.
    - 3) Midwest Fasteners, Inc.; WA-150.
    - 4) Nelson Stud Welding; Speed Clips.
  - b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
  - c. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.
- F. Wire: 0.062-inch (1.6-mm) soft-annealed, stainless steel.

## 2.5 CORNER ANGLES

- A. Aluminum Corner Angles: 0.040 inch (1.0 mm) thick, minimum 1 by 1 inch (25 by 25 mm), aluminum according to ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14.

## PART 3 - EXECUTION

### 3.1 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.

### **3.2 PREPARATION**

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

### **3.3 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- (75-mm-)** wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced **4 inches (100 mm)** o.c.
  3. Overlap jacket longitudinal seams at least **1-1/2 inches (38 mm)**. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at **4 inches (100 mm)** 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 (100 mm)** beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

### 3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  3. Extend jacket of outdoor insulation outside roof flashing at least **2 inches (50 mm)** below top of roof flashing.
  4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least **2 inches (50 mm)**.
  4. Seal jacket to wall flashing with flashing sealant.
- C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least **2 inches (50 mm)**.
1. Comply with requirements in Division 07 Section "Penetration Firestopping" firestopping and fire-resistive joint sealers.
- E. Insulation Installation at Floor Penetrations:
1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least **2 inches (50 mm)**.
  2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."
  3. INSTALLATION OF MINERAL-FIBER INSULATION
- F. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
  2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
  3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
    - a. On duct sides with dimensions **18 inches (450 mm)** and smaller, place pins along longitudinal centerline of duct. Space **3 inches (75 mm)** maximum from insulation end joints, and **16 inches (400 mm)** o.c.

- b. On duct sides with dimensions larger than 18 inches (450 mm), place pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    - d. Do not overcompress insulation during installation.
    - e. Impale insulation over pins and attach speed washers.
    - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
  - 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches (50 mm) from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
    - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    - b. Install vapor stops for ductwork and plenums operating below 50 deg F (10 deg C) at 18-foot (5.5-m) intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches (75 mm).
  - 5. Overlap unfaced blankets a minimum of 2 inches (50 mm) on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches (450 mm) o.c.
  - 6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
  - 7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.
- G. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
  - a. On duct sides with dimensions **18 inches (450 mm)** and smaller, place pins along longitudinal centerline of duct. Space **3 inches (75 mm)** maximum from insulation end joints, and **16 inches (400 mm)** o.c.
  - b. On duct sides with dimensions larger than **18 inches (450 mm)**, space pins **16 inches (400 mm)** o.c. each way, and **3 inches (75 mm)** maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
  - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
  - d. Do not overcompress insulation during installation.
  - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing **2 inches (50 mm)** from one edge and one end of insulation segment. Secure laps to adjacent insulation section with **1/2-inch (13-mm)** outward-clinching staples, **1 inch (25 mm)** o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
  - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
  - b. Install vapor stops for ductwork and plenums operating below **50 deg F (10 deg C)** at **18-foot (5.5-m)** intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than **3 inches (75 mm)**.
5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.

6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with ~~6-inch-~~ (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced ~~6 inches~~ (150 mm) o.c.
  7. FIELD-APPLIED JACKET INSTALLATION
- H. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
1. Draw jacket smooth and tight to surface with ~~2-inch~~ (50-mm) overlap at seams and joints.
  2. Embed glass cloth between two ~~0.062-inch-~~ (1.6-mm-) thick coats of lagging adhesive.
  3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- I. Where FSK jackets are indicated, install as follows:
1. Draw jacket material smooth and tight.
  2. Install lap or joint strips with same material as jacket.
  3. Secure jacket to insulation with manufacturer's recommended adhesive.
  4. Install jacket with ~~1-1/2-inch~~ (38-mm) laps at longitudinal seams and ~~3-inch-~~ (75-mm-) wide joint strips at end joints.
  5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
  6. FINISHES
- J. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.
1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
    - a. Finish Coat Material: Interior, flat, latex-emulsion size.
    - b. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- K. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- L. Do not field paint aluminum or stainless-steel jackets.

### 3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
  - 1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

### 3.6 DUCT INSULATION SCHEDULE, GENERAL

- A. Plenums and Ducts Requiring Insulation, see Insulation Schedule
- B. Items Not Insulated:
  - 1. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
  - 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.

### 3.7 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Concealed and exposed, rectangular and round supply-air and return-air duct insulation shall be the following:
  - 1. Mineral-Fiber Blanket: 1-1/2 inches (38 mm) thick and 0.75-lb/cu. ft. (12-kg/cu. m) nominal density.
- B. Concealed and exposed, rectangular and round conditioned outdoor-air duct insulation shall be the following:
  - 1. Mineral-Fiber Blanket: 1-1/2 inches (38 mm) thick and 0.75-lb/cu. ft. (12-kg/cu. m) nominal density.

- C. Concealed and exposed, rectangular and round exhaust/relief-air insulation shall be the following:
  - 1. Mineral-Fiber Blanket: 1-inch thick and 0.75-lb/cu. ft. (12-kg/cu. m) nominal density.

**END OF SECTION 230713**

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## **SECTION 230719 – HVAC AND PLUMBING PIPING INSULATION**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section includes insulating the following HVAC and plumbing piping systems:
  - 1. Condensate drain piping, indoors.
  - 2. Domestic cold water and humidifier make-up.
  - 3. Refrigerant piping.
  - 4. Roof drain leaders and bodies.
  - 5. SUBMITTALS
- B. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).
- C. Shop Drawings:
  - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
  - 2. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
  - 3. Detail application of field-applied jackets.
- D. Qualification Data: For qualified Installer.
- E. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- F. Field quality-control reports.

### **1.3 QUALITY ASSURANCE**

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
  - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
  - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

### **1.4 DELIVERY, STORAGE, AND HANDLING**

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

### **1.5 COORDINATION**

- A. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

### **1.6 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.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

## PART 2 - PRODUCTS

### 2.1 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
  - 1. Products: Subject to compliance with requirements, provide the following:
    - a. Aeroflex USA, Inc.; Aerocel.
    - b. Armacell LLC; AP Armaflex.
    - c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.
- G. Mineral-Fiber, Preformed Pipe Insulation:
  - 1. Products: Subject to compliance with requirements, provide the following:
    - a. Fibrex Insulations Inc.; Coreplus 1200.
    - b. Johns Manville; Micro-Lok.
    - c. Knauf Insulation; 1000-Degree Pipe Insulation.
    - d. Manson Insulation Inc.; Alley-K.
    - e. Owens Corning; Fiberglas Pipe Insulation.
  - 2. Type I, 850 deg F (454 deg C) Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

## **2.2 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. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
  - 1. Products: Subject to compliance with requirements, provide the following:
    - a. Aeroflex USA, Inc.; Aeroseal.
    - b. Armacell LLC; Armaflex 520 Adhesive.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
    - d. K-Flex USA; R-373 Contact Adhesive.
  - 2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 3. Use adhesive that complies 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," including 2004 Addenda.
- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
  - 1. Products: Subject to compliance with requirements, provide the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
    - b. Eagle Bridges - Marathon Industries; 225.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
    - d. Mon-Eco Industries, Inc.; 22-25.
  - 2. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 3. Use adhesive that complies 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," including 2004 Addenda.
- D. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, provide the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
    - b. Eagle Bridges - Marathon Industries; 225.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.
    - d. Mon-Eco Industries, Inc.; 22-25.
  2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  3. Use adhesive that complies 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," including 2004 Addenda.
- E. PVC Jacket Adhesive: Compatible with PVC jacket.
1. Products: Subject to compliance with requirements, provide the following:
    - a. Dow Corning Corporation; 739, Dow Silicone.
    - b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
    - c. P.I.C. Plastics, Inc.; Welding Adhesive.
    - d. Speedline Corporation; Polyco VP Adhesive.
  2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  3. Use adhesive that complies 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," including 2004 Addenda.
  4. MASTICS
- F. 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).
- G. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.
1. Products: Subject to compliance with requirements, provide the following:

- a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
    - b. Vimasco Corporation; 749.
  2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, **0.013 perm** (**0.009 metric perm**) at **43-mil** (**1.09-mm**) dry film thickness.
  3. Service Temperature Range: **Minus 20 to plus 180 deg F** (**Minus 29 to plus 82 deg C**).
  4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
  5. Color: White.
- H. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below-ambient services.
1. Products: Subject to compliance with requirements, provide the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Encacel.
    - b. Eagle Bridges - Marathon Industries; 570.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 60-95/60-96.
  2. Water-Vapor Permeance: ASTM F 1249, **0.05 perm** (**0.033 metric perm**) at **30-mil** (**0.8-mm**) dry film thickness.
  3. Service Temperature Range: **Minus 50 to plus 220 deg F** (**Minus 46 to plus 104 deg C**).
  4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
  5. Color: White.
  6. SEALANTS
- I. Joint Sealants:
1. Joint Sealants for Cellular-Glass, Phenolic, and Polyisocyanurate Products: Subject to compliance with requirements, provide the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
    - b. Eagle Bridges - Marathon Industries; 405.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-45.
    - d. Mon-Eco Industries, Inc.; 44-05.
    - e. Pittsburgh Corning Corporation; Pittseal 444.
  2. Materials shall be compatible with insulation materials, jackets, and substrates.
  3. Permanently flexible, elastomeric sealant.

4. Service Temperature Range: **Minus 100 to plus 300 deg F (Minus 73 to plus 149 deg C).**
5. Color: White or gray.
6. For indoor applications, use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Use sealants that 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," including 2004 Addenda.

J. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide the following:
  - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
  - b. Eagle Bridges - Marathon Industries; 405.
  - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
  - d. Mon-Eco Industries, Inc.; 44-05.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: **Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).**
5. Color: Aluminum.
6. For indoor applications, use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Use sealants that 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," including 2004 Addenda.

K. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide the following:
  - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: **Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).**
5. Color: White.

6. For indoor applications, use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  7. Use sealants that 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," including 2004 Addenda.
  8. FIELD-APPLIED FABRIC-REINFORCING MESH
- L. Woven Glass-Fiber Fabric: Approximately 2 oz./sq. yd. (68 g/sq. m) with a thread count of 10 strands by 10 strands/sq. in. (4 strands by 4 strands/sq. mm) for covering pipe and pipe fittings.
1. Products: Subject to compliance with requirements, provide the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Chil-Glas Number 10.

## 2.3 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
  - B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
  - C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
1. Products: Subject to compliance with requirements, provide the following:
    - a. Johns Manville; Zeston.
    - b. P.I.C. Plastics, Inc.; FG Series.
    - c. Proto Corporation; LoSmoke.
    - d. Speedline Corporation; SmokeSafe.
  2. Adhesive: As recommended by jacket material manufacturer.
  3. Color: Color-code jackets based on system. Color as indicated.
  4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
    - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
    - b. Metal Jacket:



5. Products: Subject to compliance with requirements, provide one of the following:
  - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
  - b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
  - c. RPR Products, Inc.; Insul-Mate.
6. Aluminum Jacket: Comply with **ASTM B 209** (**ASTM B 209M**), Alloy 3003, 3005, 3105, or 5005, Temper H-14.
  - a. Sheet and roll stock ready for shop or field sizing.
  - b. Finish and thickness are indicated in field-applied jacket schedules.
  - c. Moisture Barrier for Indoor Applications: **3-mil-** (**0.075-mm-**) thick, heat-bonded polyethylene and kraft paper
  - d. Moisture Barrier for Outdoor Applications: **3-mil-** (**0.075-mm-**) thick, heat-bonded polyethylene and kraft paper.
  - e. Factory-Fabricated Fitting Covers:
    - 1) Same material, finish, and thickness as jacket.
    - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
    - 3) Tee covers.
    - 4) Flange and union covers.
    - 5) End caps.
    - 6) Beveled collars.
    - 7) Valve covers.
    - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

## 2.4 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
  1. Products: Subject to compliance with requirements, provide the following:
    - a. ABI, Ideal Tape Division; 428 AWF ASJ.
    - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
    - c. Compac Corporation; 104 and 105.
    - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
  2. Width: **3 inches** (**75 mm**).
  3. Thickness: **11.5 mils** (**0.29 mm**).

4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
8. SECUREMENTS

B. Bands:

1. Products: Subject to compliance with requirements, provide the following:
  - a. ITW Insulation Systems; Gerrard Strapping and Seals.
  - b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.
2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch (0.38 mm) thick, 1/2 inch (13 mm) wide with wing seal or closed seal.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.

D. Wire: 0.062-inch (1.6-mm) soft-annealed, stainless steel.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. C & F Wire.

## PART 3 - EXECUTION

### 3.1 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.
  3. Proceed with installation only after unsatisfactory conditions have been corrected.
  4. PREPARATION
- B. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- C. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Carbon Steel: Coat carbon steel operating at a service temperature between **32 and 300 deg F (0 and 149 deg C)** with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- D. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- E. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

### **3.2 GENERAL INSTALLATION REQUIREMENTS**

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe 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. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. 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.
  4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
1. Draw jacket tight and smooth.
  2. Cover circumferential joints with **3-inch- (75-mm-)** wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced **4 inches (100 mm)** o.c.
  3. Overlap jacket longitudinal seams at least **1-1/2 inches (38 mm)**. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at **2 inches (50 mm)** 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 pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least **4 inches (100 mm)** beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above-ambient services, do not install insulation to the following:
1. Vibration-control devices.
  2. Testing agency labels and stamps.
  3. Nameplates and data plates.
  4. Manholes.
  5. Handholes.

6. Cleanouts.
  7. PENETRATIONS
- Q. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  3. Extend jacket of outdoor insulation outside roof flashing at least **2 inches (50 mm)** below top of roof flashing.
  4. Seal jacket to roof flashing with flashing sealant.
- R. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least **2 inches (50 mm)**.
  4. Seal jacket to wall flashing with flashing sealant.
- S. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- T. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
1. Comply with requirements in Division 07 Section "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- U. Insulation Installation at Floor Penetrations:
1. Pipe: Install insulation continuously through floor penetrations.
  2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."
  3. GENERAL PIPE INSULATION INSTALLATION
- V. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

**W. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:**

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

- X. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- Y. Install removable insulation covers at locations indicated. Installation shall conform to the following:
  - 1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
  - 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
  - 3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
  - 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least **2 inches (50 mm)** over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
  - 5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.
  - 6. INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION
- Z. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- AA. Insulation Installation on Pipe Flanges:
  - 1. Install pipe insulation to outer diameter of pipe flange.
  - 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
  - 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
  - 4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- BB. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

CC. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
5. INSTALLATION OF MINERAL-FIBER INSULATION

DD. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at **6 inches (150 mm)** o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

EE. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least **1 inch (25 mm)**, and seal joints with flashing sealant.

FF. Insulation Installation on Pipe Fittings and Elbows:



1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

GG. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.
5. FIELD-APPLIED JACKET INSTALLATION

HH. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch (50-mm) overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- (1.6-mm-) thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

II. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch (38-mm) laps at longitudinal seams and 3-inch- (75-mm-) wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

JJ. Where PVC jackets are indicated, install with 1-inch (25-mm) overlap at longitudinal seams and end joints; for horizontal applications. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

KK. Where metal jackets are indicated, install with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints

with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands **12 inches (300 mm)** o.c. and at end joints.

### **3.3 FINISHES**

- A. Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.
  - 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
    - a. Finish Coat Material: Interior, flat, latex-emulsion size.
    - b. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- B. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- C. Do not field paint aluminum or stainless-steel jackets.

### **3.4 FIELD QUALITY CONTROL**

- A. Perform tests and inspections.
- B. Tests and Inspections:
  - 1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

### **3.5 PIPING INSULATION SCHEDULE, GENERAL**

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
1. Drainage piping located in crawl spaces.
  2. Underground piping.
  3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

### 3.6 INDOOR PIPING INSULATION SCHEDULE

- A. Condensate and Equipment Drain:
1. All Pipe Sizes: Insulation shall be the following:
    - a. Flexible Elastomeric: **3/4 inch** thick.
    - b. Indirect drain (for HVAC condensate):
  2. All Pipe Sizes: Insulation shall be the following:
    - a. Flexible Elastomeric: **3/4 inch** thick.
- B. Refrigerant Suction and Hot-Gas Piping:
1. All Pipe Sizes: Insulation shall be the following:
    - a. Flexible Elastomeric: **1 inch** thick.
    - b. VRF System Refrigerant Piping (all):
  2. All Pipe Sizes: Insulation shall be the following:
    - a. Flexible Elastomeric: **3/4 inch** thick.
    - b. Domestic cold water:
  3. All Pipe Sizes: Insulation shall be the following:
    - a. Flexible Elastomeric: **3/4 inch (19 mm)** thick.
    - b. Storm Drain Piping:
  4. All Pipe Sizes: Insulation shall be the following:
    - a. Flexible Elastomeric: **3/4 inch (19 mm)** thick.

### 3.7 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

- A. Refrigerant Piping:
1. All Pipe Sizes: Insulation shall be the following:
    - a. Flexible Elastomeric: **1 inches (50 mm)** thick.

### **3.8 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE**

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. Refrigerant Piping, Exposed:
  - 1. Aluminum, Smooth with Z-Shaped Locking Seam: **0.032 inch** thick.

**END OF SECTION 230719**

## **SECTION 230800 - COMMISSIONING OF HVAC AND PLUMBING SYSTEMS**

### **PART 1 – GENERAL**

#### **1.01. 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.

#### **1.02. SUMMARY**

- A. This section includes commissioning process requirements for Mechanical and Plumbing systems, assemblies, and equipment.
- B. Related Sections: Edit As Required.
  - 1. Division 01 Section 019113 "Commissioning Requirements" for general commissioning process requirements.

#### **1.03. DESCRIPTION**

- A. Refer to Division 01 Section 019113 "Commissioning Requirements" for the description of commissioning.

#### **1.04. DEFINITIONS**

- A. Refer to Division 01 Section 019113 "Commissioning Requirements" for definitions.

#### **1.05. SUBMITTALS**

- A. Refer to Division 01 Section 019113 "Commissioning Requirements" for CxA's role.
- B. Refer to Division 01 Section 013300 "Submittal Procedures" for specific requirements.
- C. In addition, provide the following:
  - 1. Certificates of readiness
  - 2. Certificates of completion of installation, prestart, and startup activities.
  - 3. O&M manuals

4. Test reports

D. Control Drawings Submittal

1. The control drawings shall have a key to all abbreviations.
2. The control drawings shall contain graphic schematic depictions of the systems and each component.
3. The schematics will include the system and component layout of any equipment that the control system monitors, enables or controls, even if the equipment is primarily controlled by packaged or integral controls.
4. Provide a full points list with at least the following included for each point:
  - a. Controlled system
  - b. Point abbreviation
  - c. Point description
  - d. Display unit
  - e. Control point or set point (Yes / No)
  - f. Monitoring point (Yes / No)
  - g. Intermediate point (Yes / No)
  - h. Calculated point (Yes / No)
  - i.

**1.06. QUALITY ASSURANCE**

- A. Test Equipment Calibration Requirements: Contractors will comply with test manufacturer's calibration procedures and intervals. Recalibrate test instruments immediately after instruments have been repaired resulting from being dropped or damaged. Affix calibration tags to test instruments. Furnish calibration records to CxA upon request.

**1.07. COORDINATION**

- A. Refer to Division 01 Section 019113 "Commissioning Requirements" for requirements pertaining to coordination during the commissioning process.

**PART 2 – PRODUCTS**

**2.01. TEST EQUIPMENT**

- A. All standard testing equipment required to perform startup, initial checkout and functional performance testing shall be provided by the Contractor for the equipment being tested. For example, the mechanical contractor of Division 23 shall ultimately be responsible for

all standard testing equipment for the HVAC&R system and controls system in Division 23, except for equipment specific to and used by TAB in their commissioning responsibilities. A sufficient quantity of two-way radios shall be provided by each subcontractor.

- B. Special equipment, tools and instruments (specific to a piece of equipment and only available from vendor) required for testing shall be included in the base bid price to the Owner and left on site, except for stand-alone data logging equipment that may be used by the CxA.
- C. Proprietary test equipment and software required by any equipment manufacturer for programming and/or start-up, whether specified or not, shall be provided by the manufacturer of the equipment. Manufacturer shall provide the test equipment, demonstrate its use, and assist in the commissioning process as needed. Proprietary test equipment (and software) shall become the property of the Owner upon completion of the commissioning process.
- D. Data logging equipment and software required to test equipment will be provided by the CxA, but shall not become the property of the Owner.
- E. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified in the Specifications. If not otherwise noted, the following minimum requirements apply: Temperature sensors and digital thermometers shall have a certified calibration within the past year to an accuracy of 0.5°F and a resolution of + or - 0.1°F. Pressure sensors shall have an accuracy of + or - 2.0% of the value range being measured (not full range of meter) and have been calibrated within the last year.

## **PART 3 – EXECUTION**

### **3.01. GENERAL DOCUMENTATION REQUIREMENTS**

- A. With assistance from the installing contractors, the CxA will prepare Pre-Functional Checklists for all commissioned components, equipment, and systems
- B. Red-lined Drawings:
  - 1. The contractor will verify all equipment, systems, instrumentation, wiring and components are shown correctly on red-lined drawings.
  - 2. Preliminary red-lined drawings must be made available to the Commissioning Team for use prior to the start of Functional Performance Testing.
  - 3. Changes, as a result of Functional Testing, must be incorporated into the final as-built drawings, which will be created from the red-lined drawings.
  - 4. The contracted party, as defined in the Contract Documents will create the as-built drawings.
- C. Operation and Maintenance Data:

1. Contractor will provide a copy of O&M literature within 45 days of each submittal acceptance for use during the commissioning process for all commissioned equipment and systems.
2. The CxA will review the O&M literature once for conformance to project requirements.
3. The CxA will receive a copy of the final approved O&M literature once corrections have been made by the Contractor.

**D. Demonstration and Training:**

1. Contractor will provide demonstration and training as required by the specifications.
2. A complete training plan and schedule must be submitted by the contractor to the CxA four weeks (4) prior to any training.
3. A training agenda for each training session must be submitted to the CxA one (1) week prior the training session.
4. The CxA shall be notified at least 72 hours in advance of scheduled tests so that testing may be observed by the CxA and Owner's representative. A copy of the test record shall be provided to the CxA, Owner, and Architect.
5. Engage a Factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain specific equipment.
6. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, trouble shooting, servicing, and maintaining equipment.
7. Review data in O&M Manuals.

**E. Systems manual requirements: Remove if Systems manual is not required.**

1. The Systems Manual is intended to be a usable information resource containing all of the information related to the systems, assemblies, and Commissioning Process in one place with indexes and cross references.
2. The GC shall include final approved versions of the following information for the Systems Manual:
  - a. As-Built System Schematics
  - b. Verified Record Drawings
  - c. Test Results (not otherwise included in Cx Record)
  - d. Periodic Maintenance Information for computer maintenance management system
  - e. Recommendations for recalibration frequency of sensors and actuators
  - f. A list of contractors, subcontractors, suppliers, architects, and engineers involved in the project along with their contact information
  - g. Training Records, Information on training provided, attendees list, and any on-going training



3. This information shall be organized and arranged by building system, such as fire alarm, chilled water, heating hot water, etc.
4. Information should be provided in an electronic version to the extent possible. Legible, scanned images are acceptable for non-electronic documentation to facilitate this deliverable.

### **3.02. CONTRACTOR'S RESPONSIBILITIES**

- A. Mechanical, Controls and TAB Contractors. The commissioning responsibilities applicable to each of the mechanical, controls and TAB contractors of Division 23 are as follows (all references apply to commissioned equipment only):
- B. Perform commissioning tests to demonstrate system's performance conforms to specified criteria.
- C. Attend construction phase controls coordination meetings.
- D. Attend testing, adjusting, and balancing review and coordination meetings.
- E. Participate in HVAC&R systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CxA.
- F. Provide information requested by the CxA for final commissioning documentation.
- G. Include requirements for submittal data, operation and maintenance data, and training in each purchase order or sub-contract written.
- H. Prepare preliminary schedule for Mechanical system orientations and inspections, operation and maintenance manual submissions, training sessions, pipe and duct system testing, flushing and cleaning, equipment start-up, testing and balancing and task completion for owner. Distribute preliminary schedule to commissioning team members.
- I. Update schedule as required throughout the construction period.
- J. During the startup and initial checkout process, execute the related portions of the prefunctional checklists for all commissioned equipment.
- K. Assist the CxA in all verification and functional performance tests.
- L. Gather operation and maintenance literature on all equipment, and assemble in binders as required by the specifications. Submit to CxA (45) days after submittal acceptance.
- M. Coordinate with the CxA to provide (48) hour advance notice so that the witnessing of equipment and system start-up and testing can begin.
- N. Notify the CxA a minimum of (2) weeks in advance of the time for start of the testing and balancing work. Attend the initial testing and balancing meeting for review of the official testing and balancing procedures.
- O. Participate in, and schedule vendors and contractors to participate in the training sessions.
- P. Provide written notification to the CM/GC and CxA Authority that the following work has been completed in accordance with the contract documents, and that the equipment,

systems, and sub-system are operating as required.

1. HVAC&R equipment including all fans, air handling units, ductwork, dampers, terminals, and all other equipment furnished under this Division.
  2. Fire stopping in the fire rated construction, including fire and smoke damper installation, caulking, gasketing and sealing of smoke barriers.
  3. Fire detection and smoke detection devices installed by the HVAC contractor.
- Q. The equipment supplier shall document the performance of his equipment.
- R. Provide a complete set of red-lined drawings to the CxA prior to the start of Functional Performance Testing.
- S. Test, Adjust and Balance Contractor
1. Attend initial commissioning coordination meeting scheduled by the Commissioning Authority.
  2. Submit the site specific testing and balancing plan to the CxA and AE for review and acceptance.
  3. Attend the testing and balancing review meeting scheduled by the CxA. Be prepared to discuss the procedures that shall be followed in testing, adjusting, and balancing the HVAC&R system.
  4. At the completion of the testing and balancing work, and the submittal of the final testing and balancing report, notify the HVAC&R contractor and the CM/GC.
  5. At the completion of testing and balancing work, and the submittal of the final testing and balancing report, notify the HVAC&R Contractor and the CM/GC.
  6. Participate in verification of the testing and balancing report, which will consist of repeating measurements contained in the testing and balancing reports. Assist in diagnostic purposes when directed.
- T. Provide training of the Owner's operating staff using expert qualified personnel, as specified.
- U. Equipment Suppliers.
1. Provide all requested submittal data, including detailed start-up procedures and specific responsibilities of the Owner, to keep warranties in force.
  2. Assist in equipment testing per agreements with contractors.
  3. Provide information requested by CxA regarding equipment sequence of operation and testing procedures.
- V. Refer to Division 01 Section 019113 "Commissioning Requirements" for additional contractor responsibilities.

### **3.03. OWNER'S RESPONSIBILITIES**

- A. Refer to Division 01 Section 019113 "Commissioning Requirements" for Owner's Responsibilities.

### **3.04. DESIGN PROFESSIONAL'S RESPONSIBILITIES**

- A. Refer to Division 01 Section 019113 "Commissioning Requirements" for Design Professional's Responsibilities.

### **3.05. CxA'S RESPONSIBILITIES**

- A. Refer to Division 01 Section 019113 "Commissioning Requirements" for CxA's Responsibilities.

### **3.06. TESTING PREPARATION**

- A. Certify in writing to the CxA that HVAC&R systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.
- B. Certify in writing to the CxA that HVAC&R instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.
- C. Certify in writing that testing, adjusting, and balancing procedures have been completed and that testing, adjusting, and balancing reports have been submitted, discrepancies corrected, and corrective work approved.
- D. Place systems, subsystems, and equipment into operating mode (modes) to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).
- E. Inspect and verify the position of each device and interlock identified on checklists.
- F. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.
- G. Testing Instrumentation: Install temporary measuring instruments and logging devices as necessary.

### **3.07. TESTING, ADJUSTING AND BALANCING VERIFICATION**

- A. Prior to performance of Testing, Adjusting and Balancing work, provide copies of sample reports, sample forms, checklists, and certificates to the CxA.
- B. Notify the CxA at least ten (10) days in advance of testing and balancing Work, and provide access for the CxA to witness testing and balancing Work.
- C. Provide technicians, instrumentation, and tools to verify testing and balancing of HVAC&R systems at the direction of the CxA.

1. The CxA will notify testing and balancing subcontractor ten (10) days in advance of the date of field verification. Notice will not include data points to be verified.
2. The testing and balancing subcontractor shall use the same instruments (by model and serial number) that were used when original data were collected.
3. Failure of an item includes, other than sound, a deviation of more than 10 percent. Failure of more than 10 percent of selected items shall result in rejection of final testing, adjusting, and balancing report. If sound pressure readings are part of the TAB scope of work, a deviation of 3 dB shall result in rejection of final testing. Variations in background noise must be considered.
4. Remedy the deficiency and notify the CxA so verification of failed portions can be performed.

### **3.08. GENERAL TESTING REQUIREMENTS**

- A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.
- B. Scope of HVAC&R testing shall include entire HVAC&R installation, from central equipment for heat generation and refrigeration through distribution systems to each conditioned space. Testing shall include measuring capacities and effectiveness of operational and control functions.
- C. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.
- D. The CxA along with the HVAC&R contractor, testing and balancing Subcontractor, and HVAC&R Instrumentation and Control Subcontractor shall prepare detailed testing plans, procedures, and checklists for HVAC&R systems, subsystems, and equipment.
- E. Tests will be performed using design conditions whenever possible.
- F. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the CxA and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.
- G. The CxA may direct that set points be altered when simulating conditions is not practical.
- H. The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.
- I. If tests cannot be completed because of a deficiency outside the scope of the HVAC&R system, document the deficiency and report it to the Owner.
- J. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

### **3.09. HVAC&R SYSTEMS, SUBSYSTEMS, AND EQUIPMENT TESTING PROCEDURES**

- A. Equipment Testing and Acceptance Procedures: Testing requirements are specified in individual Division 23 sections. Provide submittals, test data, inspector record, and certifications to the CxA.
- B. HVAC&R Instrumentation and Control System Testing: Field testing plans and testing requirements are specified in Division 23 Sections "Instrumentation and Control for HVAC" and on the MI700 series Control Drawings with "Sequence of Operations for HVAC Controls." Assist the CxA with preparation of testing plans.
- C. Pipe system cleaning, flushing, hydrostatic tests, and chemical treatment: Test requirements are specified in Division 23 piping Sections. HVAC&R Contractor shall prepare a pipe system cleaning, flushing, and hydrostatic testing plan. Provide cleaning, flushing, testing, and treating plan and final reports to the CxA. Plan shall include the following:
  - 1. Sequence of testing and testing procedures for each section of pipe to be tested, identified by pipe zone or sector identification marker. Markers shall be keyed to Drawings for each pipe sector, showing the physical location of each designated pipe test section. Drawings keyed to pipe zones or sectors shall be formatted to allow each section of piping to be physically located and identified when referred to in pipe system cleaning, flushing, hydrostatic testing, and chemical treatment plan.
  - 2. Description of equipment for flushing operations.
  - 3. Minimum flushing water velocity.
  - 4. Tracking checklist for managing and ensuring that all pipe sections have been cleaned, flushed, hydrostatically tested, and chemically treated.
- D. Refrigeration System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of chillers, cooling towers, refrigerant compressors and condensers, heat pumps, and other refrigeration systems. The CxA shall determine the sequence of testing and testing procedures for each equipment item and pipe section to be tested.
- E. HVAC&R Distribution System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of air, steam, and hydronic distribution systems; special exhaust; and other distribution systems, including HVAC&R terminal equipment and unitary equipment.
- F. Vibration and Sound Tests: Provide technicians, instrumentation, tools, and equipment to test performance of vibration isolation.
- G. The work included in the commissioning process involves a complete and thorough evaluation of the operation and performance of all components, systems and subsystems. The following equipment and systems shall be evaluated:
  - 1. Air Handling Unit – DOAS with energy recovery
  - 2. Building Automation System (see below)

3. Computer Room AC
4. Ductwork
5. Terminal Unit
6. Testing, Adjusting and Balancing
7. VFD,s
8. VRF Systems

**3.10. DEFICIENCIES/NON-CONFORMANCE, COST OF RETESTING, FAILURE DUE TO MANUFACTURER DEFECT**

- A. Refer to Division 01 Section 019113 "Commissioning Requirements" for requirements pertaining to deficiencies/non-conformance, cost of retesting, or failure due to manufacturer defect.

**3.11. APPROVAL**

- A. Refer to Division 01 Section 019113 "Commissioning Requirements" for approval procedures.

**3.12. DEFERRED TESTING**

- A. Refer to Division 01 Section 019113 "Commissioning Requirements" for requirements pertaining to deferred testing.

**3.13. OPERATION AND MAINTENANCE MANUALS**

- A. The Operation and Maintenance Manuals shall conform to Contract Documents requirements as stated in Division 01.
- B. Refer to Division 01 Section 019113 "Commissioning Requirements" for the AE and CxA roles in the Operation and Maintenance Manual contribution, review and approval process.
- C. An updated as-built version of the control drawings and sequences of operation shall be included in the final controls O&M manual submittal.

**3.14. TRAINING OF OWNER PERSONNEL**

- A. Refer to Division 01 Section 019113 "Commissioning Requirements" for requirements pertaining to training.
- B. Mechanical Contractor. The mechanical contractor shall have the following training responsibilities:
  1. Provide the CxA with a training plan two weeks before the planned training.

2. Provide designated Owner personnel with comprehensive orientation and training in the understanding of the systems and the operation and maintenance of each piece of HVAC equipment including, but not limited to, all HVAC equipment (ex. pumps, heat exchangers, chillers, heat rejection equipment, air conditioning units, air handling units, fans, terminal units, controls and water treatment systems, etc.)
3. Training shall normally start with classroom sessions followed by hands-on training on each piece of equipment, which shall illustrate the various modes of operation, including startup, shutdown, fire/smoke alarm, power failure, etc.
4. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.
5. The appropriate trade or manufacturer's representative shall provide the instructions on each major piece of equipment. This person may be the start-up technician for the piece of equipment, the installing contractor or manufacturer's representative. Practical building operating expertise as well as in-depth knowledge of all modes of operation of the specific piece of equipment are required. More than one party may be required to execute the training.
6. The controls contractor shall attend sessions other than the controls training, as requested, to discuss the interaction of the controls system as it relates to the equipment being discussed.
7. The training sessions shall follow the outline in the Table of Contents of the operation and maintenance manual and illustrate whenever possible the use of the O&M manuals for reference.
8. Training shall include:
  - a. Use of the printed installation, operation and maintenance instruction material included in the O&M manuals.
  - b. A review of the written O&M instructions emphasizing safe and proper operating requirements, preventative maintenance, special tools needed and spare parts inventory suggestions. The training shall include start-up, operation in all modes possible, shut-down, seasonal changeover and any emergency procedures.
  - c. Discussion of relevant health and safety issues and concerns.
  - d. Discussion of warranties and guarantees.
  - e. Common troubleshooting problems and solutions.
  - f. Explanatory information included in the O&M manuals and the location of all plans and manuals in the facility.
  - g. Discussion of any peculiarities of equipment installation or operation.
  - h. The format and training agenda in The HVAC Commissioning Process, ASHRAE Guideline 1-2007, is recommended.
9. Hands-on training shall include start-up, operation in all modes possible, including

- manual, shut-down and any emergency procedures and preventative maintenance for all pieces of equipment.
10. The mechanical contractor shall fully explain and demonstrate the operation, function and overrides of any local packaged controls, not controlled by the central control system.
  11. Training shall occur after functional testing is complete, unless approved otherwise by the Owner.
  12. Air filter locations and replacement procedures.
- C. Controls Contractor. The controls contractor shall have the following training responsibilities:
1. Provide the CxA and AE with a training plan four weeks before the planned training.
  2. The controls contractor shall provide designated Owner personnel training on the control system in this facility. The intent is to clearly and completely instruct the Owner on all the capabilities of the control system.
  3. Training manuals. The standard operating manual for the system and any special training manuals will be provided for each trainee, with three extra copies left for the O&M manuals. In addition, copies of the system technical manual will be demonstrated during training and three copies submitted with the O&M manuals. Manuals shall include detailed description of the subject matter for each session. The manuals will cover all control sequences and have a definitions section that fully describes all relevant words used in the manuals and in all software displays. Manuals will be approved by the CxA and AE. Copies of audiovisuals shall be delivered to the Owner.
  4. The trainings will be tailored to the needs and skill-level of the trainees.
  5. The trainers will be knowledgeable on the system and its use in buildings. For the on-site sessions, the most qualified trainer(s) will be used. The Owner shall approve the instructor prior to scheduling the training.
  6. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.
  7. The controls contractor shall attend sessions other than the controls training, as requested, to discuss the interaction of the controls system as it relates to the equipment being discussed.
  8. There shall be three (3) training sessions:
    - a. Training I. Control System. The first training shall consist of 8 hours of actual training. This training may be held on-site or in the supplier's facility. If held off-site, the training may occur prior to final completion of the system installation. Upon completion, each student, using appropriate documentation, should be able to perform elementary operations and describe general hardware architecture and functionality of the system.



- b. Training II. Building Systems. The second session shall be held on-site for a period of 8 hours of actual hands-on training after the completion of system commissioning. The session shall include instruction on:
  - 1) Specific hardware configuration of installed systems in this building and specific instruction for operating the installed system, including HVAC systems, lighting controls and any interface with security and communication systems.
  - 2) Security levels, alarms, system start-up, shut-down, power outage and restart routines, changing set points and alarms and other typical changed parameters, overrides, freeze protection, manual operation of equipment, optional control strategies that can be considered, energy savings strategies and set points that if changed will adversely affect energy consumption, energy accounting, procedures for obtaining vendor assistance, etc.
  - 3) All trending and monitoring features (values, change of state, totalization, etc.), including setting up, executing, downloading, viewing both tabular and graphically and printing trends. Trainees will actually set-up trends in the presence of the trainer.
  - 4) Every screen shall be completely discussed, allowing time for questions.
  - 5) Use of keypad or plug-in laptop computer at the zone level.
  - 6) Use of remote access to the system via phone lines or networks.
  - 7) Setting up and changing an air terminal unit controller.
  - 8) Graphics generation
  - 9) Point database entry and modifications
  - 10) Understanding DDC field panel operating programming (when applicable)
- c. Training III. The third training will be conducted on-site six months after occupancy and consist of 8 hours of training. The session will be structured to address specific topics that trainees need to discuss and to answer questions concerning operation of the system.

D. TAB. The TAB contractor shall have the following training responsibilities:

- 1. TAB shall meet for 4 hours with facility staff after completion of TAB and instruct them on the following:
  - a. Go over the final TAB report, explaining the layout and meanings of each data type.
  - b. Discuss any outstanding deficient items in control, ducting or design that may affect the proper delivery of air or water.
  - c. Identify and discuss any terminal units, duct runs, diffusers, coils, fans and pumps that are close to or are not meeting their design capacity.

- d. Discuss any temporary settings and steps to finalize them for any areas that are not finished.
- e. Other salient information that may be useful for facility operations, relative to TAB.

**END OF SECTION 230800**

## SECTION 230900 - INSTRUMENTATION AND CONTROL FOR HVAC

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Requirements of the Government's Solicitation and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.
- B. DDC Control system shall be fully compatible with the existing Building BAS and base-wide automation system: Johnson Controls. Provide interface with new VRF system controls and equipment.
- C. Controls for new VRF system equipment shall be seamlessly integrated into the existing LG VRF system.

#### 1.3 DEFINITIONS

- A. DDC: Direct digital control.
- B. I/O: Input/output.
- C. LonWorks: A control network technology platform for designing and implementing interoperable control devices and networks.
- D. MS/TP: Master slave/token passing.
- E. PC: Personal computer.
- F. PID: Proportional plus integral plus derivative.
- G. RTD: Resistance temperature detector.

#### 1.4 SYSTEM PERFORMANCE

- A. Comply with the following performance requirements:

1. Graphic Display: Display graphic with minimum 20 dynamic points with current data within 10 seconds.
2. Graphic Refresh: Update graphic with minimum 20 dynamic points with current data within 8 seconds.
3. Object Command: Reaction time of less than two seconds between operator command of a binary object and device reaction.
4. Object Scan: Transmit change of state and change of analog values to control units or workstation within six seconds.
5. Alarm Response Time: Annunciate alarm at workstation within 45 seconds. Multiple workstations must receive alarms within five seconds of each other.
6. Program Execution Frequency: Run capability of applications as often as five seconds, but selected consistent with mechanical process under control.
7. Performance: Programmable controllers shall execute DDC PID control loops, and scan and update process values and outputs at least once per second.
8. Reporting Accuracy and Stability of Control: Report values and maintain measured variables within tolerances as follows:
  - a. Space Temperature: Plus or minus 1 deg F (0.5 deg C).
  - b. Ducted Air Temperature: Plus or minus 1 deg F (0.5 deg C).
  - c. Outside Air Temperature: Plus or minus 2 deg F (1.0 deg C).
  - d. Dew Point Temperature: Plus or minus 3 deg F (1.5 deg C).
  - e. Relative Humidity: Plus or minus 5 percent.

**1.5 SEQUENCE OF OPERATION – SEE DRAWINGS.**

**1.6 SUBMITTALS**

- A. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.
  1. DDC System Hardware: Bill of materials of equipment indicating quantity, manufacturer, and model number. Include technical data for operator workstation equipment, interface equipment, control units, transducers/transmitters, sensors, actuators, valves, relays/switches, control panels, and operator interface equipment.
  2. Control System Software: Include technical data for operating system software, operator interface, color graphics, and other third-party applications.
  3. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.

- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
1. Bill of materials of equipment indicating quantity, manufacturer, and model number.
  2. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
  3. Wiring Diagrams: Power, signal, and control wiring.
  4. Details of control panel faces, including controls, instruments, and labeling.
  5. Written description of sequence of operation.
  6. Schedule of dampers including size, leakage, and flow characteristics.
  7. Schedule of valves including flow characteristics.
  8. DDC System Hardware:
    - a. Wiring diagrams for control units with termination numbers.
    - b. Schematic diagrams and floor plans for field sensors and control hardware.
    - c. Schematic diagrams for control, communication, and power wiring, showing trunk data conductors and wiring between operator workstation and control unit locations.
  9. Control System Software: List of color graphics indicating monitored systems, data (connected and calculated) point addresses, output schedule, and operator notations.
  10. Controlled Systems:
    - a. Schematic diagrams of each controlled system with control points labeled and control elements graphically shown, with wiring.
    - b. Scaled drawings showing mounting, routing, and wiring of elements including bases and special construction.
    - c. Written description of sequence of operation including schematic diagram.
    - d. Points list.
- C. Data Communications Protocol Certificates: Certify that each proposed DDC system component complies with ASHRAE 135.
- D. Data Communications Protocol Certificates: Certify that each proposed DDC system component complies with LonWorks.
- E. Software and Firmware Operational Documentation: Include the following:
1. Software operating and upgrade manuals.
  2. Program Software Backup: On a magnetic media or compact disc, complete with data files.
  3. Device address list.

4. Printout of software application and graphic screens.
5. Software license required by and installed for DDC workstations and control systems.
- F. Software Upgrade Kit: For Government to use in modifying software to suit future systems revisions or monitoring and control revisions.
- G. Qualification Data: For Installer.
- H. Field quality-control test reports.
- I. Operation and Maintenance Data: For HVAC instrumentation and control system to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
  1. Maintenance instructions and lists of spare parts for each type of control device and compressed-air station.
  2. Interconnection wiring diagrams with identified and numbered system components and devices.
  3. Keyboard illustrations and step-by-step procedures indexed for each operator function.
  4. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
  5. Calibration records and list of set points.

#### **1.7 QUALITY ASSURANCE**

- A. Installer Qualifications: Automatic control system manufacturer's authorized representative who is trained and approved for installation of system components required for this Project.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with ASHRAE 135 for DDC system components.

#### **1.8 DELIVERY, STORAGE, AND HANDLING**

- A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to equipment manufacturer.

- B. System Software: Update to latest version of software at Project completion.

## **1.9 COORDINATION**

- A. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.
- B. Coordinate supply of conditioned electrical branch circuits for control units and operator workstation.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

### **2.2 CONTROL SYSTEM**

- A. Manufacturers:
  - 1. Johnson Controls, Inc.
- B. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, accessories, and software connected to distributed controllers operating in multiuser, multitasking environment on token-passing network and programmed to control mechanical systems. An operator workstation permits interface with the network via dynamic color graphics with each mechanical system, building floor plan, and control device depicted by point-and-click graphics.

### **2.3 DDC EQUIPMENT**

- A. Operator Workstation: Not required.
- B. Control Units: Modular, comprising processor board with programmable, nonvolatile, random-access memory; local operator access and display panel; integral interface equipment; and backup power source.

1. Units monitor or control each I/O point; process information; execute commands from other control units, devices, and operator stations; and download from or upload to operator workstation or diagnostic terminal unit.
  2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
    - a. Global communications.
    - b. Discrete/digital, analog, and pulse I/O.
    - c. Monitoring, controlling, or addressing data points.
    - d. Software applications, scheduling, and alarm processing.
    - e. Testing and developing control algorithms without disrupting field hardware and controlled environment.
  3. Standard Application Programs:
    - a. Electric Control Programs: Demand limiting, duty cycling, automatic time scheduling, start/stop time optimization, night setback/setup, on-off control with differential sequencing, staggered start, antishort cycling, PID control, DDC with fine tuning, and trend logging.
    - b. HVAC Control Programs: Optimal run time, supply-air reset, and enthalpy switchover.
    - c. Chiller Control Programs: Control function of condenser-water reset, chilled-water reset, and equipment sequencing.
    - d. Programming Application Features: Include trend point; alarm processing and messaging; weekly, monthly, and annual scheduling; energy calculations; run-time totalization; and security access.
    - e. Remote communications.
    - f. Maintenance management.
    - g. Units of Measure: Inch-pound and SI (metric).
  4. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.
  5. ASHRAE 135 Compliance: Control units shall use ASHRAE 135 protocol and communicate using ISO 8802-3 (Ethernet) datalink/physical layer protocol.
  6. LonWorks Compliance: Control units shall use LonTalk protocol and communicate using EIA/CEA 709.1 datalink/physical layer protocol.
- C. Local Control Units: Modular, comprising processor board with electronically programmable, nonvolatile, read-only memory; and backup power source.
1. Units monitor or control each I/O point, process information, and download from or upload to operator workstation or diagnostic terminal unit.
  2. Stand-alone mode control functions operate regardless of network status. Functions include the following:



- a. Global communications.
  - b. Discrete/digital, analog, and pulse I/O.
  - c. Monitoring, controlling, or addressing data points.
3. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.
4. ASHRAE 135 Compliance: Control units shall use ASHRAE 135 protocol and communicate using ISO 8802-3 (Ethernet) datalink/physical layer protocol.
5. LonWorks Compliance: Control units shall use LonTalk protocol and communicate using EIA/CEA 709.1 datalink/physical layer protocol.
- D. I/O Interface: Hardwired inputs and outputs may tie into system through controllers. Protect points so that shorting will cause no damage to controllers.
  1. Binary Inputs: Allow monitoring of on-off signals without external power.
  2. Pulse Accumulation Inputs: Accept up to 10 pulses per second.
  3. Analog Inputs: Allow monitoring of low-voltage (0- to 10-V dc), current (4 to 20 mA), or resistance signals.
  4. Binary Outputs: Provide on-off or pulsed low-voltage signal, selectable for normally open or normally closed operation.
  5. Analog Outputs: Provide modulating signal, either low voltage (0- to 10-V dc) or current (4 to 20 mA).
  6. Tri-State Outputs: Provide two coordinated binary outputs for control of three-point, floating-type electronic actuators.
  7. Universal I/Os: Provide software selectable binary or analog outputs.
- E. Power Supplies: Transformers with Class 2 current-limiting type or overcurrent protection; limit connected loads to 80 percent of rated capacity. DC power supply shall match output current and voltage requirements and be full-wave rectifier type with the following:
  1. Output ripple of 5.0 mV maximum peak to peak.
  2. Combined 1 percent line and load regulation with 100-mic.sec. response time for 50 percent load changes.
  3. Built-in overvoltage and overcurrent protection and be able to withstand 150 percent overload for at least 3 seconds without failure.
- F. Power Line Filtering: Internal or external transient voltage and surge suppression for workstations or controllers with the following:
  1. Minimum dielectric strength of 1000 V.
  2. Maximum response time of 10 nanoseconds.
  3. Minimum transverse-mode noise attenuation of 65 dB.
  4. Minimum common-mode noise attenuation of 150 dB at 40 to 100 Hz.

## **2.4 UNITARY CONTROLLERS**

- A. Unitized, capable of stand-alone operation with sufficient memory to support its operating system, database, and programming requirements, and with sufficient I/O capacity for the application.
  - 1. Configuration: Local keypad and display; diagnostic LEDs for power, communication, and processor; wiring termination to terminal strip or card connected with ribbon cable; memory with bios; and 72-hour battery backup.
  - 2. Operating System: Manage I/O communication to allow distributed controllers to share real and virtual object information and allow central monitoring and alarms. Perform automatic system diagnostics; monitor system and report failures.
  - 3. ASHRAE 135 Compliance: Communicate using read (execute and initiate) and write (execute and initiate) property services defined in ASHRAE 135. Reside on network using MS/TP datalink/physical layer protocol and have service communication port for connection to diagnostic terminal unit.
  - 4. LonWorks Compliance: Communicate using EIA/CEA 709.1 datalink/physical layer protocol using LonTalk protocol.
  - 5. Enclosure: Dustproof rated for operation at 32 to 120 deg F (0 to 50 deg C).
  - 6. Enclosure: Waterproof rated for operation at 40 to 150 deg F (5 to 65 deg C).

## **2.5 ALARM PANELS**

- A. Unitized cabinet with suitable brackets for wall or floor mounting. Fabricate of 0.06-inch- (1.5-mm-) thick, furniture-quality steel or extruded-aluminum alloy, totally enclosed, with hinged doors and keyed lock and with manufacturer's standard shop-painted finish.
- B. Indicating light for each alarm point, single horn, acknowledge switch, and test switch, mounted on hinged cover.
  - 1. Alarm Condition: Indicating light flashes and horn sounds.
  - 2. Acknowledge Switch: Horn is silent and indicating light is steady.
  - 3. Second Alarm: Horn sounds and indicating light is steady.
  - 4. Alarm Condition Cleared: System is reset and indicating light is extinguished.
  - 5. Contacts in alarm panel allow remote monitoring by independent alarm company.

## **2.6 ELECTRONIC SENSORS**

- A. Description: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.

**B. Thermistor Temperature Sensors and Transmitters:**

1. Accuracy: Plus or minus 0.5 deg F (0.3 deg C) at calibration point.
2. Wire: Twisted, shielded-pair cable.
3. Insertion Elements in Ducts: Single point, 18 inches (460 mm) long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft. (0.84 sq. m).
4. Averaging Elements in Ducts: 72 inches (1830 mm) long, flexible ; use where prone to temperature stratification or where ducts are larger than 10 sq. ft. (1 sq. m).
5. Insertion Elements for Liquids: Brass or stainless-steel socket with minimum insertion length of 2-1/2 inches (64 mm).
6. Room Sensor Cover Construction: Manufacturer's standard locking covers.
  - a. Set-Point Adjustment: Exposed.
  - b. Set-Point Indication: Exposed.
  - c. Thermometer: None.
7. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
8. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.

**C. RTDs and Transmitters:**

1. Accuracy: Plus or minus 0.2 percent at calibration point.
2. Wire: Twisted, shielded-pair cable.
3. Insertion Elements in Ducts: Single point, 18 inches (460 mm) long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft. (0.84 sq. m).
4. Averaging Elements in Ducts: 48 inches (1200 mm) long, rigid; use where prone to temperature stratification or where ducts are larger than 9 sq. ft. (0.84 sq. m); length as required.
5. Insertion Elements for Liquids: Brass socket with minimum insertion length of 2-1/2 inches (64 mm).
6. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
7. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.

**D. Humidity Sensors: Bulk polymer sensor element.**

1. Accuracy: 5 percent full range with linear output.
2. Room Sensor Range: 20 to 80 percent relative humidity.
3. Duct Sensor: 20 to 80 percent relative humidity range with element guard and mounting plate.

4. Outside-Air Sensor: 20 to 80 percent relative humidity range with mounting enclosure, suitable for operation at outdoor temperatures of minus 22 to plus 185 deg F (minus 30 to plus 85 deg C).
5. Duct and Sensors: With element guard and mounting plate, range of 0 to 100 percent relative humidity.

E. Room Temperature Sensor Cover Construction:

1. Set-Point Adjustment: Exposed.
2. Set-Point Indication: Exposed.

F. Room sensor accessories include the following:

1. Insulating Bases: For sensors located on exterior walls.
2. Adjusting Key: As required for calibration and cover screws.

## 2.7 STATUS SENSORS

- A. Status Inputs for Fans: Differential-pressure switch with pilot-duty rating and with adjustable range of 0- to 5-inch wg (0 to 1240 Pa).
- B. Status Inputs for Electric Motors: Comply with ISA 50.00.01, current-sensing fixed- or split-core transformers with self-powered transmitter, adjustable and suitable for 175 percent of rated motor current.
- C. Voltage Transmitter (100- to 600-V ac): Comply with ISA 50.00.01, single-loop, self-powered transmitter, adjustable, with suitable range and 1 percent full-scale accuracy.
- D. Current Switches: Self-powered, solid-state with adjustable trip current, selected to match current and system output requirements.

## 2.8 THERMOSTATS

- A. Combination Thermostat and Fan Switches: Line-voltage thermostat with push-button or lever-operated fan switch.
  1. Label switches "FAN ON-OFF-AUTO".
  2. Mount on single electric switch box.
- B. Low-Voltage, On-Off Thermostats: NEMA DC 3, 24-V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater, concealed set-point adjustment, 55 to 85 deg F (13 to 30 deg C) set-point range, and 2 deg F (1 deg C) maximum differential.

- C. Line-Voltage, On-Off Thermostats: Bimetal-actuated, open contact or bellows-actuated, enclosed, snap-switch or equivalent solid-state type, with heat anticipator; listed for electrical rating; with concealed set-point adjustment, 55 to 85 deg F (13 to 30 deg C) set-point range, and 2 deg F (1 deg C) maximum differential.
  - 1. Electric Heating Thermostats: Equip with off position on dial wired to break ungrounded conductors.
  - 2. Selector Switch: Integral, manual on-off-auto.
- D. Immersion Thermostat: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range and adjustable set point.
- E. Airstream Thermostats: Two-pipe, fully proportional, single-temperature type; with adjustable set point in middle of range, adjustable throttling range, plug-in test fitting or permanent pressure gage, remote bulb, bimetal rod and tube, or averaging element.
- F. Electric, Low-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual-reset switch that trips if temperature sensed across any 12 inches (300 mm) of bulb length is equal to or below set point.
  - 1. Bulb Length: Minimum 20 feet (6 m).
  - 2. Quantity: One thermostat for every 20 sq. ft. (2 sq. m) of coil surface.
- G. Electric, High-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual-reset switch that trips if temperature sensed across any 12 inches (300 mm) of bulb length is equal to or above set point.
  - 1. Bulb Length: Minimum 20 feet (6 m).
  - 2. Quantity: One thermostat for every 20 sq. ft. (2 sq. m) of coil surface.

## **2.9 ACTUATORS**

- A. Electric Motors: Size to operate with sufficient reserve power to provide smooth two-position action.
  - 1. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
  - 2. Nonspring-Return Motors for Valves Larger Than NPS 2-1/2 (DN 65): Size for running torque of 150 in. x lbf (16.9 N x m) and breakaway torque of 300 in. x lbf (33.9 N x m).
  - 3. Spring-Return Motors for Valves Larger Than NPS 2-1/2 (DN 65): Size for running and breakaway torque of 150 in. x lbf (16.9 N x m).

4. Nonspring-Return Motors for Dampers Larger Than 25 Sq. Ft. (2.3 sq. m): Size for running torque of 150 in. x lbf (16.9 N x m) and breakaway torque of 300 in. x lbf (33.9 N x m).
  5. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft. (2.3 sq. m): Size for running and breakaway torque of 150 in. x lbf (16.9 N x m).
- B. Electronic Modulating Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
1. Manufacturers:
    - a. Belimo Aircontrols (USA), Inc.
  2. Valves: Size for torque required for valve close off at maximum pump differential pressure.
  3. Dampers: Size for running torque calculated as follows:
    - a. Parallel-Blade Damper with Edge Seals: 7 inch-lb/sq. ft. (86.8 kg-cm/sq. m) of damper.
    - b. Opposed-Blade Damper with Edge Seals: 5 inch-lb/sq. ft. (62 kg-cm/sq. m) of damper.
    - c. Parallel-Blade Damper without Edge Seals: 4 inch-lb/sq. ft. (49.6 kg-cm/sq. m) of damper.
    - d. Opposed-Blade Damper without Edge Seals: 3 inch-lb/sq. ft. (37.2 kg-cm/sq. m) of damper.
    - e. Dampers with 2- to 3-Inch wg (500 to 750 Pa) of Pressure Drop or Face Velocities of 1000 to 2500 fpm (5 to 13 m/s): Increase running torque by 1.5.
    - f. Dampers with 3- to 4-Inch wg (750 to 1000 Pa) of Pressure Drop or Face Velocities of 2500 to 3000 fpm (13 to 15 m/s): Increase running torque by 2.0.
  4. Coupling: V-bolt and V-shaped, toothed cradle.
  5. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
  6. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on nonspring-return actuators.
  7. Power Requirements (Two-Position Spring Return): 24-V ac.
  8. Power Requirements (Modulating): Maximum 10 VA at 24-V ac or 8 W at 24-V dc.
  9. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
  10. Temperature Rating: Minus 22 to plus 122 deg F (Minus 30 to plus 50 deg C).
  11. Run Time: 90 seconds.

## **2.10 DAMPERS**

- A. Dampers: AMCA-rated, parallel-blade design; 0.108-inch- (2.8-mm-) minimum thick, galvanized-steel or 0.125-inch- (3.2-mm-) minimum thick, extruded-aluminum frames with holes for duct mounting; damper blades shall not be less than 0.064-inch- (1.6-mm-) thick galvanized steel with maximum blade width of 8 inches (200 mm) and length of 48 inches (1220 mm).
  - 1. Secure blades to 1/2-inch- (13-mm-) diameter, zinc-plated axles using zinc-plated hardware, with oil-impregnated sintered bronze blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.
  - 2. Operating Temperature Range: From minus 40 to plus 200 deg F (minus 40 to plus 93 deg C).
  - 3. Edge Seals, Standard Pressure Applications: Closed-cell neoprene.
  - 4. Edge Seals, Low-Leakage Applications: Use inflatable blade edging or replaceable rubber blade seals and spring-loaded stainless-steel side seals, rated for leakage at less than 10 cfm per sq. ft. (50 L/s per sq. m) of damper area, at differential pressure of 4-inch wg (1000 Pa) when damper is held by torque of 50 in. x lbf (5.6 N x m); when tested according to AMCA 500D.

## **2.11 CONTROL CABLE**

- A. Electronic and fiber-optic cables for control wiring are specified in Division 27 Section "Communications Horizontal Cabling."
- B. Minimum cable to be plenum plated, shielded, 1B gauge.

# **PART 3 - EXECUTION**

## **3.1 EXAMINATION**

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
  - 1. Verify compatibility with and suitability of substrates.
- B. Examine roughing-in for products to verify actual locations of connections before installation.
  - 1. Examine roughing-in for instruments installed in piping to verify actual locations of connections before installation.

2. Examine roughing-in for instruments installed in duct systems to verify actual locations of connections before installation.
- C. Examine walls, floors, roofs, and ceilings for suitable conditions where product will be installed.
- D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 DDC SYSTEM INTERFACE WITH OTHER SYSTEMS AND EQUIPMENT**

- A. Communication Interface to Equipment with Integral Controls:
  1. DDC system shall have communication interface with equipment having integral controls and having a communication interface for remote monitoring or control.
  2. Equipment to Be Connected:
    - a. Dedicated outdoor-air units specified in Section 237433 "Dedicated Outdoor-Air Units."
    - b. Computer-room air-conditioning units

### **3.3 DDC SYSTEM INTERFACE WITH EXISTING SYSTEMS**

- A. Interface with Existing Systems:
  1. DDC systems shall interface existing base-wide systems to achieve integration.
  2. Monitoring and Control of DDC System by Existing Control System:
    - a. DDC system performance requirements shall be satisfied when monitoring and controlling DDC system by existing control system.
    - b. Operator of existing system shall be able to upload, download, monitor, trend, control and program every input and output point in DDC system from existing control system using existing control system software and operator workstations.
    - c. Remote monitoring and control from existing control system shall not require operators of existing control system to learn new software.
    - d. Interface of DDC system into existing control system shall be transparent to operators of existing control system and allow operators to program, monitor, and control DDC system from any operator workstation connected to existing control system.



### **3.4 GENERAL INSTALLATION REQUIREMENTS**

- A. Install products to satisfy more stringent of all requirements indicated.
- B. Install products level, plumb, parallel, and perpendicular with building construction.
- C. Support products, tubing, piping wiring and raceways.
- D. If codes and referenced standards are more stringent than requirements indicated, comply with requirements in codes and referenced standards.
- E. Fabricate openings and install sleeves in ceilings, floors, roof, and walls required by installation of products. Before proceeding with drilling, punching, and cutting, check for concealed work to avoid damage. Patch, flash, grout, seal, and refinish openings to match adjacent condition.
- F. Firestop penetrations made in fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."
- G. Seal penetrations made in acoustically rated assemblies. Comply with requirements in Section 079200 "Joint Sealants."
- H. Fastening Hardware:
  - 1. Stillson wrenches, pliers, and other tools that damage surfaces of rods, nuts, and other parts are prohibited for work of assembling and tightening fasteners.
  - 2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force or by oversized wrenches.
  - 3. Lubricate threads of bolts, nuts and screws with graphite and oil before assembly.
- I. If product locations are not indicated, install products in locations that are accessible and that will permit service and maintenance from floor, equipment platforms, or catwalks without removal of permanently installed furniture and equipment.

### **3.5 GATEWAY INSTALLATION**

- A. Install gateways if required for DDC system communication interface requirements indicated.
- B. Test gateway to verify that communication interface functions properly.

### **3.6 ROUTER INSTALLATION**

- A. Install routers if required for DDC system communication interface requirements indicated.
- B. Test router to verify that communication interface functions properly.

### **3.7 CONTROLLER INSTALLATION**

- A. Install controllers in enclosures to comply with indicated requirements.
- B. Connect controllers to field power supply and to UPS units where indicated.
- C. Install controller with latest version of applicable software and configure to execute requirements indicated.
- D. Test and adjust controllers to verify operation of connected I/O to achieve performance indicated requirements while executing sequences of operation.
- E. Installation of Network Controllers:
  - 1. Quantity and location of network controllers shall be determined by DDC system manufacturer to satisfy requirements indicated.
  - 2. Install controllers in a protected location that is easily accessible by operators.
  - 3. Top of controller shall be within 72 inches of finished floor.
- F. Installation of Programmable Application Controllers:
  - 1. Quantity and location of programmable application controllers shall be determined by DDC system manufacturer to satisfy requirements indicated.
  - 2. Install controllers in a protected location that is easily accessible by operators.
  - 3. Top of controller shall be within 72 inches of finished floor.
- G. Application-Specific Controllers:
  - 1. Quantity and location of application-specific controllers shall be determined by DDC system manufacturer to satisfy requirements indicated.
  - 2. For controllers not mounted directly on equipment being controlled, install controllers in a protected location that is easily accessible by operators.

### **3.8 ENCLOSURES INSTALLATION**

- A. Install the following items in enclosures, to comply with indicated requirements:

1. Gateways.
2. Routers.
3. Controllers.
4. Electrical power devices.
5. UPS units.
6. Relays.
7. Accessories.
8. Instruments.
9. Actuators

B. Attach wall-mounted enclosures to wall using the following types of steel struts:

1. For NEMA 250, Type 1 Enclosures: Use painted steel strut and hardware.
2. For NEMA 250, Type 4 Enclosures and Enclosures Located Outdoors: Use stainless-steel strut and hardware.
3. Install plastic caps on exposed cut edges of strut.

C. Install continuous and fully accessible wireways to connect conduit, wire, and cable to multiple adjacent enclosures. Wireway used for application shall have protection equal to NEMA 250 rating of connected enclosures.

### **3.9 ELECTRIC POWER CONNECTIONS**

- A. Connect electrical power to DDC system products requiring electrical power connections.
- B. Design of electrical power to products not indicated with electric power is delegated to DDC system provider and installing trade. Work shall comply with NFPA 70 and other requirements indicated.
- C. Comply with requirements in Section 260100 for electrical power conductors, cables and raceways.

### **3.10 IDENTIFICATION**

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements in Section 260000.
- B. Install engraved phenolic nameplate with unique identification on face for each of the following:
  1. DDC controller.
  2. Enclosure.

### **3.11 CONTROL WIRE, CABLE AND RACEWAYS INSTALLATION**

- A. Comply with NECA 1.
- B. Comply with TIA 568-C.1.
- C. Wiring Method: Install cables in raceways and cable trays except in accessible ceiling spaces. Conceal raceway and cables except in unfinished spaces.
  - 1. Install plenum cable in environmental air spaces, including plenum ceilings.
  - 2. Comply with requirements for cable trays specified in Section 260536 "Cable Trays for Electrical Systems."
  - 3. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."
- D. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- E. Field Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
- F. Conduit Installation:
  - 1. Install conduit expansion joints where conduit runs exceed 200 feet, and conduit crosses building expansion joints.
  - 2. Coordinate conduit routing with other trades to avoid conflicts with ducts, pipes and equipment and service clearance.
  - 3. Maintain at least 3-inch separation where conduits run axially above or below ducts and pipes.
  - 4. Limit above-grade conduit runs to 100 feet without pull or junction box.
  - 5. Do not install raceways or electrical items on any "explosion-relief" walls, or rotating equipment.
  - 6. Do not fasten conduits onto the bottom side of a metal deck roof.
  - 7. Flexible conduit is permitted only where flexibility and vibration control is required.
  - 8. Limit flexible conduit to 3 feet long.
  - 9. Conduit shall be continuous from outlet to outlet, from outlet to enclosures, pull and junction boxes, and shall be secured to boxes in such manner that each system shall be electrically continuous throughout.
  - 10. Direct bury conduits underground or install in concrete-encased duct bank where indicated.
    - a. Use rigid, nonmetallic, Schedule 80 PVC.

- b. Provide a burial depth according to NFPA 70, but not less than 24 inches.
- 11. Secure threaded conduit entering an instrument enclosure, cabinet, box, and trough, with a locknut on outside and inside, such that conduit system is electrically continuous throughout. Provide a metal bushing on inside with insulated throats. Locknuts shall be the type designed to bite into the metal or, on inside of enclosure, shall have a grounding wedge lug under locknut.
- 12. Conduit box-type connectors for conduit entering enclosures shall have an insulated throat.
- 13. Connect conduit entering enclosures in wet locations with box-type connectors or with watertight sealing locknuts or other fittings.
- 14. Offset conduits where entering surface-mounted equipment.
- 15. Seal conduit runs used by sealing fittings to prevent the circulation of air for the following:
  - a. Conduit extending from interior to exterior of building.
  - b. Conduit extending into pressurized duct and equipment.
  - c. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.

**G. Wire and Cable Installation:**

- 1. Cables serving a common system may be grouped in a common raceway. Install control wiring and cable in separate raceway from power wiring. Do not group conductors from different systems or different voltages.
- 2. Install cables with protective sheathing that is waterproof and capable of withstanding continuous temperatures of 90 deg C with no measurable effect on physical and electrical properties of cable.
  - a. Provide shielding to prevent interference and distortion from adjacent cables and equipment.
- 3. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
- 4. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
- 5. UTP Cable Installation:
  - a. Comply with TIA 568-C.2.
  - b. Do not untwist UTP cables more than 1/2 inch from the point of termination, to maintain cable geometry.
- 6. Installation of Cable Routed Exposed under Raised Floors:

- a. Install plenum-rated cable only.
  - b. Install cabling after the flooring system has been installed in raised floor areas.
  - c. Coil cable 6 feetlong not less than 12 inches in diameter below each feed point.
7. Identify each wire on each end and at each terminal with a number-coded identification tag. Each wire shall have a unique tag.
8. Provide strain relief.
9. Terminate wiring in a junction box.
  - a. Clamp cable over jacket in junction box.
  - b. Individual conductors in the stripped section of the cable shall be slack between the clamping point and terminal block.
10. Terminate field wiring and cable not directly connected to instruments and control devices having integral wiring terminals using terminal blocks.
11. Install signal transmission components according to IEEE C2, REA Form 511a, NFPA 70, and as indicated.
12. Keep runs short. Allow extra length for connecting to terminal boards. Do not bend flexible coaxial cables in a radius less than 10 times the cable OD. Use sleeves or grommets to protect cables from vibration at points where they pass around sharp corners and through penetrations.
13. Ground wire shall be copper and grounding methods shall comply with IEEE C2. Demonstrate ground resistance.
14. Wire and cable shall be continuous from terminal to terminal without splices.
15. Use insulated spade lugs for wire and cable connection to screw terminals.
16. Use shielded cable to transmitters.
17. Use shielded cable to temperature sensors.
18. Perform continuity and meager testing on wire and cable after installation.
19. Do not install bruised, kinked, scored, deformed, or abraded wire and cable. Remove and discard wire and cable if damaged during installation, and replace it with new cable.
20. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
21. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
22. Protection from Electro-Magnetic Interference (EMI): Provide installation free of (EMI). As a minimum, comply with the following requirements:
  - a. Comply with BICSI TDMM and TIA 569-C for separating unshielded cable from potential EMI sources, including electrical power lines and equipment.
  - b. Separation between open cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

- 1) Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
  - 2) Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
  - 3) Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.
- c. Separation between cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
- 1) Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
  - 2) Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
  - 3) Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.
- d. Separation between cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
- 1) Electrical Equipment Rating Less Than 2 kVA: No requirement.
  - 2) Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
  - 3) Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.
- e. Separation between Cables and Electrical Motors and Transformers, 5 kVA or 5 HP and Larger: A minimum of 48 inches.
- f. Separation between Cables and Fluorescent Fixtures: A minimum of 5 inches.

### **3.12 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and installations, including connections.
- B. Perform the following tests and inspections:
  1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
  3. Testing of Pneumatic and Air-Signal Tubing:

- a. Test for leaks and obstructions.
- b. Disconnect each pipe and tubing line before a test is performed, and blowout dust, dirt, trash, condensate and other foreign materials with compressed air. Use commercially pure compressed air or nitrogen as distributed in gas cylinders. Air from an oil-free compressor with an air dryer is an acceptable alternative for the test.
- c. After foreign matter is expelled and line is free from obstructions, plug far end of tubing run.
- d. Connect a pressure source to near end of run with a needle valve between air supply and tubing run.
- e. Connect a pressure gage accurate to within 0.5 percent of test between the shutoff needle valve and tubing run under test.
- f. For system pressures above 30 psig, apply a pressure of 1.5 times operating pressure. Record pressure in tubing run every 10 minutes for one hour. Allowable drop in pressure in one-hour period shall not exceed 1 psig.
- g. For system pressures 30 psig and below, apply a pressure of 2.0 times operating pressure to piping and tubing run. Record pressure in tubing run every 5 minutes for one hour. Allowable drop in pressure in one-hour period shall not exceed 0.5 psig.

**C. Testing:**

1. Perform preinstallation, in-progress, and final tests, supplemented by additional tests, as necessary.
2. Preinstallation Cable Verification: Verify integrity and serviceability for new cable lengths before installation. This assurance may be provided by using vendor verification documents, testing, or other methods. As a minimum, furnish evidence of verification for cable attenuation and bandwidth parameters.
3. In-Progress Testing: Perform standard tests for correct pair identification and termination during installation to ensure proper installation and cable placement. Perform tests in addition to those specified if there is any reason to question condition of material furnished and installed. Testing accomplished is to be documented by agency conducting tests. Submit test results for Project record.
4. Final Testing: Perform final test of installed system to demonstrate acceptability as installed. Testing shall be performed according to a test plan supplied by DDC system manufacturer. Defective Work or material shall be corrected and retested. As a minimum, final testing for cable system, including spare cable, shall verify conformance of attenuation, length, and bandwidth parameters with performance indicated.
5. Test Equipment: Use a fiber-optic time domain reflectometer for testing of length and optical connectivity.
6. Test Results: Record test results and submit copy of test results for Project record.



### **3.13 DDC SYSTEM I/O CHECKOUT PROCEDURES**

- A. Check installed products before continuity tests, leak tests and calibration.
- B. Check instruments for proper location and accessibility.
- C. Check instruments for proper installation on direction of flow, elevation, orientation, insertion depth, or other applicable considerations that will impact performance.
- D. Check instrument tubing for proper isolation, fittings, slope, dirt legs, drains, material and support.
- E. For pneumatic products, verify that air supply for each product is properly installed.
- F. Control Damper Checkout:
  - 1. Verify that control dampers are installed correctly for flow direction.
  - 2. Verify that proper blade alignment, either parallel or opposed, has been provided.
  - 3. Verify that damper frame attachment is properly secured and sealed.
  - 4. Verify that damper actuator and linkage attachment is secure.
  - 5. Verify that actuator wiring is complete, enclosed and connected to correct power source.
  - 6. Verify that damper blade travel is unobstructed.
- G. Instrument Checkout:
  - 1. Verify that instrument is correctly installed for location, orientation, direction and operating clearances.
  - 2. Verify that attachment is properly secured and sealed.
  - 3. Verify that conduit connections are properly secured and sealed.
  - 4. Verify that wiring is properly labeled with unique identification, correct type and size and is securely attached to proper terminals.
  - 5. Inspect instrument tag against approved submittal.
  - 6. For instruments with tubing connections, verify that tubing attachment is secure and isolation valves have been provided.
  - 7. For flow instruments, verify that recommended upstream and downstream distances have been maintained.
  - 8. For temperature instruments:
    - a. Verify sensing element type and proper material.
    - b. Verify length and insertion.

**3.14 DDC SYSTEM I/O ADJUSTMENT, CALIBRATION AND TESTING:**

- A. Calibrate each instrument installed that is not factory calibrated and provided with calibration documentation.
- B. Provide a written description of proposed field procedures and equipment for calibrating each type of instrument. Submit procedures before calibration and adjustment.
- C. For each analog instrument, make a three-point test of calibration for both linearity and accuracy.
- D. Equipment and procedures used for calibration shall comply with instrument manufacturer's written instructions.
- E. Provide diagnostic and test equipment for calibration and adjustment.
- F. Field instruments and equipment used to test and calibrate installed instruments shall have accuracy at least twice the instrument accuracy being calibrated. An installed instrument with an accuracy of 1 percent shall be checked by an instrument with an accuracy of 0.5 percent.
- G. Calibrate each instrument according to instrument instruction manual supplied by manufacturer.
- H. If after calibration indicated performance cannot be achieved, replace out-of-tolerance instruments.
- I. Comply with field testing requirements and procedures indicated by ASHRAE's Guideline 11, "Field Testing of HVAC Control Components," in the absence of specific requirements, and to supplement requirements indicated.
- J. Analog Signals:
  - 1. Check analog voltage signals using a precision voltage meter at zero, 50, and 100 percent.
  - 2. Check analog current signals using a precision current meter at zero, 50, and 100 percent.
  - 3. Check resistance signals for temperature sensors at zero, 50, and 100 percent of operating span using a precision-resistant source.
- K. Digital Signals:
  - 1. Check digital signals using a jumper wire.
  - 2. Check digital signals using an ohmmeter to test for contact making or breaking.

**L. Control Dampers:**

1. Stroke and adjust control dampers following manufacturer's recommended procedure, from 100 percent open to 100 percent closed and back to 100 percent open.
2. Stroke control dampers with pilot positioners. Adjust damper and positioner following manufacturer's recommended procedure, so damper is 100 percent closed, 50 percent closed and 100 percent open at proper air pressure.
3. Check and document open and close cycle times for applications with a cycle time less than 30 seconds.
4. For control dampers equipped with positive position indication, check feedback signal at multiple positions to confirm proper position indication.

**M. Meters: Check sensors at zero, 50, and 100 percent of Project design values.**

**N. Sensors: Check sensors at zero, 50, and 100 percent of Project design values.**

**O. Switches: Calibrate switches to make or break contact at set points indicated.**

**P. Transmitters:**

1. Check and calibrate transmitters at zero, 50, and 100 percent of Project design values.
2. Calibrate resistance temperature transmitters at zero, 50, and 100 percent of span using a precision-resistant source.

### **3.15 DDC SYSTEM CONTROLLER CHECKOUT**

**A. Verify power supply.**

1. Verify voltage, phase and hertz.
2. Verify that protection from power surges is installed and functioning.
3. Verify that ground fault protection is installed.
4. If applicable, verify if connected to UPS unit.
5. If applicable, verify if connected to a backup power source.
6. If applicable, verify that power conditioning units, transient voltage suppression and high-frequency noise filter units are installed.

**B. Verify that wire and cabling is properly secured to terminals and labeled with unique identification.**

**C. Verify that spare I/O capacity is provided.**

### **3.16 DDC CONTROLLER I/O CONTROL LOOP TESTS**

#### **A. Testing:**

1. Test every I/O point connected to DDC controller to verify that safety and operating control set points are as indicated and as required to operate controlled system safely and at optimum performance.
2. Test every I/O point throughout its full operating range.
3. Test every control loop to verify operation is stable and accurate.
4. Adjust control loop proportional, integral and derivative settings to achieve optimum performance while complying with performance requirements indicated. Document testing of each control loop's precision and stability via trend logs.
5. Test and adjust every control loop for proper operation according to sequence of operation.
6. Test software and hardware interlocks for proper operation. Correct deficiencies.
7. Operate each analog point at the following:
  - a. Upper quarter of range.
  - b. Lower quarter of range.
  - c. At midpoint of range.
8. Exercise each binary point.
9. For every I/O point in DDC system, read and record each value at operator workstation, at DDC controller and at field instrument simultaneously. Value displayed at operator workstation, at DDC controller and at field instrument shall match.
10. Prepare and submit a report documenting results for each I/O point in DDC system and include in each I/O point a description of corrective measures and adjustments made to achieve desired results.

### **3.17 DDC SYSTEM VALIDATION TESTS**

- A. Perform validation tests before requesting final review of system. Before beginning testing, first submit Pretest Checklist and Test Plan.
- B. After approval of Test Plan, execute all tests and procedures indicated in plan.
- C. After testing is complete, submit completed test checklist.
- D. Pretest Checklist: Submit the following list with items checked off once verified:
  1. Detailed explanation for any items that are not completed or verified.

2. Required mechanical installation work is successfully completed and HVAC equipment is working correctly.
3. HVAC equipment motors operate below full-load amperage ratings.
4. Required DDC system components, wiring, and accessories are installed.
5. Installed DDC system architecture matches approved Drawings.
6. Control electric power circuits operate at proper voltage and are free from faults.
7. Required surge protection is installed.
8. DDC system network communications function properly, including uploading and downloading programming changes.
9. Using BACnet protocol analyzer, verify that communications are error free.
10. Each controller's programming is backed up.
11. Equipment, products, tubing, wiring cable and conduits are properly labeled.
12. All I/O points are programmed into controllers.
13. Testing, adjusting and balancing work affecting controls is complete.
14. Dampers and actuators zero and span adjustments are set properly.
15. Each control damper and actuator goes to failed position on loss of power.
16. Valves and actuators zero and span adjustments are set properly.
17. Each control valve and actuator goes to failed position on loss of power.
18. Meter, sensor and transmitter readings are accurate and calibrated.
19. Control loops are tuned for smooth and stable operation.
20. View trend data where applicable.
21. Each controller works properly in standalone mode.
22. Safety controls and devices function properly.
23. Interfaces with fire-alarm system function properly.
24. Electrical interlocks function properly.
25. Operator workstations and other interfaces are delivered, all system and database software is installed, and graphic are created.
26. Record Drawings are completed.

**E. Test Plan:**

1. Prepare and submit a validation test plan including test procedures for performance validation tests.
2. Test plan shall address all specified functions of DDC system and sequences of operation.
3. Explain detailed actions and expected results to demonstrate compliance with requirements indicated.
4. Explain method for simulating necessary conditions of operation used to demonstrate performance.
5. Include a test checklist to be used to check and initial that each test has been successfully completed.
6. Submit test plan documentation 20 business days before start of tests.

**F. Validation Test:**

1. Verify operating performance of each I/O point in DDC system.
  - a. Verify analog I/O points at operating value.
  - b. Make adjustments to out-of-tolerance I/O points.
    - 1) Identify I/O points for future reference.
    - 2) Simulate abnormal conditions to demonstrate proper function of safety devices.
    - 3) Replace instruments and controllers that cannot maintain performance indicated after adjustments.
2. Simulate conditions to demonstrate proper sequence of control.
3. Readjust settings to design values and observe ability of DDC system to establish desired conditions.
4. After 24 Hours following Initial Validation Test:
  - a. Re-check I/O points that required corrections during initial test.
  - b. Identify I/O points that still require additional correction and make corrections necessary to achieve desired results.
5. After 24 Hours of Second Validation Test:
  - a. Re-check I/O points that required corrections during second test.
  - b. Continue validation testing until I/O point is normal on two consecutive tests.
6. Completely check out, calibrate, and test all connected hardware and software to ensure that DDC system performs according to requirements indicated.
7. After validation testing is complete, prepare and submit a report indicating all I/O points that required correction and how many validation re-tests it took to pass. Identify adjustments made for each test and indicate instruments that were replaced.

**G. DDC System Network Bandwidth Test:**

1. Test network bandwidth usage on all DDC system networks to demonstrate bandwidth usage under DDC system normal operating conditions and under simulated HLC.
2. To pass, none of DDC system networks shall use more than 70 percent of available bandwidth under normal and HLC operation.

### **3.18 FINAL REVIEW**

- A. Submit written request to Architect when DDC system is ready for final review. Written request shall state the following:
  - 1. DDC system has been thoroughly inspected for compliance with contract documents and found to be in full compliance.
  - 2. DDC system has been calibrated, adjusted and tested and found to comply with requirements of operational stability, accuracy, speed and other performance requirements indicated.
  - 3. DDC system monitoring and control of HVAC systems results in operation according to sequences of operation indicated.
  - 4. DDC system is complete and ready for final review.
- B. Review by Architect shall be made after receipt of written request. A field report shall be issued to document observations and deficiencies.
- C. Take prompt action to remedy deficiencies indicated in field report and submit a second written request when all deficiencies have been corrected. Repeat process until no deficiencies are reported.
- D. Should more than two reviews be required, DDC system manufacturer and Installer shall compensate entity performing review for total costs, labor and expenses, associated with third and subsequent reviews. Estimated cost of each review shall be submitted and approved by DDC system manufacturer and Installer before making the review.
- E. Prepare and submit closeout submittals when no deficiencies are reported.
- F. A part of DDC system final review shall include a demonstration to parties participating in final review.
  - 1. Provide staff familiar with DDC system installed to demonstrate operation of DDC system during final review.
  - 2. Provide testing equipment to demonstrate accuracy and other performance requirements of DDC system that is requested by reviewers during final review.
  - 3. Demonstration shall include, but not be limited to, the following:
    - a. Accuracy and calibration of 20 I/O points randomly selected by reviewers. If review finds that some I/O points are not properly calibrated and not satisfying performance requirements indicated, additional I/O points may be selected by reviewers until total I/O points being reviewed that satisfy requirements equals quantity indicated.

- b. HVAC equipment and system hardwired and software safeties and life-safety functions are operating according to sequence of operation. Up to 20 I/O points shall be randomly selected by reviewers. Additional I/O points may be selected by reviewers to discover problems with operation.
- c. Correct sequence of operation after electrical power interruption and resumption after electrical power is restored for randomly selected HVAC systems.
- d. Operation of randomly selected dampers and valves in normal-on, normal-off and failed positions.
- e. Reporting of alarm conditions for randomly selected alarms, including different classes of alarms, to ensure that alarms are properly received by operators and operator workstations.
- f. Trends, summaries, logs and reports set-up for Project.
- g. Software's ability to communicate with controllers, operator workstations, uploading and downloading of control programs.
- h. Software's ability to edit control programs off-line.
- i. Data entry to show Project-specific customizing capability including parameter changes.
- j. Step through penetration tree, display all graphics, demonstrate dynamic update, and direct access to graphics.
- k. Execution of digital and analog commands in graphic mode.
- l. Spreadsheet and curve plot software and its integration with database.
- m. Online user guide and help functions.
- n. Multitasking by showing different operations occurring simultaneously on four quadrants of split screen.
- o. System speed of response compared to requirements indicated.
- p. For Each Network and Programmable Application Controller:
  - 1) Memory: Programmed data, parameters, trend and alarm history collected during normal operation is not lost during power failure.
  - 2) Operator Interface: Ability to connect directly to each type of digital controller with a portable operator workstation and PDA. Show that maintenance personnel interface tools perform as indicated in manufacturer's technical literature.
  - 3) Standalone Ability: Demonstrate that controllers provide stable and reliable standalone operation using default values or other method for values normally read over network.
  - 4) Electric Power: Ability to disconnect any controller safely from its power source.
  - 5) Wiring Labels: Match control drawings.
  - 6) Network Communication: Ability to locate a controller's location on network and communication architecture matches Shop Drawings.
  - 7) Nameplates and Tags: Accurate and permanently attached to control panel doors, instrument, actuators and devices.



- q. For Each Operator Workstation:
  - 1) I/O points lists agree with naming conventions.
  - 2) Graphics are complete.
  - 3) UPS unit, if applicable, operates.
- r. Communications and Interoperability: Demonstrate proper interoperability of data sharing, alarm and event management, trending, scheduling, and device and network management. Requirements must be met even if only one manufacturer's equipment is installed.
  - 1) Data Presentation: On each operator workstation, demonstrate graphic display capabilities.
  - 2) Reading of Any Property: Demonstrate ability to read and display any used readable object property of any device on network.
  - 3) Set Point and Parameter Modifications: Show ability to modify set points and tuning parameters indicated.
  - 4) Peer-to-Peer Data Exchange: Network devices are installed and configured to perform without need for operator intervention to implement Project sequence of operation and to share global data.
  - 5) Alarm and Event Management: Alarms and events are installed and prioritized according to Government. Demonstrate that time delays and other logic are set up to avoid nuisance tripping. Show that operators with sufficient privileges are permitted.
  - 6) Schedule Lists: Schedules are configured for start and stop, mode change, occupant overrides, and night setback as defined in sequence of operations.
  - 7) Schedule Display and Modification: Ability to display any schedule with start and stop times for calendar year. Show that all calendar entries and schedules are modifiable from any connected operator workstation by an operator with sufficient privilege.
  - 8) Archival Storage of Data: Data archiving is handled by operator workstation and server and local trend archiving and display is accomplished.
  - 9) Modification of Trend Log Object Parameters: Operator with sufficient privilege can change logged data points, sampling rate, and trend duration.
  - 10) Device and Network Management:
    - a) Display of network device status.
    - b) Display of BACnet Object Information.
    - c) Silencing devices transmitting erroneous data.
    - d) Time synchronization.
    - e) Remote device re-initialization.

- f) Backup and restore network device programming and master database(s).
- g) Configuration management of routers.

### **3.19 EXTENDED OPERATION TEST**

- A. Extended operation test is intended to simulate normal operation of DDC system by Government.
- B. Operate DDC system for an operating period of 14 consecutive calendar days following Substantial Completion. Coordinate exact start date of testing with Government.
- C. Provide an operator familiar with DDC system installed to man an operator workstation during eight hours of each normal business day occurring during operating period.
- D. During operating period, DDC system shall demonstrate correct operation and accuracy of monitored and controlled points as well as operation capabilities of sequences, logs, trends, reports, specialized control algorithms, diagnostics, and other software indicated.
  - 1. Correct defects of hardware and software when it occurs.
- E. Definition of Failures and Downtime during Operating Period:
  - 1. Failed I/O point constituting downtime is an I/O point failing to perform its intended function consistently and a point physically failed due to hardware and software.
  - 2. Downtime is when any I/O point in DDC system is unable to fulfill its' required function.
  - 3. Downtime shall be calculated as elapsed time between a detected point failure as confirmed by an operator and time point is restored to service.
  - 4. Maximum time interval allowed between DDC system detection of failure occurrence and operator confirmation shall be 0.5 hours.
  - 5. Downtime shall be logged in hours to nearest 0.1 hour.
  - 6. Power outages shall not count as downtime, but shall suspend test hours unless systems are provided with UPS and served through a backup power source.
  - 7. Hardware or software failures caused by power outages shall count as downtime.
- F. During operating period, log downtime and operational problems are encountered.
  - 1. Identify source of problem.
  - 2. Provide written description of corrective action taken.
  - 3. Record duration of downtime.
  - 4. Maintain log showing the following:
    - a. Time of occurrence.

- b. Description of each occurrence and pertinent written comments for reviewer to understand scope and extent of occurrence.
  - c. Downtime for each failed I/O point.
  - d. Running total of downtime and total time of I/O point after each problem has been restored.
- 5. Log shall be available to Government for review at any time.
- G. For DDC system to pass extended operation test, total downtime shall not exceed 2 percent of total point-hours during operating period.
  - 1. Failure to comply with minimum requirements of passing at end of operating period indicated shall require that operating period be extended one consecutive day at a time until DDC system passes requirement.
- H. Evaluation of DDC system passing test shall be based on the following calculation:
  - 1. Downtime shall be counted on a point-hour basis where total number of DDC system point-hours is equal to total number of I/O points in DDC system multiplied by total number of hours during operating period.
  - 2. One point-hour of downtime is one I/O point down for one hour. Three points down for five hours is a total of 15 point-hours of downtime. Four points down for one-half hour is 2 point-hours of downtime.
  - 3. Example Calculation: Maximum allowable downtime for 30-day test when DDC system has 1000 total I/O points (combined analog and binary) and has passing score of 1 percent downtime is computed by 30 days x 24 h/day x 1000 points x 1 percent equals 7200 point-hours of maximum allowable downtime.
- I. Prepare test and inspection reports.

### **3.20 ADJUSTING**

- A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

### **3.21 MAINTENANCE SERVICE**

- A. Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12months' full maintenance by DDC system manufacturer's authorized service representative. Include monthly preventive maintenance, repair or replacement of worn or defective components, cleaning, calibration and adjusting as required for proper

operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

### **3.22 SOFTWARE SERVICE AGREEMENT**

- A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two year(s).
- B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within one year(s) from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.
  - 1. Upgrade Notice: At least 30 days to allow Government to schedule and access system and to upgrade computer equipment if necessary.

### **3.23 DEMONSTRATION**

- A. Engage a factory-authorized service representative with complete knowledge of Project-specific system installed to train Government's maintenance personnel to adjust, operate, and maintain DDC system.
- B. Extent of Training:
  - 1. Base extent of training on scope and complexity of DDC system indicated and training requirements indicated. Provide extent of training required to satisfy requirements indicated even if more than minimum training requirements are indicated.
  - 2. Inform Government of anticipated training requirements if more than minimum training requirements are indicated.
  - 3. Minimum Training Requirements:
    - a. Provide not less than five days of training total.
    - b. Stagger training over multiple training classes to accommodate Government's requirements. All training shall occur before end of warranty period.
    - c. Total days of training shall be broken into not more than two separate training classes.
    - d. Each training class shall be not less than two consecutive day(s).
- C. Training Schedule:
  - 1. Schedule training with Government 20 business days before expected Substantial Completion.

2. Training shall occur within normal business hours at a mutually agreed on time. Unless otherwise agreed to, training shall occur Monday through Friday, except on U.S. Federal holidays, with two morning sessions and two afternoon sessions. Each morning session and afternoon session shall be split in half with 15-minute break between sessions. Training, including breaks and excluding lunch period, shall not exceed eight hours per day.
3. Provide staggered training schedule as requested by Government.

**D. Training Attendee List and Sign-in Sheet:**

1. Request from Government in advance of training a proposed attendee list with name, phone number and e-mail address.
2. Provide a preprinted sign-in sheet for each training session with proposed attendees listed and no fewer than six blank spaces to add additional attendees.
3. Preprinted sign-in sheet shall include training session number, date and time, instructor name, phone number and e-mail address, and brief description of content to be covered during session. List attendees with columns for name, phone number, e-mail address and a column for attendee signature or initials.
4. Circulate sign-in sheet at beginning of each session and solicit attendees to sign or initial in applicable location.
5. At end of each training day, send Government an e-mail with an attachment of scanned copy (PDF) of circulated sign-in sheet for each session.

**E. Training Attendee Headcount:**

1. Plan in advance of training for five attendees.
2. Headcount may vary depending on training content covered in session. Attendee access may be restricted to some training content for purposes of maintaining system security.

**F. Attendee Training Manuals:**

1. Provide each attendee with a color hard copy of all training materials and visual presentations.
2. Hard-copy materials shall be organized in a three-ring binder with table of contents and individual divider tabs marked for each logical grouping of subject matter. Organize material to provide space for attendees to take handwritten notes within training manuals.
3. In addition to hard-copy materials included in training manual, provide each binder with a sleeve or pocket that includes a DVD or flash drive with PDF copy of all hard-copy materials.

**G. Instructor Requirements:**

1. One or multiple qualified instructors, as required, to provide training.

2. Instructors shall have not less than five years of providing instructional training on not less than five past projects with similar DDC system scope and complexity to DDC system installed.

**H. Organization of Training Sessions:**

1. Organize training sessions into logical groupings of technical content and to reflect different levels of operators having access to system. Plan training sessions to accommodate the following three levels of operators:
  - a. Daily operators.
  - b. Advanced operators.
  - c. System managers and administrators.
2. Plan and organize training sessions to group training content to protect DDC system security. Some attendees may be restricted to some training sessions that cover restricted content for purposes of maintaining DDC system security.

**I. Training Outline:**

1. Submit training outline for Government review at least 10 business day before scheduling training.
2. Outline shall include a detailed agenda for each training day that is broken down into each of four training sessions that day, training objectives for each training session and synopses for each lesson planned.

**J. On-Site Training:**

1. Government will provide conditioned classroom or workspace with ample desks or tables, chairs, power and data connectivity for instructor and each attendee.
2. Instructor shall provide training materials, projector and other audiovisual equipment used in training.
3. Provide as much of training located on-site as deemed feasible and practical by Government.
4. On-site training shall include regular walk-through tours, as required, to observe each unique product type installed with hands-on review of operation, calibration and service requirements.
5. Operator workstation provided with DDC system shall be used in training. If operator workstation is not indicated, provide a temporary workstation to convey training content.

**K. Training Content for Daily Operators:**

1. Basic operation of system.
2. Understanding DDC system architecture and configuration.

3. Understanding each unique product type installed including performance and service requirements for each.
4. Understanding operation of each system and equipment controlled by DDC system including sequences of operation, each unique control algorithm and each unique optimization routine.
5. Operating operator workstations, printers and other peripherals.
6. Logging on and off system.
7. Accessing graphics, reports and alarms.
8. Adjusting and changing set points and time schedules.
9. Recognizing DDC system malfunctions.
10. Understanding content of operation and maintenance manuals including control drawings.
11. Understanding physical location and placement of DDC controllers and I/O hardware.
12. Accessing data from DDC controllers.
13. Operating portable operator workstations.
14. Review of DDC testing results to establish basic understanding of DDC system operating performance and HVAC system limitations as of Substantial Completion.
15. Running each specified report and log.
16. Displaying and demonstrating each data entry to show Project-specific customizing capability. Demonstrating parameter changes.
17. Stepping through graphics penetration tree, displaying all graphics, demonstrating dynamic updating, and direct access to graphics.
18. Executing digital and analog commands in graphic mode.
19. Demonstrating control loop precision and stability via trend logs of I/O for not less than 10 percent of I/O installed.
20. Demonstrating DDC system performance through trend logs and command tracing.
21. Demonstrating scan, update, and alarm responsiveness.
22. Demonstrating spreadsheet and curve plot software, and its integration with database.
23. Demonstrating on-line user guide, and help function and mail facility.
24. Demonstrating multitasking by showing dynamic curve plot, and graphic construction operating simultaneously via split screen.
25. Demonstrating the following for HVAC systems and equipment controlled by DDC system:
  - a. Operation of HVAC equipment in normal-off, -on and failed conditions while observing individual equipment, dampers and valves for correct position under each condition.
  - b. For HVAC equipment with factory-installed software, show that integration into DDC system is able to communicate with DDC controllers or gateways, as applicable.

- c. Using graphed trends, show that sequence of operation is executed in correct manner, and HVAC systems operate properly through complete sequence of operation including seasonal change, occupied and unoccupied modes, warm-up and cool-down cycles and other modes of operation indicated.
- d. Hardware interlocks and safeties function properly and DDC system performs correct sequence of operation after electrical power interruption and resumption after power is restored.
- e. Reporting of alarm conditions for each alarm, and confirm that alarms are received at assigned locations, including operator workstations.
- f. Each control loop responds to set point adjustment and stabilizes within time period indicated.
- g. Sharing of previously graphed trends of all control loops to demonstrate that each control loop is stable and set points are being maintained.

**L. Video of Training Sessions:**

- 1. Provide a digital video and audio recording of each training session. Create a separate recording file for each session.
- 2. Stamp each recording file with training session number, session name and date.
- 3. Provide Government with two copies of digital files on DVDs or flash drives for later reference and for use in future training.
- 4. Government retains right to make additional copies for intended training purposes without having to pay royalties.

**END OF SECTION 230900**



## **SECTION 232300 - REFRIGERANT PIPING**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Refrigerant pipes and fittings for VRF, CRAC and DOAS systems.
  - 2. Refrigerants.

#### **1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of valve, refrigerant piping, and piping specialty.

#### **1.4 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

#### **1.5 QUALITY ASSURANCE**

- A. Welding Qualifications: Qualify procedures and personnel according to 2010 ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
- B. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."
- C. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

#### **1.6 PRODUCT STORAGE AND HANDLING**

- A. Store piping with end caps in place to ensure that piping interior and exterior are clean when installed.

## **PART 2 - PRODUCTS**

### **2.1 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.

### **2.2 COPPER TUBE AND FITTINGS**

- A. Copper Tube: ASTM B 280, Type ACR.
- B. Wrought-Copper Fittings: ASME B16.22.
- C. Brazing Filler Metals: AWS A5.8/A5.8M.

### **2.3 REFRIGERANTS**

- A. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.

## **PART 3 - EXECUTION**

### **3.1 PIPING APPLICATIONS FOR REFRIGERANT R-410A**

- A. Suction Lines for: Copper, Type ACR, factory nitrogen-charged line-sets and wrought-copper fittings with brazed joints.
- B. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications: Copper, Type ACR, factory nitrogen-charged line-sets and wrought-copper fittings with brazed joints.

### **3.2 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. 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.
- L. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

### **3.3 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. 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.
  - 3. 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.

### **3.4 HANGERS AND SUPPORTS**

- A. Install the following pipe attachments:
  - 1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet long.
  - 2. 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 diameters:
  - 1. NPS 1/2: Maximum span, 60 inches; minimum rod, 1/4 inch.
  - 2. NPS 5/8: Maximum span, 60 inches; minimum rod, 1/4 inch.
  - 3. NPS 1: Maximum span, 72 inches; minimum rod, 1/4 inch.
  - 4. NPS 1-1/4: Maximum span, 96 inches; minimum rod, 3/8 inch.
  - 5. NPS 1-1/2: Maximum span, 96 inches; minimum rod, 3/8 inch.
  - 6. NPS 2: Maximum span, 96 inches; minimum rod, 3/8 inch.
  - 7. NPS 2-1/2: Maximum span, 108 inches; minimum rod, 3/8 inch.
- C. Support multifloor vertical runs at least at each floor.

### **3.5 FIELD QUALITY CONTROL**

- A. Perform the following tests and inspections:
  - 1. Comply with ASME B31.5, Chapter VI.
  - 2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
  - 3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in "Performance Requirements" Article.

- a. Fill system with nitrogen to the required test pressure.
- b. System shall maintain test pressure at the manifold gage throughout duration of test.
- c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
- d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

B. Prepare test and inspection reports.

### **3.6 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.

**END OF SECTION 232300**

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## **SECTION 233113 - METAL DUCTS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Single-wall round ducts and fittings.
3. Sheet metal materials.
4. Duct liner for transfer air ducts only.
5. Sealants and gaskets.
6. Hangers and supports.

- B. Related Sections:

1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

#### **1.3 PERFORMANCE REQUIREMENTS**

- A. 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. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

#### **1.4 SUBMITTALS**

- A. Product Data: For each type of the following products:

1. Liners and adhesives.
2. Sealants and gaskets.

**B. LEED Submittals:**

1. Product Data for Prerequisite EQ 1: Documentation indicating that duct systems comply with ASHRAE 62.1, Section 5 - "Systems and Equipment."
2. Product Data for Prerequisite EA 2: Documentation indicating that duct systems comply with ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."
3. Leakage Test Report for Prerequisite EA 2: Documentation of work performed for compliance with ASHRAE/IESNA 90.1, Section 6.4.4.2.2 - "Duct Leakage Tests."
4. Duct-Cleaning Test Report for Prerequisite EQ 1: Documentation of work performed for compliance with ASHRAE 62.1, Section 7.2.4 - "Ventilation System Start-Up."
5. Product Data for Credit EQ 4.1: For adhesives and sealants, documentation including printed statement of VOC content.
6. Laboratory Test Reports for Credit EQ 4: For adhesives and sealants, documentation indicating that products 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. 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. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.

**D. Welding certificates.**

**E. Field quality-control reports.**

## **1.5 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**

### **2.1 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."

### **2.2 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: Subject to compliance with requirements, provide products by one of the following:
  - a. Eastern Sheet Metal.
  - b. McGill AirFlow LLC.
  - c. SEMCO Incorporated.
  - d. Sheet Metal Connectors, Inc.
  - e. Spiral Manufacturing Co., Inc.
- 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 (1524 mm) 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 (2286 mm) in diameter with butt-welded longitudinal seams.
  2. Fabricate flat-oval ducts larger than 72 inches (1830 mm) in width (major dimension) 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."

## **2.3 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: G60 (Z180).
  2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.
- D. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- E. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

## **2.4 DUCT LINER**

- A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
1. Manufacturers: Subject to compliance with requirements, provide products by one of the:
    - a. CertainTeed Corporation; Insulation Group.
    - b. Johns Manville.
    - c. Knauf Insulation.
    - d. Owens Corning.
  2. Maximum Thermal Conductivity:
    - 1) Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F (0.039 W/m x K) at 75 deg F (24 deg C) mean temperature.
    - 2) Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F (0.033 W/m x K) at 75 deg F (24 deg C) mean temperature.
  3. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.

4. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
  - a. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - b. 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."
- B. Insulation Pins and Washers:
  1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch (38-mm) galvanized carbon-steel washer.
  2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick aluminum; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.
- C. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."
  1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
  2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
  3. Butt transverse joints without gaps, and coat joint with adhesive.
  4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
  5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
  6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm (12.7 m/s).
  7. Secure liner with mechanical fasteners 4 inches (100 mm) from corners and at intervals not exceeding 12 inches (300 mm) transversely; at 3 inches (75 mm) from transverse joints and at intervals not exceeding 18 inches (450 mm) longitudinally.
  8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
    - a. Fan discharges.

- b. Intervals of lined duct preceding unlined duct.
  - c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm (12.7 m/s) or where indicated.
- 9. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.
  - a. Sheet Metal Inner Duct Perforations: 3/32-inch (2.4-mm) diameter, with an overall open area of 23 percent.
- 10. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

## **2.5 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. Two-Part Tape Sealing System:
  - 1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
  - 2. Tape Width: 4 inches (102 mm).
  - 3. Sealant: Modified styrene acrylic.
  - 4. Water resistant.
  - 5. Mold and mildew resistant.
  - 6. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive and negative.
  - 7. Service: Indoor and outdoor.
  - 8. Service Temperature: Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).
  - 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
  - 10. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 11. 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."
- C. 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 (2500 Pa), 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.

**D. Solvent-Based Joint and Seam Sealant:**

1. Application Method: Brush on.
2. Base: Synthetic rubber resin.
3. Solvent: Toluene and heptane.
4. Solids Content: Minimum 60 percent.
5. Shore A Hardness: Minimum 60.
6. Water resistant.
7. Mold and mildew resistant.
8. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
9. VOC: Maximum 395 g/L.
10. 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."
11. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive or negative.
12. Service: Indoor or outdoor.
13. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

**E. 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, use sealant that has 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."

- F. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

## **2.6 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 (Table 5-1M), "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 Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- F. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- G. Trapeze and Riser Supports:
  - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
  - 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
  - 3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

## **PART 3 - EXECUTION**

### **3.1 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 and flat-oval 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 (25 mm), 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 (38 mm).
- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "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."

### **3.2 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.

### **3.3 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, Return/Exhaust-Air Ducts: Seal Class B.
  - 4. Supply-Air Ducts in Pressure Classes 2-Inch wg (500 Pa) and Lower: Seal Class B.
  - 5. Return-Air Ducts: Seal Class B.

### **3.4 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 (100 mm) thick.
  - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) 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 (Table 5-1M), "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 (610 mm) of each elbow and within 48 inches (1200 mm) 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 (5 m).
- 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.

### **3.5 CONNECTIONS**

- A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

### **3.6 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. Paint materials and application requirements are specified in Division 09 painting Sections.

### **3.7 FIELD QUALITY CONTROL**

- A. Perform tests and inspections.
- B. Duct System Cleanliness Tests:
  - 1. Visually inspect duct system to ensure that no visible contaminants are present.
  - 2. 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.

### **3.8 START UP**

- A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

### **3.9 DUCT SCHEDULE**

- A. Fabricate ducts with galvanized sheet steel. All ducted VRF units to be 1-inch pressure class for supply, ½-inch for return, all outside air supply to be 2-inche pressure class, all outside system return/exhaust to be 1-inch pressure class.
- B. Intermediate Reinforcement:
  - 1. Galvanized-Steel Ducts: Galvanized steel.
- C. Liner:
  - 1. Return Air Ducts: Fibrous glass, Type II 1 inch (25 mm)
  - 2. Transfer Ducts: Fibrous glass, Type I 1 inch (25 mm).
- D. 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 (5 m/s) 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 (5 to 7.6 m/s):
      - 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 (7.6 m/s) 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. 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."
    - b. Round Elbows, 12 Inches (305 mm) > and Smaller in Diameter: Stamped or pleated.
    - c. Round Elbows, 14 Inches (356 mm) and Larger in Diameter: Welded.
- E. 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.

**END OF SECTION 233113**

## **SECTION 233713 - DIFFUSERS, REGISTERS, AND GRILLES**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Louver face diffusers.
  - 2. Louver Face Grilles.
  - 3. Laminar Flow Diffusers
- B. Related Sections:
  - 1. Division 08 Section "Louvers and Vents" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
  - 2. Division 23 Section "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

#### **1.3 SUBMITTALS**

- A. Product Data: For each type of product indicated, include the following:
  - 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
  - 2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.
- B. Samples for Initial Selection: For diffusers, registers, and grilles with factory-applied color finishes.
- C. Samples for Verification: For diffusers, registers, and grilles, in manufacturer's standard sizes to verify color selected.

## **PART 2 - PRODUCTS**

### **2.1 CEILING DIFFUSERS**

#### **A. Louver Face Diffuser:**

1. Devices shall be specifically designed for variable-air-volume flows.
2. Material: Aluminum.
3. Finish: Baked enamel, white.
4. Mounting: Surface or T-bar per the reflected ceiling plans.
5. Pattern: One-way, Two-way, Two-way corner, Three-way, Four-way, core style as indicated on the plans.
6. Dampers: Radial opposed blade.
7. Accessories:
  - a. Square to round neck adaptor where round runout is indicated on the plans.

### **2.2 REGISTERS AND GRILLES**

#### **A. Louver Face Grille:**

1. Material: Aluminum.
2. Finish: Baked enamel, white.
3. Face Blade Arrangement: Horizontal spaced  $\frac{3}{4}$  inch apart.
4. Rear-Blade Arrangement: Vertical spaced  $\frac{3}{4}$  inch apart.
5. Frame: 1-1/4 inches wide.
6. Mounting: Countersunk screw or Lay in, per the plans.

### **2.3 LAMINAR FLOW DIFFUSERS**

#### **A. General**

1. Diffuser shall be Group E Non-Aspirating Diffuser per ASHRAE Standard 170-2017.
2. Diffuser plenum shall be constructed of a single sheet of 20 gauge galvanized steel and welded at all seams and corners. Plenum shall be attached to the mounting frame with rivets. Inlet collar shall be sealed to the top of the plenum. Integral internal baffle for evenly distributing air over the entire face of the diffuser shall be mounted in the inlet of the diffuser. Integral baffle shall be constructed from stainless steel.

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3. The face of the diffuser shall be 13 percent free area perforated 22 gauge

galvanized steel. The face shall be secured in place by quarter-turn fasteners for quick removal and sanitizing. Diffusers shall be provided with two stainless steel safety cables for ease of installation/removal and to prevent accidental dropping and of the diffuser face.

4. Diffusers shall be supplied with ½" foil-faced natural fiber external insulation. Insulation shall have a flamespread index of 0-25 and a smoke developed index of 0-50 (25/50 rating) when tested in accordance with ASTM E84.
5. Finish: shall be one of the following:
  - a. #26 White.
  - b. The finish shall be a powder coat paint, baked at 425°F.
  - c. The paint thickness shall be 2.0 – 3.0 mils, gloss at 60° per ASTM D523-89 of 60 – 70%
  - d. The paint shall have a pencil hardness per ASTM D3363-92A of H – 2H,
  - e. The paint shall have crosshatch adhesion per ASTM D3359-83 of 5B
  - f. The paint must pass a salt spray test per ASTM B117-9048 of 1000 hours,
  - g. The paint must pass a humidity test per ASTM D2247-92 of 1000 hours
  - h. The paint must pass a conical mandrel per ASTM D522 of 1/8" conical bend, no cracking

## 2.4 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

## PART 3 - EXECUTION

### 3.1 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.

### 3.2 INSTALLATION

- A. Install diffusers, registers, and 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. Make final locations where indicated, as much as practical. 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 diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

### **3.3 ADJUSTING**

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

**END OF SECTION 233713**



## **SECTION 238123.12 – COMPUTER-ROOM AIR-CONDITIONERS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section includes floor-mounted, computer-room air conditioners of 7 tons and larger.

#### **1.3 DEFINITIONS**

- A. COP: Coefficient of performance.
- B. EER: Energy efficiency ratio.
- C. SCR: Silicon controlled rectifier.

#### **1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include material descriptions, dimensions of individual components and profiles, and finishes for computer-room air-conditioning units.
  - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For computer-room air conditioners.
  - 1. Include plans, elevations, sections, and attachment details.
  - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 3. Include diagrams for power, signal, and control wiring.
- C. Color Samples: For unit cabinet, discharge grille, and exterior louver and for each color and texture specified.

## **1.5 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Plans, elevations, and other details, drawn to scale, using input from installers of the items involved.
- B. Seismic Qualification Data: Certificates, for computer-room air conditioners, accessories, and components, from manufacturer.
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Field quality-control reports.
- D. Sample Warranty: For special warranty.

## **1.6 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For computer-room air conditioners to include in emergency, operation, and maintenance manuals.

## **1.7 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. Fan Belts: One set(s) for each belt-driven fan.
  - 2. Filters: One set(s) of filters for each unit.

## **1.8 WARRANTY**

- A. Special Warranty: Manufacturer agrees to repair or replace components of computer-room air conditioners that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period for Compressors: Manufacturer's standard, but not less than five years from date of Substantial Completion.
  - 2. Warranty Period for Humidifiers: Manufacturer's standard, but not less than three years from date of Substantial Completion.

3. Warranty Period for Control Boards: Manufacturer's standard, but not less than three years from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 PERFORMANCE REQUIREMENTS**

- A. Seismic Performance: Computer-room air conditioners shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- 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. ASHRAE Compliance:
  1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
  2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - "Ventilation Rate Procedures," and Section 7 - "Construction and Startup."
- D. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1.
- E. ASME Compliance: Fabricate and label water-cooled condenser shell to comply with ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," Division 1.

### **2.2 MANUFACTURED UNITS**

- A. Description: Self-contained, factory assembled, prewired, and prepiped; consisting of cabinet, fan, filters, and controls; for vertical floor mounting in upflow configuration.
- B. Cabinet and Frame: Welded tubular-steel frame with removable double-thick steel panels and insulated with 1-inch-thick duct liner.
  1. Finish of Interior Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- C. Supply-Air Fan:
  1. Forward curved, double width, double inlet, centrifugal, with adjustable V-belt drive.
  2. Plenum, single inlet, direct drive, electronically commutated, and variable speed.
- D. Refrigeration System:

1. Compressor: Scroll with oil strainer, internal motor overload protection, resilient suspension system, and crankcase heater.
2. Refrigeration Circuit:
  - a. Low-pressure switch.
  - b. Manually reset, high-pressure switch.
  - c. Thermal-expansion valve with external equalizer.
  - d. Sight glass with moisture indicator.
  - e. Service shutoff valves.
  - f. Charging valves.
  - g. Hot-gas bypass.
  - h. Refrigerant charge.
3. Refrigerant: R-407C or R-410A to match existing Stulz CRAC unit..
4. Refrigerant Evaporator Coil: Direct-expansion coil of seamless copper tubes expanded into aluminum fins, with two circuits, each with solenoid valve.
  - a. Mount stainless-steel drain pan complying with ASHRAE 62.1 under coil assembly.
5. Remote Air-Cooled Refrigerant Condenser:
  - a. Integral, copper-tube aluminum-fin coil.
  - b. Condenser with surge protection device (SPD) and locking disconnect in the enclosed electrical panel section.
  - c. Fan: Direct-drive, variable-speed propeller type.
  - d. Split system shall have suction- and liquid-line compatible fittings and refrigerant piping for field interconnection.
6. .
- E. Hot-Gas Reheat: Copper-tube, aluminum-fin coil with three-way solenoid valve and refrigerant check valve.
- F. Electric-Resistance Reheat Coil:
  1. Finned-tube electric elements with contactor and high-temperature-limit switches.
  2. SCR to proportionally control the reheat elements providing precise temperature control.
- G. Pre-Filter: 2-inch-thick, MERV 8, disposable, pleated, glass-fiber media.
- H. Ultrasonic Steam Humidifier: Self-contained, microprocessor-controlled unit with nebulizing modules, piezoelectric transducer, printed circuit control board and fitted nebula distribution device cover.
  1. Plumbing Components and Valve Bodies: Plastic, linked by flexible rubber hosing, with water fill with air gap and solenoid valve incorporating built-in

- strainer, high and low water floats, heat sink dissipater, and drain with integral air gap.
  - 2. Control: Proportional to provide gradual modulation from zero to 100 percent capacity with field-adjustable maximum capacity.
  - 3. Drain Cycle: Field-adjustable drain duration and drain interval. If the humidifier is idle for 72 hours, an automatic drain cycle shall occur.
  - 4. Boost fan.
  - 5. Vertical mounting rack.
- I. Disconnect Switch: Non-locking, non-automatic, molded-case circuit breaker with handle accessible when panel is closed and capable of preventing access until switched to off position.
- J. Control System:
- 1. Microprocessor unit-mounted panel.
  - 2. Fan contactor.
  - 3. Compressor contactor.
  - 4. Compressor start capacitor.
  - 5. Control transformer with circuit breaker.
  - 6. Solid-state temperature- and humidity-control modules.
  - 7. Humidity contactor.
  - 8. Time-delay relay.
  - 9. Heating contactor.
  - 10. Smoke sensor.
  - 11. High-temperature thermostat.
  - 12. Solid-state, wall-mounted control panel with start-stop switch, adjustable humidity set point, and adjustable temperature set point.
  - 13. Remote panel to monitor and change temperature and humidity set points and sensitivities of the unit and unit alarms.
  - 14. Sequential load activation, periodic hot-water-reheat coil flushing, and self-diagnostics.
  - 15. Lead/lag and sequencing of two units.
- K. Fan Motors:
- 1. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
  - 2. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load does not require motor to operate in service factor range above 1.0.
  - 3. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.
  - 4. Type: Open dripproof.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for hydronic piping systems to verify actual locations of piping connections before equipment installation.
- C. Examine walls, floors, and roofs for suitable conditions where computer-room air conditioners will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION**

- A. Layout and install computer-room air conditioners and suspension system coordinated with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.
- B. Install computer-room air conditioners coordinated with computer-room access flooring Installer.
- C. Install computer-room air conditioners level and plumb, maintaining manufacturer's recommended clearances.
- D. Air-Cooled Refrigerant Condenser Mounting: Install using elastomeric pads on concrete base. Minimum Deflection: 1/4 inch.

### **3.3 CONNECTIONS**

- A. Piping installation requirements are specified in other heating, ventilating, and air-conditioning Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to computer-room air conditioners, allow space for service and maintenance.
- C. Water and Drainage Connections: Comply with applicable requirements in Section 22 00 00.

- D. Refrigerant Piping: Comply with applicable requirements in Section 232300 "Refrigerant Piping." Provide shutoff valves and piping.

### **3.4 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
  - 1. Inspect for and remove shipping bolts, blocks, and tie-down straps.
  - 2. After installing computer-room air conditioners and after electrical circuitry has been energized, test for compliance with requirements.
  - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Computer-room air conditioners will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.
- E. After startup service and performance test, change filters and flush humidifier.

### **3.5 ADJUSTING**

- A. Adjust initial temperature and humidity set points.
- B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.
- C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

### **3.6 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain computer-room air conditioners.

**CF-35 ADAL Squadron Operations Building  
187th Fighter Wing, Dannelly Field, ANG  
Montgomery, AL**

**FAKZ189102**

**November 2022**

**Type B3 (100%) Submittal**

**END OF SECTION 238123.12**



## **SECTION 238126 - SPLIT-SYSTEM AIR-CONDITIONERS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section includes ductless ceiling or wall mount split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components. Units to be either stand alone or connected to the existing LG VRF system.

#### **1.3 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.

#### **1.4 INFORMATIONAL SUBMITTALS**

- A. Field quality-control reports.
- B. Warranty: Sample of special warranty.
- C. Delegated-Design Submittal: For fan supports indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
  - 1. Detail mounting, securing, and flashing of roof curb to roof structure. Indicate coordinating requirements with roof membrane system.
  - 2. Wind- Restraint Details: Detail fabrication and attachment of wind restraints and snubbers. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors.

## **1.5 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

## **1.6 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. Filters: One set(s) for each air-handling unit.

## **1.7 QUALITY ASSURANCE**

- 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. ASHRAE Compliance:
  - 1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
- C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

## **1.8 WARRANTY**

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period:
    - a. For Compressor: Five year(s) from date of Substantial Completion.
    - b. For Parts: One year(s) from date of Substantial Completion.
    - c. For Labor: One year(s) from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 PERFORMANCE REQUIREMENTS**

- A. Delegated Design: Engage a qualified professional engineer in the State of Alabama, to design roof mounting and restraints for equipment, including comprehensive engineering analysis.
  - 1. Design equipment supports to comply with wind performance requirements.
- B. Wind-Restraint Performance:
  - 1. Basic Wind Speed: 120 mph.
  - 2. Building Classification Category: III.
  - 3. Minimum 10 lb/sq. ft. multiplied by the maximum area of the mechanical component projected on a vertical plane that is normal to the wind direction, and 45 degrees either side of normal.
- C. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified."

### **2.2 INDOOR UNITS**

- A. Ceiling Cassette Ductless, Evaporator-Fan Components: Factory assembled and tested, include factory wiring, piping, electronic expansion valve, and controls.
  - 1. Recessed Ceiling Cabinet: Enameled steel with removable panels on front and ends or high strength molded polymer, sound absorbing thermal insulation, adjustable four-way supply/return grille, washable polymer return air filter, outside air duct connection.
  - 2. Refrigerant Coil: Copper tube with mechanically bonded aluminum fins, thermal-expansion valve, liquid and gas line thermistors, condensate pan, and condensate pump. Comply with ARI 210/240.
  - 3. Fan: Direct drive, multi-speed, statically and dynamically balanced impeller, thermally protected motor.
  - 4. Controls: Packaged networked control and diagnostics system, auto-restart function, time delays.
  - 5. Space controller shall include the following features:
    - a. Configurable display
    - b. On/Off, Operation mode, Setpoint
    - c. Individual zone control
    - d. Independent cool and heat setpoints
    - e. Weekly programmable scheduling

- f. Night setback
    - g. Automatic cooling/heating changeover for heat pump systems
    - h. Temperature set-point range restrictions.
    - i. Room temperature sensing for units with outside air ducted to the unit (or return to unit)
  - 6. Performance: as scheduled on drawings.
- B. Ceiling Concealed Ducted, Evaporator-Fan Components: Factory assembled and tested, include factory wiring, piping, electronic expansion valve, and controls.
  - 1. Concealed Ceiling Cabinet: Galvanized steel with removable panels on front and ends, sound absorbing thermal insulation, adjustable four-way supply/return grille, washable polymer return air filter, return air duct connection, supply air duct connections.
  - 2. Refrigerant Coil: Copper tube with mechanically bonded aluminum fins, thermal-expansion valve, liquid and gas line thermistors, condensate pan, and condensate pump. Comply with ARI 210/240.
  - 3. Fan: Direct drive, multi-speed, statically and dynamically balanced impeller, thermally protected motor.
  - 4. Controls: Packaged networked control and diagnostics system, auto-restart function, time delays, adjustable external static pressure switch.
  - 5. Space controller shall include the following features:
    - a. Configurable display
    - b. On/Off, Operation mode, Setpoint
    - c. Individual zone control
    - d. Independent cool and heat setpoints
    - e. Weekly programmable scheduling
    - f. Night setback
    - g. Automatic cooling/heating changeover for heat pump systems
    - h. Temperature set-point range restrictions.
    - i. Room temperature sensing for units with outside air ducted to the unit (or return to unit)
  - 6. Performance: as scheduled on drawings.
- C. Ceiling Concealed Ducted energy recovery unit: Factory assembled and tested, include factory wiring, fans, filter, plate type total energy recovery and controls.
  - 1. Cabinet: Galvanized steel with removable panels on front and ends, thermal insulation, duct connections.
  - 2. Fan: Direct drive, multi-speed or ECM, statically and dynamically balanced impeller, thermally protected motor.
  - 3. Heat exchanger element shall be constructed of specially treated cellulosic fiber membrane separated by corrugated layers to allow total heat (sensible and latent) energy recovery from the exhaust air to the supply air or from the supply air to the exhaust air as determined by design conditions.
  - 4. Filter: at both inlet connections to heat exchanger

5. The ERV shall have an automatic supply side by-pass damper to allow inbound ventilation air to by-pass the energy transfer core when outside weather conditions warrant.
6. Performance: as scheduled on drawings.

## **2.3 OUTDOOR UNITS**

### **A. Air-Cooled, Compressor-Condenser Components:**

1. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
2. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
  - a. Compressor Type: Scroll.
  - b. Refrigerant Charge: R-410A.
  - c. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 206/110.
3. Fan: Aluminum-propeller type, directly connected to motor.
4. Motor: Permanently lubricated, with integral thermal-overload protection.
5. Low Ambient Wind Baffle Kit: Permits operation down to 10 deg F.
6. Mounting Base: Polyethylene.

## **2.4 ACCESSORIES**

- A. Thermostat: Low voltage with subbase to control compressor and evaporator fan.
- B. Automatic-reset timer to prevent rapid cycling of compressor.
- C. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.
- D. Drain Hose: For condensate.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install units level and plumb.

- B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- C. Install roof-mounted, compressor-condenser components on equipment supports specified in Section 077200 "Roof Accessories." Anchor units to supports with removable, cadmium-plated fasteners.
- D. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

### **3.2 CONNECTIONS**

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.

### **3.3 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. 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.
- C. Remove and replace malfunctioning units and retest as specified above.
- D. Prepare test and inspection reports.

### **3.4 STARTUP SERVICE**

- A. Perform startup service.
  - 1. Complete installation and startup checks according to manufacturer's written instructions.

### **3.5 DEMONSTRATION**

- A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

**END OF SECTION 238126**

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DIVISION 26 & 27  
ELECTRICAL



Prepared by: J. Barry Gravlee, P.E.

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**SECTION 26 01 00  
ELECTRICAL**

**PART 1 - GENERAL**

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**1.01. RELATED DOCUMENTS:**

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections apply to work specified in this section.

**1.02. QUALIFICATIONS OF ELECTRICAL CONTRACTORS:**

- A. Electrical contractor must be properly established as an electrical contractor by the State of Alabama. Electrical contractor shall have had previous experience in the satisfactory installation of at least three systems of this type and size in the State of Alabama.

**1.03. CODES, PERMITS AND INSPECTIONS:**

Comply with applicable laws of the community, with latest edition of National Electrical Code (NEC), NFC 70, and the International Building Code (IBCC) or the edition adopted by the local authority having jurisdiction, where not in conflict with those laws, and with the service rules of the local utility company.

Obtain and pay for all permits and deposits, and arrange for inspections as required.

After completion of the work, submit certificate of final inspection and approval from the local electrical inspector, certifying that the installation complies with all regulations governing same.

**1.04. MATERIALS:**

All materials shall be new, and UL approved where a standard has been established.

Manufacturers' names and model numbers shown on the plans and in the specifications are given to indicate the type and general quality of items to be provided. Equal products by other manufacturers will be accepted.

Material substitutions will be considered only when evidence of equality and suitability, satisfactory to the Architect/Engineer has been presented in writing, with samples if requested by the Architect/Engineer. All prior approvals must have the approval of the engineer of record at the offices of Gunn and Associates, P.C. located at 3102 Highway 14, Millbrook, AL 36054, Phone: 334-285-1273

All proposed substitutions shall be approved in writing at least ten (10) days prior to the bid date.

It shall be understood that the Architect/Engineer has the authority to reject any material or equipment used which is not specified or approved, or showing defects of manufacture or workmanship, before or after such material or equipment is installed.

**1.05. WORKMANSHIP:**

Execute all work so as to present a neat and workmanlike appearance when completed.

**1.06. DESCRIPTION OF WORK:**

Furnish all labor and materials required to complete the electrical work indicated on the drawings or herein specified. Major work included in Section 16 shall be:

Remove or relocate all electrical or electronic services located on or crossing through the project property, either above or below grade, which would obstruct the construction of the project or conflict in any manner with the complete project or any code pertaining thereto.

Furnish and install a complete electrical light and power system including but not limited to the connection of all meters, switchboards, panelboards, circuit breakers, power outlets, convenience outlets, lighting fixtures, switches, and/or other equipment forming part of the electrical system.

Furnish and install a complete system of outlet boxes, face plates, conduit raceways, backboard, and service entrance conduit for the communications system.

Furnish and install outlet boxes, brass f-connector outlets, conduit raceways, RG6 cabling from each outlet to the nearest backboard, backboard, and service entrance conduit for the cable television outlet system.

Connect all electrical equipment whether furnished by this contractor or by others.

Furnish and install all disconnect switches not included as an integral part of equipment.

Furnish and install a complete Lighting Control System.

Furnish and install a complete Fire Alarm/Mass Notification System compliant with applicable provisions of UFC 4-021-01 and the National Fire Protection Association (NFPA) Standard No. 72.

Provide new lightning protection system. (LPS). The contractor shall engage a registered professional engineer whose area of practice includes lightning protection systems. The engineer shall review the existing building lightning protection design as well as the new building plans and provide a new LPS design for the building. This plan shall include repair of existing system components as well as providing additional components required by the building modifications indicated in the architectural, structural, mechanical, electrical, and plumbing plans. The new design arrived at by the LPS engineer shall be implemented by the electrical contractor as part of this project.

Complete the alterations, additions, and renovations to the electrical system in the existing building as specified herein or as shown on the drawings.

Procure and pay for permits and certifications as required by local and state ordinances and Fire Underwriters certificate of inspection.

Visit the site and determine conditions that affect this contract. Failure to do so will in no way relieve the Contractor of his responsibility under his contract.

Submit to the Architect a certificate of final inspection from local and/or state inspection authorities.

Establish and maintain temporary electrical services for construction purposes.

**1.07. DRAWINGS AND SPECIFICATIONS:**

This Contractor shall examine drawings and Specifications relating to the work of all trades and become fully informed as to the extent and character of work required and its relation to all other work in the project prior to submission of bid and prior to the start of any construction.

Drawings and Specifications shall be considered as complementary each to the other. What is called for by one shall be as binding as if called for by both. Where conflicts occur, secure clarification from the Architect in advance of bidding; otherwise incorporate the more stringent conditions into the bid price.

Omissions from the drawings and specifications or the mis-description of details of work which are evidently necessary to carry out the intent of the drawings and specifications, or which are customarily performed, shall not relieve the Contractor from performing such omissions and details of work; they shall be performed as if fully and correctly set forth and described in the drawings and specifications

The drawings indicate diagrammatically the extent, general character, and the approximate location of the work to be performed. In the interest of clearness, the work is not always shown to scale or exact location. Check all measurements, locations of conduit, fixtures, outlets, and equipment with the detailed architectural, structural, and mechanical drawings, and lay out work so as to fit in with ceiling grids, ductwork, sprinkler piping and heads, and other parts. Take finished dimensions at the job site in preference to using scale dimensions.

Where the work is indicated but with minor details omitted, furnish and install the work complete so as to perform its intended functions.

Where doubt arises as to the meaning of the plans and specifications, obtain the Architect's decision before proceeding with parts affected; otherwise assume liability for damage to other work and for making necessary corrections to work in question.

Except as noted above, make no changes in or deviations from the work as shown or specified except on written order of the Architect.

#### **1.08. EXISTING CONDITIONS:**

Before submitting a bid, visit the site and ascertain all existing conditions.

Make such adjustments in work as are required by the actual conditions encountered.

No consideration will be given after bid opening for alleged misunderstandings regarding utility connections, integration of work with existing system, or other existing conditions.

#### **1.09. SUBMITTALS:**

Follow procedure outlined in Division 1.

Submittals shall be bound together and shall include a coversheet indicating the following:

Project name

Trade contractor's name

Supplier's name

Name and phone number of supplier's contact person

A list of each item submitted with manufacturers' names and model numbers.

Within 20 days of award of contract and prior to beginning any work on the project submit six (6) copies of manufacturer's drawings/data sheets for the following items to the Engineer for review:

Conductors

Cable Pulling tensions. Provide cable pull tension calculations (lateral and longitudinal) on all underground cable runs over 150 feet for cables sized #1 and larger. Provide one line diagram indicating pulling tensions on each run and number and size of each pull box along anticipated route. Calculations shall include changes in direction or elevation of feeder runs.

Wiring Devices

Conduit Wrapping Tape

Switchboards

Panelboards

Power system breaker coordination. Submit proper breaker settings recommendations with breaker coordination study.

Contractor shall coordinate with mechanical/plumbing shop drawings prior to submitting power package to engineer. Adjust overcurrent devices accordingly.

Disconnect Switches

Dry Type Transformers

Motor Starters

Fire Stopping

Lighting Control System: Include conduit and cable layout, terminal to terminal wiring showing color code and wire numbers, and complete technical data on each system component. Furnish the Owner one set of as built drawings at completion of the project. Coordinate with lighting control riser on drawings for further shop drawings requirements.

Lighting Fixtures (include photometric data for each fixture)

Lamps

Ballasts

Fixture Support Equipment

Lighting Standards (Poles)

T Secondary Surge Arresters

Transient Voltage Surge Suppressors(Surge Protective Devices)

**Fire Alarm System: The fire alarm shop drawings shall bear the approval of the fire protection provider to insure all supervisory valves and flow switches are being monitored by the fire alarm system. Coordinate with fire protection provider prior to bid and provide monitoring for all supervisory valves and flow switches for entire building. Bid accordingly. Include conduit and cable layout, battery calculations, terminal to terminal wiring showing color code and wire numbers, and complete technical data on each system component. Additionally, the contractor or his/her fire alarm system vendor shall provide audibility calculations indicating compliance with all applicable provisions of NFPA 72 and the IBC. The contract drawings indicate a minimum design required to comply with applicable codes. However, since devices vary from manufacturer to manufacturer the contractor shall be responsible for furnishing any/all additional devices as required to provide audibility and**

**visibility levels that comply with applicable sections of NFPA 72 and IBC.  
Furnish the Owner one set of as built drawings at completion of the project.  
Provide a copy of the fire alarm contractor's State Fire Marshal's Permit  
with the submittals for approval.**

Submit samples upon request.

The Contractor is responsible for verifying all quantities and for verifying and coordinating dimensional data with the available space for items other than the basis of design.

Provide a 1/2" = 1' - 0" scale drawing of all electrical rooms containing more than a single panelboard section or containing a panelboard and other electrical and/or mechanical equipment. These drawings shall be submitted along with equipment data sheets.

The contractor shall review and approve, or make appropriate notations on each item prior to submittal to the architect. Submittals without contractor's approval will be rejected.

#### **1.10. COORDINATION OF SERVICE WITH OTHER TRADES:**

It shall be the responsibility of the Electrical Contractor to coordinate the electrical service characteristics to each piece of electrically operated equipment with all trades providing electrically operated equipment.

Within ten (10) working days of notification to proceed with construction from the Architect, the Electrical Contractor shall notify, in writing, all trades providing electrically operated equipment the characteristic of the electrical power being supplied to each piece of electrically operated equipment.

A copy of this notification shall be provided to the General Contractor and the Architect.

Be informed as to equipment being furnished by other trades, but not liable for added cost incurred by equipment substitutions made by others which require excess electrical wiring or equipment above that indicated on drawings or specified.

The contractor providing the equipment shall be responsible for the additional costs.

#### **1.11. PROGRESS OF WORK:**

Schedule work as necessary to cooperate with other trades, Do not delay other trades. Maintain necessary competent mechanics and supervision to provide an orderly progression of the work.

#### **1.12. PROTECTION OF PERSONS AND PROPERTY DURING CONSTRUCTION:**

Take all precautions necessary to provide safety and protection to persons and the protection of materials and property.

Protect items of equipment from stains, corrosion, scratches, and any other damage or dirt, whether in storage, at job site or installed. No damaged or dirty equipment, lenses, or reflectors will be accepted.

Live panelboards, outlets, switches, motor control equipment, junction boxes, etc., shall be protected against contact of live parts and conductors by personnel.

**1.13. CLEANING UP:**

During the progress of work, keep the Owner's premises in a neat and orderly condition, free from accumulation of debris resulting from this work. At the completion of the work, remove all material, scrap, etc. not a part of this Contract.

**1.14. AS-BUILT DRAWINGS, AND OPERATING AND MAINTENANCE INSTRUCTIONS:**

Prior to the Final Acceptance Inspection the Contractor shall turn over to the Architect one set of reproducible "as built" drawings, including corrected fire alarm system shop drawings, three (3) sets of all equipment catalogs and maintenance data, manufacturers' warranties, and three (3) sets of shop drawings on all equipment.

**1.15. TESTING:**

Upon completion of the work, conduct a thorough test in the presence of Architect or his representative, and demonstrate that all systems are in perfect working condition.

**1.16. INSPECTIONS:**

The contractor shall have all systems ready for operation and an electrician available to remove panel fronts, coverplates, fixture doors, etc., at the final inspection and any other scheduled inspections.

It is the contractor's responsibility to have the job ready for inspections when they are scheduled. We will perform inspections as required by our contract. If project is not ready during inspection and requires a re-inspection by Gunn & Associates, then the contractor shall pay Gunn & Associates, P.C. for the re-inspection. The payment shall be made directly to Gunn & Associates, P.C. in the amount to be determined by engineer. Not to exceed \$1,500 for single re-inspection fee. Payment must be received by Gunn & Associates prior to scheduling re-inspection.

Inspections for Temporary or Permanent Power required by any utility companies are not in our scope of work. If contractor needs Gunn & Associates, P.C. to perform inspections, contractor must include an inspection cost of \$1,000 per inspection in their base bid. Payment must be received by Gunn & Associates prior to scheduling inspection.

**1.17. DEMONSTRATION:**

By on-off, stop-start operation, demonstrate to the Owner or his representative, the use, working, resetting, and adjusting of each and every system. Submit statement initialed by the Owner that such demonstration has been made.

**1.18. WARRANTY:**

Warrant the entire electrical system in proper working order. Replace, without additional charge, all work or material that may develop defects (ordinary wear and tear or damage resulting from improper handling excepted) within a period of one year from date of final to general contractor. Provide the owner with two bound copies of all manufacturers' warranties.

Data and Telecommunications system cabling shall be warranted for a minimum of 15 years.



**1.19. TEMPORARY SYSTEMS:**

The Electrical Contractor shall be responsible for furnishing and installing equipment and materials necessary for providing electrical power and lighting where needed for the construction of the project.

Electrical Contractor will be responsible for paying for and providing temporary construction power and lighting for entire job site. Coordinate with local jurisdictions and utility companies and pay all fees necessary to get temporary power to the job site. General Contractor shall be responsible for all monthly utility cost for duration of project or date of substantial completion.

**1.20. SERVICE INTERRUPTION CLEARANCE WITH OWNER:**

Before submitting a proposal, check with the Owner concerning interruption of service to the existing electrical systems. No interruption shall be made except at such time and for such duration as approved by the Owner. The Contractor's bid shall include all necessary over-time and weekend work.

**1.21. DEFINITIONS:**

“AWG” - American Wire Gauge

“ADA” – Americans with Disabilities Act

“As required” - Any and all items required to complete the installation of an item so as to perform its intended function.

“Circuiting” - Conductors, raceways, raceway fittings, and associated hardware.

“EMT” – Electrical Metallic Tubing, “thin wall”

“IBC” – International Building Code

“Install” - furnish, install, and make all necessary connections to and/or for the item(s) indicated or specified.

“NEC” - National Electrical Code, ANSI/NFPA 70, latest edition or the edition adopted by the authority having jurisdiction.

“Necessary” - Any and all items required to complete the installation of an item so as to perform its intended function.

“NEMA” - National Electrical Manufacturers’ Association

“NFPA” - National Fire Protection Association

“PVC Conduit” – Rigid Nonmetallic Polyvinyl Chloride conduit

“RGS Conduit” – Rigid galvanized steel conduit

“UL” - Underwriters’ Laboratories, Inc.

**PART 2 - MATERIALS**

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**2.01. GENERAL:**

This section includes all basic materials for raceways, fittings, busways, conductors, panelboards, switchboards, lighting fixtures and accessories, etc., as required for a complete installation.

All materials shall be new and listed by the Underwriters Laboratories. Material substitutions will be considered only when evidence of equality and suitability, satisfactory to the Architect has been presented in writing, with samples if requested by the Architect.

It shall be understood that the Architect/Engineer has the authority to reject any material or equipment used which is not specified or approved, or showing defects of manufacture or workmanship, before or after such material or equipment is installed.

## **2.02. CONDUITS:**

**Rigid Metal (Galvanized Steel-RGS) Conduit:** Rigid metal conduit shall be mild steel piping, galvanized inside and outside, and conform to ASA Specification 080.1 and Underwriters' Laboratories Specifications.

**Intermediate Metal Conduit (IMC):** IMC shall be hot dipped galvanized inside and outside and manufactured in accordance with U.L. Standard #6 or #1242.

**Electrical Metallic Tubing (EMT):** EMT shall be high grade steel electro-galvanized outside and lacquer or enamel coating inside and conform to ASA Specifications 080.1 and Underwriters' Laboratories Specifications.

**Rigid Nonmetallic Conduit (PVC):** PVC conduit where exposed shall be high impact Schedule 80; below ground and below or in slab PVC shall be of high impact Schedule 40 PVC and shall conform to Underwriters' Laboratories Standard UL-651.

**Rigid Aluminum:** Rigid Aluminum conduit shall be manufactured from 6063, t-1 aluminum alloy and shall meet the requirements of Federal Spec. WW-C-540c and ANSI C80.5 and shall be U.L. listed in accordance with UL-6.

## **2.03. COUPLINGS, FITTINGS, AND CONNECTORS:**

**RGS & IMC:** Rigid galvanized or intermediate metallic conduit shall meet or exceed ANSI C80.1, UL-6 and/or federal specification WW-C-581.

**EMT:** EMT fittings shall be all steel type setscrew or insulated throat compression type. Pressure indented or slip fit type will not be accepted. All connectors to be insulated.

**PVC:** PVC fittings shall be of high impact PVC Schedule 40 or Schedule 80 to match the installed conduit. Joints shall be made with PVC solvent cement as recommended by manufacturer.

**Rigid Aluminum:** Fittings used with Rigid Aluminum conduit shall be formed of the same alloy as the conduit or shall be copper free cast aluminum unless specifically indicated otherwise.

## **2.04. CONDUIT BODIES:**

Conduit bodies shall be malleable iron except in kitchen, dishwashing, and waste water treatment areas conduit bodies shall be copper free cast aluminum with stamped aluminum covers.

Covers shall be screw retained with wedge nut or threaded body. Covers on bodies installed outdoors shall be approved and rated for installation outdoors.

Bodies shall comply with NEC 370 and 373.

**RGS & IMC:** Rigid galvanized or intermediate metallic conduit bodies shall meet or exceed ANSI C80.1, UL-6 and/or federal specification WW-C-581.

Conduit cannot be used as the sole ground source. Provide separate insulated green grounding wire.

**2.05. BUSHINGS:**

Bushings up to and including 1" shall have a tapered throat.

Bushings 1-1/4" and larger shall be the insulating type.

Grounding bushings shall be specification grade insulated grounding type bushings with tin plated copper grounding saddles.

Bushings shall be zinc plated malleable iron or copper free cast aluminum.

Bushings for terminating Data, Telecommunications, control, CATV, and similar conduits above ceilings and at backboards may be PVC or Polyethylene insulating bushings.

**2.06. EXPANSION FITTINGS:**

Conduit Expansion Joints shall be UL Listed.

Expansion joints in rigid metal conduits shall consist of a threaded malleable iron body, pressure bushing, watertight packing, pressure ring, gasket, insulating bushing, and external grounding jumper.

Expansion joints for EMT conduit shall be same as above with additional EMT couplings and connectors

Expansion joints in PVC conduit shall exceed IAPMO industry standards..

Expansion joints shall provide a minimum of 4" of conduit movement.

**2.07. CONDUIT ACCESSORIES:**

Conduit clamps and supports for metallic conduit shall be galvanized steel.

Conduit clamps and supports for nonmetallic conduit shall be nonmetallic high impact PVC.

Conduit clamps for aluminum conduits shall be stainless steel or cast copper free aluminum with stainless steel fasteners.

**2.08. FLEXIBLE CONDUIT:**

Liquidtight flexible metal conduit:

Neoprene-jacketed liquidtight flexible metal conduit.

**2.09. ELECTRICAL TAPES:**

General use electrical tape shall be 8 mil (.008") thick, minimum, premium grade, pressure sensitive, flame retardant, vinyl electrical tape meeting UL 510, ASTM-D-3005, and MIL-I-24391C.

Rubber tape used as primary tape shall be a 30 mil (.030") thick, minimum self-amalgamating, low voltage rubber tape rated for use through 600 V.

Electrical filler tape shall be a 125 mil (.125") thick, minimum, self-amalgamating, low voltage insulating compound rated for use through 5 kV.

**2.10. PIPE WRAPPING TAPE:**

Pipe wrapping tape shall be a 10 mil (.010") thick, minimum, pressure sensitive, vinyl tape manufactured for pipe wrapping applications.

The tape shall be UV, bacteria, and fungus resistant.

The manufacturer's name and tape type shall be printed on the back of the tape.

**2.11. WIRE NUTS:**

Wire nuts for conductor splicing shall be winged type connectors with a square, plated steel spring and flame retardant thermoplastic shell.

The connector shall be rated for the number and size conductors being connected.

The Wire Nuts shall be rated for 105°C. And UL 486C listed.

**2.12. SPLIT BOLT CONNECTORS:**

Split bolt connectors for splicing conductors shall be UL 486A listed, shall be tin plated copper, and shall have a hexagonal head and nut.

Split bolt connectors for conductors size AWG #4 and larger shall have a serrated spacer bar between conductors.

**2.13. MULTI-TAP CONNECTORS:**

Multi-tap connectors shall be insulated type

Multi-tap connectors shall be rated for the conductor sizes indicated on the drawings.

The connectors shall be provided for the number of conductors indicated, including any future taps shown, plus a minimum of one additional tap.

**2.14. FIRE STOPPING:**

Fire sealant shall be intumescent caulk, putty, sheet and/or wrap/strip as required to attain the proper rating.

**2.15. JUNCTION BOXES (THRU 4-11/16 ):**

Sheet Metal: To be standard type with knockouts made of hot dipped galvanized steel.

**2.16. JUNCTION AND PULL BOXES (LARGER THAN 4-11/16 ):**

Shall be cast metal for all below grade exterior use and where indicated on plans. All other shall be oil tight, JIC boxes not less than 16 gauge

**2.17. PULL BOXES:**

Galvanized sheet metal screw-cover type with UL.

**2.18. JUNCTION AND TERMINAL BOXES FOR AUXILIARY SYSTEMS:**

Junction boxes for auxiliary system circuiting splicing shall be formed of galvanized steel.

Boxes shall have hinged front, locking door(s).

Metal back plates shall be provided for mounting terminal strips or other devices.

Screw terminal strips shall be provided with a minimum of 25 percent spare terminals.

Boxes shall be sized to accommodate the terminal blocks and conductors, providing code required bending space.

Provide complete back boxes for all surface mounted devices. Back box shall have knockout on top and bottom as needed. Surface mounted junction boxes with devices mounted to it will not be accepted.

**2.19. AUXILIARY GUTTERS (WIRING TROUGHS):**

Gutters shall be of sizes shown and/or required by the NEC (whichever is larger), constructed of code gauge, galvanized sheet steel, painted ANSI 61 gray.

Gutters shall be UL listed and shall be of NEMA 3R construction in wet or damp locations or shall be as indicated on the drawings.

**2.20. STRUT SYSTEM FOR SUPPORT OF ELECTRICAL EQUIPMENT:**

Strut shall be 1-5/8" except where heavier strut is required to support the load, for rigidity, or where specifically indicated otherwise.

Cold-formed steel ASTM A 570 or A 446 GR A.

Stainless Steel Strut: Type 304, ASTM A 240.

Hot Dipped Galvanized Steel Strut: Zinc coated after manufacturing operations are complete, ASTM A 123 or A 153

Electro-galvanized Steel Strut: Electrolytically zinc coated, ASTM B 633 Type III SC 1.

Fittings: Same material as strut, ASTM A 575, A 576, A 36, A 635, or A 240.

Zinc Primer: As recommended by strut manufacturer.

**2.21. OUTLET BOXES:**

General: Except as noted, boxes shall be standard hot dipped galvanized steel at least 1-1/2" deep, of metal at least 1/16" thick; sized to accommodate devices and conductors per NEC Article 370

Ceiling and Wall Bracket Outlets: 4" octagonal boxes with plaster rings appropriate for finish surface.

Typical boxes (for switches, receptacles and auxiliary systems):

4" square boxes ganged as required. Box volume shall be in accordance with NEC Section 370 – provide extensions as required.

Furnish with 3/4" plaster rings where employed in plaster, 1" tile covers where used in ceramic tile, 1" plaster rings where set in exposed concrete, and otherwise appropriate for surface and construction.

Use 4-11/16" square, 2-1/8" deep boxes where more than 10 conductors enter the boxes. Provide extensions as required to provide volume per NEC.

Where existing walls are furred out with shallow hatch channel and sheet rock then the contractor will be required to use a shallow junction as required.

All exposed junction boxes for receptacles, communications devices, switches, and fire alarm devices shall be provided with back boxes. Do not use standard junction boxes when exposed. No exposed edges of devices plates will be allowed. No knockouts on the side of the box.

Boxes in Exposed (or Thin-Coat Plastered) Masonry: Where conduit connections permit, employ solid flush-type, square-cornered, masonry boxes with turned-in device holders; otherwise employ typical box with 1-1/2" square-cut tile cover.

Multiple Outlet Floor Boxes:

Floor boxes shall be multi-outlet type providing space for four separate services for duplex outlets and/or Data/Telecommunications outlets.

Floor boxes shall be provided with covers flush access hatch with carpet trim for carpeted floors trim for vinyl covered floors.

Floor boxes shall be provided with 20 amp duplex grounding duplex receptacles, isolated ground receptacles, and Data/Telecommunications outlets as indicated on the drawings.

Data outlets shall be modular type capable of housing up to six (6) Cat 5e jacks.

Boxes shall be provided with two (2) active jacks unless indicated otherwise on the drawings.

Provide blank plates for all unused openings.

The boxes shall be equal to what is specified on drawings.

Boxes used with Exposed Conduit: 4" square utility boxes.

Exterior Boxes: Galvanized cast-metal boxes Make weatherproof with gasketed covers.

Exterior Boxes: All receptacle boxes shall be recessed unless specifically called out not to be. This includes exterior receptacles in all masonry type walls including but not limited to Pre-cast, Brick, Block, etc.

Boxes used with Recessed Lighting Fixtures: Provide a 4" square box with blank cover.

Boxes in Dry Wall Construction: Sectional type switch boxes at least 2-1/2" deep may be used instead of typical box (but not where dry wall finish is applied over masonry back-up and not where multi- gang devices occur).

## **2.22. CONDUCTORS AND CABLES:**

### **Power Conductors**

The ungrounded conductors (phase) and the grounded conductor (neutral) of each voltage system being installed shall be phase identified the full length of the conductor with the color characteristics manufactured in the insulation of cable from the cable manufacturer. Required color cable will then be installed for the specific voltage system as identified in these specifications.

All conductors shall be copper with not less than 98% conductivity and with current carrying capacities per N.E.C. for 60°C. for sizes through #1 AWG and 75°C for conductors #1/0 and above.

All conductors shall have manufacturer's name, type insulation, and conductor size imprinted on jacket at regular intervals.

Conductors of size #10 and smaller shall be solid copper conductors with 600 volt type THHN or THWN insulation.

Conductors of size #8 and larger shall be stranded copper conductors with 600 volt type THHN or THWN insulation.

All motor branch circuits, HVAC, and plumbing equipment shall be stranded copper conductors with 600 volt type RHH-RHW insulation.

All conductors installed in conduit below grade shall be rated for wet location.

### **Fixture Wire:**

- a. Conductors feeding into fixtures, other than fluorescent fixtures, of 300 watts or less shall be #14, 200°C., type SF-2, for fixtures of more than 300 watts #12, 200 °C., type SF-2 shall be used.

- b. Conductors pulled through fluorescent fixtures shall have Type TFN or TFFN fixture wire, rated 90oC.

Control and Signal Wire: Conductor type TFF, minimum size #16 copper and fully color-coded, shall be used.

### **2.23. WIRING DEVICES:**

General: Manufacturer's and catalog numbers listed are used to establish style, type and quality. Unless otherwise indicated on drawings, all wiring devices shall be UL listed, side-wired specification grade.

Wall switches: 120/277V, 20A, AC, flush enclosed, quiet type switches with thermoplastic body and polycarbonate toggles.

Duplex receptacles (general purpose): 125V/20A flush duplex back and side wired hard use specification grade receptacles, NEMA 5-20R configuration, with nylon face and body, grounding terminal and break-off fins for converting to 2-circuit use.

Receptacles shall meet Federal Specification WC-596.

Tamper Resistant Duplex receptacles,: 125V/20A flush duplex, hospital grade, tamper resistant receptacles, NEMA 5-20R configuration, with nylon face and body, grounding terminal. Receptacles shall meet Federal Specification WC-596. Color to match wall switches.

Ground Fault Circuit Interrupt Receptacles: 125V/20 amp ground fault circuit interrupting receptacle for personnel protection, NEMA 5-20R configuration, Each GFCI symbol on drawing indicates a GFCI type receptacle. Do not through-wire non-GFCI receptacles from GFCI receptacles where ground fault protection is required. All exterior receptacles shall be ground fault interrupting type with weatherproof coverplates.

Single Receptacles: Flush Bakelite receptacles with side wiring and grounding terminal, voltage, amperage, and configuration as required for circuit indicated.

Each single or multi outlet receptacle, other than straight blade, 15 or 20 amp, 120 volts, NEMA 5-15R or NEMA 5-20R, shall be provided with matching cord plugs.

Wiring devices shall be of color as directed by Architect. Devices must be available in ivory, brown, black, white, and gray. Devices connected to the emergency generator shall be red in color.

All projects classified as an elementary school type facility shall be provided with tamper proof type receptacles.

Pin and Sleeve Devices:

Pin and Sleeve Devices shall be watertight plugs and receptacles of the ratings shown on the legend and/or schedules.

Devices shall be listed to UL Standard 498 and UL Classified or IEC Standards 309-1 and 309-2.

Devices shall be furnished as matching plugs and receptacles with cast aluminum angled backbox.

### **2.24. DEVICE PLATES:**

Type appropriate for the associated wiring device, equal to Sierra Stainless Steel Smoothline. Device plates shall be of color as directed by Architect. Devices must be available in ivory, brown, black, white, and stainless steel. Provide single plate of proper gang where more than one device occurs (do not gang dimmers with rocker switches).

Damp Location: 20 amp, 125 and 250 volt receptacles - Covers shall be weatherproof when plugs are not installed, provide cast aluminum weatherproof coverplates with single lift cover and gasket equal.

Wet Locations, 20 amp, 125 and 250 volt receptacles: Covers shall be weatherproof In-Use covers, rated NEMA 3R when in use and shall be constructed of cast aluminum with sealing gasket.

Coverplates for exposed cast aluminum boxes in kitchen and dishwashing areas shall be cast coverplates, without lift cover, unless specifically indicated otherwise on the drawings.

Color: Wiring device cover plates shall be of color as indicated on drawings or directed by Architect. Devices must be available in ivory, brown, black, white, gray, and stainless steel.

Jumbo and Mini-Jumbo plates will not be accepted.

## **2.25. OCCUPANCY SENSORS AND ACCESSORIES FOR LIGHTING CONTROL:**

Occupancy sensors shall be totally passive in nature, in that the sensors shall not emit or interfere with any other electronic device, or human characteristic. Sensors shall be dual technology, i.e.: Passive Infrared (PIR) and Microphonic.

PIR shall initiate an "on" condition and the PIR or microphones shall maintain the load "on".

Upon detection of human activity by the detector the lights shall come on and a time delay shall be initiated to maintain the lights on for a pre-set time period. The time delay shall be factory set and field adjustable from 30 seconds to 20 minutes.

All devices shall be factory warranted for 5 years.

All sensors shall be low voltage, 12 to 24 volts and shall work in conjunction with remote power packs.

Occupancy sensors shall be as shown on drawings.

## **2.26. GROUNDING:**

Ground Rods shall be 3/4" x 10' copperclad steel.

All grounding conductors shall be copper.

## **2.27. LIGHTING FIXTURES**

General:

All Lighting Fixtures shall be UL labeled.

Fixtures installed in fire rated ceilings or ceiling assemblies shall be rated for installation in fire rated ceilings.

Furnish fixtures complete with lamps, ballasts and internal wiring factory installed.



Fixtures shall be furnished as specified herein and as shown on the fixture schedule on the plans. Catalog numbers shown are for basic units; furnish all fixtures complete with flexible connections, trim, plaster frames, and all other appurtenances necessary to the installation.

Fluorescent fixtures shall be equipped with flat, flush steel doors, unless scheduled otherwise, with spring loaded cam latches, shall be powder coat painted after fabrication, shall have lenses equal to ALP or KSH 12.125, .125" lenses, and shall be rated for installation in fire rated ceilings.

Substitutions: Reference to a specific manufacturer's product is made to establish a standard of quality and design, and to give a general description of the basic type desired. Equal products by the listed manufacturers will be accepted subject to the Engineer's approval.

It shall be the responsibility of the contractor to verify the exact type ceiling, type fixture mounting and trim, and recessing depth of all recessed fixtures prior to purchasing any fixtures.

Stems on stem mounted fixtures shall be approved ball aligner type, swivel 30 degrees from vertical with swivel below canopy. Paint stems the same color as the fixture trim. Stems in unfinished areas may be unpainted conduit.

High and low bay fixtures shall be equipped with safety chains. Every suspended fixture in hangar shall have safety chains.

Fixtures installed on the exterior of buildings, on poles, or on pedestals shall be rated for wet location installation.

Lamping for all new luminaries shall be new at the time of final acceptance.

Building permanent lighting shall not be used for temporary or construction lighting at anytime prior to final acceptance. If used for temporary construction lighting, then relamp all fixtures prior to final inspection.

All high bay fluorescent, induction or HID fixtures installed in hangar or similar use areas shall be provided with wire guard.

Emergency and Exit lighting Fixtures shall be equipped with a Self-testing module which shall perform the following functions:

Continuous monitoring of charger operation and battery voltage with visual indication of normal operation and of malfunction.

Monthly discharge cycling of battery with monitoring of transfer circuit function, battery capacity and emergency lamp operation with visual indication of malfunction. The battery capacity test may be conducted by using a synthetic load. Manual test switch to simulate a discharge test cycle.

Modules shall have low voltage battery disconnect (LVD) and brownout protection circuit.

All lighting fixtures and exit signs shown as emergency on drawings shall be provided with a minimum 1100 lumen emergency battery ballast capable of 90 minutes of illumination. No exceptions.

Ballasts:

It shall be the responsibility of the lighting fixture supplier to insure compatibility of the ballasts and lamps provided.

Lamps: Type and size as scheduled.

LED bulb shape shall comply with ANSI C79.1. Lamp base shall comply with ANSI C81.61.

Minimum CRI of LED lamps shall be 80 with a color temperature as shown on drawings.

Rated life of all LED lamping shall be a minimum of 50,000 hours failure to 75% of lamp output.

LED lamping shall be capable of dimming from 100% to 0%.

Warranties:

- a. LED fixtures shall be rated at 50,000 hours mean time to failure of half of led array or 10 years whichever comes first.

## **2.28. PANELBOARDS:**

General: All panelboards shall be dead front type manufactured and installed in accordance with UL and NEMA standards and shall carry a UL label. Ampacity, service voltage, and configuration shall be as indicated on drawings. Panelboards shall be clearly marked with ampacity, voltage, and maximum short current ratings.

Enclosure:

Panelboard enclosures shall be as indicated on drawings.

Unless otherwise indicated, all boxes shall be constructed of galvanized (or equivalent rust-resistant) sheet steel with hinged front trim.

Fronts shall be door in door with two lockable latches to open door, lock, and latch. All panelboard locks shall be keyed alike. Piano hinges with screw latches will not be permitted.

Fronts shall be finished with gray baked enamel over a rust-inhibiting phosphatized coating.

All dual section panels shall be equal in size. Sub-Feed circuit breakers will not be allowed to feed second section.

Sub-Feed circuit breakers feeding additional panels or equipment shall be branch mounted.

Provide permanent numbering of the panelboards. Stickers are not considered permanent.

Any panelboard schedule that indicates more than 42 circuits shall be provided in two equally sized panelboards.

Main circuit breakers shall be centered mounted. Main breaker cannot be mounted on buss bars with other circuit breakers.

Buss Assembly:

Bussing shall be copper.

The buss assembly A.I.C. shall be rated as indicated on drawings. Ratings shall be established by heat rise tests, in accordance with UL Standard 67.

All bussing shall accept bolt on circuit breakers.

Current carrying parts of all bussing shall be plated. In lighting and receptacle panels, bussing shall be designed for connection to the branch circuit breakers in the phase sequence format. Distribution panelboards shall be fully bussed.

Ground bars shall be provided in all panelboards.

Neutral bar shall be fully sized with lugs suitable for incoming and outgoing conductors.

Provide insulated ground buss where indicated on the panelboard schedules.

**Circuit Breakers:**

Circuit breakers shall be quick-make, quick-break, thermal magnetic, molded case, bolt on type.

Circuit Breakers shall be numbered and arranged as indicated on the panelboard schedules and/or single line wiring diagrams. Numbers shall be permanently attached to trim.

SWD Circuit Breakers: Single pole circuit breakers rated 15 and 20 amperes and intended to switch 277 volts or less fluorescent lighting loads shall be UL rated for switching duty and shall be marked "SWD".

HACR Circuit Breakers: Circuit breakers 60 amperes or below, 240 volts, 1-, 2-, or 3-pole, intended to protect multi-motor and combination-load installations involved in heating, air conditioning, and refrigerating equipment shall be UL listed as HACR type and shall be marked "Listed HACR Type."

Circuit breakers serving fire alarm systems, dedicated emergency/exit lighting circuits, and area of rescue communications systems shall be equipped with a screw-on, mechanical handle blocking device which locks the circuit breaker in the "ON" position.

Circuit breakers serving circuits in residential bedrooms shall be Arc Fault Interrupting(AFI) type circuit breakers and shall be UL 1699 listed.

**Directories:**

Each panelboard shall be equipped with a metal directory frame with a clear cover welded to the inside of the door.

Equipment Short Circuit Rating: Short Circuit Interrupting Ratings shall be as indicated on the plans and schedules. Unless specifically indicated otherwise all rating are "Fully Rated" capacities. Where no rating is given, the contractor shall verify the available short current with the serving utility and provide equipment rated accordingly.

Lighting panelboard cans shall be a maximum of 20" wide and 5 3/4" deep. Cans of multi-section panelboards shall be the same size.

Provide nameplate as called out on drawings.

All circuit breakers 1200-amp and up shall comply with NEC Article 240.87 Arc Energy Reduction.

All flush mounted panel shall be provided with six (6) 3/4" conduit stubbed up above accessible ceiling.

**2.29. DISTRIBUTION PANELBOARDS:**

Furnish and install distribution and power panelboards as indicated in the panelboard schedule(s) or single line wiring diagrams and where shown on the plans.

Panelboards shall be dead front, safety type equipped with thermal magnetic, molded case circuit breakers with trip ratings as indicated on the schedule(s).

Panelboard bussing shall be copper.

Panelboard buss structure and main lugs or main breaker(s) shall have the fault current ratings as indicated on the drawings. Ratings shall be established by heat rise tests conducted according to UL Standard UL67.

Circuit breakers shall be equipped with individually insulated, braced and protected connectors. The front faces of all circuit breakers shall be flush with each other.

Main circuit breakers shall be centered mounted. Main breaker cannot be mounted on buss bars with other circuit breakers.

An engraved phenolic label shall be permanently attached to the front of the panelboard adjacent to each circuit breaker identifying the load served by the circuit breaker.

Automatic tripping shall be clearly shown by the breaker handle taking a position between ON and OFF when the breaker is automatically tripped.

Provisions for additional breakers shall be such that no additional connectors or hardware will be required to add breakers.

The panelboard assembly shall be enclosed in a steel cabinet. The rigidity and gauge of steel shall be as specified in UL Standards. End walls shall be removable. The size of wiring gutters shall be in accordance with the National Electrical Code, NEMA, and UL Standards for panelboards.

Cabinets shall be equipped with four piece fronts.

The panelboard interior assembly shall be dead front with panelboard front removed.

Main lugs or main breaker shall be barriered on live sides.

The barrier in front of the main lugs shall be hinged to a fixed part of the interior. The end of the buss structure opposite the mains shall be barriered.

Circuit breakers serving Fire Alarm Systems, Security Systems, and/or Emergency/Exit lights shall be equipped with mechanical, screw-on type, locking devices. These devices shall not be padlock type devices.

Panelboards shall be listed by Underwriters' Laboratories and to bear UL label.

Panelboards shall be rated for use as Service Entrance Equipment where required by the National Electrical Code. Panelboards shall be by Cutler-Hammer, General Electric, or Siemens. Square D will not be accepted.

Provide nameplate as called out on drawings.

All circuit breakers 1200-amp and up shall comply with NEC Article 240.87 Arc Energy Reduction.

All flush mounted panel shall be provided with six (6) ¾" conduit stubbed up above accessible ceiling.

T All service entrance main circuit breakers shall be 100% rated.

## **2.30. SWITCHBOARDS:**

Construction.

1. The Switchboard shall consist of the required number of vertical sections, bolted together to form a rigid assembly. Provide ventilators located on the top of the

switchgear over the breaker and bus compartments to ensure adequate ventilation within the enclosure.

2. Each vertical steel unit, forming part of the switchgear line-up, shall be a self-contained housing having one or more individual breaker or instrument compartments, a centralized bus compartment, and a rear cabling compartment.
3. The switchgear shall be suitable for use as service entrance equipment and be labeled in accordance with UL requirements.

#### **Bussing**

1. Switchboard buss structure and main lugs or main breaker(s) shall have the fault current ratings as indicated on the drawings. Ratings shall be established by heat rise tests conducted according to UL Standard UL67.
2. All bus bars shall be tin-plated copper. Main horizontal bus bars shall be mounted with all three phases arranged in the same vertical plane. Bus sizing shall be based on ANSI standard temperature rise criteria of 65 degrees C over a 40 degrees C ambient (outside the enclosure).
3. Provide a full capacity neutral bus.
4. A copper ground bus shall be furnished firmly secured to each vertical section structure and shall extend the entire length of the switchgear. The ground bus short time withstand rating shall meet that of the largest circuit breaker within the assembly.
5. All hardware used on conductors shall be high-tensile strength and zinc plated. All bus joints shall be provided with Belleville-type washers.

#### **Wiring/Terminations**

1. A termination system shall be provided such that no additional cable bracing, tying or lashing is required to maintain the short circuit withstand ratings of the assembly through 200 kA.
2. Lugs shall be provided in the incoming line section for connection of the main grounding conductor. Additional lugs for connection of other grounding conductors shall be provided as indicated on the drawings.

An engraved phenolic label shall be permanently attached to the front of the switchboard adjacent to each circuit breaker identifying the load served by the circuit breaker.

Automatic tripping shall be clearly shown by the breaker handle taking a position between ON and OFF when the breaker is automatically tripped.

Provisions for additional breakers shall be such that no additional connectors or hardware will be required to add breakers.

Circuit breakers shall be provided with the ratings indicated on the drawings.

Switchboards shall be listed by Underwriters' Laboratories and to bear UL label.

Switchboards shall be rated for use as Service Entrance Equipment where required by the National Electrical Code.

All circuit breakers 1200-amp and up shall comply with NEC Article 240.87 Arc Energy Reduction.

Provide electronic metering on the main for voltage, amps, kVA, & KW.

All service entrance main circuit breakers shall be 100% rated.

**2.31. SAFETY SWITCHES:**

Furnish and install safety switches as indicated on the drawings.

Switches installed on 277/480 volts systems shall be rated for 600 volts and those installed on 120/208 volt or 120/240 volt systems shall be rated for 240 volts.

Switches shall be NEMA Heavy Duty Type HD and Underwriters' Laboratory listed.

General Duty disconnects will not be accepted.

Enclosures for switches mounted outdoors shall be NEMA 3R or as indicated on the plans.

Enclosures for switches installed in kitchen and dishwashing areas shall be NEMA 4X stainless steel or as indicated on the plans.

All safety switches for equipment with remote controls shall be equipped with a control circuit disconnect interlock.

Switches shall be lockable in the "ON" and in the "OFF" positions.

Provide each disconnect with a nameplate that indicates equipment name, voltage/phase, and feed from location.

Provide keyed brass locks on all disconnects that is located on the exterior of the building or in any area that is accessible to children or the public. All the brass locks shall be keyed the same, and turn over 10 sets of keys to the owner at substantial completion.

Disconnect locations shown on drawings is diagrammatically shown. Disconnects shall be coordinated with other trades and placed in the optimal locations to serve equipment and shall be installed in the least obtrusive location. Disconnects will have to be moved at the cost of the contractor when there is conflicts with NEC clearances, access to space, or servicing of equipment. Architect/Engineer will have final judgment of proper location.

**2.32. MOTOR RATED SWITCHES (WITHOUT OVERLOAD PROTECTION):**

Motor Rated Switches without overload switches shall be rated for motor starting operation.

Switches shall be 20 or 30 amp, two or three pole as required for the application.

Switches installed for site disconnect switches shall be equipped with padlocking provisions.

**2.33. MANUAL MOTOR STARTERS (TUMBLER SWITCH TYPE WITH OVERLOAD PROTECTION):**

Starting and thermal overload protection for single phase motors 1/8 Hp to 1 HP shall be provided by manual motor starters with overload units rated as required by the specific motor to be served.

Switches installed for site disconnect switches shall be equipped with padlocking provisions.

#### 2.34. INTEGRAL HORSEPOWER MANUAL MOTOR STARTERS:

General: Manual motor starters for three phase motors shall be Integral Horsepower type sized as required for the motor served. Unless otherwise indicated, starters shall be full line voltage, single speed, and non-reversing type with push-button start-stop operation.

Enclosures: Starters shall be furnished with NEMA 1 surface mount enclosure or NEMA 3R enclosures for outdoor installation unless otherwise indicated.

Thermal protection: Each starter shall be equipped with thermal overload protection in all ungrounded phases. Protection shall consist of thermal overload relays meeting NEMA ICS 2, mounted within the starter. The proper size and number of heater elements shall be installed in each starter.

#### 2.35. TRANSIENT VOLTAGE SURGE PROTECTORS (SURGE PROTECTIVE DEVICES):

Provide transient voltage surge protectors (Surge Protective Devices) where indicated on the plans. At a minimum provide on all service entrance panelboards/switchboards and any panelboard/switchboards on the secondary side of a dry-type transformer.

Service Entrance Panelboards and at Subpanel Protectors shall be listed and labeled and components recognized in accordance with UL 1283 and UL 1449 Second Edition, including highest fault current of Section 37.3.

All devices shall meet or exceed the following:

NEMA LS 1-1992.

Minimum surge current capability, single pulse rated, per mode:

b. Service Entrance – 100 kA (200 kA per phase)

a. Distribution and branch panelboards – 80 kA (160 kA per phase)

UL 1449, Second Edition, Listed and Labeled, and Recognized Component

Suppressed Voltage Ratings shall not exceed (1.2x50 $\mu$ s, 6kV open circuit and 8x20 $\mu$ s, 500A short circuit test wave forms at end of 6" lead):

Voltage	L-N	L-G	N-G	L-L
208Y/120v	400	400	330	700
480Y/277V	800	800	800	1500

Testing shall be done at the end of 6" leads with the complete unit including any fuses and all other components making up the unit.

The devices shall have a minimum EMI/RFI filtering of –50dB at 100kHz with an insertion ratio of 50:1 using MIL-STD-220A methodology.

Devices shall utilize MOV's of 25 mm diameter or larger, shall have pilot lights visible on the outside of the enclosure to indicate device operating condition, and shall provide contacts for remote monitoring of device condition.

Devices shall be modular in design with individual module fusing and thermal protection.

Devices shall incorporate visual alarm signals that indicate the failure of a single MOV and total loss of protection.

Wye connected devices shall provide L-L, L-N, L-G, and N-G surge diversion with L-N/L-G bonded at service entrance devices. Delta connected devices shall provide L-L and L-G protection.

Data Line Surge Protectors: Data Line Surge Protectors shall be UL 497B listed and labeled. The units shall be heavy duty devices utilizing a combination of silicone diodes and gas tube technology to provide surge protection.

All devices shall have a minimum warranty period of five years, incorporating unlimited replacement of suppressor parts if they fail during the warranty period.

**2.36. SECONDARY SURGE ARRESTERS:**

Secondary surge arresters shall be UL listed under UL Classification (Lightning Protection) Surge Arresters(OWHX).

Surge arresters shall be rated at same voltage and phase configuration as service.

**2.37. FUSES:**

General: Fuses shall be UL listed time delay types with a minimum interrupting rating of 100,000 amps symmetrical.

200 amps and below: Provide Class RK-5 current limiting, time delay, rejection type.

201 to 600 amps: Class RK-1, current limiting, time delay, rejection.

Above 600 amps: Class L current limiting, time delay.

**2.38. DRY TYPE TRANSFORMERS:**

General: Transformers shall be constructed in conformance with IEEE, NEMA and ANSI standards.

Transformers shall be dry type with copper windings, rated as scheduled on drawings.

Transformers rated at 15 KVA and below shall be Class 185 (115 degree Celsius rise); transformers rated above 15 KVA and above shall be Class 200 (150 degree Celsius rise).

Transformers shall have ventilated code gauge steel enclosure. Enclosures shall be for indoor installation unless indicated otherwise

Units shall be equipped with four (4) 2-1/2% full capacity taps, two above and two below rated primary voltage.

Core and coils shall be mounted on vibration pads and sound level of enclosed units shall be in conformance with NEMA standards.

**2.39. LABELING:**

Provide laminated plastic nameplates for each panelboard, equipment enclosure, relay, switch, and device.

Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic 0.125 inch thick, white with black center core.

Provide red laminated plastic label with white center core where indicated.

Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core.



Minimum size of nameplates shall be one by 2.5 inches.

Lettering shall be a minimum of 0.25 inch high normal block style.

See Panelboard details for proper labeling of all panelboards.

#### **2.40. PHOTOCELLS, TIME SWITCHES AND CONTACTORS:**

Photocells: Units shall have 1" diameter, hermetically sealed, cadmium sulfide sensing cell with 3-prong NEMA locking plug, rated for wet locations. Units shall have built-in time delay.

Time switches:

Unless otherwise indicated on drawings, time switches shall be 24 hour electromechanical type having synchronous motor drive with two single pole double throw contacts rated 20 amps minimum.

TT Unit shall have spring back up, with automatic rewind, capable of providing 16 hours minimum of reserve power upon electric power failure.

Units shall be furnished in an enclosure, NEMA 1 indoor and NEMA 3 outdoors.

Enclosures shall be flush mount unless otherwise indicated on drawings.

Time switch(es) shall be digital, seven day format, two channel time switches with 9v lithium battery 30 day back-up and with metal indoor enclosure.

Contactors: Units shall be electrically held or electrically operated mechanically held, as indicated on drawings, and shall be recommended by manufacturer for type of load served.

Contacts shall double-break type of same ampere rating as line side circuit wiring.

Contacts shall be field-convertible to normally open or normally closed.

Contactor coils shall be encapsulated. Electrically held contactors shall have continuously rated coils. Mechanically held contactors shall be equipped with coil-clearing contacts to energize coils only when switching.

Units shall be furnished in an enclosure, NEMA 1 indoor and NEMA 3 outdoors.

#### **2.41. CONCRETE:**

Concrete for electrical requirements shall be:

Composed of fine aggregate (sand), coarse aggregate (graded from three-sixteenth (3/16) inch to one (1) inch), Portland cement, and water proportioned and mixed so as to produce a plastic, workable mixture.

Aggregates shall be free from detrimental amounts of dirt, vegetable matter, soft fragments, or other foreign substances.

Water shall be fresh, clean, and free from salts, alkali, organic matter, and other impurities.

Concrete shall have a minimum 3000 psi ultimate twenty-eight day compressive strength and a maximum three (3) inch slump.

### **PART 3 - EXECUTION**

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#### **3.01. GENERAL:**

This section includes the installation of the complete electrical system.

### **3.02. ELECTRICAL SYSTEM DEMOLITION:**

Before any new work begins the Contractor shall determine and document in writing to the satisfaction of the Engineer the condition of existing electrical work and auxiliary systems that are to remain in service. After the new work begins any existing electrical work or systems that are found to be inoperative or defective and not so documented shall be repaired or replaced by the Contractor at no additional cost to the Owner.

Existing electrical equipment and materials to be reused shall be tested and repaired as required and installed for first class operation.

General: The manner in which the remaining portions of the electrical system are terminated, supported and generally maintained for permanent use shall comply with all applicable regulations of the National Electrical Code, applicable NFPA codes and any local codes.

Refer carefully to construction drawings prior to commencing with demolition to determine the intent of demolition. Contact the Engineer if there appears to be any conflict between the demolition and construction drawings.

See "Renovation" Section regarding modification and relocation of circuits.

Phasing: Phasing shall be as coordinated by the General Contractor.

Work in Occupied Areas: Coordinate work carefully with General Contractor to provide minimum disruption to occupied portions of project. Provide minimum of 24 hours advance notice to Owner of demolition activities that will affect Owner's normal operation.

Protections: Take necessary measures as required for protection of the Owner's personnel and the general public, as well as Owner's property. Provide temporary barricades, partitions, bracing, and weather protection as needed. Remove all temporary protections at completion of work.

Flame Cutting: Do not use cutting torches for removal until work area is cleared of flammable materials. Maintain portable fire suppression equipment during flame-cutting operations.

System Protection: Protect and maintain all portions of existing system not indicated for demolition, including but not limited to light fixtures, panelboards and circuits.

Fire Protection: Coordinate with general contractor to insure that all penetrations of fire-rated decks and partitions are properly sealed.

Removal of Circuits: All circuits indicated for removal shall be entirely removed, including raceway, back to take-off point or as far as possible without chasing (unless chasing is indicated). Where it is not possible to remove conduit, all conductors shall be removed and the conduit shall be permanently capped. Floor outlets indicated for removal shall be entirely removed, including outlet box, and capped below floor level (minimum 4" below floor level if in slab).

Where floor slab is damaged in the course of demolition, it shall be permanently repaired as soon as practicable.

Leave existing branch circuits and feeders which run through reworked areas and serve existing equipment to remain in service, continuous and uninterrupted.

Where service interruptions are required, obtain approval for interruptions in writing from Architect 14 days prior to interruption. Submit schedule of work to be performed and the time required to accomplish work with request for interruption.

Disposition of Material: Where electrical equipment is indicated for removal and not indicated for re-use, the owner shall have the option of taking possession of the equipment, the Contractor shall deliver any such material to a local site designated by the owner. The Contractor shall be responsible for disposing of all other materials in accordance with applicable codes and laws.

### **3.03. ELECTRICAL SYSTEM RENOVATION:**

General: Provide renovations as indicated on drawings and specified herein as required for a complete, operational system, even though every item is not indicated.

This Section is intended to serve as a supplement to the applicable sections within this Division, and in no way relieves the contractor from the requirements of any other Section.

All renovations shall comply with all applicable regulations of the National Electric Code, applicable NFPA codes and any local codes

Materials and workmanship: Execute all work so as to present a neat and workmanlike appearance when completed. Except where otherwise indicated, all materials shall be new, UL approved where a standard has been established. Where specific means and methods for affecting renovations are not covered in drawings and specifications, the contractor shall exercise prudent judgment in following accepted practices.

Modifications: All major deviations from the drawings and specifications shall be approved in writing by the Engineer.

Inspection:

Inspect all existing electrical system components which are accessible, including fixtures, wiring devices, raceway and panelboards.

Perform minor repairs to loose or damaged connections, damaged or missing supports, replacement of broken devices, replacement of missing plates and junction box covers and other visible damage or disrepair.

Report major damage to Engineer.

Renovation Services: In addition to the scope of work indicated on the drawings and specified herein, it shall be the responsibility of this Division to provide minor modification and repair services made necessary to electrical system components through the normal course of renovation. Such services shall include but not be limited to minor repair or relocation of branch circuits necessitated by the work of other trades, as coordinated by the General Contractor.

Penetrations: Coordinate penetrations of existing walls, decks, and roofs required for electrical system with General Contractor. Do not cut structural members without the prior consent of Structural Engineer.

Raceway.

a Unless specifically indicated otherwise, existing raceway may not be used.

- b Where existing raceway is indicated for possible re-use, it shall be the responsibility of this Division to verify that the condition and configuration of the raceway is in compliance with the NEC.

**Panelboards:** Where new circuits are run to an existing panelboard, thoroughly inspect the panelboard for any indications of arcing, overheating, or other damage. Report damage to the Engineer. Unless specifically allowed, tandem circuit breakers shall not be utilized.

**Clearing of Neutral Faults:** Any and all neutral faults to ground on existing system shall be corrected.

**Service Ground:** Visually inspect existing service ground electrode system for damage and code compliance. Check continuity from panel to each electrode with a meter. Make repairs as required.

**Lighting Fixtures:** Where existing lighting fixtures are indicated for re-use, they shall be thoroughly cleaned and relamped, no exceptions. Where existing lighting fixtures are indicated for replacement, it shall be the responsibility of this Division to verify the compatibility of new fixtures with existing ceiling type, existing penetrations, available support, and other existing conditions prior to submittal of fixtures. Any variances or required modifications shall be clearly indicated on the fixture submittal.

**Backfilling, Grading, and Sodding:**

- Restore surface features, including vegetation, at areas disturbed by Work of this Section.

- Reestablish original grades, unless otherwise indicated.

- If sod has been removed, replace it as soon as possible after backfilling is completed.

- Restore areas disturbed by trenching, storing of dirt, cable laying, and other activities to their original condition.

- Include application of topsoil, fertilizer, lime, seed, sod, sprig, and mulch.

- Comply with Division 2 Section "Landscaping." Maintain restored surfaces.

- Restore disturbed paving as indicated.

### **3.04. ELECTRICAL SERVICE:**

**General:** A 1500 KVA pad-mounted transformer will be in place and ready for the contractor to connect to the transformer. The contractor will be responsible for connection to the transformer and providing all modifications, lugs, excavation, conduit, cables, junction boxes, owner's preferred metering, etc. required to connect to the existing transformer.

**Main Service Equipment:** Provide UL approved service entrance components as indicated on drawings or specified herein.

Provide a full size copy of the AS-BUILT Power Riser Diagram framed behind plexiglass screwed to the wall near service entrance in main electrical room.

**Service lateral or feeder:** Extend lateral or feeder of the size shown on drawings from service equipment to the point of service as indicated (verify exact location with Utility Company).

For Underground Service, provide and install transformer pad, primary underground conduit to utility riser as directed by Utility Company, underground secondary conduit, and secondary conductors. Conduit shall be of size and quantity as indicated on drawings. Provide spare 4" conduit in transformer pad extending 2' beyond edge of pad with PVC cap. Provide 480# polypropylene pull line in each empty conduit.

On service transformers with multiple taps, it shall be the responsibility of this section to coordinate tap selection with the electric utility to insure the proper nominal voltage.

### **3.05. TELEPHONE SERVICE:**

General: Communications service is outside the scope of this project.

### **3.06. CABLE TELEVISION (CATV) SERVICE:**

General: Cable TV service is outside the scope of this project.

### **3.07. GROUNDING:**

Bond the neutral conductor and various conductive materials in the building per NEC Article 250.

Grounding Electrode System: A bare copper grounding conductor shall be bonded to grounding electrodes as specified below. This conductor shall serve as ground for system neutral and for building equipment bonding. Where conductor is #6, or smaller, or is subject to injury, it shall be run in conduit, Schedule 80 PVC or Rigid Galvanized to which the conductor shall be bonded at both ends.

Grounding electrodes shall be as follows:

- c. Cold water piping, if metal and in direct contact with the earth for 10 feet or more, at the point of entry into the building. Grounding electrode shall be attached with UL approved bronze clamp.
- b. Building structural steel, if present and accessible.
- c. Grounding electrode shall be attached with exothermic weld connector.
- d. Foundation reinforcing bar system. Coordinate with General Contractor to provide turned up re-bar (sleeved) near service point for attachment of grounding electrode above grade. Grounding electrode shall be attached with UL approved bronze clamp or exothermic weld connector.
- e. Driven ground rod(s).
  - 1) Three 3/4" x 10' copper weld rods shall be driven into the ground at the lowest point adjacent to the building, spaced a minimum of 10' apart.
  - 2) Ground rods shall be driven to 12" below grade.
  - 3) The grounding electrode conductor shall be attached to the rod(s) with UL approved bronze clamp or exothermic weld connector.
- f. Existing grounding electrode system. If an existing electrical service is in place, it must be bonded to the new grounding electrode system.

Connections to grounding rods, building structure, counterpoise, and conductor junctions shall be made by exothermic weld unless specifically noted otherwise.

Electric system (neutral) ground: The current carrying neutral leg of the wiring system shall be of insulated conductor, and shall be connected to the grounding electrode

conductor only via the neutral connection at the service equipment. Each branch circuit or multi-outlet branch circuit shall be provided with a dedicated neutral conductor.

Equipment grounding conductors:

An equipment grounding conductor (copper with green insulation except where bare copper is used) shall be provided in all wiring raceways.

Sizes shall be in accordance with NEC 250.

The equipment grounding conductor shall originate in the same panelboard, panelboard section, as the circuit conductors.

The equipment grounding conductor bonding the sections of multi-section panelboards shall be sized per NEC 250.

The equipment grounding conductor is not included in number of branch circuit conductors indicated on the drawings.

Gas piping: Bond interior above grade gas piping to the grounding electrode.

Common Ground Bonding with Lightning Protection System: Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.

Grounding electrode resistance shall be less than 15 ohms. The resistance of the grounding electrode shall be tested by the Fall of Potential Method.

Each grounding conductors at the service entrance ground bus bar shall be provided with a brass round identifying tag. Tag shall indicate where ground wire is terminated.

### **3.08. EXCAVATION, CUTTING AND BACKFILLING:**

Provide cutting and patching, under the supervision of the General Contractor, as required for the work in Section 26.

Locate all existing below grade and/or below floor utilities prior to beginning any site excavation or cutting of existing floor slabs. The Contractor shall repair any damage to existing utilities or systems.

Saw cut existing concrete slabs and asphalt paving.

Trenching:

Dig trenches true to line, with a flat, even bottom.

Width of the trench shall provide not less than 3 inches clearance from the conduit to each side of the trench.

Insure that foundation walls and footings and adjacent load bearing soils are not disturbed in any way.

Conduits shall be installed below footings where possible. Where a line passes under a footing, make crossing with the smallest possible trench to accommodate the conduits/sleeves.

Where a line must pass adjacent to and below the bottom of a column footing, or the corner of a continuous footing, backfill the trench with concrete up to the level of the footing bottom, for a distance away from the footing equal to the depth of the fill.

Keep excavation free from water, by pumping if necessary.

Where rock, soft spots, or sharp-edged materials are encountered, excavate the bottom for an additional 3 inches, fill and tamp level to proper elevation with sand or earth free from particles that would be retained on a 1/4 inch sieve.

Remove and relocate existing obstructions as directed.

The Contractor shall be responsible for the repair and/or replacement of any damage to existing utilities, structure, or finishes.

Coordinate work with other trades as work progresses so cutting and patching will be minimal.

Refer to Section "Earthwork" for shoring, sub-soil assumptions and data, work around trees, surplus earth, etc.

See Section 260100, "Conduit Installation, Below grade and below slab conduit installation", for installation of conduits in trenches.

**Backfilling:**

Immediately after inspection, cover conduits with 3" of compacted sand or earth free from particles that would be retained on a 1/4 inch sieve. Do not to disturb the alignment or joints of the conduits.

Carefully backfill with 4" of earth free from clods, brick, etc., firmly puddling and tamping.

Thereafter, puddle and tamp every vertical 4" for hand tamping or 8" for heavy duty mechanical tamping.

Backfill shall meet the compaction requirements set forth in Division 2.

Backfilling Beneath Slabs and Pavement: Trenches beneath future slabs or pavement, including but not limited to buildings, drives, parking areas, sidewalks, playground surfaces, and equipment pads, shall be backfilled, from 3" above top of conduits to final grade, with crushed aggregate, AHD 825, type B, compacted in 4" layers to 100% ASTM 698.

Install marking tape above conduits at 12 inches below grade.

**3.09. SLEEVES, INSERTS, AND SUPPORTS:**

Provide and install No. 16 gauge galvanized steel or iron sleeves in all walls, floors, ceilings, and partitions. Sleeves shall have no more than 1/2" clearance around pipes and insulation.

The contractor shall furnish to other responsible trades all sleeves, inserts, anchors and other required items which are to be built in by other trades for securing of all hangers or other supports by the Contractor.

The contractor shall assume all responsibility for the placing and sizing of all sleeves, inserts, etc., and shall either directly supervise or give explicit instructions to other trades for their installation.

The contractor shall seal all conduits through floors, smoke partitions, and floor partitions, with a sealant approved for the application.

All sleeves through sound barrier walls and partitions shall be sealed with mineral wool.

Through the floor conduit penetrations shall be sealed watertight.

Furnish and install steel angles and channels as required for mounting and bracing heavy equipment and conduits. Steel shall be securely bolted or welded to structure and equipment bolted to the steel framework. Obtain the approval of the Architect prior to welding.

### **3.10. BELOW GRADE THRU WALL WATER SEALS:**

Each conduit penetrating exterior, below grade, cast concrete walls shall have the annular space around the conduit sealed with an approved Thru Wall Water Seal System.

Where the system includes water seal thru wall sleeves, the Electrical shall provide properly sized sleeves to the contractor responsible for constructing the walls and shall be responsible for the proper location of each sleeve.

Where openings are to be core drilled, the Electrical Contractor shall be responsible for the core drilling and for coordinating proper sizing and location of each opening.

### **3.11. FIRE STOPPING:**

The Electrical Contractor shall be responsible for firestopping of all penetrations of fire rated partitions made by any and all lighting, power, and auxiliary circuiting, sleeves and/or equipment.

The Electrical Contractor shall submit manufacturers' UL System drawings for the systems to be utilized. The systems shall be compatible with the partition ratings as indicated on the Architectural drawings and in accordance with details on the Electrical drawings.

Penetrations of fire rated partitions shall be sealed with an approved fire sealant resulting in the completed penetration having the same fire rating as the partition.

The installation shall be in accordance with the manufacturer's UL system detail and installation instructions to attain the required fire partition rating.

Empty sleeves through 1 and 2 hour rated partitions shall be plugged with mineral wool.

Sleeves through 4 hour rated partitions shall be plugged with mineral wool and fire stopping material.

### **3.12. ROOF PENETRATIONS:**

Furnish roof flashing for all equipment, installed under Section 26, which penetrates through the roof. Flashing shall be approved by the Architect prior to installation.

### **3.13. CONDUIT INSTALLATION:**

Conduits shall be as follows:

Overhead Service Entrance - Rigid Galvanized Steel (RGS) Conduit or IMC.

Underground Service Laterals: Schedule 40 rigid PVC in horizontal runs with rigid galvanized steel elbows turning up to vertical RGS.

Where subject to moisture or mechanical injury - RGS conduit.

TTT ALL conduits exposed to moisture or subject to mechanical damage shall be RGS. Where conduit exits building, the changeover from EMT to rigid shall be inside exterior wall.

In open shop and industrial installations RGS shall be run to 10' A.F.F.



All conduit exposed on the outside of the building envelope shall be Rigid Galvanized Steel (RGS) conduit. This includes all conduits on and/or under canopies or awnings.

In concrete or solid masonry – RGS conduit

Above furred spaces or in cells of hollow masonry - EMT

Concealed inside drywall construction walls and above lay-in ceilings – EMT.

Exposed conduits:

d. Conduits installed exposed in shop, warehouse, and manufacturing areas shall be RGS up to 12' A.F.F. Conduits in such spaces above 12' A.F.F. may be EMT unless indicated otherwise on the drawings.

b. Exposed indoors in non-hazardous unfinished areas not subject to physical damage - EMT

c. Exposed in kitchen and dishwashing areas: Rigid aluminum.

Branch circuits in slab (3/4") - PVC. Turn up through slab with RGS ells - no exceptions. Extend rigid turn-ups 2" minimum above finish floor level.

Circuits beneath building vapor barrier - PVC. Turn up through slab with RGS ells - no exceptions. All elbows 45° and greater shall be RGS. Extend RGS turn-ups 2" minimum above finish floor level.

Below Grade – PVC with RGS, or rigid aluminum where applicable, elbows turning up to vertical. All below grade elbows 45° and greater shall be RGS.

Motor, HVAC equipment, and vibrating equipment connections - flexible metal conduit, liquid tight flexible metal conduit outdoors, in kitchen and dishwashing area, or in other wet areas. Liquidtight flexible nonmetallic conduit shall be used only where specifically indicated.

IMC may be used where RGS is indicated.

Conduit sizes:

Unless specifically indicated otherwise herein or on the drawings, the minimum conduit size shall be 3/4".

e. All conduits installed below grade or below slab shall be 3/4" minimum.

f. The minimum size for flexible lighting fixture "whips" shall be 3/8" and the maximum length shall be 6 feet. Lighting fixture "whips" shall be defined as flexible conduits with conductors feeding one or more recessed lighting fixtures installed in suspended, lay-in, acoustical ceiling systems from a single junction box.

c. 1/2" conduit may be for final connections to equipment or fixtures where conduit is less than three (3) feet in length and is extended from a junction box or from a 3/4" conduit stub up.

Conduits shall be sized in accordance with the National Electrical Code as adopted by the local authority having jurisdiction or as amended to date, except where a larger size is indicated on the drawings or specified herein.

Layout:

Generally follow the conduit layout shown on the drawings. However, the layout is diagrammatic only and must be adjusted for structural conditions, built-in

equipment and other factors. Offsets are not indicated and must be furnished as required.

Install all conduits concealed except in equipment rooms and where exposed runs are specifically indicated.

Install conduit runs to avoid proximity to steam or hot water pipes. In no place shall a conduit be run within 6" of such pipes except where crossings are unavoidable, then conduit shall be kept at least 1" from the covering of the pipe crossed.

Eliminate trapped runs insofar as possible.

Do not chase new work, but instead build in conduit as work progresses.

Do not run conduit in cavity of exterior walls.

Run concealed conduits in direct line with long sweep bends and offsets where practicable.

Install exposed conduit with runs parallel or perpendicular to walls, structural members, or intersections of vertical planes and ceilings, with right-angle turns consisting of cast-metal fittings or symmetrical bends.

Where conduits are indicated exposed overhead, runs down to wall outlets shall be concealed in wall.

#### **Conduit Installation:**

Securely fasten conduits to all sheet metal outlets, cabinets, junction and pull boxes with locknuts and bushings, taking care to see that stout mechanical and solid electrical connections are obtained.

All conduits shall have bushings with smooth beveled throats installed at both ends prior to installing conductors. Split bushings around conductors shall be taken to indicate that the conductors were pulled into conduit without the proper bushings installed and a basis for requiring the replacing of the conductors.

Conduits entering service enclosures (panelboards, disconnect switches, switchboards, motor control centers, etc. used as service entrance equipment) shall be provided with specification grade, insulating, grounding type bushings. Grounding bushing shall be bonded together and bonded to the service grounding buss.

#### **Support:**

- a Raceways shall be securely and rigidly supported to the building structure in a neat and workmanlike manner, and wherever possible, parallel runs or horizontal conduit shall be grouped together on adjustable trapeze hangers.
- b Support shall be provided at appropriate intervals not exceeding eight (8) feet with straps, hangers, and brackets specifically designed for the application. Channels shall be 1 inch for 18-inch wide trapeze, 1-3/8 inch for 24 to 30 inch, and 1-5/8 inch for over 30 inch wide trapeze. Perforated steel straphangers, "butterfly clips", or tie-wire supports are not acceptable.
- e Conduits shall not be supported from ceiling support wires.
- f Conduits installed along wall surfaces shall be supported with galvanized steel brackets specifically designed for conduits and sized for the conduit used.

- g. PVC conduits shall be supported per the NEC with PVC or stainless clamps and stainless steel hardware.
- h. Attach to supporting devices with screws, bolts, expansion sleeves or other workmanlike means appropriate to the surface.
- i. In stud walls, anchors shall be completely rattle proof.
- j. For conduits in damp and wet locations, use stainless steel clamps and stand-offs, or galvanized malleable or cast iron clamps and spacers.
- k. All mounting hardware for aluminum conduit shall be stainless steel.
- l. Surface mounted conduits installed in kitchen and dishwashing areas shall be supported off walls approximately 3/16".

Thread rigid conduits so that the ends meet in couplings; cut ends square, ream smooth and draw up tight.

All field cut threads shall be cleaned with a solvent such as mineral spirits and painted with two coats of galvanize primer.

TTTT Cap conduit ends to keep out water and trash during construction.

Field made bends:

- g. Avoid field-made bends where possible, but where necessary, use a proper hickey or conduit-bending machine.
- h. Field made bends in PVC conduit shall be made with a heated PVC conduit bender.
- i. Make no bends with radius less than six times the conduit diameter, nor more than 90 degrees.

Make changes in direction with pull boxes, symmetrical bends and/or cast-metal fittings.

Total bends in any conduit run shall not exceed the equivalent of four, quarter (90°) bends for a total of 360°, per NEC, between pull boxes.

Replace any crushed or deformed conduits.

Conduits passing through roofs shall be in place before roof is installed.

Conduits installed in concrete/grout filled CMU walls shall be Rigid steel or IMC conduits installed field wrapped with 0.010 inch thick pipe-wrapping plastic tape applied with a 50 percent overlay. Painted on coating shall not be acceptable.

Where conduits pass through or across building expansion joints, provide hot-dipped galvanized expansion fittings with bonding jumpers.

Insure that all penetrations of firewalls are sealed per NEC and IBCC.

Right and left couplings shall not be used; conduit couplings of the Erikson type shall be used at location requiring such joints.

Paint all conduits exposed in finished spaces. Paint shall consist of one coat of zinc rich primer plus two top coats of water-based latex paint, color to match adjacent finishes. Verify colors and paint system with Architect.

All conduit runs entering the building from outdoors shall be sealed against moisture migration and condensation by filling with insulating type foam.

All conduits passing through walls of coolers or freezers shall have seal fitting installed on the outside of the cooler/freezer wall and within 3" of the wall. Fitting shall be sealed per manufacturer's recommendations.

Install telephone, data, intercom, and signal system raceways, 2-inch trade size and smaller, in maximum lengths of 150 feet and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements, in addition to requirements above.

Below grade and below slab conduit installation:

See Section 260100, "Excavation, Cutting, and Backfilling" for trenching and backfilling requirements.

Rigid steel or IMC conduits installed below slab-on-grade or in the earth shall be field wrapped with 0.010 inch thick pipe-wrapping plastic tape applied with a 50 percent overlay, or shall have a factory-applied polyvinyl chloride, plastic resin, or epoxy coating system. Painted on coatings shall not be acceptable. Wrap shall extend a minimum of 1" above slabs or 3" above finished grade where there is no slab. Alternate methods must approved by Engineer prior to bids.

Top of the conduit shall be not less than 30 inches below grade.

Run conduit in straight lines except where a change of direction is necessary.

Conduits stubbed up from below grade or slab into exterior walls shall be turned toward the interior of the building below slab fill perpendicular to the wall. Conduits shall not be turned out toward the exterior unless specifically indicated to do so.

Placing of conduits below slab on grade:

- j. Conduits 1-1/4" and larger shall be installed a minimum of 12" below the bottom of slab in the clay/sand fill below any gravel fill material.
- k. Conduits 1" and smaller may be installed in the porous/gravel fill below the vapor barrier.

Multiple Conduits:

- l. Separate multiple conduits by a minimum distance of 2-1/2 inches horizontally and 3 inches vertically, except that light and power conduits shall be separated from control, signal, and telephone conduits by a minimum distance of 3 inches horizontally and vertically.
- m. Where multiple layers of conduits are to be placed in a trench, each layer shall be placed in the trench, straight and parallel, clear fill material (see Excavation, Cutting, and Backfilling) placed and tamped in place to provide the specified spacing, and each subsequent layer placed in the same manner.
- n. Stagger the joints of the conduits by rows and layers to strengthen the conduit assembly.
- o. Conduits shall not be placed haphazardly in the trench.

Where conduits pass through footings or foundation walls:

- p. Conduits roughed in beneath slab shall exit the foundation perpendicular to the building spaced approximately 3" apart. Conduits shall be arranged in a single horizontal row where practical.
- q. Secure approval from the Architect and Structural Engineer prior to penetrating any footing or foundation wall.
- r. Schedule 40 PVC sleeves shall be cast in the footings or foundation wall for the conduits to pass through.

- s. Multiple sleeves shall have 3" clearance, vertically and horizontally, between the sleeves unless directed otherwise by the Architect and/or Structural Engineer.

Where PVC conduit is installed below grade a PVC to rigid metallic conduit coupling shall be installed in the horizontal run and a rigid galvanized steel conduit elbow installed to turn up to above grade. Where above grade conduits are indicated to be rigid aluminum the elbow turning up to vertical shall be rigid aluminum.

Rigid aluminum conduit shall be wrapped same as RGS through concrete from 2" each side of the concrete.

Rigid galvanized conduit shall extend a minimum of 6" above the finished floor level.

In hazardous areas the coupling shall be below grade and a single section of conduit installed up to 18" A.F.F. to accept the required seal fitting.

Wiring shall be extended in rigid threaded conduit to equipment, except that where required, flexible conduit may be used from 6 inches above the floor to the served equipment.

Conduits shall exit concrete slabs vertically.

- t. Where adequate support cannot be obtained by wiring to reinforcing steel, obtain support with solid iron stakes (which may be driven through membrane) cut off flush with slab after pouring.

- b. At turn-ups of adjacent runs of exposed conduit, obtain alignment by wiring members to a temporary horizontal member.

TTTTT Empty or spare conduit stub-ups shall be capped with a threaded cap.

Encasement Under Roads, Structures, and at other locations indicated on the drawings:

- u. Under roads, paved areas, railroad tracks, and other locations indicated on the plans install conduits in concrete encasement of rectangular cross-section providing a minimum of 3 inch concrete cover around ducts.
- c. Provide plastic duct spacers that interlock vertically and horizontally. Spacer assemblies shall consist of base spacers, intermediate spacers, and top spacers to provide a completely enclosed and locked-in conduit assembly.
- d. Install #4 rebar at each corner of the encasement and at not more than 18" on center vertically and horizontally on the sides of the encasement. #4 rebar hoops shall be installed at not more than 18" on center along the length of the encasement.
- e. Concrete encasement shall extend at least 5 feet beyond the edges of paved areas and roads, and 12 feet beyond the rails on each side of railroad tracks.

Conduits to be installed under existing paved areas, which are not to be disturbed, and under roads and railroad tracks, shall be installed through a zinc coated, rigid steel, sleeve, jacked into place.

Conduits installed between handholes, manholes or other accessible areas shall have a minimum slope of 3 inches in each 100 feet away from buildings and toward manholes and other necessary drainage points.

The contractor shall provide properly rated and sized junction and pull boxes as required on all underground conduit runs 150 feet and greater so as to

minimize pulling tensions on cables to be installed in conduits. In no case shall pull or junction boxes be further than 300 feet apart. Provide pulling tension calculations on all underground runs over 200 feet as required in Paragraph 1.09 Submittals.

**Conduit Installation in concrete slabs:**

Conduit installed in concrete slabs shall be rigid steel or IMC. Rigid steel or IMC conduits installed in slabs-on-grade shall be field wrapped with 0.010 inch thick pipe-wrapping plastic tape applied with a 50 percent overlay, or shall have a factory-applied polyvinyl chloride, plastic resin, or epoxy coating system. Painted on coatings shall not be acceptable.

At slabs on grade, conduit, 3/4" maximum, may be run in the slab; larger conduit shall be run below slab.

Where adequate support cannot be obtained by wiring to reinforcing steel, obtain support with solid iron stakes (which may be driven through membrane) cut off flush with slab after pouring.

At turn-ups of adjacent runs of exposed conduit, obtain alignment by wiring members to a temporary horizontal member.

**Flexible conduit:**

At motor or equipment connections:

- v. The maximum length allowable for flexible conduit shall be 36 inches except at lighting fixtures.
- w. Flexible conduit installed outdoors shall be installed so as to provide an 8 inch minimum drip loop as measured from the lowest end of the conduit.

At lighting fixture connections provide flexible steel conduit by one of the manufacturers named for rigid.

- x. Maximum length allowable shall be 72 inches.
- y. Support flexible conduit such that it does not contact the ceiling system, ductwork, or other equipment above the ceiling. The conduit shall not be attached to a ceiling or ceiling support system.
- z. All fixture whips shall be supported within 12" of outlet/junction boxes with single hole clamps.

**Empty conduit:**

Install a #14 galvanized fish wire or polypropylene pull cord with 14-inch free ends in all empty power and/or auxiliary conduits.

All conduits indicated to be terminated above the ceiling shall have an elbow turned out above the ceiling and shall be terminated with an insulating bushing.

Empty conduits stubbed out of buildings below grade:

- aa. Empty conduits stubbed out of buildings below grade shall extend 5 feet outside of the building foundation.
- bb. Install a 12"x 12"x 6" concrete marker at grade, above the end of the conduits, with "ELEC" inscribed on top.
- f. Note on as-built drawings the exact location where empty conduit(s) are stubbed out below grade to the building exterior. Indicate conduit sizes and number of each size.

g. The contractor shall provide properly rated and sized junction and pull boxes as required on all underground conduit runs 150 feet and greater. In no case shall pull or junction boxes be further than 200 feet apart.

Conduit entries into enclosures, panelboards, and wiring troughs:

Layout conduit entries carefully to allow clearances for the number and sizes of conduits, electrical equipment, and future expansion.

In sheet metal equipment use Knock-Out punch, or equal, to cut holes for conduit installation. Do not drill holes, or cut holes out with snips or torch.

In cast enclosures and boxes drill conduit openings with correct size drill for tight fit.

**All unction box covers above the ceiling shall be labeled to which circuits or systems they contain.**

### **3.14. CONDUIT BODIES:**

Conduit bodies shall be sized in accordance with NEC 370, and 373.

Conduit bodies for conductor sizes AWG #4 and larger shall be mogul type bodies sized in accordance with NEC 370-28.

Conduit bodies for conductor sizes AWG #6 and smaller shall be sized in accordance with NEC 370-16(c).

### **3.15. JUNCTION AND PULL BOXES:**

Junction and pull boxes shall be sized per NEC to accommodate the installed number and size of conductors and conduits.

Boxes shall be securely fastened in place.

Boxes serving lighting fixtures installed in accessible, suspended ceilings:

Provide number of boxes as required to maintain fixture whips within the 6' maximum length.

Generally attach to underside of structure above, in accessible location, to accommodate a maximum 6' flexible conduit connection to each fixture or fixture run.

Where the structure above is more than 18" above the ceiling the boxes shall be supported within 18 inches of the ceiling with all thread rod and/or strut.

Install galvanized steel utility box plates, by box manufacturer, at exposed conduit fittings or boxes.

**All unction box covers above the ceiling shall be labeled to which circuits or systems they contain.**

### **3.16. WIRE AND CABLE INSTALLATION:**

No conductor shall be smaller than #12 except where so designated on the drawings or specified elsewhere.

Multiwire lighting branch circuits shall be used where indicated.

Wiring devices shall be connected such that each device can be removed without interrupting the neutral or equipment grounding conductors serving other outlets on the same circuit(s).

Joints and splices in wire shall be made with solderless connectors, and covered so that insulation is equal to conductor insulation. Wire nuts shall not be used for conductor #8 and larger.

No splices shall be pulled into conduit.

Both conductors and conduit shall be continuous from outlet to outlet.

No conductor shall be pulled into the conduit until the conduit is cleaned of all foreign matter.

- T When installing parallel conductors, it is mandatory that all conductors making up the feeder be exactly the same length, the same size, and type of conductor with the same insulation. Each group of conductors making up a phase or neutral must be bonded together at both ends in an approved manner.

MC cable or Non-Metallic Sheath cable will not be accepted unless specifically called for on drawings.

Wiring thru light fixtures and receptacles will not be accepted.

### **3.17. AUXILIARY GUTTERS (WIRING TROUGHS):**

Auxiliary Gutters shall be sized per NEC to accommodate the installed number, size, and orientation of conductors and conduits.

Conductors serving a gutter shall be extended without reduction in size, for the entire length of the gutter.

All taps and splices shall be made with insulated multi-tap connectors.

### **3.18. CIRCUITS AND BRANCH CIRCUITS:**

Outlets shall be connected to branch circuits as indicated on the drawings by circuit number adjacent to outlet symbols, and no more outlets than are indicated shall be connected to a circuit.

### **3.19. WIRE JOINTS:**

Except for motor circuits, wire joints for #8 and smaller wire shall be made with twist on connectors.

Wire joints and splices for motor circuits, for conductors #6 and larger, and for smaller conductors where other connectors are not rated for the number of conductors involved shall be made with split bolt connectors rated for the applicable conductor size, number of conductors, and conductor material.

Properly tape and insulate all joints to attain the same insulation rating as the cable insulation.

Splices for #6 through #1 shall have a minimum of two (2) layers of rubber tape covered by a minimum of three (3) layers of electrical tape.

Splices for #1/0 and larger conductors shall have a minimum of two (2) layers of electrical filler tape covered by a minimum of three (3) layers of electrical tape.

Splices in control conductors shall be avoided as much as possible. Stranded control conductor up to #12 may be connected or spliced with hand crimped type compression connectors. The connectors shall be of the proper size for the conductors being connected.



Splices and joints made with mechanical/hydraulic type compression connectors:

Connections and splices shall be made with connectors rated for the applicable conductor size and conductor material.

Dies used shall leave the die number embossed in the connector. The Contractor shall provide the Engineer with the Manufacturer's connector and die chart prior to final inspection.

Taps and splices in auxiliary gutters/troughs shall be made with insulated multi-tap connectors.

Wire joints and splices made below grade shall be made with UL listed waterproof connectors, wire nuts, or splice kits.

All joints and splices shall be made in junction boxes, wiring troughs, or conduit bodies sized per NEC.

All connections to switchboards, panelboards, transformers, generators, ATS, or any other type electrical distribution type equipment shall be compression type fittings. Mechanical fittings will not be accepted in these applications.

### **3.20. STRUT SYSTEM FOR SUPPORT OF ELECTRICAL EQUIPMENT:**

Strut Systems: Strut shall be utilized to rack exposed piping vertically or horizontally on walls and across slabs (where applicable). Strut may be utilized to support piping above ceilings, for support of equipment, and elsewhere as deemed appropriate.

Strut in conditioned spaces and above accessible ceilings shall be electro-galvanized.

Strut installed outdoors, in mechanical rooms, and in other unconditioned spaces shall be hot-dipped galvanized.

Strut installed in waste water treatment facilities, kitchens, dishwashing spaces, and labs shall be stainless steel.

Strut fittings and hardware, including anchors, shall be same material as strut.

Saw cut strut square, 6" minimum lengths. Strut on continuous runs of pipe shall be same length. File or grind burrs from saw cuts.

After installation, electro-galvanized and hot-dipped galvanized strut shall be painted with two coats of zinc primer.

### **3.21. OUTLET BOX INSTALLATION:**

General: The drawings indicate approximate locations only; determine the exact location at the building in view of all structural and architectural conditions. Obtain Architect's verification of final locations.

Outlet boxes shall be sized per NEC to accommodate the installed number and size of conductors, wiring devices, and conduits.

Ceiling and Wall Bracket Outlets: 4" octagonal boxes with plaster rings appropriate for finish surface.

Typical boxes (for switches, receptacles and auxiliary systems): 4" square boxes ganged as required. Furnish with 3/4" plaster rings where employed in plaster, 1" tile covers where used in ceramic tile, 1" plaster rings where set in exposed concrete, and otherwise appropriate for surface and construction.

Boxes in Exposed (or Thin-Coat Plastered) Masonry: Where conduit connections permit, employ solid flush-type, square-cornered, masonry boxes with turned-in device holders; otherwise employ typical box with 1-1/2" square-cut tile cover. .

**Multiple Outlet Floor Boxes:**

Verify the exact location of the floor boxes with the Architect prior to rough-in.

Set the boxes in accordance with the manufacturer's instructions.

Boxes shall be set so that the box is flush with the finished floor; the boxes shall not cause a rise or fall in the floor.

The power outlets shall be connected to the circuits indicated by the numbers next to the symbol.

For Data outlets, install a 1" C. to above the nearest corridor ceiling..

Boxes used with Exposed Conduit: 4" square utility boxes.

Exterior Boxes: Cast-metal boxes, Make weatherproof with gasketed covers.

Boxes used with Recessed Lighting Fixtures in suspended acoustical tile ceilings:

Provide a 4" square box with blank cover adjacent to each fixture or fixture group.

Install a flexible metal conduit fixture "whip" from the box to the fixtures. The "whip" shall not be longer than 72".

Attach the box to the underside of the structure above, in an accessible location, not more than 18" above the lay-in ceiling.

Where structure is more than 18" above the ceiling, the boxes shall be supported from all-thread rods, strut, or a combination of rod and strut.

**Boxes in Dry Wall Construction:**

Outlet boxes shall be securely fastened in place.

Outlet boxes installed in metal stud construction shall be supported by brackets screwed to studs. Clip on brackets shall not be accepted.

cc. Where a single outlet box is installed adjacent to a stud, brackets may attach to a single stud with a brace against the back of the opposite wall.

dd. Where outlets do not fall next to a stud or where more than one outlet is installed between studs use a metal bracket attached to both studs.

ee. Outlet boxes three gangs and wider shall be supported with support member screwed to the two adjacent studs.

Sectional type switch boxes at least 2-1/2" deep may be used instead of typical box (but not where dry wall finish is applied over masonry back-up and not where multi- gang devices occur).

Outlets in unfinished masonry walls may be slightly adjusted upward or downward to suit masonry courses, provided outlets are mounted at uniform heights throughout the installation.

Coordinate installation of outlet boxes in masonry walls with the masonry contractor to insure that boxes are flush with face of wall and grouted smooth around boxes such that covers, fixtures or devices install flush on face of wall.

Where outlets at different levels are shown adjacent, install in one vertical line where possible. Avoid conflict with wainscot caps, splash backs and upper cabinets by adjusting height slightly up or down as directed.

Back to back boxes shall be staggered with at least 3 inches between boxes.

Back to back boxes in fire rated partitions shall have a minimum of 24" horizontal and/or vertical separation between them.

Backs of boxes three gang and larger installed in fire rated partitions shall be wrapped with self adhesive fire stopping tape.

Locate switch outlets on the lock side of doors and so that the first switch in a single or gang installation is approximately 6" to 10" from the doorjamb. Verify door swings on Architectural Drawings.

Dimmers shall be ganged together in accordance with the manufacturer's instructions where appropriate, but shall not be ganged with toggle switches.

- T Coordinate carefully with appropriate trades the size and orientation (vertical, horizontal) of outlet boxes for thermostats, data outlets, fire alarm equipment, security equipment, and other control and communications outlets.

**Mounting Heights:**

Confirm all mounting height with local codes and authorities prior to bid and adjust as required:

Switches, generally	48" A.F.F. to top of outlet
Safety switches	Center of Switch 48" A.F.F. or as required.
Receptacles, generally	16" A.F.F. to bottom of outlet
Receptacles over counters	Bottom of outlet 6" above countertops or 2" above backsplashes
Telephone Outlets	16" A.F.F. to bottom of outlet
Computer Outlets	16" A.F.F. to bottom of outlet
Television Outlets	16" A.F.F. to bottom of outlet or as indicated
Wall mounted exit and emergency lights	Bottom of fixture 7'- 6" A.F.F. or 12" below Ceiling whichever is lower
Thermostat	Top of outlet 48" A.F.F. or as noted by mechanical drawings.
Clocks & clock outlets	Top of outlet 12" below ceiling, 8' maximum.
Brass bell	Top of outlet 12" below ceiling, 8' maximum.
Electric Water Coolers	Coordinate location with plumbing contractor to locate the receptacle(s) concealed within the EWC enclosure per manufacturer's installation instructions.

Install blank coverplates on all unused power and auxiliary outlet boxes. Blank coverplates shall match other cover plates installed in the facility.

Furnish blank plates, matching those on the other outlets in the same area, on TV outlets and other outlets installed for future use.

**3.22. WIRING DEVICES:**

Install wall devices vertically' unless otherwise noted, so that all devices of any given height will align exactly.

Where boxes are not flush or square with the finished wall surface install wiring devices utilizing a leveler and retainer.

Plates shall be plumb and true with all four edges contacting wall surface.

Mount receptacles with grounding terminals down.

Do not install devices until plastering or other type wall covering has been completed; install ahead of painting work, but protect from paint spatter.

Use screw terminal connections only.

Do not gang dimmer switches with toggle switches.

Each single or multi outlet receptacle, other than straight blade, 15 or 20 amp, 120 volts, NEMA 5-15R or NEMA 5-20R, shall be provided with matching cord plugs and a minimum of 8 feet of Type SOW cable matching the receptacle size and configuration.

Pin and sleeve plugs for food service equipment shall be provided with a Type SOW cable connected to the equipment and plug of sufficient length to reach from the equipment to the plug with a minimum of 18" slack cord. Minimum length shall be 6 feet from equipment to plug.

Provide wire mesh cable grips at the plug, cord connector, and for overhead support on all overhead cord connector drops.

### **3.23. OCCUPANCY SENSORS AND ASSOCIATED DEVICES FOR LIGHTING CONTROL:**

Occupancy sensors and associated devices and circuiting shall be installed in strict accordance with the manufacturer's instructions.

Wall, corner mounted sensors shall be mounted as close to the ceiling as possible on the manufacturer's corner mounting bracket.

Power packs shall be mounted above the ceiling. Power packs shall be installed utilizing two (2) 4" x 4" x 2-1/8" deep boxes joined together using the nipple on the powerpack in accordance with the manufacturer's instructions. One of the boxes shall contain the power pack and control wiring and the other shall contain the power wiring.

All control and power circuiting shall be in EMT conduit. Where the devices are not equipped with conduit connections the conduit shall be brought up as close as possible to the device and terminated with insulating bushings.

### **3.24. ELECTRICALLY POWERED EQUIPMENT AND CONTROLS:**

Provide and install power circuits for all electrically powered equipment and controls.

Heating, Ventilating, and Air Conditioning Control Wiring and Conduit:

The electrical contractor shall be responsible for installing outlet boxes for flush mounted HVAC system thermostats in dry wall or masonry wall construction and, where called for on the plans, for surface mounted metallic raceway in finished areas. Extend 3/4" conduit from the outlet to above nearest accessible ceiling and terminate horizontally. Refer to the Mechanical/HVAC plans for thermostat

locations and coordinate exact type outlet required and orientation with the Mechanical/HVAC contractor.

The Mechanical Contractor shall be responsible for the installation of all outlets and conduit for surface mounted devices in unfinished areas such as shops, warehouses, industrial facilities, etc.

The mechanical contractor shall furnish and install all low and line voltage control wiring required for the temperature control and/or ventilation systems.

Where Fire Alarm system duct mounted smoke detectors and HVAC shut down interface relays are provided, the Electrical contractor shall provide wiring from the smoke detectors to the HVAC shut down interface relay. All circuiting from the shut down relay to the HVAC controls and/or starters shall be provided and installed by the Mechanical/Controls contractor.

The mechanical contractor shall furnish all motor starters for the temperature control and/or ventilation equipment unless otherwise indicated on the electrical plans or elsewhere in these electrical specifications. The electrical contractor shall install all motor starters, except for equipment with factory installed starters, for the temperature control and/or ventilation equipment.

Where exhaust fans are supplied with field installed speed controllers, the Electrical Contractor shall provide all necessary circuiting to the fan/speed controller and between the fan and the speed controller.

### **3.25. DISCONNECTING MEANS:**

Where required by the National Electrical Code and/or other applicable codes or authorities, or where indicated on the electrical plans, the electrical contractor shall furnish and install an approved disconnecting means for all electrically powered equipment and/or controllers for such equipment whether the disconnecting means is or is not shown on the electrical plans.

The location, rating, and enclosure for the disconnecting means shall be as required by the National Electrical Code and/or other applicable codes or authorities.

Manual motor starters with thermal overload protection may be used in lieu of safety switches for individual motors under 1 horsepower.

Motor rated switches may be used for the disconnecting means when supplied of correct voltage, phase, amperage rating, and enclosure type.

Where the disconnecting means shown on the electrical plans has a rating greater than the required code rating, the greater rating device shall be installed.

An approved horsepower rated fusible safety switch shall be installed where the circuit overcurrent protection does not provide overload protection for the equipment served and where required to meet the equipment's listing requirements.

Motor rated switches may be used as service disconnect switches when supplied with a pad-lockable, handle locking guard.

Install an engraved phenolic nameplate on the front of each switch enclosure identifying the equipment served by the safety switch and source of power (i.e., panel

name and circuit number). Plates shall be white with black lettering. The plates shall be permanently installed with stainless steel screws or stainless steel rivets.

All disconnects installed in public areas or in areas readily accessible to the public shall be lockable and shall be furnished with a brass lock. Provide 10 keys for each lock.

All disconnect locks furnished on the project shall be keyed alike.

### **3.26. DATA AND TELECOMMUNICATIONS SYSTEMS:**

Install a 1" conduit from each Data and Communications outlet box to above the nearest corridor ceiling, or other location of the nearest Data/Telecomm cable tray, and terminate with an insulating bushing within 18" of the J-Hooks or cable tray.

Conduits shall be run with no more than the equivalent of three 90 degree bends.

The conduit shall be run without pull boxes, junction boxes, or conduit bodies.

Install outlet boxes and conduits for the intercom system. See specifications for intercom system.

### **3.27. LIGHTING FIXTURES:**

The installation and support of all lighting fixtures shall be the responsibility of the Electrical Contractor.

Lay out work as shown, and to provide attractive and efficient arrangement.

Install fixtures level, plumb, and true with ceiling and walls, and in alignment with adjacent lighting fixtures.

Provide adequate and substantial supports for fixtures in accordance with manufacturers' directions and as specified herein.

A Re-lock system will not be accepted for installing lights.

Wire grid mounted luminaries individually to junction boxes with flexible conduit not more than 6 feet in length. Individual flexible connections shall be 2 #14 and 1 #14 ground THHN in 3/8" flexible conduit. Ground wire shall be bonded at each end.

Fluorescent fixtures with "U" lamps and fixtures with PL fluorescent lamps shall have all fixtures in a room installed with the lamps oriented in the same direction.

Fixtures mounted in inverted "T" grids:

For round fixtures or fixtures smaller in size than the ceiling grid, provide a minimum of four wires per fixture located within 4 inches of each corner of the ceiling grid in which the fixture is located. Do not support fixtures by ceiling acoustical panels. Fixtures shall be supported independent of the ceiling system or shall be supported by at least two metal channels spanning the grid system, and secured to, the ceiling tees. One support wire shall be attached to the center of the fixture or to each of the metal channels.

Surface mounted fixtures:

ff. Surface mounted fixtures installed on lay-in ceiling systems shall be supported independent of the ceiling system from the building structure with a minimum of two (2) 3/8", minimum, all-thread rods.

gg. Install nuts and washers on inside and outside of the fixture housing to provide a rigid installation.

- hh. Provide cross bracing as required such that fixtures have no lateral movement.

All suspended lighting fixtures shall be provided with chain or cable sway bracing to keep fixtures from swinging.

Fixtures installed in fire rated assemblies shall be tented in accordance with the specified assembly.

Means shall be provided to keep insulation 4" minimum away from fixtures not rated for direct contact with insulation.

Prior to final inspection clean fixtures and lamps with a soft cloth or sponge and detergent (not soap) solution.

All emergency and exit lights designated on drawings shall be provided with an 1100-lumen battery ballast.

All light fixtures shall be supported to the structure independent of the ceiling system on two opposite sides. Support wires shall be different color from ceiling support wires. Engage all ceiling mounting clips. If light fixture is not provided with grid support clips, then the contractor will be responsible to support the fixture on all four sides with support wires. See "Typical Lay-In Luminaire Detail" on drawings for further requirements.

### **3.28. PANELBOARDS AND SWITCHBOARDS:**

Panelboards and switchboards shall be installed where shown on the drawings.

Ratings and configurations shall be as scheduled and/or indicated on the drawings.

The Electrical Contractor shall coordinate installation of equipment in Electrical and Electrical/Mechanical spaces with other trades such that Code required clearances and working space around the electrical equipment is maintained.

Conduit termination:

In general use panelboards with blank ends, without knockouts.

Layout conduit entries carefully to allow clearances for drywall or CMU wall thickness, and to accommodate the number and sizes of home run conduits and specified spare conduits.

Use Knock-Out punch to cut holes in panelboard ends and/or sides for conduit installation. Do not drill holes, or cut holes out with snips or torch.

Phase arrangement in panelboards shall be per the NEC, phase A, B, C from front to back, top to bottom, or left to right as viewed from the front.

In Delta connected systems the "high" leg shall be the B phase and shall be clearly marked with an orange outer finish.

Multi-Section Panelboards:

Sub-feed conductors shall be the same size as the conductors feeding the main section.

Circuiting originating in one section shall not pass through another section.

Circuit conductors and grounding conductors shall originate in the same panelboard section.

A separate isolated grounding conductor shall be installed from the main section to the sub-feed section(s).

TTTTTT Where the panelboard is rated for service entrance equipment the each sub-feed section shall have a separate isolated ground buss fed from the main section ground buss.

**Labeling:**

Each panelboard shall have an engraved phenolic plate permanently installed on the front of the panel with the panel name, current rating, and voltage rating.

Where there is more than one nominal voltage system the panel shall also have an engraved phenolic plate describing the means of identification used to identify the phase and system of each ungrounded conductor of the system served by the panel.

Plates shall be white with black lettering.

Panelboard circuit numbers shall be as indicated on the panelboard schedules.

**3.29. PHOTOELECTRIC CELLS, TIMERS, AND CONTACTORS FOR LIGHTING CONTROL:**

Install time clocks where accessible.

Install photoelectric cells so that lighting fixtures do not affect the cell.

Adjust time clock(s) and photoelectric cells as required for proper operation.

**3.30. DRY TYPE TRANSFORMERS:**

Flexible metallic conduit equipped with bare stranded copper ground jumper shall be provided for all transformer primary and secondary connections

TT Transformer secondaries shall be grounded to the building steel and to the primary and secondary side conduit systems.

**3.31. SECONDARY SURGE ARRESTERS:**

Secondary surge arresters shall be installed in strict accordance with the manufacturer's recommendations.

Arrester may be mounted to the side of a surface mounted panelboard or trough. If such a surface is not available, the arrester shall be mounted on a bracket in its own flush mount enclosure located immediately adjacent to the service panel. Insure that all leads are attached per manufacturer's recommendations. Excess lead length shall be cut off prior to making connections.

**3.32. CONCRETE:**

The Electrical Contractor shall be responsible for placing concrete for electrical equipment pads, lighting standard bases, electrical equipment supports, and at other locations as indicated on the electrical drawings and/or specified herein.

This Contractor shall be responsible for size, location, and orientation of the pads, bases, etc. Any required additions or modifications to concrete due to incorrect size, location, or orientation shall be the responsibility of this contractor.

Concrete shall be cured for a period of not less than seven (7) days prior to setting poles, transformers, switchgear, motor control centers, or other pad mounted equipment.



Forms shall be completely removed after concrete has cured and prior to setting equipment.

A smooth wood float finish shall be given to exposed, unformed concrete.

Honeycombed, or otherwise defective areas of concrete shall be repaired by patching with cement mortar.

### **3.33. EQUIPMENT TOUCHUP AND PAINTING:**

Clean damaged and disturbed areas on all painted surfaces of enclosures, cabinets, and equipment, sand smooth, and apply primer, intermediate, and finish coats of paint to suit the degree of damage at each location. Paint shall be the manufacturers supplied touch up paint or a matching paint. Prep all surfaces to be painted by removing all rust, dirt, oil, and any other material that might inhibit good paint adhesion by mechanical means and/or with solvents.

Follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats.

Repair damage to galvanized finishes with two coats of zinc-rich paint recommended by manufacturer.

Paint cut ends.

Paint all drilled and punched holes.

Paint all knicks and scratches.

Paint all field cut conduit threads.

Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

**END OF SECTION**

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**SECTION 26 0213**  
**ENGINE GENERATORS**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes packaged engine-generator sets for **standby** power supply with the following features:
  - 1. **Diesel** engine.
  - 2. **Unit-mounted** cooling system.
  - 3. **Unit-mounted and remote-mounted** control and monitoring.
  - 4. Performance requirements for sensitive loads.
  - 5. Fuel system.
  - 6. Outdoor enclosure.
  - 7. This installation required two (2) engine generator sets operating in parallel.
- B. Related Requirements:
  - 1. Section 263600 "Transfer Switches" for transfer switches including sensors and relays to initiate automatic-starting and -stopping signals for engine-generator sets.

1.3 DEFINITIONS

- A. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.
- B. EPS: Emergency power supply.
- C. EPSS: Emergency power supply system.

1.4 ACTION SUBMITTALS

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

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
2. Include thermal damage curve for generator.
3. Include time-current characteristic curves for generator protective device.
4. Include fuel consumption in **gallons per hour** at 0.8 power factor at 0.5, 0.75 and 1.0 times generator capacity.
5. Include generator efficiency at 0.8 power factor at 0.5, 0.75 and 1.0 times generator capacity.
6. Include air flow requirements for cooling and combustion air in cfm at 0.8 power factor, with air supply temperature of 95, 80, 70, and 50 deg F. Provide drawings showing requirements and limitations for location of air intake and exhausts.
7. Include generator characteristics, including, but not limited to kw rating, efficiency, reactances, and short-circuit current capability.

B. Shop Drawings:

1. Include plans and elevations for engine-generator set and other components specified. Indicate access requirements affected by height of subbase fuel tank.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Identify fluid drain ports and clearance requirements for proper fluid drain.
4. Design calculations for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
5. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include base weights.
6. Include diagrams for power, signal, and control wiring. Complete schematic, wiring, and interconnection diagrams showing terminal markings for EPS equipment and functional relationship between all electrical components.

## 1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For **manufacturer and testing agency**.

B. Source quality-control reports, including, but not limited to the following:

1. Certified summary of prototype-unit test report.
2. Certified Test Reports: For components and accessories that are equivalent, but not identical, to those tested on prototype unit.
3. Certified Summary of Performance Tests: Certify compliance with specified requirement to meet performance criteria for sensitive loads.
4. Report of factory test on units to be shipped for this Project, showing evidence of compliance with specified requirements.
5. Report of sound generation.
6. Report of exhaust emissions showing compliance with applicable regulations.

- 7. Certified Torsional Vibration Compatibility: Comply with NFPA 110.
- C. Field quality-control reports.
- D. Warranty: For special warranty.

#### **1.6 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For packaged engine generators to include in emergency, operation, and maintenance manuals.
  - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
    - a. List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.
    - b. Operating instructions laminated and mounted adjacent to generator location.
    - c. Training plan.

#### **1.7 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. Fuses: One for every 10 of each type and rating but no fewer than one of each.
  - 2. Indicator Lamps: Two for every six of each type used, but no fewer than two of each.
  - 3. Filters: One set each of lubricating oil, fuel, and combustion-air filters.
  - 4. Tools: Each tool listed by part number in operations and maintenance manual.

#### **1.8 QUALITY ASSURANCE**

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved by manufacturer.
- B. Testing Agency Qualifications: Member company of NETA or an NRTL.
  - 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

## 1.9 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: two (2) years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.

### 2.2 PERFORMANCE REQUIREMENTS

- A. ASME Compliance: Comply with ASME B15.1.
- B. NFPA Compliance:
1. Comply with NFPA 37.
  2. Comply with NFPA 70.
  3. Comply with NFPA 99.
  4. Comply with NFPA 110 requirements for Level 1 emergency power supply system.
- C. UL Compliance: Comply with UL 2200.
- D. Engine Exhaust Emissions: Comply with EPA Tier 2 requirements and applicable state and local government requirements.
- E. Noise Emission: Comply with **applicable state and local government requirements** for maximum noise level at dispatch area due to sound emitted by generator set including engine, engine exhaust, engine cooling-air intake and discharge, and other components of installation.
- F. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
1. Ambient Temperature: **5 to 40 deg C.**
  2. Relative Humidity: Zero to 95 percent.
  3. Altitude: Sea level to **1000 feet (300 m.**

## 2.3 ASSEMBLY DESCRIPTION

- A. Factory-assembled and -tested, water-cooled engine, with brushless generator and accessories.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
- C. EPSS Class: Engine-generator set shall be classified as a **Class 2** in accordance with NFPA 110.
- D. Induction Method: **Turbocharged**.
- E. Governor: Adjustable isochronous, with speed sensing.
- F. Emissions: Comply with EPA Tier **2** requirements.
- G. Mounting Frame: Structural steel framework to maintain alignment of mounted components without depending on concrete foundation. Provide lifting attachments sized and spaced to prevent deflection of base during lifting and moving.
  - 1. Rigging Diagram: Inscribed on metal plate permanently attached to mounting frame to indicate location and lifting capacity of each lifting attachment and generator-set center of gravity.
- H. Capacities and Characteristics:
  - 1. Power Output Ratings: Nominal ratings as indicated at 0.8 power factor excluding power required for the continued and repeated operation of the unit and auxiliaries.
  - 2. Output Connections: Three-phase, **four** wire.
  - 3. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.
- I. Generator-Set Performance for Sensitive Loads:
  - 1. Oversizing generator compared with the rated power output of the engine is permissible to meet specified performance.
    - a. Nameplate Data for Oversized Generator: Show ratings required by the Contract Documents rather than ratings that would normally be applied to generator size installed.
  - 2. Steady-State Voltage Operational Bandwidth: 1 percent of rated output voltage from no load to full load.

3. Transient Voltage Performance: Not more than 10 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within 0.5 second.
4. Steady-State Frequency Operational Bandwidth: Plus or minus 0.25 percent of rated frequency from no load to full load.
5. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
6. Transient Frequency Performance: Less than 2-Hz variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within three seconds.
7. Output Waveform: At no load, harmonic content measured line to neutral shall not exceed 2 percent total with no slot ripple. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
8. Sustained Short-Circuit Current: For a three-phase, bolted short circuit at system output terminals, system shall supply a minimum of 300 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to winding insulation or other generator system components.
9. Excitation System: Performance shall be unaffected by voltage distortion caused by nonlinear load.
  - a. Provide permanent magnet excitation for power source to voltage regulator.
10. Start Time: Comply with NFPA 110, Type 10, system requirements.

## 2.4 ENGINE

- A. Fuel: **Fuel oil, Grade DF-2.**
- B. Rated Engine Speed: 1800 rpm.
- C. Maximum Piston Speed for Four-Cycle Engines: **2250 fpm (11.4 m/s).**
- D. Lubrication System: The following items are mounted on engine or skid:
  1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
  2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
  3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.



- E. Jacket Coolant Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity.
- F. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine-generator-set mounting frame and integral engine-driven coolant pump.
  - 1. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
  - 2. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
  - 3. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.
  - 4. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
  - 5. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, ultraviolet-, and abrasion-resistant fabric.
    - a. Rating: **50-psig (345-kPa)** maximum working pressure with coolant at **180 deg F (82 deg C)**, and noncollapsible under vacuum.
    - b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.
- G. Cooling System: Closed loop, liquid cooled, with remote radiator and **integral engine-driven** coolant pump. Comply with requirements "Hydronic Piping" specification for coolant piping.
  - 1. Configuration: Side intake and **Vertical** air discharge.
  - 2. Radiator Core Tubes: **Nonferrous-metal construction other than aluminum.**
  - 3. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
  - 4. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.
  - 5. Fan: Driven by **totally enclosed electric motor with sealed bearings.**
  - 6. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
  - 7. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.

- H. Muffler/Silencer: Critical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.
  - 1. Minimum sound attenuation of 25 dB at 500 Hz.
  - 2. Sound level measured at a distance of **25 feet (8 m)** from exhaust discharge after installation is complete shall be **78 dBA** or less.
- I. Air-Intake Filter: **Heavy-duty**, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.
- J. Starting System **24-V** electric, with negative ground.
  - 1. Components: Sized so they are not damaged during a full engine-cranking cycle with ambient temperature at maximum specified in "Performance Requirements" Article.
  - 2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
  - 3. Cranking Cycle: **As required by NFPA 110 for system level specified.**
  - 4. Battery: **Lead acid**, with capacity within ambient temperature range specified in "Performance Requirements" Article to provide specified cranking cycle at least **three times** without recharging.
  - 5. Battery Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.
  - 6. Battery Compartment: Factory fabricated of metal with acid-resistant finish and thermal insulation. Thermostatically controlled heater shall be arranged to maintain battery above 10 deg C regardless of external ambient temperature within range specified in "Performance Requirements" Article. Include accessories required to support and fasten batteries in place. Provide ventilation to exhaust battery gases.
  - 7. Battery Stand: Factory-fabricated, two-tier metal with acid-resistant finish designed to hold the quantity of battery cells required and to maintain the arrangement to minimize lengths of battery interconnections.
  - 8. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35 A minimum continuous rating.
  - 9. Battery Charger: Current-limiting, automatic-equalizing and float-charging type designed for **lead-acid** batteries. Unit shall comply with UL 1236 and include the following features:
    - a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.

- b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from **minus 40 deg F (minus 40 deg C)** to **140 deg F (plus 60 deg C)** to prevent overcharging at high temperatures and undercharging at low temperatures.
- c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
- d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.
- e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
- f. Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet.

## **2.5 DIESEL FUEL-OIL SYSTEM**

- A. Comply with NFPA 30.
- B. Piping: Fuel-oil piping shall be Schedule 40 black steel, complying with requirements in Section 231113 "Facility Fuel-Oil Piping." Cast iron, aluminum, copper, and galvanizing shall not be used in the fuel-oil system.
- C. Main Fuel Pump: Mounted on engine to provide primary fuel flow under starting and load conditions.
- D. Fuel Filtering: Remove water and contaminants larger than 1 micron.
- E. Relief-Bypass Valve: Automatically regulates pressure in fuel line and returns excess fuel to source.
- F. Subbase-Mounted, Double-Wall, Fuel-Oil Tank: Factory installed and piped, complying with UL 142 fuel-oil tank. Features include the following:
  - 1. Tank level indicator.
  - 2. Fuel-Tank Capacity: Minimum 133 percent of total fuel required for periodic maintenance operations between fuel refills, plus fuel for the hours of continuous operation for indicated EPSS class.
  - 3. Leak detection in interstitial space.
  - 4. Vandal-resistant fill cap.
  - 5. Containment Provisions: Comply with requirements of authorities having jurisdiction.

## **2.6 CONTROL AND MONITORING**

- A. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set starts. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms.
- B. Manual Starting System Sequence of Operation: Switching on-off switch on the generator control panel to the on position starts generator set. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms.
- C. Provide minimum run time control set for **30** minutes with override only by operation of a remote emergency-stop switch.
- D. Comply with UL 508A.
- E. Configuration: Operating and safety indications, protective devices, basic system controls, engine gages, instrument transformers, generator disconnect switch or circuit breaker, and other indicated components shall be grouped in a combination control and power panel. Control and monitoring section of panel shall be isolated from power sections by steel barriers. Panel shall be powered from the engine-generator set battery. Panel features shall include the following:
  - 1. Wall-Mounting Cabinet Construction: Rigid, self-supporting steel unit complying with NEMA ICS 6. Power bus shall be copper. Bus, bus supports, control wiring, and temperature rise shall comply with UL 891.
  - 2. Switchboard Construction: Freestanding unit complying with Section 262413 "Switchboards."
  - 3. Switchgear Construction: Freestanding unit complying with Section 262300 "Low-Voltage Switchgear."
- F. Indicating Devices : As required by NFPA 110 for Level **1** system, including the following:
  - 1. AC voltmeter.
  - 2. AC ammeter.
  - 3. AC frequency meter.
  - 4. EPS supplying load indicator.
  - 5. Ammeter and voltmeter phase-selector switches.
  - 6. DC voltmeter (alternator battery charging).
  - 7. Engine-coolant temperature gage.

8. Engine lubricating-oil pressure gage.
  9. Running-time meter.
  10. Current and Potential Transformers: Instrument accuracy class.
- G. Protective Devices and Controls in Local Control Panel: Shutdown devices and common visual alarm indication as required by NFPA 110 for Level 1 system, including the following:
1. Start-stop switch.
  2. Overcrank shutdown device.
  3. Overspeed shutdown device.
  4. Coolant high-temperature shutdown device.
  5. Coolant low-level shutdown device.
  6. Low lube oil pressure shutdown device.
  7. Air shutdown damper shutdown device when used.
  8. Overcrank alarm.
  9. Overspeed alarm.
  10. Coolant high-temperature alarm.
  11. Coolant low-temperature alarm.
  12. Coolant low-level alarm.
  13. Low lube oil pressure alarm.
  14. Air shutdown damper alarm when used.
  15. Lamp test.
  16. Contacts for local and remote common alarm.
  17. Coolant high-temperature prealarm.
  18. Generator-voltage adjusting rheostat.
  19. Main fuel tank low-level alarm.
    - a. Low fuel level alarm shall be initiated when the level falls below that required for operation for the duration required in "Fuel Tank Capacity" Paragraph in "Diesel Fuel-Oil System" Article.
  20. Run-Off-Auto switch.
  21. Control switch not in automatic position alarm.
  22. Low-starting air pressure alarm.
  23. Low-starting hydraulic pressure alarm.
  24. Low cranking voltage alarm.
  25. Battery-charger malfunction alarm.
  26. Battery low-voltage alarm.
  27. Battery high-voltage alarm.
  28. Generator overcurrent protective device not closed alarm.
- H. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.

- I. Common Remote Panel with Common Audible Alarm: Comply with NFPA 110 requirements for Level 1 systems. Include necessary contacts and terminals in control and monitoring panel. Remote panel shall be powered from the engine-generator set battery.
- J. Remote Alarm Annunciator: Comply with NFPA 99. An LED labeled with proper alarm conditions shall identify each alarm event, and a common audible signal shall sound for each alarm condition. Silencing switch in face of panel shall silence signal without altering visual indication. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset. Cabinet and faceplate are surface- or flush-mounting type to suit mounting conditions indicated.
  - 1. Overcrank alarm.
  - 2. Coolant low-temperature alarm.
  - 3. High engine temperature prealarm.
  - 4. High engine temperature alarm.
  - 5. Low lube oil pressure alarm.
  - 6. Overspeed alarm.
  - 7. Low fuel main tank alarm.
  - 8. Low coolant level alarm.
  - 9. Low cranking voltage alarm.
  - 10. Contacts for local and remote common alarm.
  - 11. Audible-alarm silencing switch.
  - 12. Air shutdown damper when used.
  - 13. Run-Off-Auto switch.
  - 14. Control switch not in automatic position alarm.
  - 15. Fuel tank derangement alarm.
  - 16. Fuel tank high-level shutdown of fuel supply alarm.
  - 17. Lamp test.
  - 18. Low cranking voltage alarm.
  - 19. Generator overcurrent protective device not closed.
- K. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.
- L. Remote Emergency-Stop Switch: Flush; wall mounted, unless otherwise indicated; and labeled. Push button shall be protected from accidental operation.

## **2.7 GENERATOR OVERCURRENT AND FAULT PROTECTION**

- A. Overcurrent protective devices for the entire EPSS shall be coordinated to optimize selective tripping when a short circuit occurs. Coordination of protective devices shall consider both utility and EPSS as the voltage source.

1. Overcurrent protective devices for the EPSS shall be accessible only to authorized personnel.
- B. Generator Circuit Breaker: Molded-case, electronic-trip type; 100 percent rated; complying with UL 489.
  1. Tripping Characteristics: Adjustable long-time and short-time delay and instantaneous.
  2. Trip Settings: Selected to coordinate with generator thermal damage curve.
  3. Shunt Trip: Connected to trip breaker when generator set is shut down by other protective devices.
  4. Mounting: Adjacent to or integrated with control and monitoring panel.
- C. Generator Protector: Microprocessor-based unit shall continuously monitor current level in each phase of generator output, integrate generator heating effect over time, and predict when thermal damage of alternator will occur. When signaled by generator protector or other generator-set protective devices, a shunt-trip device in the generator disconnect switch shall open the switch to disconnect the generator from load circuits. Protector performs the following functions:
  1. Initiates a generator overload alarm when generator has operated at an overload equivalent to 110 percent of full-rated load for 60 seconds. Indication for this alarm is integrated with other generator-set malfunction alarms. Contacts shall be available for load shed functions.
  2. Under single or three-phase fault conditions, regulates generator to 300 percent of rated full-load current for up to 10 seconds.
  3. As overcurrent heating effect on the generator approaches the thermal damage point of the unit, protector switches the excitation system off, opens the generator disconnect device, and shuts down the generator set.
  4. Senses clearing of a fault by other overcurrent devices and controls recovery of rated voltage to avoid overshoot.
- D. Ground-Fault Indication: Comply with NFPA 70, "Emergency System" signals for ground fault.
  1. Indicate ground fault with other generator-set alarm indications.
  2. Trip generator protective device on ground fault.

## **2.8 GENERATOR, EXCITER, AND VOLTAGE REGULATOR**

- A. Comply with NEMA MG 1.
- B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.

- C. Electrical Insulation: Class H or Class F.
- D. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required. Provide **12** lead alternator.
- E. Range: Provide **broad** range of output voltage by adjusting the excitation level.
- F. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.
- G. Enclosure: Dripproof.
- H. Instrument Transformers: Mounted within generator enclosure.
- I. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified and as required by NFPA 110.
  - 1. Adjusting Rheostat on Control and Monitoring Panel: Provide plus or minus 5 percent adjustment of output-voltage operating band.
  - 2. Maintain voltage within **15** percent on one step, full load.
  - 3. Provide anti-hunt provision to stabilize voltage.
  - 4. Maintain frequency within **5** percent and stabilize at rated frequency within **5** seconds.
- J. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.
- K. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.
- L. Subtransient Reactance: **12** percent, maximum.

## 2.9 OUTDOOR GENERATOR-SET ENCLOSURE

- A. Description: Vandal-resistant, sound-attenuating, weatherproof aluminum housing, wind resistant up to **150 mph**. Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Panels shall be removable by one person without tools. Instruments and control shall be mounted within enclosure.
- B. Description: Prefabricated or pre-engineered galvanized-steel-clad, integral structural-steel-framed, walk-in enclosure, erected on concrete foundation.
  - 1. Structural Design and Anchorage: Comply with ASCE 7 for wind loads up to **150 mph**.
  - 2. Seismic Design: Comply with seismic requirements in Section 260548.16 "Seismic Controls for Electrical Systems."



3. Hinged Doors: With padlocking provisions.
  4. Space Heater: Thermostatically controlled and sized to prevent condensation.
  5. Lighting: Provide weather resistant **fluorescent** lighting with **30 footcandles ((330 LUX))** average maintained.
  6. Thermal Insulation: Manufacturer's standard materials and thickness selected in coordination with space heater to maintain winter interior temperature within operating limits required by engine-generator-set components.
  7. Muffler Location: **External to** enclosure.
- C. Engine Cooling Airflow through Enclosure: Maintain temperature rise of system components within required limits when unit operates at 110 percent of rated load for 2 hours with ambient temperature at top of range specified in system service conditions.
1. Louvers: Fixed-engine, cooling-air inlet and discharge. Storm-proof and drainable louvers prevent entry of rain and snow.
  2. Automatic Dampers: At engine cooling-air inlet and discharge. Dampers shall be closed to reduce enclosure heat loss in cold weather when unit is not operating.
  3. Ventilation: Provide temperature-controlled exhaust fan interlocked to prevent operation when engine is running.
- D. Interior Lights with Switch: Factory-wired, vapor-proof fixtures within housing; arranged to illuminate controls and accessible interior. Arrange for external electrical connection.
1. AC lighting system and connection point for operation when remote source is available.
  2. DC lighting system for operation when remote source and generator are both unavailable.
- E. Convenience Outlets: Factory wired, GFCI. Arrange for external electrical connection.
- 2.10 MOTORS
- A. Description: NEMA MG 1, Design B, medium induction random-wound, squirrel cage motor.
  - B. Efficiency: Energy efficient, as defined in NEMA MG 1.
  - C. Service Factor: 1.15.
  - D. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
  - E. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

- F. Temperature Rise: Match insulation rating.
- G. Code Letter Designation:
  - 1. Motors **15** HP and Larger: NEMA starting Code F or Code G.
  - 2. Motors Smaller than **15** HP: Manufacturer's standard starting characteristic.
- H. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.
- I. Controllers, Electrical Devices, and Wiring: Electrical devices and connections are specified in electrical Sections.

## 2.11 VIBRATION ISOLATION DEVICES

- A. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic restraint.
  - 1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to wind loads or if weight is removed; factory-drilled baseplate bonded to **1/4-inch-(6-mm-)** thick, elastomeric isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
  - 2. Outside Spring Diameter: Not less than 80 percent of compressed height of the spring at rated load.
  - 3. Minimum Additional Travel: 50 percent of required deflection at rated load.
  - 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
  - 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
  - 6. Minimum Deflection: **1 inch (25 mm)**.
- B. Vibration isolation devices shall not be used to accommodate misalignments or to make bends.

## 2.12 FINISHES

- A. Indoor and Outdoor Enclosures and Components: Manufacturer's standard finish over corrosion-resistant pretreatment and compatible primer.

## 2.13 SOURCE QUALITY CONTROL

- A. Prototype Testing: Factory test engine-generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.

1. Tests: Comply with NFPA 110, Level 1 Energy Converters and with IEEE 115.
- B. Project-Specific Equipment Tests: Before shipment, factory test engine-generator set and other system components and accessories manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:
  1. Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.
  2. Test generator, exciter, and voltage regulator as a unit.
  3. Full load run.
  4. Maximum power.
  5. Voltage regulation.
  6. Transient and steady-state governing.
  7. Single-step load pickup.
  8. Safety shutdown.
  9. Provide 14 days' advance notice of tests and opportunity for observation of tests by Owner's representative.
  10. Report factory test results within 10 days of completion of test.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine-generator performance.
- B. Examine roughing-in for piping systems and electrical connections. Verify actual locations of connections before packaged engine-generator installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
  1. Notify **Architect** no fewer than **two** working days in advance of proposed interruption of electrical service.
  2. Do not proceed with interruption of electrical service without **Architect's** written permission.

### 3.3 INSTALLATION

- A. Comply with packaged engine-generator manufacturers' written installation and alignment instructions and with NFPA 110.
- B. Equipment Mounting:
  - 1. Install packaged engine generators on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in **Cast-in-Place Concrete. section**
  - 2. Coordinate size and location of concrete bases for packaged engine generators. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
  - 3. Coordinate size and location of roof curbs, equipment supports, and roof penetrations for remote radiators. These items are specified in Section 077200 "Roof Accessories."
- C. Install packaged engine-generator to provide access, without removing connections or accessories, for periodic maintenance.
- D. Install **pac aged engine-generator** with **restrained spring isolators** having a minimum deflection of **1 inch (25 mm)** on **4-inch- (100-mm-)** high concrete base. Secure **enclosure** to anchor bolts installed in concrete bases. Concrete base construction is specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- E. Install condensate drain piping to muffler drain outlet full size of drain connection with a shutoff valve, stainless-steel flexible connector, and Schedule 40, black steel pipe with welded joints.
- F. Installation requirements for piping materials and flexible connectors are specified in Section 232116 "Hydronic Piping Specialties." Copper and galvanized steel shall not be used in the fuel-oil piping system.
- G. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

### 3.4 CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping and specialties.
- B. Connect fuel, cooling-system, and exhaust-system piping adjacent to packaged engine-generator to allow service and maintenance.
- C. Connect engine exhaust pipe to engine with flexible connector.

- D. Connect fuel piping to engines with a gate valve and union and flexible connector.
  - 1. Diesel storage tanks, tank accessories, piping, valves, and specialties for fuel systems are specified in mechanical piping section.
- E. Ground equipment according to Section 16100 Electrical.
- F. Connect wiring according to Section 16100 Electrical. Provide a minimum of one 90 degree bend in flexible conduit routed to the generator set from a stationary element.
- G. Balance single-phase loads to obtain a maximum of 10 percent unbalance between any two phases.

### 3.5 IDENTIFICATION

- A. Install a sign indicating the generator neutral is bonded to the main service neutral at the main service location.

### 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.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections.
- D. Tests and Inspections:
  - 1. Perform tests recommended by manufacturer and each visual and mechanical inspection and electrical and mechanical test listed in the first two subparagraphs as specified in NETA Acceptance Testing Specification. Certify compliance with test parameters.
    - a. Visual and Mechanical Inspection
      - 1) Compare equipment nameplate data with drawings and specifications.
      - 2) Inspect physical and mechanical condition.
      - 3) Inspect anchorage, alignment, and grounding.
      - 4) Verify the unit is clean.

- b. Electrical and Mechanical Tests
  - 1) Perform insulation-resistance tests in accordance with IEEE 43.
    - a) Machines larger than 200 horsepower (150 kilowatts). Test duration shall be 10 minutes. Calculate polarization index.
    - b) Machines 200 horsepower (150 kilowatts) or less. Test duration shall be one minute. Calculate the dielectric-absorption ratio.
  - 2) Test protective relay devices.
  - 3) Verify phase rotation, phasing, and synchronized operation as required by the application.
  - 4) Functionally test engine shutdown for low oil pressure, overtemperature, overspeed, and other protection features as applicable.
  - 5) Conduct performance test in accordance with NFPA 110.
  - 6) Verify correct functioning of the governor and regulator.
- 2. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here including, but not limited to, single-step full-load pickup test.
- 3. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.
  - a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
  - b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
  - c. Verify acceptance of charge for each element of the battery after discharge.
  - d. Verify that measurements are within manufacturer's specifications.
- 4. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
- 5. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine-generator system before and during system operation. Check for air, exhaust, and fluid leaks.
- 6. Exhaust-System Back-Pressure Test: Use a manometer with a scale exceeding 40-inch wg (120 kPa). Connect to exhaust line close to engine exhaust manifold. Verify that back pressure at full-rated load is within manufacturer's written allowable limits for the engine.
- 7. Exhaust Emissions Test: Comply with applicable government test criteria.
- 8. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50 and 100 percent step-load increases and decreases, and verify that performance is as specified.

9. Harmonic-Content Tests: Measure harmonic content of output voltage at 25 percent and 100 percent of rated linear load. Verify that harmonic content is within specified limits.
10. Noise Level Tests: Measure A-weighted level of noise emanating from generator-set installation, including engine exhaust and cooling-air intake and discharge, at **four** locations **25 feet (7.6 m) from edge of the generator enclosure**, and compare measured levels with required values.
11. Perform 8 hour load bank test.
  - a. Perform manufacturer's after-starting checks and inspections.
  - b. Test the engine generator for six hours of continuous operation as follows:
    - 1) Two hours while delivering 100% of the specified kW.
    - 2) Four hours while the engine generator is delivering 80% of its specified kW rating.
    - 3) If during the 6-hour continuous test, an engine generator failure occurs or the engine generator cannot maintain specified power output, the test(s) are null and void. After repair and/or adjustments, the test(s) shall be repeated at no additional cost to the Government until satisfactory results are attained.
    - 4) Record the following test data at 30-minute intervals:
      - a) Time of day, as well as reading of running time indicator.
      - b) kW.
      - c) Voltage on each phase.
      - d) Amperes on each phase.
      - e) Engine RPM.
      - f) Frequency.
      - g) Coolant water temperature.
      - h) Fuel pressure.
      - i) Oil pressure.
      - j) Outdoor temperature.
      - k) Average ambient temperature in the vicinity of the engine generator.
    - 5) Demonstrate that the engine generator will attain proper voltage and frequency within the specified time limit from a cold start after the closing of a single contact.
    - 6) Furnish a resistance-type load for the testing of the engine generator. Test loads shall always include adequate resistance to assure stability of the loads and equipment during all of the testing operations. The test load kW rating shall not be less than 100% of the specified kW rating of the engine generator.
    - 7) Starting System Test:
      - a) Demonstrate that the batteries and cranking motor are capable of five starting attempts of 10 seconds cranking each at 10-second intervals with the battery charger turned off.
      - b) Remote Annunciator Panel Tests:

- i. Simulate conditions to verify proper operation of each visual or audible indication, interconnecting hardware and software, and reset button.
  - 8) Fuel systems shall be flushed and tested.
  - 9) Automatic Operation Tests:
    - a) Test the engine generator and associated automatic transfer switches to demonstrate automatic starting, loading and unloading. The load for this test shall be the actual connected loads. Initiate loss of normal source and verify the specified sequence of operation. Restore the normal power source and verify the specified sequence of operation. Verify resetting of controls to normal.
  - 10) At the completion of the field tests, fill the main storage tank and day tank with fuel of grade and quality as recommended by the manufacturer of the engine. Fill all engine fluids to levels as recommended by manufacturer.
  - 11) When any defects are detected during the tests, correct all the deficiencies and repeat all or part of the 6-hour continuous test as requested by the engineer at no cost to the owner.
  - 12) Provide test and inspection results in writing to the engineer for review and acceptance.
- E. Coordinate tests with tests for transfer switches and run them concurrently.
- F. Test instruments shall have been calibrated within the last 12 months, traceable to NIST Calibration Services, and adequate for making positive observation of test results. Make calibration records available for examination on request.
- G. Leak Test: After installation, charge exhaust, coolant, and fuel systems and test for leaks. Repair leaks and retest until no leaks exist.
- H. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation for generator and associated equipment.
- I. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- J. Remove and replace malfunctioning units and **retest** as specified above.
- K. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.
- L. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.



### **3.7 MAINTENANCE SERVICE**

- A. Initial Maintenance Service: Beginning at Substantial Completion, provide **12 months'** full maintenance by skilled employees of manufacturer's designated service organization. Include quarterly exercising to check for proper starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Provide parts and supplies same as those used in the manufacture and installation of original equipment.

### **3.8 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators.

### **3.9 SEQUENCE OF OPERATIONS**

- A. Sequence of operations will be as follows:
  - 1. The generators will be controlled in an overall lead/lag configuration. At loss of primary power signals are sent from transfer switches calling for both engine/generators to start. Whichever generator comes to a stable operating condition first will close into the primary power distribution system. When the other generator closes into the primary power distribution system then the generator that served as the primary power source from the last outage will disconnect from the primary power distribution system allowing the building to be supplied from the remaining generator. The disconnected generator will enter a 15 minute cool down period before powering down. The goal of this operation is to allow equal usage of both generators.
  - 2. If at any time during the period when emergency power is in use in the building the load on the system reaches 95% then the second generator will start and close into the bus to assist in handling the peak power period. If the overall building load drops to 70% or below and remains there for 30 minutes then a time-out period will be started and if the load remains below 70% for a period of 30 minutes then the generator will disconnect from the building primary power bus, cool down for 15 minutes and then shut down.

**END OF SECTION 26 0213**

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## **SECTION 26 0415**

### **TRANSFER SWITCHES**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

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

##### **1.2 SUMMARY**

- A. This Section includes transfer switches rated 600 V and less, including the following:
  - 1. Non-automatic transfer switches.

##### **1.3 SUBMITTALS**

- A. Product Data: For each type of product indicated. Include rated capacities, weights, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings: Dimensioned plans, elevations, sections, and details showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.
  - 1. Single-Line Diagram: Show connections between transfer switch, bypass/isolation switch, power sources, and load; and show interlocking provisions for each combined transfer switch and bypass/isolation switch.
- C. Qualification Data: For manufacturer.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Operation and Maintenance Data," include the following:
  - 1. Features and operating sequences, both automatic and manual.
  - 2. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.

#### **1.4 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Maintain a service center capable of providing training, parts, and emergency maintenance repairs within a response period of less than eight hours from time of notification.
- B. Source Limitations: Obtain non-automatic transfer switches through one source from a single manufacturer.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with NEMA ICS 1.
- E. Comply with NFPA 70.
- F. Comply with NFPA 99.
- G. Comply with NFPA 110.
- H. Comply with UL 1008 unless requirements of these Specifications are stricter.

#### **1.5 PROJECT CONDITIONS**

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service:
  - 1. Notify Contracting Officer no fewer than two days in advance of proposed interruption of electrical service.
  - 2. Do not proceed with interruption of electrical service without the government's written permission.

#### **1.6 COORDINATION**

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products may submit on this project.

### **2.2 GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS**

- A. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.
- B. Tested Fault-Current Closing and Withstand Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.
  - 1. Where transfer switch includes internal fault-current protection, rating of switch and trip unit combination shall exceed indicated fault-current value at installation location.
- C. Solid-State Controls: Repetitive accuracy of all settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.
- D. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.41. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.
- E. Electrical Operation: Accomplish by a non-fused, momentarily energized solenoid or electric-motor-operated mechanism, mechanically and electrically interlocked in both directions.
- F. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.
  - 1. Limitation: Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are not acceptable.
  - 2. Switch Action: Double throw; mechanically held in both directions.
  - 3. Contacts: Silver composition or silver alloy for load-current switching. Conventional automatic transfer-switch units, rated 225 A and higher, shall have separate arcing contacts.
- G. Neutral Terminal: Solid and fully rated, unless otherwise indicated.

- H. Oversize Neutral: Ampacity and switch rating of neutral path through units indicated for oversize neutral shall be double the nominal rating of circuit in which switch is installed.
- I. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, either by color-code or by numbered or lettered wire and cable tape markers at terminations. Color-coding and wire and cable tape markers are specified in Division 26 Section "Electrical Identification."
  - 1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.
  - 2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
  - 3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.
- J. Enclosures: General-purpose NEMA 250, Type 3R complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

## **2.3 AUTOMATIC TRANSFER SWITCHES**

- A. Comply with Level 1 equipment according to NFPA 110.
- B. Switching Arrangement: Double-throw type, incapable of pauses or intermediate position stops during normal functioning, unless otherwise indicated.
- C. Manual Switch Operation: Under load, with door closed and with either or both sources energized. Transfer time is same as for electrical operation. Control circuit automatically disconnects from electrical operator during manual operation.
- D. Manual Switch Operation: Unloaded. Control circuit automatically disconnects from electrical operator during manual operation.
- E. Signal-Before-Transfer Contacts: A set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Interval is adjustable from 1 to 30 seconds.
- F. Digital Communication Interface: Matched to capability of remote annunciator or annunciator and control panel.
- G. Transfer Switches Based on Molded-Case-Switch Components: Comply with NEMA AB 1, UL 489, and UL 869A.
- H. Automatic Closed-Transition Transfer Switches: Include the following functions and characteristics:
  - 1. Fully automatic make-before-break operation.

2. Load transfer without interruption, through momentary interconnection of both power sources not exceeding 100 ms.
  3. Initiation of No-Interruption Transfer: Controlled by in-phase monitor and sensors confirming both sources are present and acceptable.
    - a. Initiation occurs without active control of generator.
    - b. Controls ensure that closed-transition load transfer closure occurs only when the 2 sources are within plus or minus 5 electrical degrees maximum, and plus or minus 5 percent maximum voltage difference.
  4. Failure of power source serving load initiates automatic break-before-make transfer.
- I. In-Phase Monitor: Factory-wired, internal relay controls transfer so it occurs only when the two sources are synchronized in phase. Relay compares phase relationship and frequency difference between normal and emergency sources and initiates transfer when both sources are within 15 electrical degrees, and only if transfer can be completed within 60 electrical degrees. Transfer is initiated only if both sources are within 2 Hz of nominal frequency and 70 percent or more of nominal voltage.
- J. Motor Disconnect and Timing Relay: Controls designate starters so they disconnect motors before transfer and reconnect them selectively at an adjustable time interval after transfer. Control connection to motor starters is through wiring external to automatic transfer switch. Time delay for reconnecting individual motor loads is adjustable between 1 and 60 seconds, and settings are as indicated. Relay contacts handling motor-control circuit inrush and seal currents are rated for actual currents to be encountered.
- K. Programmed Neutral Switch Position: Switch operator has a programmed neutral position arranged to provide a midpoint between the two working switch positions, with an intentional, time-controlled pause at midpoint during transfer. Pause is adjustable from 0.5 to 30 seconds minimum and factory set for 0.5 second, unless otherwise indicated. Time delay occurs for both transfer directions. Pause is disabled unless both sources are live.
- L. Automatic Transfer-Switch Features:
1. Undervoltage Sensing for Each Phase of Normal Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage is adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
  2. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals. Adjustable from zero to six seconds, and factory set for one second.
  3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set

- for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
4. Time Delay for Retransfer to Normal Source: Adjustable from 0 to 30 minutes, and factory set for 10 minutes to automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
  5. Test Switch: Simulate normal-source failure.
  6. Switch-Position Pilot Lights: Indicate source to which load is connected.
  7. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.
    - a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
    - b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."
  8. Provide source indicating annunciator in the dispatch room to indicate sources available for facility as well as current source providing power to the facility.
  9. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
  10. Transfer Override Switch: Overrides automatic retransfer control so automatic transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.
  11. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.
  12. Engine Shutdown Contacts: Instantaneous; shall initiate shutdown sequence at remote engine-generator controls after retransfer of load to normal source.
  13. Engine Shutdown Contacts: Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.
  14. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods are adjustable from 10 to 30 minutes. Factory settings are for 7-day exercise cycle, 60-minute running period, and 10-minute cool-down period. Exerciser features include the following:
    - a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
    - b. Push-button programming control with digital display of settings.
    - c. Integral battery operation of time switch when normal control power is not available.



## **2.4 NONAUTOMATIC TRANSFER SWITCHES**

- A. Operation: Electrically actuated by push buttons designated "Normal Source" and "Alternate Source." Switch shall be capable of transferring load in either direction with either or both sources energized.
- B. Operation: Electrically actuated by push buttons designated "Normal Source" and "Alternate Source." In addition, removable manual handle provides quick-make, quick-break manual-switching action. Switch shall be capable of electrically or manually transferring load in either direction with either or both sources energized. Control circuit disconnects from electrical operator during manual operation.
- C. Manually Operated Double-Throw Switching Arrangement: Incapable of pauses or intermediate position stops during switching sequence.
- D. Nonautomatic Transfer-Switch Accessories:
  - 1. Pilot Lights: Indicate source to which load is connected.
  - 2. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and alternate-source sensing circuits.
    - a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
    - b. Emergency Power Supervision: Red light with nameplate engraved "Alternate Source Available."
  - 3. Unassigned Auxiliary Contacts: One set of normally closed contacts for each switch position, rated 10 A at 240-V ac.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Design each fastener and support to carry load indicated by seismic requirements and according to seismic-restraint details.
- B. Identify components according to Division 26 Section "Electrical."

### **3.2 CONNECTIONS**

- A. Wiring to Remote Components: Match type and number of cables and conductors to control and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.

- B. Ground equipment according to Division 26 Section "Electrical."
- C. Connect wiring according to Division 26 Section "Electrical."

### **3.3 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. Report results in writing.

### **3.4 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train six (6) Owner's maintenance personnel to adjust, operate, and maintain transfer switches. Training shall be for a minimum period of 4 hours. Training session shall be recorded and shall be turned over to the owner in standard motion picture entertainment group (MPEG) format on a digital video disc (DVD). Provide two (2) copies of training session disc to owner with closeout documents. Orientation session shall be scheduled at the owner's convenience and shall coincide with engine generator training. Coordinate with owner's representative to schedule testing for staff members.
- B. Coordinate this training with that for generator equipment.

**END OF SECTION 26 0415**

**SECTION 270526 - GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Grounding conductors.
  - 2. Grounding connectors.
  - 3. Grounding busbars.
  - 4. Grounding labeling.

**1.3 DEFINITIONS**

- A. BCT: Bonding conductor for telecommunications.
- B. EMT: Electrical metallic tubing.
- C. TGB: Telecommunications grounding busbar.
- D. TMGB: Telecommunications main grounding busbar.

**1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: For communications equipment room signal reference grid. Include plans, elevations, sections, details, and attachments to other work.

**1.5 INFORMATIONAL SUBMITTALS**

- A. As-Built Data: Plans showing as-built locations of grounding and bonding infrastructure, including the following:
  - 1. Ground rods.

2. Ground and roof rings.
  3. BCT, TMGB, TGBs, and routing of their bonding conductors.
- B. Qualification Data: For **Installer**, installation supervisor, and field inspector.
- C. Qualification Data: For testing agency and testing agency's field supervisor.
- D. Field quality-control reports.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.
1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
    - a. Result of the ground-resistance test, measured at the point of BCT connection.
    - b. Result of the bonding-resistance test at each TGB and its nearest grounding electrode.

#### 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
1. Installation Supervision: Installation shall be under the direct supervision of ITS **Technician**, who shall be present at all times when Work of this Section is performed at Project site.
  2. Field Inspector: Currently registered by BICSI as a **registered communications distribution designer** to perform the on-site inspection.

### PART 2 - PRODUCTS

#### 2.1 SYSTEM COMPONENTS

- A. Comply with J-STD-607-A.

#### 2.2 CONDUCTORS

- A. Comply with UL 486A-486B.

- B. Insulated Conductors: Stranded copper wire, green or green with yellow stripe insulation, insulated for 600 V, and complying with UL 83.
  - 1. Ground wire for custom-length equipment ground jumpers shall be No. 6 AWG, 19-strand, UL-listed, Type THHN wire.
  - 2. Cable Tray Equipment Grounding Wire: **No. 6 AWG**.
- C. Cable Tray Grounding Jumper:
  - 1. Not smaller than No. 6 AWG **26 cmils (13.3 sq. mm)** and not longer than **12 inches (300 mm)**. If jumper is a wire, it shall have a crimped grounding lug with two holes and long barrel for two crimps. If jumper is a flexible braid, it shall have a one-hole ferrule. Attach with grounding screw or connector provided by cable tray manufacturer.
- D. Bare Copper Conductors:
  - 1. Solid Conductors: ASTM B 3.
  - 2. Stranded Conductors: ASTM B 8.
  - 3. Tinned Conductors: ASTM B 33.
  - 4. Bonding Cable: **28 kcmils (14.2 sq. mm)**, 14 strands of No. 17 AWG conductor, and **1/4 inch (6.3 mm)** in diameter.
  - 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
  - 6. Bonding Jumper: Tinned-copper tape, braided conductors terminated with two-hole copper ferrules; **1-5/8 inches (41 mm)** wide and **1/16 inch (1.6 mm)** thick.

## 2.3 CONNECTORS

- A. Irreversible connectors listed for the purpose. Listed by an NRTL as complying with NFPA 70 for specific types, sizes, and combinations of conductors and other items connected. Comply with UL 486A-486B.
- B. Compression Wire Connectors: Crimp-and-compress connectors that bond to the conductor when the connector is compressed around the conductor. Comply with UL 467.
  - 1. Electroplated tinned copper, C and H shaped.
- C. Signal Reference Grid Connectors: Combination of compression wire connectors, access floor grounding clamps, bronze U-bolt grounding clamps, and copper split-bolt connectors, designed for the purpose.
- D. Busbar Connectors: Cast silicon bronze, solderless **compression** type, mechanical connector; with a long barrel and two holes spaced on **5/8- or 1-inch (15.8- or 25.4-mm)** centers for a two-bolt connection to the busbar.

- E. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

## 2.4 GROUNDING BUSBARS

- A. TMGB: Predrilled, wall-mounted, rectangular bars of hard-drawn solid copper, **1/4 by 4 inches (6.3 by 100 mm)** <Insert dimensions> in cross section, length as indicated on Drawings. The busbar shall be NRTL listed for use as TMGB and shall comply with J-STD-607-A.
  - 1. Predrilling shall be with holes for use with lugs specified in this Section.
  - 2. Mounting Hardware: Stand-off brackets that provide a **4-inch ((100-mm))**<Insert dimension> clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.
  - 3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.
- B. Rack and Cabinet Grounding Busbars: Rectangular bars of hard-drawn solid copper, accepting conductors ranging from No. 14 to No. 2/0 AWG, NRTL listed as complying with UL 467, and complying with J-STD-607-A. Predrilling shall be with holes for use with lugs specified in this Section.
  - 1. Cabinet-Mounted Busbar: Terminal block, with stainless-steel or copper-plated hardware for attachment to the cabinet.
  - 2. Rack-Mounted Horizontal Busbar: Designed for mounting in **19- or 23-inch (483- or 584-mm)** equipment racks. Include a copper splice bar for transitioning to an adjoining rack, and stainless-steel or copper-plated hardware for attachment to the rack.
  - 3. Rack-Mounted Vertical Busbar: **72 or 36 inches ((1827 or 914 mm) long, with)**stainless-steel or copper-plated hardware for attachment to the rack.

## 2.5 LABELING

- A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- B. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be **3/8 inch (10 mm)**. Overlay shall provide a weatherproof and UV-resistant seal for label.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

- A. Examine the ac grounding electrode system and equipment grounding for compliance with requirements for maximum ground-resistance level and other conditions affecting performance of grounding and bonding of the electrical system.
- B. Inspect the test results of the ac grounding system measured at the point of BCT connection.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with connection of the BCT only after unsatisfactory conditions have been corrected.

**3.2 INSTALLATION**

- A. Bonding shall include the ac utility power service entrance, the communications cable entrance, and the grounding electrode system. The bonding of these elements shall form a loop so that each element is connected to at least two others.
- B. Comply with NECA 1.
- C. Comply with J-STD-607-A.

**3.3 APPLICATION**

- A. Conductors: Install solid conductor for **No. 8** AWG and smaller and stranded conductors for **No. 6** AWG and larger unless otherwise indicated.
- B. Conductor Terminations and Connections:
  - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
  - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
  - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
  - 4. Connections to Structural Steel: Welded connectors.
- C. Conductor Support:
  - 1. Secure grounding and bonding conductors at intervals of not less than **36 inches** ((900 mm).)

D. Grounding and Bonding Conductors:

1. Install in the straightest and shortest route between the origination and termination point, and no longer than required. The bend radius shall not be smaller than eight times the diameter of the conductor. No one bend may exceed 90 degrees.
2. Install without splices.
3. Support at not more than 36-inch (900-mm) intervals.
4. Install grounding and bonding conductors in 3/4-inch (21-mm) PVC conduit until conduit enters a telecommunications room. The grounding and bonding conductor pathway through a plenum shall be in EMT. Conductors shall not be installed in EMT unless otherwise indicated.
  - a. If a grounding and bonding conductor is installed in ferrous metallic conduit, bond the conductor to the conduit using a grounding bushing that complies with requirements in Section 220199 "Electrical," and bond both ends of the conduit to a TGB.

3.4 GROUNDING ELECTRODE SYSTEM

- A. The BCT between the TMGB and the ac service equipment ground shall be as shown on drawings.

3.5 GROUNDING BUSBARS

- A. Indicate locations of grounding busbars on Drawings. Install busbars horizontally, on insulated spacers 2 inches (50 mm) minimum from wall, 12 inches (300 mm) above finished floor unless otherwise indicated.
- B. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.

3.6 CONNECTIONS

- A. Bond metallic equipment in a telecommunications equipment room to the grounding busbar in that room, using equipment grounding conductors not smaller than **No. 6** AWG.
- B. Stacking of conductors under a single bolt is not permitted when connecting to busbars.
- C. Assemble the wire connector to the conductor, complying with manufacturer's written instructions and as follows:
  1. Use crimping tool and the die specific to the connector.
  2. Pretwist the conductor.



3. Apply an antioxidant compound to all bolted and compression connections.
- D. Primary Protector: Bond to the TMGB with insulated bonding conductor.
- E. Interconnections: Interconnect all TMGB with the telecommunications backbone conductor. If more than one TMGB is installed, interconnect TMGBs using the grounding equalizer conductor. The telecommunications backbone conductor and grounding equalizer conductor size shall not be less than **2 kcmils/linear foot (1 sq. mm/linear meter)** of conductor length, up to a maximum size of No. 3/0 AWG [**168 cmils (85 sq. mm)**] unless otherwise indicated.
- F. Telecommunications Enclosures and Equipment Racks: Bond metallic components of enclosures to the telecommunications bonding and grounding system. Install **bottom-mounted** rack grounding busbar unless the enclosure and rack are manufactured with the busbar. Bond the equipment grounding busbar to the TGB No. 2 AWG bonding conductors.
- G. Structural Steel: Where the structural steel of a steel frame building is readily accessible within the room or space, bond each TGB and TMGB to the vertical steel of the building frame.
- H. Electrical Power Panelboards: Where an electrical panelboard for telecommunications equipment is located in the same room or space, bond each TGB to the ground bar of the panelboard.
- I. Shielded Cable: Bond the shield of shielded cable to the TGB in communications rooms and spaces. Comply with TIA/EIA-568-B.1 and TIA/EIA-568-B.2 when grounding screened, balanced, twisted-pair cables.
- J. Rack- and Cabinet-Mounted Equipment: Bond powered equipment chassis to the cabinet or rack grounding bar. Power connection shall comply with NFPA 70; the equipment grounding conductor in the power cord of cord- and plug-connected equipment shall be considered as a supplement to bonding requirements in this Section.
- K. Equipment Room Signal Reference Grid: Provide a low-impedance path between telecommunications cabinets, equipment racks, and the reference grid, using **No. 6** AWG bonding conductors.
  1. Install the conductors in grid pattern on **4-foot (1200-mm)** centers, allowing bonding of one pedestal from each access floor tile.
  2. Bond the TGB of the equipment room to the reference grid at two or more locations.
  3. Bond all conduits and piping entering the equipment room to the TGB at the perimeter of the room.

### 3.7 IDENTIFICATION

- A. Labels shall be preprinted or computer-printed type.
  - 1. Label TMGB(s) with "fs-TMGB," where "fs" is the telecommunications space identifier for the space containing the TMGB.
  - 2. Label the BCT and each telecommunications backbone conductor at its attachment point: "WARNING! TELECOMMUNICATIONS BONDING CONDUCTOR. DO NOT REMOVE OR DISCONNECT!"

### 3.8 FIELD QUALITY CONTROL

- A. Testing Agency: **Engage** a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
  - 1. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
  - 2. Test the bonding connections of the system using an ac earth ground-resistance tester, taking two-point bonding measurements in each telecommunications equipment room containing a TMGB using the process recommended by BICSI TDMM. Conduct tests with the facility in operation.
    - a. Measure the resistance between the busbar and the nearest available grounding electrode. The maximum acceptable value of this bonding resistance is 100 milliohms.
  - 3. Test for ground loop currents using a digital clamp-on ammeter, with a full-scale of not more than 10 A, displaying current in increments of 0.01 A at an accuracy of plus/minus 2.0 percent.
    - a. With the grounding infrastructure completed and the communications system electronics operating, measure the current in every conductor connected to the TMGB. Maximum acceptable ac current level is 1 A.
- D. Excessive Ground Resistance: If resistance to ground at the BCT exceeds **5 ohms**, notify Architect promptly and include recommendations to reduce ground resistance.
- E. Grounding system will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

**F-35 ADAL Squadron Operations Building  
187th Fighter Wing, Dannelly Field, ANG  
Montgomery, AL**

**FAKZ189102**

**November 2022**

**Type B3 (100%) Submittal**

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## SECTION 271100 - COMMUNICATIONS EQUIPMENT ROOM FITTINGS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Telecommunications mounting elements.
  - 2. Backboards.
  - 3. Telecommunications equipment racks and cabinets.
  - 4. Grounding.

- B. Related Requirements:

- 1. Section 271300 "Communications Backbone Cabling" for voice and data cabling associated with system panels and devices.
  - 2. Section 271500 "Communications Horizontal Cabling" for voice and data cabling associated with system panels and devices.

#### 1.3 DEFINITIONS

- A. BICSI: Building Industry Consulting Service International.
- B. LAN: Local area network.
- C. RCDD: Registered Communications Distribution Designer.

#### 1.4 ACTION SUBMITTALS

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

- 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for equipment racks and cabinets.
  - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

- B. Shop Drawings: For communications equipment room fittings. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 2. Equipment Racks and Cabinets: Include workspace requirements and access for cable connections.
  - 3. Grounding: Indicate location of grounding bus bar and its mounting detail showing standoff insulators and wall mounting brackets.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For **Installer**, qualified layout technician, installation supervisor, and field inspector.

## 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
  - 1. Layout Responsibility: Preparation of Shop Drawings shall be under the direct supervision of **RCDD**.
  - 2. Installation Supervision: Installation shall be under the direct supervision of **Level 2 Installer**, who shall be present at all times when Work of this Section is performed at Project site.
  - 3. Field Inspector: Currently registered by BICSI as **RCDD** to perform the on-site inspection.

## PART 2 - PRODUCTS

### 2.1 BACKBOARDS

- A. Backboards: Plywood, **fire-retardant treated**, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm). Comply with requirements for plywood backing.

### 2.2 EQUIPMENT FRAMES

- A. General Frame Requirements:

1. Distribution Frames: Freestanding and wall-mounting, modular-steel units designed for telecommunications terminal support and coordinated with dimensions of units to be supported.
2. Module Dimension: Width compatible with EIA 310-D standard, **19-inch (480-mm)** panel mounting.
3. Finish: Manufacturer's standard, baked-polyester powder coat.

**B. Floor-Mounted Racks: Modular-type, **aluminum** construction.**

1. Vertical and horizontal cable management channels, top and bottom cable troughs, grounding lug, **and a power strip.**
2. Baked-polyester powder coat finish.

**C. Modular Freestanding Cabinets:**

1. Removable and lockable side panels.
2. Hinged and lockable front and rear doors.
3. Adjustable feet for leveling.
4. Screened ventilation openings in the roof and rear door.
5. Cable access provisions in the roof and base.
6. Grounding bus bar.
7. Power strip.
8. Baked-polyester powder coat finish.
9. All cabinets keyed alike.

**D. Cable Management for Equipment Frames:**

1. Metal, with integral wire retaining fingers.
2. Baked-polyester powder coat finish.
3. Vertical cable management panels shall have front and rear channels, with covers.
4. Provide horizontal crossover cable manager at the top of each relay rack, with a minimum height of two rack units each.

## **2.3 POWER STRIPS**

**A. Power Strips: Comply with UL 1363.**

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Rack mounting.
3. **Six 20-A, 120-V ac, NEMA WD 6, Configuration 5-20R** receptacles.
4. LED indicator lights for power and protection status.
5. LED indicator lights for reverse polarity and open outlet ground.

6. Circuit Breaker and Thermal Fusing: When protection is lost, circuit opens and cannot be reset.
7. Circuit Breaker and Thermal Fusing: Unit continues to supply power if protection is lost.
8. **Cord connected with 15-foot (4.5-m)** line cord.
9. Rocker-type on-off switch, illuminated when in on position.
10. Peak Single-Impulse Surge Current Rating: **33kA** per phase.
11. Protection modes shall be line to neutral, line to ground, and neutral to ground. UL 1449 clamping voltage for all three modes shall be not more than **330 V**.

## **2.4 GROUNDING**

- A. Comply with requirements in Section 270526 "Grounding and Bonding for Communications Systems" for grounding conductors and connectors.
- B. Telecommunications Main Bus Bar:
  1. Connectors: Mechanical type, cast silicon bronze, solderless irreversible crimp/**compression**-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
  2. Ground Bus Bar: Copper, minimum **1/4 inch thick by 4 inches wide (6 mm thick by 100 mm wide)** with **9/32-inch (7.14-mm)** holes spaced **1-1/8 inches (28 mm)** apart.
  3. Stand-Off Insulators: Comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.
- C. Comply with J-STD-607-A.

## **2.5 LABELING**

- A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

## **PART 3 - EXECUTION**

### **3.1 ENTRANCE FACILITIES**

- A. Contact telecommunications service provider and arrange for installation of demarcation point, protected entrance terminals, and a housing as shown on drawings.



### 3.2 INSTALLATION

- A. Comply with NECA 1.
- B. Comply with BICSI TDMM for layout and installation of communications equipment rooms.
- C. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
- D. Coordinate layout and installation of communications equipment with Owner's telecommunications and LAN equipment and service suppliers. Coordinate service entrance arrangement with local exchange carrier.
  - 1. Meet jointly with telecommunications and LAN equipment suppliers, local exchange carrier representatives, and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.
  - 2. Record agreements reached in meetings and distribute them to other participants.
  - 3. Adjust arrangements and locations of distribution frames, cross-connects, and patch panels in equipment rooms to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.
  - 4. Adjust arrangements and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in the equipment room.
- E. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.
- F. **Note that in all areas that are designated as TEMPEST areas Tempest compliant Ethernet cabling will be required. Non-TEMPEST cabling installed in these areas under this contract will be required to be removed and replaced with TEMPEST cabling at the contractor's expense.**

### 3.3 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 270544 "Sleeves and Sleeve Seals for Communications Pathways and Cabling."

### 3.4 GROUNDING

- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with J-STD-607-A.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least **2-inch (50-mm)** clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.
  - 1. Bond the shield of shielded cable to the grounding bus bar in communications rooms and spaces.

### 3.5 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements in Section 260553 "Identification for Electrical Systems."
- B. Comply with requirements in Section 099123 "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.
- C. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for **Class 2** level of administration **including optional identification requirements of this standard.**
- D. Labels shall be preprinted or computer-printed type.

END OF SECTION 271100

## SECTION 271300 - COMMUNICATIONS BACKBONE CABLING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Pathways.
- 2. UTP cable.
- 3. **50/125 and 62.5/125**-micrometer, optical fiber cabling.
- 4. Coaxial cable.
- 5. Cable connecting hardware, patch panels, and cross-connects.
- 6. Cabling identification products.

- B. Related Sections:

- 1. Section 280513 "Conductors and Cables for Electronic Safety and Security" for voice and data cabling associated with system panels and devices.

#### 1.3 DEFINITIONS

- A. BICSI: Building Industry Consulting Service International.
- B. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- C. EMI: Electromagnetic interference.
- D. IDC: Insulation displacement connector.
- E. LAN: Local area network.
- F. RCDD: Registered Communications Distribution Designer.
- G. UTP: Unshielded twisted pair.

#### **1.4 BACKBONE CABLING DESCRIPTION**

- A. Backbone cabling system shall provide interconnections between communications equipment rooms, main terminal space, and entrance facilities in the telecommunications cabling system structure. Cabling system consists of backbone cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection.
- B. Backbone cabling cross-connects may be located in communications equipment rooms or at entrance facilities. Bridged taps and splitters shall not be used as part of backbone cabling.

#### **1.5 PERFORMANCE REQUIREMENTS**

- A. General Performance: Backbone cabling system shall comply with transmission standards in TIA/EIA-568-B.1, when tested according to test procedures of this standard.

#### **1.6 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated.
  - 1. For coaxial cable, include the following installation data for each type used:
    - a. Nominal OD.
    - b. Minimum bending radius.
    - c. Maximum pulling tension.
- B. Shop Drawings:
  - 1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
  - 2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
  - 3. Cabling administration drawings and printouts.
  - 4. Wiring diagrams to show typical wiring schematics including the following:
    - a. Cross-connects.
    - b. Patch panels.
    - c. Patch cords.
  - 5. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.

6. Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:
  - a. Vertical and horizontal offsets and transitions.
  - b. Clearances for access above and to side of cable trays.
  - c. Vertical elevation of cable trays above the floor or bottom of ceiling structure.
  - d. Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray and its support elements.

#### 1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For **Installer**, qualified layout technician, installation supervisor, and field inspector.
- B. Source quality-control reports.
- C. Field quality-control reports.
- D. Maintenance Data: For splices and connectors to include in maintenance manuals.

#### 1.8 CLOSEOUT SUBMITTALS

- A. Software and Firmware Operational Documentation:
  1. Software operating and upgrade manuals.
  2. Program Software Backup: On magnetic media or compact disk, complete with data files.
  3. Device address list.
  4. Printout of software application and graphic screens.

#### 1.9 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
  1. Layout Responsibility: Preparation of Shop Drawings and **Cabling Administration Drawings, Cabling Administration Drawings, and field testing program development** by an RCDD.
  2. Installation Supervision: Installation shall be under the direct supervision of **Level 2 Installer**, who shall be present at all times when Work of this Section is performed at Project site.

3. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.
  - B. Testing Agency Qualifications: An NRTL.
    1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.
  - C. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
    1. Flame-Spread Index: **25** or less.
    2. Smoke-Developed Index: **50** or less.
  - D. 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.
  - E. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.
  - F. Grounding: Comply with ANSI-J-STD-607-A.
- 1.10 DELIVERY, STORAGE, AND HANDLING
- A. Test cables upon receipt at Project site.
    1. Test optical fiber cable to determine the continuity of the strand end to end. Use **optical loss test set**.
    2. Test optical fiber cable while on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector, including the loss value of each. Retain test data and include the record in maintenance data.
    3. Test each pair of UTP cable for open and short circuits.
- 1.11 PROJECT CONDITIONS
- A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

## 1.12 COORDINATION

- A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

## 1.13 SOFTWARE SERVICE AGREEMENT

- A. Technical Support: Beginning with Substantial Completion, provide software support for **two** years.
- B. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within **two** years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.
  - 1. Provide **30** days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

## PART 2 - PRODUCTS

### 2.1 PATHWAYS

- A. General Requirements: Comply with TIA/EIA-569-A.
- B. Cable Support: NRTL labeled for support of Category 6 cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.
  - 1. Support brackets with cable tie slots for fastening cable ties to brackets.
  - 2. Lacing bars, spools, J-hooks, and D-rings.
  - 3. Straps and other devices.
- C. Cable Trays:
  - 1. Cable Tray Material: Metal, suitable for indoors, and protected against corrosion by **electroplated zinc galvanizing, complying with ASTM B 633, Type 1, not less than 0.000472 inches (0.012 mm) thick**
    - a. Solid-Bottom Cable Trays: One-piece construction, size as shown on drawings. Provide **with** solid covers.

## 2.2 BACKBOARDS

- A. Backboards: Plywood, **fire-retardant treated**, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm). Comply with requirements in Section 061000 "Rough Carpentry" for plywood backing panels.

## 2.3 OPTICAL FIBER CABLE

- A. Description: Multimode, **50/125**-micrometer, number of fibers as shown on drawings tight buffer, optical fiber cable.
  - 1. Comply with ICEA S-83-596 for mechanical properties.
  - 2. Comply with TIA/EIA-568-B.3 for performance specifications.
  - 3. Comply with **TIA/EIA-492AAAA-B** for detailed specifications.
  - 4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
    - a. General Purpose, Nonconductive: Type OFN or OFNG.
    - b. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
    - c. Riser Rated, Nonconductive: Type OFNR, complying with UL 1666.
    - d. General Purpose, Conductive: Type OFC or OFCG.
    - e. Plenum Rated, Conductive: Type OFCP, complying with NFPA 262.
    - f. Riser Rated, Conductive: Type OFCR, complying with UL 1666.
  - 5. Conductive cable shall be **steel** armored type.
  - 6. Maximum Attenuation: **3.50** dB/km at 850 nm; **1.5** dB/km at 1300 nm.
  - 7. Minimum Modal Bandwidth: 160 MHz-km at 850 nm; 500 MHz-km at 1300 nm.
- B. Jacket:
  - 1. Jacket Color: As shown on drawings.
  - 2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA/EIA-598-B.
  - 3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed **40 inches (1000 mm)**.

## 2.4 OPTICAL FIBER CABLE HARDWARE

- A. Cross-Connects and Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors.
  - 1. Number of Connectors per Field: **One** for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to suit specified expansion criteria.



- B. Patch Cords: Factory-made, dual-fiber cables in 36-inch (900-mm) lengths.
- C. Cable Connecting Hardware:
  - 1. Comply with Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA/EIA-604-2, TIA/EIA-604-3-A, and TIA/EIA-604-12. Comply with TIA/EIA-568-B.3.
  - 2. Quick-connect, simplex and duplex, **Type LC** connectors. Insertion loss not more than 0.75 dB.
  - 3. Type SFF connectors may be used in termination racks, panels, and equipment packages.

## 2.5 IDENTIFICATION PRODUCTS

- A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

## 2.6 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
- B. Factory test cables on reels according to TIA/EIA-568-B.1.
- C. Factory test UTP cables according to TIA/EIA-568-B.2.
- D. Factory test multimode optical fiber cables according to TIA/EIA-526-14-A and TIA/EIA-568-B.3.
- E. Cable will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

## PART 3 - EXECUTION

### 3.1 ENTRANCE FACILITIES

- A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

### 3.2 WIRING METHODS

- A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters **and except in accessible ceiling spaces, in attics, and in gypsum board partitions where unenclosed wiring method may be used.** Conceal raceway and cables except in unfinished spaces.
  - 1. Install plenum cable in environmental air spaces, including plenum ceilings.
  - 2. Comply with requirements for raceways and boxes specified in Section 260533 "Raceway and Boxes for Electrical Systems."
- B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- C. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

### 3.3 INSTALLATION OF PATHWAYS

- A. Cable Trays: Comply with NEMA VE 2 and TIA/EIA-569-A.
- B. Comply with requirements for demarcation point, pathways, cabinets, and racks specified in Section 271100 "Communications Equipment Room Fittings." Drawings indicate general arrangement of pathways and fittings.
- C. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.
- D. Comply with requirements in Section 260533 "Raceway and Boxes for Electrical Systems" for installation of conduits and wireways.
- E. Install manufactured conduit sweeps and long-radius elbows whenever possible.
- F. Pathway Installation in Communications Equipment Rooms:
  - 1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed, or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.
  - 2. Install cable trays to route cables if conduits cannot be located in these positions.
  - 3. Secure conduits to backboard when entering room from overhead.
  - 4. Extend conduits **3 inches (76 mm)** above finished floor.
  - 5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

- G. Backboards: Install backboards with **96-inch (2440-mm)** dimension vertical. Butt adjacent sheets tightly, and form smooth gap-free corners and joints.

### **3.4 INSTALLATION OF CABLES**

- A. Comply with NECA 1.

- B. General Requirements for Cabling:

1. Comply with TIA/EIA-568-B.1.
2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
3. Install 110-style IDC termination hardware unless otherwise indicated.
4. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
5. Cables may not be spliced. Secure and support cables at intervals not exceeding **30 inches (760 mm)** and not more than **6 inches (150 mm)** from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
6. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Use lacing bars and distribution spools.
8. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
9. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
10. In the communications equipment room, install a **10-foot- (3-m-)** long service loop on each end of cable.
11. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

- C. UTP Cable Installation:

1. Comply with TIA/EIA-568-B.2.
2. Do not untwist UTP cables more than **1/2 inch (12 mm)** from the point of termination to maintain cable geometry.

- D. Optical Fiber Cable Installation:

1. Comply with TIA/EIA-568-B.3.
2. Cable may be terminated on connecting hardware that is rack or cabinet mounted.

E. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend UTP cable not in a wireway or pathway, a minimum of **8 inches (200 mm)** above ceilings by cable supports not more than **60 inches (1524 mm)** apart.
3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

F. Group connecting hardware for cables into separate logical fields.

G. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA/EIA-569-A recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
  - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of **5 inches (127 mm)**.
  - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of **12 inches (300 mm)**.
  - c. Electrical Equipment Rating More Than 5 kVA: A minimum of **24 inches (610 mm)**.
3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
  - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of **2-1/2 inches (64 mm)**.
  - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of **6 inches (150 mm)**.
  - c. Electrical Equipment Rating More Than 5 kVA: A minimum of **12 inches (300 mm)**.
4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
  - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
  - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of **3 inches (76 mm)**.

- c. Electrical Equipment Rating More Than 5 kVA: A minimum of **6 inches (150 mm)**.
- 5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of **48 inches (1200 mm)**.
- 6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of **5 inches (127 mm)**.

### 3.5 FIRESTOPPING

- A. Comply with requirements in Fire stopping section.

### 3.6 GROUNDING

- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with ANSI-J-STD-607-A.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least **2-inch (50-mm)** clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

### 3.7 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
  - 1. Administration Class: **1**.
  - 2. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.
- B. Comply with requirements in Section 099123 "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.
- C. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for **Class 2** level of administration **including optional identification requirements of this standard**.

- D. Comply with requirements in Section 271500 "Communications Horizontal Cabling" for cable and asset management software.
- E. Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.
- F. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, **backbone pathways and cables, entrance pathways and cables**, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors.
- G. Cable and Wire Identification:
  - 1. Label each cable within **4 inches (100 mm)** of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
  - 2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
  - 3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding **15 feet (4.5 m)**.
  - 4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
    - a. Individually number wiring conductors connected to terminal strips and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device with name and number of particular device as shown.
    - b. Label each unit and field within distribution racks and frames.
  - 5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
- H. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA 606-A, for the following:
  - 1. Cables use flexible vinyl or polyester that flexes as cables are bent.

### 3.8 FIELD QUALITY CONTROL

- A. Testing Agency: **Engage** a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
  - 1. Visually inspect UTP and optical fiber jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA/EIA-568-B.1.
  - 2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
  - 3. Test UTP copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.
    - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
  - 4. Optical Fiber Cable Tests:
    - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
    - b. Link End-to-End Attenuation Tests:
      - 1) Horizontal and multimode backbone link measurements: Test at 850 or 1300 nm in 1 direction according to TIA/EIA-526-14-A, Method B, One Reference Jumper.
      - 2) Attenuation test results for backbone links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA/EIA-568-B.1.
- D. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.

- E. Remove and replace cabling where test results indicate that they do not comply with specified requirements.
- F. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- G. Prepare test and inspection reports.

END OF SECTION 271300



## SECTION 271500 - COMMUNICATIONS HORIZONTAL CABLING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. **50/125 and 62.5/125**-micrometer, optical fiber cabling.
  - 2. Coaxial cable.
  - 3. Multiuser telecommunications outlet assemblies.
  - 4. Cable connecting hardware, patch panels, and cross-connects.
  - 5. Telecommunications outlet/connectors.
  - 6. Cabling system identification products.
  - 7. Cable management system.
- B. Related Requirements:
  - 1. Section 271300 "Communications Backbone Cabling" for voice and data cabling associated with system panels and devices.

#### 1.3 DEFINITIONS

- A. BICSI: Building Industry Consulting Service International.
- B. Consolidation Point: A location for interconnection between horizontal cables extending from building pathways and horizontal cables extending into furniture pathways.
- C. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- D. EMI: Electromagnetic interference.
- E. IDC: Insulation displacement connector.
- F. LAN: Local area network.

- G. MUTOA: Multiuser telecommunications outlet assembly, a grouping in one location of several telecommunications outlet/connectors.
- H. Outlet/Connectors: A connecting device in the work area on which horizontal cable or outlet cable terminates.
- I. RCDD: Registered Communications Distribution Designer.
- J. UTP: Unshielded twisted pair.

#### **1.4 ADMINISTRATIVE REQUIREMENTS**

- A. Coordinate layout and installation of telecommunications cabling with Owner's telecommunications and LAN equipment and service suppliers.
- B. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area.

#### **1.5 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. For coaxial cable, include the following installation data for each type used:
    - a. Nominal OD.
    - b. Minimum bending radius.
    - c. Maximum pulling tension.
- B. Shop Drawings:
  - 1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
  - 2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
  - 3. Cabling administration drawings and printouts.
  - 4. Wiring diagrams to show typical wiring schematics, including the following:
    - a. Cross-connects.
    - b. Patch panels.
    - c. Patch cords.
  - 5. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.

- C. Samples: For workstation outlets, jacks, jack assemblies, **in specified finish, one for each size and outlet configuration.**

#### 1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For **Installer**, qualified layout technician, installation supervisor, and field inspector.
- B. Source quality-control reports.
- C. Field quality-control reports.

#### 1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For splices and connectors to include in maintenance manuals.
- B. Software and Firmware Operational Documentation:
  - 1. Software operating and upgrade manuals.
  - 2. Program Software Backup: On magnetic media or compact disk, complete with data files.
  - 3. Device address list.
  - 4. Printout of software application and graphic screens.

#### 1.8 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
  - 1. Layout Responsibility: Preparation of Shop Drawings and **Cabling Administration Drawings, Cabling Administration Drawings, and field testing program development** by an RCDD.
  - 2. Installation Supervision: Installation shall be under the direct supervision of **Level 2 Installer**, who shall be present at all times when Work of this Section is performed at Project site.
  - 3. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.
- B. Testing Agency Qualifications: An NRTL.
  - 1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

## 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site.
  - 1. Test optical fiber cables to determine the continuity of the strand end to end. Use **optical loss test set**.
  - 2. Test optical fiber cables while on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector; including the loss value of each. Retain test data and include the record in maintenance data.
  - 3. Test each pair of UTP cable for open and short circuits.

## PART 2 - PRODUCTS

### 2.1 HORIZONTAL CABLING DESCRIPTION

- A. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the communications equipment room. This cabling and its connecting hardware are called a "permanent link," a term that is used in the testing protocols.
  - 1. TIA/EIA-568-B.1 requires that a minimum of two telecommunications outlet/connectors be installed for each work area.
  - 2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications outlet/connector.
  - 3. Bridged taps and splices shall not be installed in the horizontal cabling.
  - 4. Splitters shall not be installed as part of the optical fiber cabling.
- B. A work area is approximately **100 sq. ft. (9.3 sq. m)**, and includes the components that extend from the telecommunications outlet/connectors to the station equipment.
- C. The maximum allowable horizontal cable length is **295 feet (90 m)**. This maximum allowable length does not include an allowance for the length of **16 feet (4.9 m)** to the workstation equipment or in the horizontal cross-connect.
- D. Cabling requirements for CAT6 cabling will be indicated on the drawings. In most cases cabling shall be shielded twisted pair.
- E. In TEMPEST areas cabling shall be compliant with the FRD Rev S. All SAPF/SCIF areas shall have TEMPEST compliant Ethernet cabling installed.

## 2.2 PERFORMANCE REQUIREMENTS

- A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA/EIA-568-B.1 when tested according to test procedures of this standard.
- B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: **25** or less.
  - 2. Smoke-Developed Index: **50** or less.
- C. 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.
- D. Grounding: Comply with J-STD-607-A.

## 2.3 OPTICAL FIBER CABLE

- A. Description: Single Mode and Multimode, **50/125** and **62.5/125**-micrometer, fiber count as shown on drawings tight buffer, optical fiber cable.
  - 1. Comply with ICEA S-83-596 for mechanical properties.
  - 2. Comply with TIA/EIA-568-B.3 for performance specifications.
  - 3. Comply with **TIA-492AAAB** for detailed specifications.
  - 4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
    - a. General Purpose, Nonconductive: Type OFN or OFNG.
    - b. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
    - c. Riser Rated, Nonconductive: Type OFNR, complying with UL 1666.
    - d. General Purpose, Conductive: Type OFC or OFCG.
    - e. Plenum Rated, Conductive: Type OFCP, complying with NFPA 262.
    - f. Riser Rated, Conductive: Type OFCR, complying with UL 1666.
  - 5. Conductive cable shall be **steel** armored type.
  - 6. Maximum Attenuation: **3.50** dB/km at 850 nm; **1.5** dB/km at 1300 nm.
  - 7. Minimum Modal Bandwidth: 160 MHz-km at 850 nm; 500 MHz-km at 1300 nm.
- B. Jacket:
  - 1. Jacket Color: As indicated on drawings.

2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-C.
3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed **40 inches (1000 mm)**.

## 2.4 OPTICAL FIBER CABLE HARDWARE

- A. Cross-Connects and Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors.
  1. Number of Connectors per Field: **Two** for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to suit specified expansion criteria.
- B. Patch Cords: Factory-made, dual-fiber cables in **36-inch (900-mm)** lengths.
- C. Cable Connecting Hardware:
  1. Comply with Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA-604-2-B, TIA-604-3-B, and TIA/EIA-604-12. Comply with TIA/EIA-568-B.3.
  2. Quick-connect, simplex and duplex, **Type LC** connectors. Insertion loss not more than 0.75 dB.
  3. Type SFF connectors may be used in termination racks, panels, and equipment packages.

## 2.5 TELECOMMUNICATIONS OUTLET/CONNECTORS

- A. Jacks: 100-ohm, balanced, twisted-pair connector; four-pair, eight-position modular. Comply with TIA/EIA-568-B.1.
- B. Workstation Outlets: number as shown on drawings - port-connector assemblies mounted in **single** faceplate.
  1. Plastic Faceplate: High-impact plastic. Coordinate color with Section 262726 "Wiring Devices."
  2. Metal Faceplate: **Stainless steel**, complying with requirements in Section 262726 "Wiring Devices."
  3. For use with snap-in jacks accommodating any combination of UTP, optical fiber, and coaxial work area cords.
    - a. Flush mounting jacks, positioning the cord at a 45-degree angle.
  4. Legend: Factory labeled by silk-screening or engraving **stainless steel faceplates**.

5. Legend: Machine printed, in the field, using adhesive-tape label.
6. Legend: Snap-in, clear-label covers and machine-printed paper inserts.

## 2.6 GROUNDING

- A. Comply with requirements in Section 270526 "Grounding and Bonding for Communications Systems" for grounding conductors and connectors.
- B. Comply with J-STD-607-A.

## 2.7 IDENTIFICATION PRODUCTS

- A. Comply with TIA/EIA-606-A and UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- B. Comply with requirements in Section 260553 "Identification for Electrical Systems."

## 2.8 CABLE MANAGEMENT SYSTEM

- A. Description: Computer-based cable management system, with integrated database **and graphic** capabilities.
- B. Document physical characteristics by recording the network, TIA/EIA details, and connections between equipment and cable.
- C. Information shall be presented in database view, **schematic plans, or technical drawings**.
  1. **AutoCAD** drawing software shall be used as drawing and schematic plans software.
- D. System shall interface with the following testing and recording devices:
  1. Direct upload tests from circuit testing instrument into the personal computer.
  2. Direct download circuit labeling into labeling printer.

## 2.9 SOURCE QUALITY CONTROL

- A. Testing Agency: **Engage** a qualified testing agency to evaluate cables.
- B. Factory test UTP and optical fiber cables on reels according to TIA/EIA-568-B.1.

- C. Factory test UTP cables according to TIA/EIA-568-B.2.
- D. Factory test multimode optical fiber cables according to TIA-526-14-A and TIA/EIA-568-B.3.
- E. Factory-sweep test coaxial cables at frequencies from 5 MHz to 1 GHz. Sweep test shall test the frequency response, or attenuation over frequency, of a cable by generating a voltage whose frequency is varied through the specified frequency range and graphing the results.
- F. Cable will be considered defective if it does not pass tests and inspections.
- G. Prepare test and inspection reports.

### **PART 3 - EXECUTION**

#### **3.1 ENTRANCE FACILITIES**

- A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

#### **3.2 WIRING METHODS**

- A. Install cables in pathways and cable trays except within consoles, cabinets, desks, and counters. Conceal pathways and cables except in unfinished spaces.
  - 1. Install plenum cable in environmental air spaces, including plenum ceilings.
  - 2. Comply with requirements in Section 270528 "Pathways for Communications Systems."
  - 3. Comply with requirements in Section 270536 "Cable Trays for Communications Systems."
- B. Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- C. Wiring within Enclosures:
  - 1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.
  - 2. Install lacing bars and distribution spools.
  - 3. Install conductors parallel with or at right angles to sides and back of enclosure.



### 3.3 INSTALLATION OF CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:

1. Comply with TIA/EIA-568-B.1.
2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
3. Install 110-style IDC termination hardware unless otherwise indicated.
4. MUTOA shall not be used as a cross-connect point.
5. Consolidation points may be used only for making a direct connection to telecommunications outlet/connectors:
  - a. Do not use consolidation point as a cross-connect point, as a patch connection, or for direct connection to workstation equipment.
  - b. Locate consolidation points for UTP at least **49 feet (15 m)** from communications equipment room.
6. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
7. Cables may not be spliced. Secure and support cables at intervals not exceeding **30 inches (760 mm)** and not more than **6 inches (150 mm)** from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
8. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
9. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
10. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
11. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
12. In the communications equipment room, install a **10-foot- (3-m-)** long service loop on each end of cable.
13. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
14. **Note that in all areas that are designated as TEMPEST areas Tempest compliant Ethernet cabling will be required. Non-TEMPEST cabling installed in these areas under this contract will be required to be removed and replaced with TEMPEST cabling at the contractor's expense.**
- 15.

C. Optical Fiber Cable Installation:

1. Comply with TIA/EIA-568-B.3.
2. Cable may be terminated on connecting hardware that is rack or cabinet mounted.

D. Group connecting hardware for cables into separate logical fields.

E. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA-569-B for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
  - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
  - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
  - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (610 mm).
3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
  - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
  - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
  - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).
4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
  - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
  - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (76 mm).
  - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).
5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).

6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

### 3.4 GROUNDING

- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with J-STD-607-A.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

### 3.5 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
  1. Administration Class: 1.
  2. Color-code cross-connect fields. Apply colors to voice and data service backboards, connections, covers, and labels.
- B. Using cable management system software specified in Part 2, develop Cabling Administration Drawings for system identification, testing, and management. Use unique, alphanumeric designation for each cable and label cable, jacks, connectors, and terminals to which it connects with same designation. At completion, cable and asset management software shall reflect as-built conditions.
- C. Comply with requirements in Section 099123 "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.
- D. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for **Class 2** level of administration, **including optional identification requirements of this standard.**
- E. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations.

Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

- F. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, **backbone pathways and cables, entrance pathways and cables**, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606-A. Furnish electronic record of all drawings, in software and format selected by Owner.
- G. Cable and Wire Identification:
1. Label each cable within **4 inches (100 mm)** of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
  2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
  3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding **15 feet (4.5 m)**.
  4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
    - a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.
    - b. Label each unit and field within distribution racks and frames.
  5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
  6. Uniquely identify and label work area cables extending from the MUTOA to the work area. These cables may not exceed the length stated on the MUTOA label.
- H. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA-606-A.
1. Cables use flexible vinyl or polyester that flex as cables are bent.

### 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 test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform the following tests and inspections:
  - 1. Visually inspect optical fiber cable jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA/EIA-568-B.1.
  - 2. Visually confirm **Category 6**, marking of outlets, cover plates, outlet/connectors, and patch panels.
  - 3. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
  - 4. Test UTP backbone copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.
    - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
  - 5. Optical Fiber Cable Tests:
    - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
    - b. Link End-to-End Attenuation Tests:
      - 1) Horizontal and multimode backbone link measurements: Test at 850 or 1300 nm in 1 direction according to TIA-526-14-A, Method B, One Reference Jumper.
      - 2) Attenuation test results for backbone links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA/EIA-568-B.1.
  - 6. Optical Fiber Cable Performance Tests: Perform optical fiber end-to-end link tests according to TIA/EIA-568-B.1 and TIA/EIA-568-B.3.
  - 7. Coaxial Cable Tests: Conduct tests according to Section 274133 "Master Antenna Television System."

8. Final Verification Tests: Perform verification tests for **optical fiber** systems after the complete communications cabling and workstation outlet/connectors are installed.
  - a. Voice Tests: These tests assume that dial tone service has been installed. Connect to the network interface device at the demarcation point. Go off-hook and listen and receive a dial tone. If a test number is available, make and receive a local, long distance, and digital subscription line telephone call.
  - b. Data Tests: These tests assume the Information Technology Staff has a network installed and is available to assist with testing. Connect to the network interface device at the demarcation point. Log onto the network to ensure proper connection to the network.
- D. Document data for each measurement. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.
- E. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

### 3.7 SOFTWARE SERVICE AGREEMENT

- A. Technical Support: Beginning with Substantial Completion, provide software support for **two** years.
- B. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within **two** years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.
  1. Provide **30** days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

### 3.8 DEMONSTRATION

- A. **Train** Owner's maintenance personnel in cable-plant management operations, including changing signal pathways for different workstations, rerouting signals in failed cables, and keeping records of cabling assignments and revisions when extending wiring to establish new workstation outlets. **Include training in cabling administration software.**

**F-35 ADAL Squadron Operations Building  
187th Fighter Wing, Dannelly Field, ANG  
Montgomery, AL**

**FAKZ189102**

**November 2022**

**Type B3 (100%) Submittal**

END OF SECTION 271500

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## SECTION 281300 - SECURITY SYSTEM

### PART 1 GENERAL

#### 1.01 SUMMARY

- A. Section includes all work to be performed by the Government's security contractor, ADVANTOR Systems. All costs for equipment and labor associated with security systems shall be included in the General Contractor's bid for the cost. All security equipment and installation labor shall be provided as part of this Contract by the Owner's security Contractor. Refer to Government solicitation documents for the limited source justification associated with this scope of the work.
- B. ADVANTOR Systems has been involved during the design for this project and has prepared a tentative bill of materials/quote for the work required. However, the Contractor shall contact ADVANTOR during the bid process to receive an updated bill of materials/quote for the scope of work indicated on the drawings. The tentative bill of materials with quantities and costs redacted is included as an attachment to this specification section.
  - 1. *Note that final design drawings may not be fully reflected in the most current bill of materials/quote on file with ADVANTOR systems. Contractor shall coordinate with ADVANTOR systems to ensure all equipment, labor, and effort required to provide a complete and functioning systems with devices and layouts indicated on the drawings is provided by the General Contractor as part of the bid.*
- C. Refer to phasing plan and specification section 00 0102 Project Information and Summary for specific phasing requirements that will impact sequencing of the work and likely require multiple mobilizations by ADVANTOR systems to successfully complete the work.

#### 1.02 REFERENCES

- A. NFPA 70 - National Electrical Code
- B. NFPA 101 - Life Safety Code
- C. UL 294 - Access Control Systems
- D. UL 1076 - Proprietary Burglar Alarm Units and Systems
- E. Americans with Disabilities Act - Public Law 101.336
- F. FCC

- G. RoHS - Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment
- H. CE - Conformité Européenne
- I. UFC – Unified Facilities Criteria

### **1.03 SUBMITTALS**

- A. Single-line block diagram showing all related equipment interfaces
- B. Manufacturer technical data sheets
- C. Shop Drawings
- D. Software: One (1) set of fully functional software in manufacturer's original media packaging

### **1.04 CLOSE-OUT SUBMITTALS**

- A. Maintenance Contracts
- B. Operation and Maintenance Data or Manuals
- C. Warranty Documentation
- D. Record Documentation
- E. Software
- F. Commissioning Documentation and Check-Off List
- G. As-Built Drawings
- H. Training Course Materials
- I. Training Presentations
- J. Training Class Video Files

### **1.05 WARRANTY**

- A. Provide manufacturer's standard warranty in-keeping with requirements of the Vendor's master agreement with the Air National Guard.

## **PART 2 PRODUCT**

### **2.01 SYSTEM**

#### **A. Description**

1. See attached ADVANTOR scope of work and material list.

## **PART 3 - EXECUTION**

### **3.01 INSTALLERS**

#### **A. Contractor requirements:**

1. Provide satisfactory evidence of liability insurance and Workmen's Compensation coverage for employed personnel as required by law.
2. Ensure that all personnel working on the project are registered with the state or local jurisdiction licensing board as provided for by current state or municipal statutes.

#### **B. Installer and technician requirements:**

1. Must be experienced and qualified to accomplish all work promptly and satisfactorily.
2. Installer must be an employee of ADVANTOR systems that is qualified and approved to furnish installation services for systems of the type and complexity included within the project scope. Provide proof that designated service and support personnel have successfully completed the appropriate manufacturer offered hardware and software training and certification for installation, service and maintenance of the specified system.
3. Advise Contracting Officer Representative in writing of all designated service and support personnel responsible for installation as well as pre and post warranty service.

### **3.02 EXAMINATION**

- A. Inspect the installation site prior to bidding the job.
- B. Report any discrepancies between the project specification and bid documents and the site examination prior to the bid opening date.

### **3.03 PREPARATION**

- A. Order all required parts and equipment upon notification of award.

- B. Bench test all equipment prior to delivery to the job site.
- C. Verify the availability of power where required. If a new source of power is required, a licensed electrician shall be used to install it.
- D. Verify the availability of communication infrastructure where required.
- E. Arrange for obtaining all programming information including access times, free access times, door groups, operator levels, etc.

### **3.04 INSTALLATION**

#### **A. Requirements**

- 1. Install all system components and appurtenances in accordance with the manufacturer's specifications, referenced practices, guidelines, and applicable codes.
- 2. Furnish all necessary interconnections, services, and adjustments required for a complete and operable system as specified.
- 3. Control signal, communications, and data transmission line grounding shall be installed as necessary to preclude ground loops, noise, and surges from adversely affecting system operation.
- 4. Carefully follow the instructions in the manufacturers' installation manual to ensure all steps have been taken to provide a reliable, easy to operate system.
- 5. Perform all work as indicated in the project specifications, project drawings, and ADVANTOR scope document included as an attachment to this specification section.
- 6. Pre-program system and load onto Government's host computer.

#### **B. Systems Integration**

- 1. Integrate new system into existing base security fiber-optic network. Provide installation in compliance with applicable Air Force Instructions (AFI) and other directives.
- 2. Test and certify that new systems are operations and communicating with Base Defense Operations Center (BDOC) prior to completion.
- 3. Coordinate with 187<sup>th</sup> Fighter Wing Communications Group as required to provide system connectivity.
- 4. Work in harmony with all other trades.

5. Integrate related system and sub-systems.

### **3.05 QUALITY CONTROL**

#### **A. Workmanship**

1. Comply with highest industry standards, except when specified requirements indicate more rigid standards or more precise workmanship.
2. Perform work with persons experienced and qualified to produce workmanship specified.
3. Maintain quality control over suppliers and subcontractors.
4. Quality of workmanship is critical. Government will have the authority to reject work which does not conform to the project documents.

#### **B. Site Tests and Inspections**

1. Execute adequate testing of the system to insure proper operation.
2. Upon reaching Beneficial Occupancy, perform a complete test and inspection of the system. If found to be installed and operating properly, notify the Government of your readiness to perform the formal test and inspection of the complete system.
3. Submit the Record Drawings (as-builts) to Contracting Officer Representative for review prior to inspection.
4. During the formal test and inspection (commissioning) of the system, have personnel available with tools and equipment to remove devices from their mounts to inspect wiring connections. Provide wiring diagrams and labeling charts to properly identify all wiring.
5. If corrections are needed, the contractor will be provided with a punch list of all discrepancies. Perform the needed corrections in a timely fashion.
6. Notify Government when ready to perform a re-inspection of the installation.

#### **C. Software Engineering Support**

1. Provide software engineer services to assist the Government in coordinating the interfaces between the security management system and the staff databases or other remote systems.

2. Software engineer shall be certified by or employed by the system manufacturer, and shall be thoroughly knowledgeable of the system applications.
3. Software engineer shall be on-site and available to meet with Contracting Officer Representatives for a period of not less than two consecutive days. On-site visit shall be scheduled at the convenience of the Government.

### **3.06 SYSTEM STARTUP**

- A. Provide initial programming and configuration of the security management system.
- B. Programming shall include defining hardware, doors, monitor points, clearance codes, time codes, door groups, alarm groups, operating sequences, camera call-ups, etc. Input of all program data shall be by contractor. Consult with Contracting Officer Representative to determine operating parameters.
- C. Government, with the cooperation and assistance of contractor, will input the cardholder data for each access card.
- D. Maintain hard copy worksheets which fully document the system program and configuration
- E. Worksheets shall be kept up to date on a daily basis until final acceptance by Government.
- F. Worksheets shall be subject to inspection and approval by Government.
- G. Provide final copies to Government prior to project close-out.
- H. Maintain a complete, up-to-date backup of the system configuration and cardholder database.
- I. Backup shall be maintained throughout programming period until final acceptance by Government.
- J. Submit back-up media to Government upon Final Acceptance.
- K. Provide follow-up assistance with system configuration sixty (60) days after start-up of system as requested by Government. Include a labor allowance for follow-up assistance in base bid price.

### **3.07 CLOSEOUT ACTIVITIES**

- A. Commissioning
  1. Place entire system into full and proper operation as designed and specified.

2. Verify that all hardware components are properly installed, connected, communicating, and operating correctly.
3. Verify that all system software is installed, configured, and complies with specified functional requirements.
4. Perform final acceptance testing in the presence of Contracting Officer Representative, executing a point by point inspection against a documented test plan that demonstrates compliance with system requirements as designed and specified.
5. Submit documented test plan to Government at least fourteen (14) days in advance of acceptance test, inspection and check-off.
6. Conduct final acceptance tests in presence of Contracting Officer Representative, verifying that each device point and sequence is operating correctly and properly reporting back to control panel and control center.
7. Acceptance by Government is contingent on successful completion of check-off; if check-off is not completed due to additional work required, re-schedule and perform complete check-off until complete in one pass, unless portions of system can be verified as not adversely affected by additional work.
8. System shall not be considered accepted until all acceptance test items have been successfully checked-off. Beneficial use of part or all of the system shall not be considered as acceptance.

**B. Training**

1. Provide system operations, administration, and maintenance training by factory trained personnel qualified to instruct.
2. Training shall be oriented to the specific system being installed under this contract as designed and specified.
3. Provide training sessions at Government's facility, and schedule at the Government's convenience.
4. Provide written training outline and agenda for each training session prior to scheduling.
5. Record and provide copies of training programs for Government knowledgebase.
6. Government will designate personnel to be trained.
7. Provide classroom instruction for people selected by Government.

- a. Provide two (2) hours of individual hands-on training for each person.
  - b. Hands-on training shall include the opportunity for each person to operate the system.
  - c. Hands-on training shall include practice of each operation that an operator would be expected to perform.
8. Provide printed training materials for each trainee including product manuals, course outline, workbook or student guides, and written examinations for certification.
9. Cover all operating features of the system, including the following:
- a. System set-up and cardholder database configuration.
  - b. Access control features.
  - c. Alarm monitoring features.
  - d. Report generation and searches.
  - e. Card management.
  - f. Database backup procedures.
  - g. Routine maintenance and adjustment procedures.

**END OF SECTION**





# ADVANTOR®

## SYSTEMS

Quote No: **BF24JUN22-2**  
Valid Through: 9/22/2022

Site:

Dannelly Field 187th FW F35 Squad Ops Building Renovation

Date: 6/24/2022

DW/

Qty	Part Number	Item Description	Unit Price	Open Mkt Subtotal
<b>Monitoring Station</b>				
	59000011	CIS FPR 1010 STG ENC 1 LIC		
	08507088	CIS FPR1K-DT-RACK-MNT= FIREPOWER 1010 RACK-MOUNT KIT		
		<b>Subtotal Monitoring Station</b>		
<b>Advantor Equipment</b>				
	IG2LANS1COFI	IG2 LAN 115V FIPS		
	INF IEM II W/PS	INFRAGUARD EXPANSION MODULE II WITH POWER SUPPLY REV4		
	IG2 CHAS 115	IG2 CHASSIS 115V		
	INFRATOUGH	INFRATOUGH KEYPAD		
	07917203	ACT INFRATOUGH BACK BOX		
	07917204	KIT INFRATOUGH BACK PLATE		
		<b>Subtotal Advantor Equipment</b>		
<b>IDS Equipment</b>				
	08066542	MAG HSS-L2D-000 DUAL ALARM CONTACT CLOSED LOOP LEVEL 2		
	49000101	BMS/HSS INSTALLATION KIT		
	08065752	OPX SX360Z PIR 360 CEILING MOUNT		
	49000301	KIT CEILING MOTION INSTALLATION		
		<b>Subtotal IDS Equipment</b>		
<b>Access Control Equipment</b>				
	11000051	HID 921PHRNEK0001U RPK40-H PIV CLASS READER		
	11000013	DOOR STRIKES BOUGHT OUT IN THE FIELD		
	08067640	SGST-W SINGLE GANG SINGLE TONE PIEZO SIREN		
	08067647	ALT EFLOW6N8 12/24VDC 6A 8 FUSE POWER SUPPLY		
	11000365	GRI TSC-20 TAMPER SWITCH REED PLUNGER CLIP MOUNT		
		<b>Subtotal Access Control Equipment</b>		
<b>CCTV Equipment</b>				
	08069264	BOS NDA-8000-PIP PENDANT INTERFACE PLATE INDOOR		
	08068224	BOS NDA-U-PSMB SURFACE MOUNT BOX WALL/CEILING		
	08068223	BOS NDA-U-WMT UNIVERSAL PENDANT WALL MOUNT DOME CAMERA, WHITE		
	08069295	BOS NDE-8502-RXT FIXED DOME 2MP HDR X STARLIGHT X		
	08067781	BOS NPJ-6001B MIDSPAN POE INJECTOR		
	08067513	CIS WS-C3560CX-8TC-S 3560-CX 8 PORT DATA IP BASE		
	08067397	CIS RCKMNT-19-CMPCT= 19"RACKMNT FOR CATALYST 3560 2960 SWITCH		
		<b>Subtotal CCTV Equipment</b>		
<b>Miscellaneous Equipment</b>				
	11000265	BAT YA-NP712GNVT BATTERY 12V 7AH TAIWAN MADE		
	11000089	SWW 811752 CAT6 MODULAR PLUG		
	11000082	SWW V-850880 CAT 6 PLENUM GRAY 1000FT		
	11000061	SWW 113002 16GA COND PLENUM PER 1000 FT		
	11000070	SWW 110251 22/6 PLEM PER 1000 FT		
	11000391	SWW 959359 22GA 3TWISTED PR STR OS CMP GREEN PER 1K		
	11000067	SWW 959360 22GA 3TWISTED PR STR OS CMP ORANGE 1K		
		LOT - CONDUIT, CONNECTORS, MOUNTING HARDWARE		
		<b>Subtotal Miscellaneous</b>		
		<b>Subtotal Overall Equipment</b>		
<b>Labor, Design &amp; Training</b>				
		LABOR		
		TRANSPORTATION, JTR PER DIEM		
		INSTALLATION OTHER DIRECT COSTS (ODC)		
		<b>Subtotal Labor</b>		
		FREIGHT		
		<b>Subtotal Freight</b>		
		<b>SUBTOTAL ALL SECTIONS</b>		
		<b>STATE TAX (IF APPLICABLE)</b>		
		<b>TOTAL</b>		

THIS QUOTATION VALID FOR 90 DAYS FROM DATE OF ISSUE

**CONTRACTOR COVID-19 STATEMENT**

THIS QUOTE/PROPOSAL IS SUBJECT TO ADEQUATE COVID-19 SAFETY PROTOCOLS. HOWEVER, THE IMPACTS OF COVID-19 CANNOT BE REASONABLY DETERMINED AT THIS TIME. THEREFORE, THIS QUOTE/PROPOSAL DOES NOT ACCOUNT FOR ANY POTENTIAL ADVERSE IMPACTS COVID-19 MAY HAVE ON ADVANTOR'S PERFORMANCE OR OBLIGATIONS HEREIN. IN THE EVENT OF ANY DELAYS OR ADVERSE IMPACTS, ADVANTOR RESERVES ANY AND ALL RIGHTS FOR AN EQUITABLE ADJUSTMENT OF THE DELIVERY SCHEDULE AND PRICES HEREIN TO OFFSET THE EFFECTS OF COVID-19 DELAYS, WITHOUT FAULT OR PENALTY OF ANY KIND.

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## **SECTION 310010 - SITE PROTECTION**

### **PART 1 GENERAL**

#### **1.01 RELATED DOCUMENTS**

- A. The General Provisions of the Contract including requirements of the Government's Solicitation and Division 01 specifications apply to the work specified in this section.

#### **1.02 DESCRIPTION**

- A. The Work of this Section includes the protection and preservation from injury or defacement of all vegetation and objects designated to remain. The contractor shall employ an arborist to instruct contractor on preservation of site trees to remain.
- B. The Contractor is solely responsible for controlling runoff and siltation from the site and onto protected or undisturbed areas of the site or adjacent sites.
- C. The Work of this Section is incidental to the Contract and will not be paid for separately except where unit prices may be in effect.

#### **1.03 QUALITY ASSURANCE**

- A. Reference Standards:

- 1. General:
  - a. Listings: Issues listed by reference, including revisions of issuing authority, form part of this specification section to extent indicated. Issues listed are identified by number, edition, date, title, or other designation established by issuing authority. Issues subsequently referred to are referred to by an issuing authority abbreviation and a basic designation.
  - b. Modification: Modifications (by the Government) to reference standards, if any, are noted with standard.
- 2. Alabama Department of Transportation (ALDOT), Standard Specifications for Highway Construction, Latest Edition:
- 3. Alabama handbook for "Erosion Control, Sediment Control, and Stormwater Management on Construction Sites and Urban Areas", published by Alabama Soil and Water Conservation Committee.
- 4. Local Codes, Ordinances, Regulations.
- 5. Local Codes, Ordinances, Regulations on tree protection.

- B. Job Meeting: Before proceeding with site clearing operations, review site features to remain and be protected at the site with the Government.
- C. Tree Damages: Extreme care to be taken to save trees that are shown to remain.
  - 1. If any trees to be saved are severely injured so as to cause a loss of natural character to the crown, or so as to impair the life support system or to cause death as a result of construction operation, the Contractor agrees to pay two hundred dollars (\$200) per one inch (1") of caliper, measured four feet (4') above the ground, for trees one inch (1") in caliper and larger, as fixed and liquidated damages, as determined by the Government.
  - 2. Severely damaged trees requiring liquidated damages will be determined by the Government. In lieu of liquidated damages replace trees damaged beyond repair or killed with trees of same specie and size.
  - 3. Damaged trees which are repairable as determined by the Government shall be repaired by a qualified tree surgeon, approved by the Government, and whose services will be at the Contractor's expense.
  - 4. Clean up and repair damages to the Government's satisfaction.
- D. Protect existing sidewalks and curbs to remain to include those in non-work areas.

## **PART 2 PRODUCTS**

### **2.01 PRODUCT/MATERIAL DESCRIPTION**

- A. Tree Protection Fencing:
  - 1. Provide and install six-foot (6') high chain link fence, including gates, in accordance with AHD Section 871.
  - 2. Zinc coated steel fabric or wire not less than (9) gauge.
  - 3. Hot-dipped galvanized steel fence supports, framing and fittings of specified sized and weights.
  - 4. Install at limits of tree protection fencing as required to protect tree canopy and roots.

## **PART 3 EXECUTION**

### **3.01 JOB CONDITIONS**

- A. It is intended that the part of the property on which new construction does not occur remain undisturbed and as is, except as noted on Drawings and in Specifications.
- B. Confine storage of materials, temporary facilities, and staging to areas approved by the Government.
- C. Do not carry on construction operations or materials storage within five feet (5') of tree protection fencing.

### **3.02 TREE PROTECTION**

- A. Protect all trees and vegetation to be preserved against damage during construction operations by:
  - 1. Installation of chain link fence as required to protect trees.
  - 2. Installation of hay bales or silt fencing to protect vegetation to remain from siltation, as shown on Drawings or as directed.
- B. Place tree protection before clearing, topsoil stripping, grading, or excavation is begun.
- C. Maintain tree protection in good repair for the duration of the construction operation, or until directed to remove.
- D. Protect Root Systems:
  - 1. Do not permit construction operations, storage material, construction, trailers, etc., within the tree protection fencing.
  - 2. Protect tree roots (area under tree canopy) from damage due to noxious materials in solution caused by run-off or spillage during mixing and placement of construction materials, or drainage from stored materials.
  - 3. Protect from flooding or excessive wetting.
- E. Watering: In case of extreme drought during construction, provide water to specimen trees or groups of trees as determined by the Government.
- F. Earthwork around trees:
  - 1. Maintain existing grade within drip line of trees unless otherwise indicated; where necessary next to new construction, limit earthwork around trees as much as

possible.

2. Where trenching or utilities is required within drip line, advise the Government before proceeding. Where roots are pruned, cut sharply and cleanly (do not chop or beak). Hand excavate where directed.
3. Do not allow exposed roots to dry out before permanent fill is placed; provide temporary cover, or pack with peat moss and wrap with burlap; keep moist.

**G. Repair of Damaged Trees:**

1. Repair tree damaged by construction operations promptly after damage occurs and in a manner acceptable to the Government.

**END OF SECTION**

**SECTION 310200 - TEMPORARY EROSION AND SEDIMENT CONTROL**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Prevention of erosion due to construction activities.
- B. Prevention of sedimentation of waterways, open drainage ways, and storm and sanitary sewers due to construction activities.
- C. Restoration of areas eroded due to insufficient preventive measures.
- D. Compensation of Owner for fines levied by authorities having jurisdiction due to non-compliance by Contractor.
- E. Materials included in this section shall meet the requirements for High Performance Sustainable Buildings for New Construction points for the following Sections:
  - 1. 2-6.1.2 - Biologically Based Products
  - 2. The contractor is expected to understand the HPSB requirements for these sections and include all applicable overhead in their base bid for the necessary documentation to achieve the above listed credits.

**1.02 REFERENCE STANDARDS**

- A. ASTM D4355/D4355M - Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus; 2014.
- B. ASTM D4491 - Standard Test Methods for Water Permeability of Geotextiles by Permittivity; 1999a (Reapproved 2014).
- C. ASTM D4533 - Standard Test Method for Trapezoid Tearing Strength of Geotextiles; 2011.
- D. ASTM D4632/D4632M - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles; 2015a.
- E. ASTM D4751 - Standard Test Method for Determining Apparent Opening Size of a Geotextile; 2012.
- F. ASTM D4873 - Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples; 2002 (Reapproved 2009).

- G. EPA (NPDES) - National Pollutant Discharge Elimination System (NPDES), Construction General Permit; Current Edition.
- H. Alabama Department of Transportation Standard Specification for Highway Construction, latest edition.
- I. All Soil Erosion and Sediment Control Ordinances in force by Federal, State and Local Governments.

### **1.03 REFERENCE STANDARDS**

- A. ASTM D4355/D4355M - Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture, and Heat in a Xenon Arc-Type Apparatus 2021.
- B. ASTM D4533/D4533M - Standard Test Method for Trapezoid Tearing Strength of Geotextiles 2015.
- C. ASTM D4632/D4632M - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles 2015a.
- D. ASTM D4751 - Standard Test Methods for Determining Apparent Opening Size of a Geotextile 2021a.
- E. ASTM D4873/D4873M - Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples 2017 (Reapproved 2021).
- F. EPA (NPDES) - National Pollutant Discharge Elimination System (NPDES), Construction General Permit Current Edition.

### **1.04 PERMITS, RESPONSIBILITY, PERFORMANCE & FINES/PENALTIES REQUIREMENTS**

- A. Comply with requirements of EPA (NPDES) for erosion and sedimentation control, as specified by the NPDES, and in compliance with requirements of Construction General Permit (CGP), whether the project is required by law to comply or not.
- B. Also comply with all more stringent requirements of State of Alabama Erosion and Sedimentation Control Manual.
- C. The contractor will be solely responsible for all erosion and sediment control issues. This includes, but is not limited to: installing, maintaining, repairing and replacing erosion and sedimentation controls as shown on the drawings and any additional as required during construction. Should any of the erosion and sedimentation controls fail to produce results, the contractor shall immediately take whatever steps are necessary to correct the deficiencies. If deficiencies in the erosion and sedimentation controls cause



any damage downstream and/or any fines/penalties are imposed, the contractor shall pay all repair costs and fines/penalties.

- D. Contractor shall obtain an ADEM NPDES Stormwater Permit. The contractor shall also have a "Construction Best Management Practices Plan" (CBMPP) prepared by a qualified professional. Contractor shall also acquire services of a qualified professional to perform inspections/reporting per permit.
- E. Do not begin clearing, grading, or other work involving disturbance of ground surface cover until applicable permits have been obtained; furnish all documentation required to obtain applicable permits.
  - 1. Obtain and pay for permits and provide security required by authority having jurisdiction.
  - 2. The Government will withhold payment to Contractor equivalent to all fines resulting from non-compliance with applicable regulations.
- F. Timing: Put preventive measures in place as soon as possible after disturbance of surface cover and before precipitation occurs.
- G. Storm Water Runoff: Control increased storm water runoff due to disturbance of surface cover due to construction activities for this project.
  - 1. Prevent runoff into storm and sanitary sewer systems, including open drainage channels, in excess of actual capacity or amount allowed by authorities having jurisdiction, whichever is less.
  - 2. Anticipate runoff volume due to the most extreme short term and 24-hour rainfall events that might occur in 25 years.
- H. Erosion On Site: Minimize wind, water, and vehicular erosion of soil on project site due to construction activities for this project.
  - 1. Control movement of sediment and soil from temporary stockpiles of soil.
  - 2. Prevent development of ruts due to equipment and vehicular traffic.
  - 3. If erosion occurs due to non-compliance with these requirements, restore eroded areas at no cost to the Government.
- I. Erosion Off Site: Prevent erosion of soil and deposition of sediment on other properties caused by water leaving the project site due to construction activities for this project.
  - 1. Prevent windblown soil from leaving the project site.

2. Prevent tracking of mud onto public roads outside site.
  3. Prevent mud and sediment from flowing onto sidewalks and pavements.
  4. If erosion occurs due to non-compliance with these requirements, restore eroded areas at no cost to the Government.
- J. Sedimentation of Waterways On Site: Prevent sedimentation of waterways on the project site, including rivers, streams, lakes, ponds, open drainage ways, storm sewers, and sanitary sewers.
1. If sedimentation occurs, install or correct preventive measures immediately at no cost to the Government; remove deposited sediments; comply with requirements of authorities having jurisdiction.
  2. If sediment basins are used as temporary preventive measures, pump dry and remove deposited sediment after each storm.
- K. Sedimentation of Waterways Off Site: Prevent sedimentation of waterways off the project site, including rivers, streams, lakes, ponds, open drainage ways, storm sewers, and sanitary sewers.
1. If sedimentation occurs, install or correct preventive measures immediately at no cost to the Government; remove deposited sediments; comply with requirements of authorities having jurisdiction.
- L. Open Water: Prevent standing water that could become stagnant.
- M. Maintenance: Maintain temporary preventive measures until permanent measures have been established.

## **1.05 SUBMITTALS**

- A. See Section 01 3001 - Submittals, for submittal procedures.
- B. Certificate: Mill certificate for silt fence fabric attesting that fabric and factory seams comply with specified requirements, signed by legally authorized official of manufacturer; indicate actual minimum average roll values; identify fabric by roll identification numbers.
- C. Inspection Reports: Submit report of each inspection; identify each preventive measure, indicate condition, and specify maintenance or repair required and accomplished.

- D. Provide written declaration that erosion control measures have been inspected by the contractor at least weekly and following rainfall and repaired by the contractor.
- E. Provide documentation demonstrating that the Erosion and Sedimentation Control (ESC) Plan was carried out appropriately. Provide a summary, sample log, checklist, inspection report, or similar documentation that demonstrates periodic inspection of the implemented measures. This documentation must include:
  - 1. Sample dates.
  - 2. Inspection frequency (at least monthly, year-round).
  - 3. At least 3 inspections equally spaced over the site work period.
  - 4. Description of any corrective action taken.
- F. Sustainability Submittals, Product data for HPSB Compliance:
  - 1. For products having Biologically Based Products, documentation indicating percentages of Biologically-Based Products

## **1.06 SUSTAINABILITY REQUIREMENTS**

- A. Contractor shall endeavor to provide materials with a high Biobased content where possible.
  - 1. See Part 2 of this specification section for specific biobased content thresholds, if applicable.

## **PART 2 PRODUCTS**

### **2.01 MATERIALS**

- A. Mulch: Use one of the following:
  - 1. Straw or hay.
  - 2. Wood waste, chips, or bark.
  - 3. Erosion control matting or netting.
  - 4. Cutback asphalt.
  - 5. Polyethylene film, where specifically indicated only.
  - 6. Mulching materials and erosion control fabric shall meet the requirements of the USDA BioPreferred Program

- B. Grass Seed For Temporary Cover: Select a species appropriate to climate, planting season, and intended purpose. If same area will later be planted with permanent vegetation, do not use species known to be excessively competitive or prone to volunteer in subsequent seasons.
- C. Bales: Air dry, rectangular straw bales.
  - 1. Cross Section: 14 by 18 inches (350 by 450 mm), minimum.
  - 2. Bindings: Wire or string, around long dimension.
- D. Bale Stakes: One of the following, minimum 3 feet (1 m) long:
  - 1. Steel U- or T-section, with minimum mass of 1.33 pound per linear foot (1.98 kg per linear m).
  - 2. Wood, 2 by 2 inches (50 by 50 mm) in cross section.
- E. Silt Fence Fabric: Polypropylene geotextile resistant to common soil chemicals, mildew, and insects; non-biodegradable; in longest lengths possible; fabric including seams with the following minimum average roll lengths:
  - 1. Average Opening Size: 30 U.S. Std. Sieve (0.600 mm), maximum, when tested in accordance with ASTM D4751.
  - 2. Permittivity:  $0.05 \text{ sec}^{-1}$ , minimum, when tested in accordance with ASTM D4491.
  - 3. Ultraviolet Resistance: Retaining at least 70 percent of tensile strength, when tested in accordance with ASTM D4355/D4355M after 500 hours exposure.
  - 4. Tensile Strength: 100 pounds-force (450 N), minimum, in cross-machine direction; 124 pounds-force (550 N), minimum, in machine direction; when tested in accordance with ASTM D4632/D4632M.
  - 5. Elongation: 15 to 30 percent, when tested in accordance with ASTM D4632/D4632M.
  - 6. Tear Strength: 55 pounds-force (245 N), minimum, when tested in accordance with ASTM D4533/D4533M.
  - 7. Color: Manufacturer's standard, with embedment and fastener lines preprinted.
- F. Silt Fence Posts: One of the following, minimum 5 feet (1500 mm) long:

1. Steel U- or T-section, with minimum mass of 1.33 pound per linear foot (1.98 kg per linear m).
  2. Softwood, 4 by 4 inches (100 by 100 mm) in cross section.
  3. Hardwood, 2 by 2 inches (50 by 50 mm) in cross section.
- G. Gravel: See Section 31 2210.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Examine site and identify existing features that contribute to erosion resistance; maintain such existing features to greatest extent possible.

### **3.02 PREPARATION**

- A. Schedule work so that soil surfaces are left exposed for the minimum amount of time.

### **3.03 SCOPE OF PREVENTIVE MEASURES**

- A. In all cases, if permanent erosion resistant measures have been installed temporary preventive measures are not required.
- B. Construction Entrances: Traffic-bearing aggregate surface.
1. Width: As required; 20 feet (7 m), minimum.
  2. Length: 50 feet (16 m), minimum.
  3. Provide at each construction entrance from public right-of-way.
  4. Where necessary to prevent tracking of mud onto right-of-way, provide wheel washing area out of direct traffic lane, with drain into sediment trap or basin.
- C. Linear Sediment Barriers: Made of silt fences.
1. Provide linear sediment barriers:
    - a. Along downhill perimeter edge of disturbed areas, including soil stockpiles.
  2. Space sediment barriers with the following maximum slope length upslope from barrier:
    - a. Slope of Less Than 2 Percent: 100 feet (30 m)..

- b. Slope Between 2 and 5 Percent: 75 feet (23 m).
  - c. Slope Between 5 and 10 Percent: 50 feet (15 m).
  - d. Slope Between 10 and 20 Percent: 25 feet (7.5 m).
  - e. Slope Over 20 Percent: 15 feet (4.5 m).
- D. Storm Drain Curb Inlet Sediment Trap: Protect each curb inlet using one of the following measures:
  - 1. Filter fabric wrapped around hollow concrete blocks blocking entire inlet face area; use one piece of fabric wrapped at least 1-1/2 times around concrete blocks and secured to prevent dislodging; orient cores of blocks so runoff passes into inlet.
  - 2. Straw bale row blocking entire inlet face area; anchor into pavement.
- E. Storm Drain Drop Inlet Sediment Traps: As detailed on drawings.
- F. Temporary Splash Pads: Stone aggregate over filter fabric; size to suit application; provide at downspout outlets and storm water outlets.
- G. Soil Stockpiles: Protect using one of the following measures:
  - 1. Cover with polyethylene film, secured by placing soil on outer edges.
  - 2. Cover with mulch at least 4 inches (100 mm) thickness of pine needles, sawdust, bark, wood chips, or shredded leaves, or 6 inches (150 mm) of straw or hay.
- H. Mulching: Use only for areas that may be subjected to erosion for less than 6 months.
  - 1. Wood Waste: Use only on slopes 3:1 or flatter; no anchoring required.
  - 2. Asphalt: Use only where no traffic, either vehicular or pedestrian, is anticipated.
- I. Temporary Seeding: Use where temporary vegetated cover is required.

### **3.04 INSTALLATION**

- A. Traffic-Bearing Aggregate Surface:
  - 1. Excavate minimum of 6 inches (150 mm).
  - 2. Place geotextile fabric full width and length, with minimum 12 inch (300 mm) overlap at joints.

3. Place and compact at least 6 inches (150 mm) of 1 1/2 to 3 1/2 inch (40 to 90 mm) diameter stone.

**B. Silt Fences:**

1. Store and handle fabric in accordance with ASTM D4873/D4873M.
2. Where slope gradient is less than 3:1 or barriers will be in place less than 6 months, use nominal 16 inch (405 mm) high barriers with minimum 36 inch (905 mm) long posts spaced at 6 feet (1830 mm) maximum, with fabric embedded at least 6 inches (150 mm) in ground.
3. Where slope gradient is steeper than 3:1 or barriers will be in place over 6 months, use nominal 28 inch (710 mm) high barriers, minimum 48 inch (1220 mm) long posts spaced at 6 feet (1830 mm) maximum, with fabric embedded at least 6 inches (150 mm) in ground.
4. Where slope gradient is steeper than 3:1 and vertical height of slope between barriers is more than 20 feet (6 m), use nominal 32 inch (810 mm) high barriers with woven wire reinforcement and steel posts spaced at 4 feet (1220 mm) maximum, with fabric embedded at least 6 inches (150 mm) in ground.
5. Install with top of fabric at nominal height and embedment as specified.
6. Do not splice fabric width; minimize splices in fabric length; splice at post only, overlapping at least 18 inches (460 mm), with extra post.
7. Fasten fabric to wood posts using one of the following:
  - a. Four nails per post with 3/4 inch (19 mm) diameter flat or button head, 1 inch (25 mm) long, and 14 gage, 0.083 inch (2.11 mm) shank diameter.
  - b. Five staples per post with at least 17 gage, 0.0453 inch (1.150 mm) wire, 3/4 inch (19 mm) crown width and 1/2 inch (12 mm) long legs.
8. Fasten fabric to steel posts using wire, nylon cord, or integral pockets.
9. Wherever runoff will flow around end of barrier or over the top, provide temporary splash pad or other outlet protection; at such outlets in the run of the barrier, make barrier not more than 12 inches (300 mm) high with post spacing not more than 4 feet (1220 mm).

**C. Straw Bale Rows:**

1. Install bales in continuous rows with ends butting tightly, with one bale at each end of row turned uphill.
2. Install bales so that bindings are not in contact with the ground.
3. Embed bales at least 4 inches (100 mm) in the ground.
4. Anchor bales with at least two stakes per bale, driven at least 18 inches (450 mm) into the ground; drive first stake in each bale toward the previously placed bale to force bales together.
5. Fill gaps between ends of bales with loose straw wedged tightly.
6. Place soil excavated for trench against bales on the upslope side of the row, compacted.

**D. Mulching Over Large Areas:**

1. Dry Straw and Hay: Apply 2-1/2 tons per acre (6350 kg per hectare); anchor using dull disc harrow or emulsified asphalt applied using same spraying machine at 100 gallons of water per ton of mulch.
2. Wood Waste: Apply 6 to 9 tons per acre (15,200 to 20,800 kg per hectare).
3. Asphalt: Apply at 1200 gallons per acre (11,000 L per hectare).
4. Erosion Control Matting: Comply with manufacturer's instructions.

**E. Mulching Over Small and Medium Areas:**

1. Dry Straw and Hay: Apply 4 to 6 inches (100 to 150 mm) depth.
2. Wood Waste: Apply 2 to 3 inches (50 to 75 mm) depth.
3. Asphalt: Apply 1/4 gallon per square yard (1 L per 100 sq m).
4. Erosion Control Matting: Comply with manufacturer's instructions.

**F. Temporary Seeding:**

1. When hydraulic seeder is used, seedbed preparation is not required.
2. When surface soil has been sealed by rainfall or consists of smooth undisturbed cut slopes, and conventional or manual seeding is to be used, prepare seedbed by scarifying sufficiently to allow seed to lodge and germinate.



3. If temporary mulching was used on planting area but not removed, apply nitrogen fertilizer at 1 pound per 1000 sq ft (0.5 kg per 100 sq m).
4. On soils of very low fertility, apply 10-10-10 fertilizer at rate of 12 to 16 pounds per 1000 sq ft (6 to 8 kg per 100 sq m).
5. Incorporate fertilizer into soil before seeding.
6. Apply seed uniformly; if using drill or cultipacker seeders place seed 1/2 to 1 inch (12 to 25 mm) deep.
7. Irrigate as required to thoroughly wet soil to depth that will ensure germination, without causing runoff or erosion.
8. Repeat irrigation as required until grass is established.

### **3.05 MAINTENANCE**

- A. Inspect preventive measures weekly, within 24 hours after the end of any storm that produces 0.5 inches (13 mm) or more rainfall at the project site, and daily during prolonged rainfall.
- B. Repair deficiencies immediately.
- C. Silt Fences:
  1. Promptly replace fabric that deteriorates unless need for fence has passed.
  2. Remove silt deposits that exceed one-third of the height of the fence.
  3. Repair fences that are undercut by runoff or otherwise damaged, whether by runoff or other causes.
- D. Straw Bale Rows:
  1. Promptly replace bales that fall apart or otherwise deteriorate unless need has passed.
  2. Remove silt deposits that exceed one-half of the height of the bales.
  3. Repair bale rows that are undercut by runoff or otherwise damaged, whether by runoff or other causes.
- E. Clean out temporary sediment control structures weekly and relocate soil on site.
- F. Place sediment in appropriate locations on site; do not remove from site.

**3.06 CLEAN UP**

- A. Remove temporary measures after permanent measures have been installed, unless permitted to remain by the Government.
- B. Clean out temporary sediment control structures that are to remain as permanent measures.
- C. Where removal of temporary measures would leave exposed soil, shape surface to an acceptable grade and finish to match adjacent ground surfaces.

**END OF SECTION**

## **SECTION 311001 - SITE CLEARING**

### **PART 1 GENERAL**

#### **1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including requirements of the Government's Solicitation and Division 01 Specification Sections, apply to this Section.

#### **1.02 SUMMARY**

- A. This Section includes the following:
  - 1. Protecting existing trees and vegetation to remain to include all site trees unless shown removed.
  - 2. Removing trees and other vegetation.
  - 3. Clearing and grubbing.
  - 4. Topsoil stripping.
  - 5. Removing above-grade site improvements.
  - 6. Disconnecting, capping or sealing, and abandoning site utilities in place.
  - 7. Disconnecting, capping or sealing, and removing site utilities.

#### **1.03 DEFINITIONS**

- A. Topsoil: Natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches in diameter; and free of weeds, roots, and other deleterious materials.

#### **1.04 MATERIALS OWNERSHIP**

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

#### **1.05 SUBMITTALS**

- A. Record drawings according to Division 1 Section "Contract Closeout."

1. Identify and accurately locate capped utilities and other subsurface structural, electrical, and mechanical conditions.

## **1.06 PROJECT CONDITIONS**

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
  1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from the Government and authorities having jurisdiction.
- B. Apply for and acquire dig permit from the Government before site clearing.

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

## **PART 3 EXECUTION**

### **3.01 PREPARATION**

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Provide erosion-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
- C. Locate and clearly flag trees and vegetation to remain or to be relocated.
- D. Protect existing site improvements to remain.
  1. Restore damaged improvements to their original condition, as acceptable to the Government.

### **3.02 TREE PROTECTION**

- A. Erect and maintain a temporary fence around drip line of individual trees or around perimeter drip line of groups of trees to remain. Remove fence when construction is complete.
  1. Do not store construction materials, debris, or excavated material within drip line of remaining trees.
  2. Do not permit vehicles, equipment, or foot traffic within drip line of remaining trees.
- B. Do not excavate within drip line of trees, unless otherwise indicated.

- C. Where excavation for new construction is required within drip line of trees, hand clear and excavate to minimize damage to root systems. Use narrow-tine spading forks, comb soil to expose roots, and cleanly cut roots as close to excavation as possible.
  - 1. Cover exposed roots with burlap and water regularly.
  - 2. Temporarily support and protect roots from damage until they are permanently relocated and covered with soil.
  - 3. Coat cut faces of roots more than 1-1/2 inches in diameter with an emulsified asphalt or other approved coating formulated for use on damaged plant tissues.
  - 4. Cover exposed roots with wet burlap to prevent roots from drying out. Backfill with soil as soon as possible.

### **3.03 UTILITIES**

- A. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed.
  - 1. Arrange to shut off indicated utilities with utility companies.
- B. Existing Utilities: Do not interrupt utilities serving facilities occupied by the Government or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
  - 1. Notify the Government not less than two days in advance of proposed utility interruptions.
  - 2. Do not proceed with utility interruptions without the Government's written permission.
- C. Excavate for and remove underground utilities indicated to be removed.

### **3.04 CLEARING AND GRUBBING**

- A. Remove obstructions, trees, shrubs, grass, and other vegetation to permit installation of new construction. Removal includes digging out stumps and obstructions and grubbing roots.
  - 1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
  - 2. Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.

3. Completely remove stumps, roots, obstructions, and debris extending to a depth of 18 inches below exposed subgrade.
4. Use only hand methods for grubbing within drip line of remaining trees.
- B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material, unless further excavation or earthwork is indicated.
  1. Place fill material in horizontal layers not exceeding 8-inch loose depth, and compact each layer to a density equal to adjacent original ground.

### **3.05 TOPSOIL STRIPPING**

- A. Remove sod and grass before stripping topsoil.
- B. Strip topsoil to whatever depths are encountered in a manner to prevent intermingling with underlying subsoil or other waste materials.
  1. Strip surface soil of unsuitable topsoil, including trash, debris, weeds, roots, and other waste materials.
- C. Stockpile topsoil materials away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust.
  1. Limit height of topsoil stockpiles to 72 inches.
  2. Do not stockpile topsoil within drip line of remaining trees.
  3. Stockpile surplus topsoil and allow for re-spreading deeper topsoil.

### **3.06 SITE IMPROVEMENTS**

- A. Remove existing above- and below-grade improvements as indicated and as necessary to facilitate new construction.
- B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
  1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut length of existing pavement to remain before removing existing pavement. Saw-cut faces vertically.

### **3.07 DISPOSAL**

- A. Disposal: Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials, including trash and debris, and legally dispose of them

**F-35 ADAL Squadron Operations Building  
187th Fighter Wing, Dannelly Field, ANG  
Montgomery, AL**

**FAKZ189102**

**November 2022**

**Type B3 (100%) Submittal**

off the Government's property.

**END OF SECTION**

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## **SECTION 312210 - EARTHWORK**

### **PART 1 GENERAL**

#### **1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including requirements of the Government's Solicitation and Division 01 Specification Sections, apply to this Section.
- B. Report of Geotechnical Subsurface Investigation, prepared by Carmichael Engineering, Inc., dated November 15, 2021. Report is included as an attachment to this specification section for the Contractor's reference and use.

#### **1.02 SUMMARY**

- A. This Section includes the following:
  - 1. Preparing subgrades for slabs-on-grade, walks, pavements, lawns, and plantings.
  - 2. Excavating and backfilling for buildings and structures.
  - 3. Drainage course for slabs-on-grade.
  - 4. Fine grading, topsoiling and preparing lawn areas.
  - 5. Excavating and backfilling trenches within building lines.
  - 6. Excavating and backfilling trenches for buried mechanical and electrical utilities and pits for buried utility structures.
  - 7. Geotechnical Reports applicable to this project.
  - 8. Preparing improved roadbed subgrade for pavement areas.
- B. Related Sections include the following:
  - 1. Division 31 Section "Site Clearing" for site stripping, grubbing, removing topsoil, and protecting trees to remain.
  - 2. Division 32 Section "Sodding" for placing of sod for lawn areas.

#### **1.03 DEFINITIONS**

- A. Backfill: Soil materials used to fill an excavation.
  - 1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.

- 2. Final Backfill: Backfill placed over initial backfill to fill a trench.
- B. Bedding Course: Layer placed over the excavated subgrade in a trench before laying pipe.
- C. Borrow: Satisfactory soil imported from off-site for use as fill or backfill.
- D. Drainage Course: Layer supporting slab-on-grade used to minimize capillary flow of pore water.
- E. Excavation: Removal of material encountered above subgrade elevations.
  - 1. Additional Excavation: Excavation below subgrade elevations as directed by the Government. Additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
  - 2. Bulk Excavation: Excavations more than 10 feet in width and pits more than 30 feet in either length or width.
  - 3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated dimensions without direction by the Government. Unauthorized excavation, as well as remedial work directed by the Government, shall be without additional compensation.
- F. Fill: Soil materials used to raise existing grades.
- G. Structures: Buildings, footings, foundations, retaining walls, slabs, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- H. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.
- I. Utilities include on-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

#### **1.04 SUBMITTALS**

- A. Material Test Reports: Submit following reports directly to the Government from the testing services, with copy to the Contractor.
  - 1. Classification according to ASTM D 2487 of each on-site or borrow soil material proposed for fill and backfill.

2. Laboratory compaction curve according to ASTM D 698 or ASTM D1557 for each on-site or borrow soil material proposed for fill and backfill.
3. One optimum moisture density curve for each type of soil encountered.
4. Verification of each footing subgrade.

#### **1.05 QUALITY ASSURANCE**

- A. Geotechnical Testing Agency: Soil testing and inspection service for quality control testing during earthwork operations shall be furnished by the Contractor. Retesting of failed test to be provided and paid for by the General Contractor.
- B. Prior to the installation or placement of concrete into in situ soil (load bearing earth), the Contractor shall receive acknowledgement from the Testing Company that the soil where the concrete is to be placed meets all compaction and other testing requirements specified and/or required by the onsite testing agent. This approval with all drawings showing pertinent information indicating that day's work attached shall be signed and dated by the onsite Testing Agent and the Contractor's Superintendent and presented to the Government onsite.
  1. The testing agency shall report to the contractor the results of all required tests, which shall be reviewed and acknowledges by the General Contractor and then submitted to the Government. The General Contractor shall not submit any failed soil density concrete or other test result(s) to the Government without including the applicable recheck test result(s) that indicate compliance with the Specifications. The recheck test result(s) shall be identified with the same number as the failed test with the notation "-R".

#### **1.06 PROJECT CONDITIONS**

- A. Site Information: The report of subsurface investigation is bound herein. Data on indicated subsurface conditions are not intended as representations or warranties of accuracy or continuity between soil borings. It is expressly understood that the Government will not be responsible for interpretations or conclusions drawn therefrom by Contractor.
  1. Additional test borings and other exploratory operations may be made by Contractor at no cost to the Government.
- B. Existing Utilities: Do not interrupt utilities serving facilities occupied by the Government or others unless permitted in writing by the Government and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify the Government not less than two days in advance of proposed utility interruptions.
  2. Do not proceed with utility interruptions without the Government's written permission.
  3. Contact utility-locator service for area where Project is located before excavating.
- C. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.
- D. Recommendations made in the reports of subsurface investigation bound herewith after this section shall be a requirement of these specifications. Where conflicts occur between the report and this specification, the more stringent requirement shall govern.

## **PART 2 PRODUCTS**

### **2.01 SOIL MATERIALS**

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
- B. Satisfactory Soils: ASTM D 2487 soil classification groups GW, GP, GM, SW, SP, and SM, or a combination of these group symbols; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.
- C. Unsatisfactory Soils: ASTM D 2487 soil classification groups GC, SC, ML, MH, CL, CH, OL, OH, and PT, or a combination of these group symbols.
1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.
- D. Backfill and Fill: Satisfactory soil materials.
- E. Base: Crushed aggregate base in accordance with requirements of Section 825 of the State of Alabama Department of Transportation Standard Specifications for Highway Construction, 2018 Edition, unless noted otherwise.
- F. Structural Fill: Structural Fill required to grade the site can include clean, non-organic, non-saturated, native clayey sand and silty sand soil available from on-site cuts or excavations. The native silt soil shall not be used for structural fill.
- G. Select fill earth originating from an off-site source shall consist of a clean, non-saturated, and non-organic clayey sand or sandy clay that contains 100% passing 3-inch

sieve, 75-100% minimum passing No. 4 sieve and 35% to 55% passing #200 mesh sieve, a liquid limit of less than 40%, and a plasticity index of 8% to 16% and a minimum dry unit weight (ASTM D-1557) of 110 pcf.

- H. Engineered Fill: All fill earth, including structural fill earth, placed in the “Controlled Areas” shall be designated as “Engineered Fill.”
- I. Bedding: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.
- J. Drainage Fill: Washed, narrowly graded mixture of crushed stone, or crushed or uncrushed gravel; ALDOT Section 800; coarse-aggregate grading Size 57 or 67.
- K. Topsoil: Topsoil shall be a natural, workable, friable, loamy soil, without admixture of subsoil, refuse, or foreign materials, suitable for growing grasses or other vegetative ground cover. Topsoil shall be furnished by the Contractor from an off-site source approved by the Government if required to supplement previously stockpiled on-site topsoil.

## **2.02 ACCESSORIES**

- A. Detectable Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick minimum, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 2’-6” deep.
  - 1. Tape Colors: Provide tape colors to utilities as follows:
    - Red: Electric
    - Yellow: Gas, oil, steam, and dangerous materials.
    - Orange: Telephone and other communications.
    - Blue: Water systems.
    - Green: Sewer systems.

## **PART 3 EXECUTION**

### **3.01 PREPARATION**

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
- B. Protect subgrades and foundation soils against freezing temperatures or frost. Provide protective insulating materials as necessary.
- C. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

### **3.02 DEWATERING**

- A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
  - 1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
  - 2. Install a dewatering system to keep subgrades dry and convey ground water away from excavations. Maintain until dewatering is no longer required.

### **3.03 EXPLOSIVES**

- A. Explosives: Do not use explosives.

### **3.04 EXCAVATION, GENERAL**

- A. Unclassified Excavation: Excavation to subgrade elevations regardless of the character of surface and subsurface conditions encountered, including rock, soil materials, and obstructions.
  - 1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

### **3.05 EXCAVATION FOR STRUCTURES**

- A. The building “control area” shall be undercut as recommended by the Report of Geotechnical Subsurface Investigation, prepared by Carmichael Engineering, Inc., for this project.
- B. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. Extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
  - 1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
  - 2. Excavation for Underground Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch. Do not disturb bottom of excavations intended for bearing surface.
- C. Phase undercutting and backfilling activities as indicated on the drawings to prevent undermining of existing facility foundation systems.

### **3.06 EXCAVATION FOR WALKS AND PAVEMENTS**

- A. Excavate surfaces under walks and pavements to indicated cross sections, elevations, and grades.
- B. Refer to paragraph 3.20 for pavement subgrade preparation. Excavate to depth required based upon the subgrade preparation method.

### **3.07 EXCAVATION FOR UTILITY TRENCHES**

- A. Excavate trenches to indicated gradients, lines, depths, and elevations.
  - 1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.
- B. Excavate trenches to uniform widths to provide a working clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit, unless otherwise indicated.
  - 1. Clearance: 12 inches on each side of pipe or conduit.
- C. 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.

1. For pipes and conduit less than 6 inches in nominal diameter and flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
2. For pipes and conduit 6 inches or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe circumference. Fill depressions with tamped sand backfill.
3. Excavate trenches 6 inches deeper than elevation required in unyielding bearing material to allow for bedding course.

### **3.08 APPROVAL OF SUBGRADE**

- A. Notify the Government when excavations have reached required subgrade.
- B. If the Government determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
  1. Additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
- C. Proof roll subgrade under building and pavement areas with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding proof rolling shall include a minimum of 2 passes in perpendicular directions over the controlled area. Do not proof roll wet or saturated subgrades.
- D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by the Government.

### **3.09 UNAUTHORIZED EXCAVATION**

- A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill may be used when approved by the Government.
  1. Fill unauthorized excavations under other construction or utility pipe as directed by the Government.

### **3.10 STORAGE OF SOIL MATERIALS**

- A. Stockpile borrow materials and satisfactory excavated soil materials. Stockpile soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.



1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

### **3.11 BACKFILL**

- A. Place and compact backfill in excavations promptly, but not before completing the following:
  1. Construction below finish grade including, where applicable, dampproofing, waterproofing, and perimeter insulation.
  2. Surveying locations of underground utilities for record documents.
  3. Inspecting and testing underground utilities.
  4. Removing concrete formwork.
  5. Removing trash and debris.
  6. Removing temporary shoring and bracing, and sheeting.
  7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

### **3.12 UTILITY TRENCH BACKFILL**

- A. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- B. Backfill trenches excavated under footings and within 18 inches of bottom of footings; fill with concrete to elevation of bottom of footings.
- C. Place and compact initial backfill material, free of particles larger than 1 inch to a height of 12 inches over the utility pipe or conduit.
  1. Carefully compact material under pipe haunches and bring backfill evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of utility system.
- D. Coordinate backfilling with utilities testing.
- E. Fill voids with approved backfill materials while shoring and bracing, and as sheeting is removed.
- F. Place and compact final backfill of satisfactory soil material to final subgrade.

### **3.13 FILL**

- A. Preparation: Remove vegetation, topsoil, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface before placing fills.
- B. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
- C. Place and compact fill material in layers to required elevations as follows:
  - 1. Under grass and planted areas, use satisfactory soil material.
  - 2. Under walks and pavements, use satisfactory soil material.
  - 3. Under steps and ramps, use satisfactory or structural fill.
  - 4. Under building slabs, use satisfactory or structural fill.
  - 5. Under footings and foundations, use satisfactory or structural fill.

### **3.14 MOISTURE CONTROL**

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill layer before compaction to within 3 percent of optimum moisture content.
  - 1. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
  - 2. Remove and replace, or scarify and air-dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

### **3.15 COMPACTION OF BACKFILLS AND FILLS**

- A. Place backfill and fill materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- B. Place backfill and fill materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
- C. Compact soil to not less than the following percentages of maximum dry unit weight according to ASTM D 698 or ASTM D-1557:
  - 1. Under structures, building slabs and steps:

- a. Scarify and recompact top 12 inches of existing subgrade material at 95 percent standard density.
  - b. Initial layers of select fill shall be compacted to 98% modified density.
  - c. The final 18" layer of select fill shall be compacted to 98% standard density.
2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill material at 95 percent standard density.
3. Under lawn or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill material at 90 percent standard density.

### **3.16 GRADING**

- A. General: Uniformly grade areas to a smooth surface, free from irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
  1. Provide a smooth transition between adjacent existing grades and new grades.
  2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
  1. Lawn or Unpaved Areas: Plus or minus 1 inch.
  2. Walks: Plus or minus 1 inch.
  3. Pavements: plus or minus ½ inch.
- C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.
- D. Topsoil: All areas disturbed by grading or other construction operations or as shown on the Site Plan, not occupied by the building or pavement, shall receive 4 inch minimum thickness topsoil from on-site stockpile or from approved off-site sources.
- E. It shall be the contractor's responsibility to hold finished grade including landscaping to grade shown on civil drawings. Do not cover over masonry weeps. Do cover concrete foundations so that no concrete is exposed.

### **3.17 BASE COURSES**

- A. Under pavements, place base course material on prepared subgrades. Refer to paragraph 3.20 for base course application for pavement systems.
  - 1. Compact base courses at optimum moisture content to required grades, lines, cross sections and thickness to not less than 100 percent of ASTM D698 standard density.
  - 2. Shape base to required crown elevations and cross-slope grades.
  - 3. When thickness of compacted base course is 6 inches or less, place materials in a single layer.
  - 4. When thickness of compacted base course exceeds 6 inches, place materials in equal layers, with no layer more than 6 inches thick or less than 3 inches thick when compacted.

### **3.18 PLANTING SOIL PREPARATION**

- A. Limit subgrade to areas that will be planted in the immediate future.
- B. Loosen subgrade to a minimum depth of 4 inches. Remove stones larger than 1-1/2 inches in any dimension and sticks, roots, rubbish, and other extraneous matter.
- C. Spread topsoil mixture to depth required to meet thickness, grades, and elevations shown, after light rolling and natural settlement. Do not spread if planting soil or subgrade is frozen.
  - 1. Place approximately ½ the thickness of topsoil mixture required. Work into top of loosened subgrade to create a transition layer and then place remainder of planting soil mixture.
  - 2. Allow for sod thickness in areas to be sodded.
- D. Preparation of Unchanged Grades: Where lawns are to be planted in areas unaltered or undisturbed by excavating, grading, or surface soil stripping operations, prepare soil as follows:
  - 1. Remove and dispose of existing grass, vegetation, and turf. Do not turn over into soil being prepared for lawns.
  - 2. Till surface soil to a depth of at least 6 inches. Apply required soil amendments and initial fertilizers and mix thoroughly into top 4 inches of soil. Trim high areas and fill in depressions. Till soil to a homogenous mixture of fine texture.

3. Clean surface soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth.
4. Remove waste material, including grass, vegetation, and turf, and legally dispose of it off the Government's property.
- E. Grade lawn and grass areas to a smooth, even surface with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit fine grading to areas that can be planted in the immediate future. Remove trash, debris, stones larger than 1-1/2 inches in any dimension, and other objects that may interfere with planting or maintenance operations.
- F. Moisten prepared lawn areas before planting when soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.
- G. Restore prepared areas if eroded or otherwise disturbed after fine grading and before planting.

### **3.19 DRAINAGE COURSE**

- A. Under slabs-on-grade, place drainage course on prepared subgrade and as follows:
  1. Compact drainage course to required cross sections and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 698.
  2. When compacted thickness of drainage course is 6 inches or less, place materials in a single layer.

### **3.20 PAVEMENT SUBGRADES**

- A. Construction Methods - See Drawings for Application:
  1. ALDOT Section 230 Improved Roadbed "Select Fill"
    - a. Where , the Contractor shall overexcavate and backfill pavement areas with 18" of "select fill" in accordance with ALDOT Section 230.
    - b. The lower 6" of "select fill" shall be compacted to 98% standard density.
    - c. The upper 12" of "select fill" shall be compacted to 100% standard density.
  2. ALDOT Section 825 Crushed Aggregate:
    - a. If this option is selected, the Contractor shall over excavate and backfill pavement areas with 9" of crushed aggregate in accordance with ALDOT Section 825.

- b. The crushed aggregate fill shall be compacted to 100% modified density.

### **3.21 FIELD QUALITY CONTROL**

- A. Testing Agency: Contractor will engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing.
- B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.
- C. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by the Government.
- D. Testing agency will test compaction of soils in place according to ASTM D 1556. Tests will be performed at the following locations and frequencies:
  - 1. Building Slab and Pavement Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 4,000 sq. ft. of fill area per each foot of vertical thickness placed on the building area and one per 6,000 sq.ft. in the pavement areas, but in no case fewer than three tests.
  - 2. Trench Backfill: At each compacted initial and final backfill layer, at least one test for each 50 feet or less of trench length, but no fewer than two tests.
- E. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained.

### **3.22 PROTECTION**

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
  - 1. Scarify or remove and replace soil material to depth as directed by the Government; reshape and recompact.
- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to the greatest extent possible.

### **3.23 DISPOSAL OF SURPLUS AND WASTE MATERIALS**

- A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off the Government's property, unless instructed otherwise by the Contracting Officer.

**END OF SECTION**

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Report of Geotechnical Subsurface Investigation

**Air National Guard Squadron Operations Addition**

Dannelly Field  
Montgomery, Alabama  
Our Job No. G21-6304



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Report of Geotechnical Subsurface Investigation

**Air National Guard Squadron Operations Addition**

Dannelly Field  
Montgomery, Alabama  
Our Job No. G21-6304

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Attachments:

Boring Plans  
Test Boring Logs  
Laboratory Test Data  
Underdrain Detail  
G11-3264 Bore Plan, Logs & Test Data  
Notes & References  
Field Procedures  
Unified Soil Classification System  
Exhibit C



## **1.0 Introduction**

Carmichael Engineering, Inc., is pleased to provide this report of our subsurface investigation for the proposed Air National Guard Squadron Operations Building Addition. A total of 2 test bores were completed in the planned building addition area. The quantity and location of the test bores were taken in accordance with the authorized scope of work. The intent of this investigation was to evaluate the subsurface conditions with respect to the development of the site for support of the proposed building addition.

This report has been prepared in accordance with generally accepted current standards of geotechnical engineering practices and no other warranties are expressed or implied. The recommendations of this report are based on our professional judgement considering the proposed construction as described by this report and the data available to us. The construction should include follow up geotechnical monitoring and construction materials testing by our firm. It is important that we confirm the expected subsurface conditions based on the soil boring data during the construction phase. This report is presented on the basis that all of our recommendations will be followed.

We completed a geotechnical investigation for the original building construction, our job no. G11-3264, in January 2011 and the data from this original report is included for reference. The original building site was prepared and developed with an “engineered fill” pad to support the existing building using shallow spread foundations.



## **2.0 Summary**

Generally, the subsurface investigation indicated conditions which should be compatible with the planned development provided the site preparation and construction are completed in accordance with the recommendations which follow in this report. Please note that our recommendations are site specific and may not be suitable for other types of structures or other locations.

A total of 2 test bores were completed to evaluate the subsurface stratigraphy. The test bores penetrated organic clayey sandy topsoil and fill earth described as cohesive clayey sand with gravel, plastic clay, and non-cohesive silty sand to depths of 2.5 to 5' below ground surface. The test bores continued beneath the fill earth into in-situ earth described as cohesive plastic clay (sections with calcareous nodules) and silty clay (marl hardpan). The predominate clay earth is of a poor drainage classification and is expansive. Beneath weak surficial soil conditions, the test bores indicated soil strengths of moderate to stronger and consolidation characteristics which are expected to be compatible with the planned type of construction.

The test bores did not indicate any groundwater during drilling. Twenty-four hours following drilling, one of the test bores indicated groundwater at a depth of 14.5' below ground surface. It should be noted that localized seasonal "perched" water conditions are common in the clay earth typical of that penetrated at this site. Generally, water which permeates the ground surface travels along thin seams within the clay earth. In open excavations, groundwater seepage can be encountered at various levels due to the irregular nature of the water carrying seams. The groundwater condition at this site is subject to seasonal variation and is expected to fluctuate. We do not anticipate that the groundwater condition will affect the construction or long-term performance of this project. Shallow groundwater encountered during construction can be controlled using shallow drainage ditches, sump pumps, and/or permanent underdrains.

The expansive and poor drainage classification of the clay earth predominate at this site is one of the primary concerns for the site development and the design of foundations, floor slabs, and pavements. The expansive clay soil can undergo volume change when subjected to fluctuating moisture contents and can cause severe damage to foundations, floor slabs, pavements, etc., which bear in or near the zone of moisture fluctuation. Providing adequate surface drainage during and following construction is critical to the performance of the foundations and ground supported floor slabs. Furthermore, site preparation during the normally wetter winter and spring seasons can cause significant time delays in the construction due to the difficulty of processing the native clay earth when in a wet or saturated condition.

The existing building structure is supported by shallow spread foundations bearing in an "engineered fill" pad constructed with an off-site borrowed "select fill". It is our opinion that the planned building addition site should be prepared in a similar manner to construct a "engineered fill" using an offsite borrowed "select fill" material. The existing "engineered fill" pad beneath the existing building is expected to extend at least 5' beyond the edge of the existing building. The construction of the original pad should have also included the placement of a perimeter



underdrain at the edge of the pad. In order to extend the existing pad to include the new building addition, the north end of the existing pad (including the underdrain) should be removed to expose the firm well compacted “select fill” pad. The new “engineered fill” pad should be keyed into the existing pad and a new perimeter underdrain should be installed at the perimeter of the new pad, tying into the existing drain as required. A minimum of 5’ of the existing soil should be undercut and removed to extend and construct the “engineered fill” pad. The minimum thickness of the new “engineered fill” pad should not be less than 6’. The building foundations and floor slabs in the addition will be completely supported by the “engineered fill” pad.

Following proper site preparation for the “engineered fill” pad, the Squadron Operations Building addition can use conventional design and construction techniques to develop a shallow spread foundation system for support of the proposed building structure. These spread foundations can be designed to bear in the firm to stronger sections of the “engineered fill” pad utilizing net allowable soil bearing pressures of up to 2,500 pounds per square foot for isolated square foundations and up to 2,000 pounds per square foot for continuous foundations. A minimum 4’ thickness of “select fill” earth placed as “engineered fill” should be maintained below the bearing level of all foundations.



### **3.0 Evaluation**

#### **3.1 Site Location**

The site subject to this report is located at the Air National Guard Facility at Dannelly Field in the City of Montgomery, Montgomery County, Alabama. Our field personnel utilized the provided site plan and a survey grade GPS to locate the site and test bore B-201 and B-202. Ground elevations at each bore location were established using the GPS. The horizontal and vertical accuracy of the GPS can be variable due to atmospheric influences, tree canopies and other obstructions. The GPS data is provided for information only and has not been field verified.

The enclosed boring plans further describe the test bore locations. Also, the boring plan and boring data from the G11-3264 geotechnical investigation for the original building is enclosed.

#### **3.2 Site Conditions**

The site consisted of a portion of the Air National Guard facility. The planned building addition is located on the north side of the existing building. The building addition site was generally clear and open with grass vegetation and sidewalks.

The local terrain is described as gently sloping. There was approximately 1' of relief between the test bore locations. Surface drainage was described as fair to good. Surface water is expected to flow over the site and discharge beyond the areas planned for development. There were no significant areas of ponded surface water located on the site during the field testing.

Site access was described as good. There was no difficulty mobilizing our track mounted Geoprobe drilling equipment at the test bore locations.

#### **3.3 Site Geology and Subsurface Stratigraphy**

Geologically, the site is located in the Coastal Plain Province and is underlain by the Mooreville Chalk Formation which was deposited in the Upper Cretaceous Epoch of the Cretaceous Period. Typically, the Mooreville Chalk formation yields finely sandy argillaceous fossiliferous chalk, the upper sections of which have weathered into a cohesive expansive clay soil.

The test bores B-201 and B-202 penetrated 2" of organic clayey sandy topsoil at ground surface. The test bores continued into fill earth described as cohesive clayey sand with gravel, plastic clay, and non-cohesive silty sand to depths of 2.5 to 5' below ground surface. Beneath the fill earth, the test bores penetrated in-situ earth described as cohesive plastic clay (sections with calcareous nodules) and silty clay (marl hardpan). A laboratory analysis confirmed a "CH" Unified Soil Classification of the predominate plastic clay earth with a plasticity index of 31. The penetration resistance values, "N", ranged from 7 to 45 blows per foot indicating consistencies of firm to hard in the predominate clay earth and relative densities of loose to firm in the predominate sand fill earth. Moisture tests indicated water contents ranging from 15.6 to 33.4%. The test bores were terminated in the in-situ earth at depths of 20' below ground surface.

The test bores did not indicate any groundwater during drilling. Twenty-four hours following





drilling, bore B-201 indicated groundwater at a depth of 14.6' below ground surface. The test bores caved at depths of 16.2 to 17' below ground surface.

The enclosed test boring records further describe the subsurface stratigraphy, Unified Soil Classifications, penetration resistance values, moisture contents, water level, caved depths, and boring termination depths.

A boring plan, the test boring logs, and test data from our geotechnical investigation for the original building, our job no. G11-3264, is enclosed for reference.

### **3.4 General Construction Information**

The following data was extrapolated from the provided construction information. The construction data described in this section was considered in the formulation of our recommendations; therefore, any significant changes, additions or modifications to the planned development may have a significant impact on our recommendations. We ask that we be advised of any significant errors, omissions, or revisions in the construction data to permit further comment as needed.

We understand the proposed Squadron Operations Building addition development will include conventional type building construction along with related grading, drainage and pavement improvements. The proposed building will include two story height and steel frame type construction. Structural loads are expected to be less than 4 kips per linear foot for wall loadings and less than 75 kips for concentrated loadings. We do not expect that the planned building superstructure will be particularly sensitive to usual settlements.

Based on the existing grades and a planned finish floor elevation of 205.0, we anticipate earth cutting/filling thicknesses will be 6' more or less to establish subgrade elevation for the building addition. The majority of the fill earth required to establish subgrade elevation is expected to originate from local off-site borrow sources.



## **4.0 Recommendations - Site Development**

### **4.1 Development Alternatives**

Several alternatives are available for the development of the subject site. With each approach, there is some level of risk to the owner for some differential movement in the structure to develop due to the nature of the native expansive clay. The differential movement can cause cosmetic damage to the structure including cracks in bricks, concrete slabs, sheetrock walls, etc., and severe differential movement can cause structural damage in some cases. Our recommendations are based on using methods and foundation systems which have been proven successful in similar soil conditions. These recommendations are intended to reduce the risk of significant foundation and floor slab movements.

A “engineered fill” pad constructed with non-expansive “select fill” in conjunction with a perimeter underdrain may be used to support a shallow spread foundation system and ground supported floor slab. This approach matches the development for the existing building. The entire foundation and floor slab system would be supported by the “select fill” material. Our recommendations for the “engineered fill” pad with shallow foundations and ground supported floor slabs are enclosed. This approach also has a risk of differential movement of the slabs and foundations due to the nature of the native expansive clay soil. This approach reduces the risks by removing the expansive soil within the normal zone of moisture fluctuation. The owner must assume this risk when selecting this type of system.

Drilled piers and structural floor slabs with void spaces or crawlspaces are the best foundation system to reduce the risks of structural movement caused by the expansive clay soil. This type of construction is expected to be significantly more expensive than shallow foundations and ground supported slab construction. We are available to provide recommendations for a drilled pier foundation and structural floor slab with a void or crawl space if desired.



## **5.0 Recommendations - Site Preparation**

### **5.1 "Controlled Areas"**

Define those areas throughout and 5' beyond the proposed perimeter building addition slab and foundations and throughout significant slopes as "controlled areas".

### **5.2 Stripping**

Remove all vegetation, topsoil, stumps, organic clay, sidewalks, and otherwise unsuitable materials from the "controlled areas". All unsuitable materials should be wasted off-site or in non-structural areas.

### **5.3 Surface Drainage**

Maintain the "controlled areas" in a drained condition that will insure the continual removal of surface water that may flow over the construction areas. Temporary site drainage, which is critical for this development, can be enhanced by the installation of the final drainage structures during the early phases of the site development.

### **5.4 Site Examination**

Prior to the placement of fill earth and following removal of cut earth, the "controlled areas" should be examined by our firm. This examination should include use proof rolling with construction equipment, test pits, visual examination, supplemental test bores, etc., as needed to determine the presence, location, and extent of any weak soil and/or otherwise unsuitable conditions. Areas which exhibit weak soil or otherwise unsuitable conditions should be corrected in accordance with our recommendations based on the field conditions.

### **5.5 Undercutting In Building Addition Area**

A minimum 5' of undercutting below existing ground surface across the entire building addition "control area" should be completed to remove the upper section of the expansive clay soil and to expose the firm in-situ soil. The undercutting should extend to a level that will provide a minimum 6' thick "engineered fill" pad for the building addition. Please note that the total thickness of the "engineered fill" pad may exceed the recommended minimum thicknesses due to the grade requirements to construct the desired finish floor elevations. The undercutting should also extend into the existing building "engineered fill" pad to expose firm to stronger well compacted "engineered fill" pad. The existing portion of the underdrain at the edge of the existing "engineered fill" pad along the north edge of the pad should also be removed along with any soft or wet soil. The exposed subgrade should be mixed, moisture conditioned to 2 to 3% above the materials optimum water content and compacted to 95% of the materials ASTM-D698 standard density prior to placement of the "engineered fill" pad.

### **5.6 "Engineered Fill" Pad**

Remove the top 5' (minimum) of the existing soil to a distance 5' beyond the outside edge of the building such that a minimum 6' thickness of "select fill" earth can be placed as "engineered fill" for support of the building. The final thickness of the "engineered fill" pad may exceed the recommended minimums. The exposed subgrade should be moisture conditioned to 2 to 3%



above the materials optimum moisture and compacted to 95% standard density. The native clay should be crowned in the center of the building pad and sloped at least 2%. A perimeter underdrain should be installed at the edge of the new building pad to intercept any water which might otherwise accumulate in the pad. The new underdrain should be connected to the existing drains. The project civil consultant should verify the grade of the existing drains and the new drains to be sure that the new and existing drains have positive drainage.

Note: Proper layout of the "engineered fill" pad and proper location of the building structure on the pad is necessary so that the pad extends at least 5' beyond the edge of the building. The "engineered fill" pad dimensions should be verified prior to fill placement and again following layout of the building structures.

### 5.7 "Select Fill"

Fill earth originating from an off-site borrow source should be designated as "select fill". "Select fill" should be used for all backfill placed in the building "controlled area". The "select fill" should consist of a clean, non-saturated, and non-organic clayey sand or sandy clay as follows.

"Select Fill" Composition

Sieve Requirements	% Passing
3"	100
No. 4	75 - 100
No. 200	35 - 55
Liquid Limit	40 max
Plasticity Index	8 to 16
Maximum Dry Unit Weight Based on ASTM-698 Standard Density Test	$\geq 110$ pcf

### 5.8 "Engineered Fill"

Place fill earth or "select fill" earth in thin lifts not to exceed 8" loose measure and thoroughly compact each lift of fill to at least 98% of the materials ASTM D-698 standard density. At the time of densification, the moisture content of the "engineered fill" earth should be within 2% of the materials optimum water content for the "select fill" and 2 to 3% above the optimum water content for the native clay. Following acceptance for moisture and density, any "engineered fill" areas which are disturbed by the construction, weather or otherwise disturbed should be corrected and retested prior to the placement of additional fill earth or structures.



### 5.9 Underdrainage

The "engineered fill" pad should be permanently drained using an "aggregate filled" underdrain provided with positive relief. After the initial 12" of "select fill" is placed and compacted, a minimum 18" deep x 12" wide trench should be excavated along the perimeter of the "engineered fill" pad area. The depth of the drain should be adjusted as required to provide positive relief throughout the length of the drain and to provide relief for the existing underdrain system along the east and west sides of the existing building. The project civil consultant should determine the grade for the existing underdrains as well as the new drains to ensure positive drainage. Depending on the drainage scheme for the original underdrain, the new underdrain may have to be constructed as a separate drain. The "aggregate filled" underdrain can be constructed by placing a minimum 4" diameter perforated drainage pipe meeting the minimum requirements of the Alabama Department of Transportation (ALDOT) Section 852.07 surrounded by size #57 or #67 gravel enveloped in filter cloth such as Mirafi 140N or equivalent. The "engineered fill" pad area should be graded in a manner such that the native clay subgrade slopes toward the perimeter underdrains so that any water which permeates the "engineered fill" pad will be intercepted and removed by the perimeter underdrain. Provide a continuous slope of at least 1.0% for the entire length of the drain. Please note that the depth of the underdrain increases along the length of the drain to provide the necessary relief. The top of the underdrain section should be held constant at 12" above the interface of the "select fill" and the native clay. The drain should be provided a positive outlet. Otherwise, install a permanent sump pit and pump to collect and discharge water from the underdrain. Note that the drain can be broken up into several legs and provided with more than one outfall so that the depth of the drain does not become excessive.



## **6.0 Recommendations -Building Shallow Foundations and Ground Floor Slabs Supported on "Select Fill" Pad**

### **6.1 Maximum Net Allowable Soil Bearing Pressures**

2,500 pounds per square foot for isolated square foundations.

2,000 pounds per square foot for continuous foundations.

Note: Foundations should bear in the firm to stronger "select fill" placed as "engineered fill" earth.

### **6.2 Minimum Foundation Dimensions**

Depth - Bottom of perimeter foundations below outside finish grades - 18".

- Bottom of interior foundations below the top of ground supported floor slabs - 18".

Width - Isolated square foundations - 28".

- Continuous wall foundations - 18".

- Turned down slab edges - 12"

Note: All foundations should be sized based on total load but the dimensions should not be less than the above referenced minimums. A minimum 4.0' thickness of the "select fill" should be maintained below the bearing level of all foundations.

### **6.3 Seismic Design**

The seismic design parameters for the IBC 2018 are as follows for the planned Squadron Operations Building addition in Montgomery, Alabama.

$S_s = 0.134$                        $S_{MS} = 0.174$                        $S_{DS} = 0.116$

$S_1 = 0.076$                        $S_{M1} = 0.114$                        $S_{D1} = 0.076$

Site Class C

Seismic Design Category B for Use Group I, II or III and Seismic Design Category C for Use Group IV.

### **6.4 Settlement and Swell Potential**

The planned building structure will be subjected to total long term settlements of up to 1" with differential settlements of up to 0.5". Provided the site is developed following the recommendations in this report, the estimated swell potential is less than 0.5". The building structure should be designed to tolerate these estimated settlements and swells. Control joints should be used at appropriate locations to reduce the effects of differential movement.

### **6.5 Foundation Construction**

Do not permit foundation bearing soil to become saturated or dry excessively. Sections which become saturated or dry excessively should be undercut just prior to placement of the foundation concrete. All foundations should be constructed as expediently as possible following excavation of the foundation trench. Weak soil exposed in foundation trenches should be compacted using a mechanical jumping jack type compacter.



Following construction of the foundations, the area adjacent to the foundation should be maintained in a drained condition. Water should not be permitted to pond adjacent to the building foundations during or following construction. Backfill adjacent to the building foundations as soon as possible to provide positive drainage. Backfill with clean soil typical of the material excavated from the foundation trenches. Masonry sand, broken brick and block or other construction debris should not be used to backfill against the foundations.

#### **6.6 Acceptance of Foundation Bearing Levels**

All foundation excavations should be examined by the projects geotechnical consultant prior to the installation of the foundation reinforcement and concrete. All unacceptable conditions should be corrected in accordance with the geotechnical consultant's recommendations.

#### **6.7 Floor Slab Bearing Conditions**

Floor slabs should bear over properly compacted "select fill". Provide a minimum 10 mil vapor barrier between the subgrade layer and the floor slab. If a leveling layer is utilized beneath the slab, it should consist of a minimum 4" layer of compactable granular fill.

#### **6.8 Control/Expansion Joints**

A liberal amount of control/expansion joints should be used to reduce the effects of the normal amounts of differential settlement and concrete shrinkage expected. The design and location of control/expansion joints should be in accordance with the recommendations of the Portland Cement Association.

#### **6.9 Acceptance of Floor Slab Bearing Levels**

All floor slab bearing levels should be examined by the projects geotechnical consultant prior to the placement of the vapor barrier. All unacceptable conditions should be corrected in accordance with the geotechnical consultant's recommendations.



## **7.0 Recommendations - General**

### **7.1 Utility Trenches**

All utility trenches (new and existing) extending through the "controlled areas" should be back-filled with "engineered fill".

### **7.2 Grading and Drainage Improvements**

Incorporate finish grades, side drainage ditches, underdrains, etc., to reduce the possibility of ponding surface water within 5' of foundations and significant slopes.

### **7.3 Vertical Cuts**

Vertical cuts greater than 4' or cuts required to remain open for extended periods of time should be sloped or braced as required for the protection of workmen entering deep excavations. Heavy construction traffic and stockpiling of excavated earth or other materials should not be permitted near the top of open unsupported excavations. Current OSHA regulations should be adhered to with respect to excavations for this project.

### **7.4 Cut and Fill Slopes**

Permanent cut and fill slopes should perform satisfactorily as steep as 3(H):1(V) in the native clay earth or "select fill". All slopes should be protected from erosion using suitable vegetation or pavements.

### **7.5 Quality Control**

A qualified geotechnical and construction materials testing consultant should provide the following services;

- 7.5.1 Verify the results of stripping, proof-rolling, and correction of weak soil conditions, quality and density of "engineered fill", and conditions of the foundation and floor slab subgrade bearing levels.
- 7.5.2 Complete soil particle size, atterberg limits and laboratory compaction tests on each different type of fill earth used in the "controlled areas".
- 7.5.3 Complete a minimum of 1 field density test per each 2,500 square feet per each 1' of vertical thickness of fill placed in the "controlled areas". Also, a minimum of 1 field density test should be taken for each 50 linear feet per each 2' of vertical thickness of fill placed at utility trenches extending through "controlled areas".
- 7.5.4 Test all structural concrete in accordance with the guidelines established by the American Concrete Institute.





## **8.0 General Comments**

The scope of this study did not include sampling or testing for an environmental analysis or assessment for this site. If an environmental assessment of this site is desired we should be contacted for further comment.

The comments of this report do not consider local flood conditions. The local flood condition/elevation (if any) should be determined and considered in the design of this project.

The frost penetration depth in the area of this project is generally taken to be less than 10". Provided our recommendations for the development of foundations and floor slabs are followed, we do not expect that the frost penetration will have any detrimental effects on the performance of these structures.

The native clay earth penetrated at this site characteristically exhibits low electrical resistivity values and can contribute to the corrosion of metal products. Metal pipes, etc., buried in the native clay should be protected or designed to eliminate the effects of such corrosion.

The comments of this report are based upon our interpretation of the construction information supplied by others, the data collected at the 2 soil test bores, and our visual examination of the site. The evaluation of subsurface conditions based on the 2 test bores taken with this study requires a certain amount of interpolation. Improper site preparation, extremes in climatic conditions, significant changes in locations, grades, time, etc., can each affect ground water, surface, and subsurface conditions. If conditions are encountered as the construction advances which vary significantly from those described by this report, we should be contacted for supplemental comment.

The scope of this investigation is not intended to establish volumetric estimates of the various subsurface materials at the site. Volumetric estimates may require a large number of test bores placed on a close grid to establish reliable cross sections. If volume estimates are required of us for the design/development of this project to advance, please contact us for further comment.

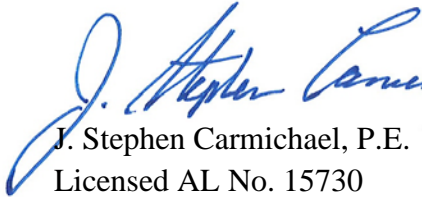
We are available to provide a review of the final plans and project specifications with respect to their compatibility with the contents of this report. Furthermore, our firm would appreciate the opportunity to continue to serve as the geotechnical consultant and to provide the construction materials testing and monitoring for this project.



### **9.0 Signature**

Thank you for selecting Carmichael Engineering, Inc., to provide the geotechnical services for this project. We are available to answer any questions concerning our findings and recommendations. If we can be of any further assistance, please contact our office.

Sincerely,

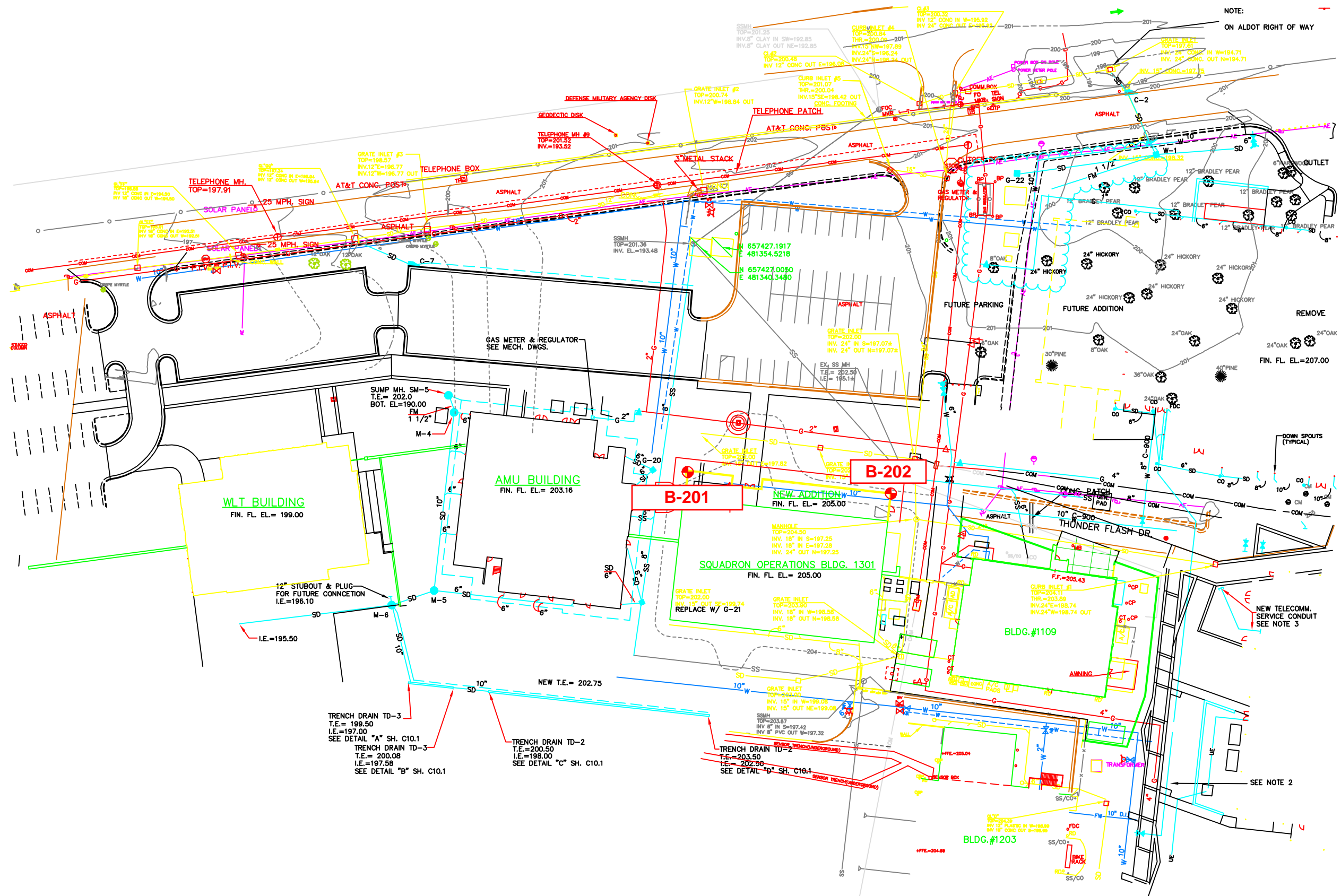
  
J. Stephen Carmichael, P.E.  
Licensed AL No. 15730



Report Distribution: 1- Mr. David Donovan, - Architect (email)

JSC/lc







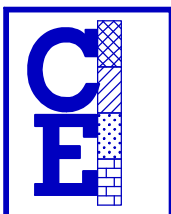
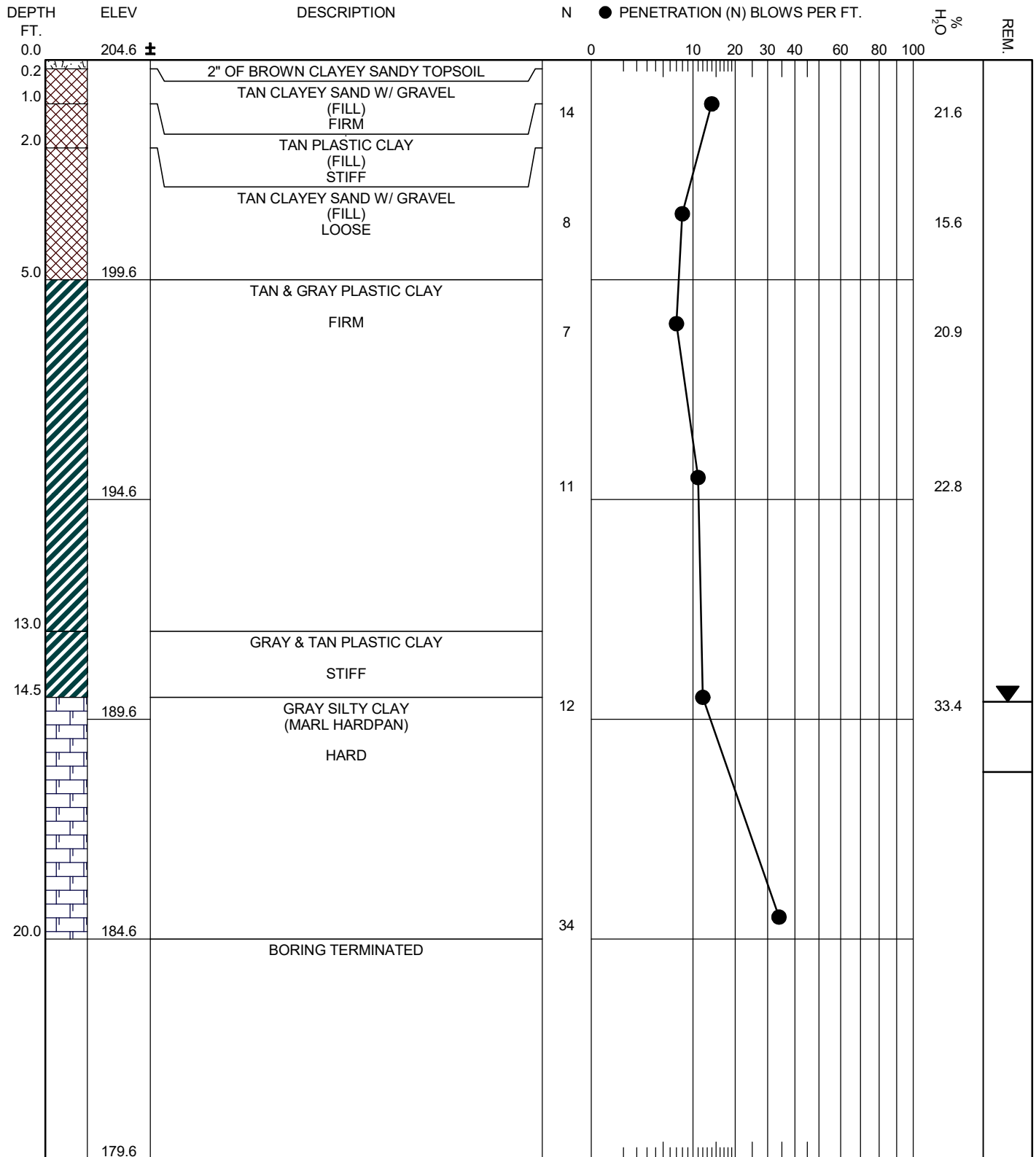


Google Earth

© 2021 Google

300 ft





Boring and Sampling Meets ASTM D-1586  
 Penetration (N) is the Number of Blows of 140 lb. Hammer  
 Falling 30 in. Required to Drive 1.4 in I.D. Sampler 1 Ft.

☒ Undisturbed Sample  
 LA Lab Analysis



Water Level 14.6' AFTER 24 HOURS

Water Level



Boring Caved 16.2' AFTER 24 HOURS

## TEST BORING LOG

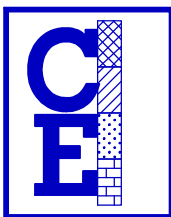
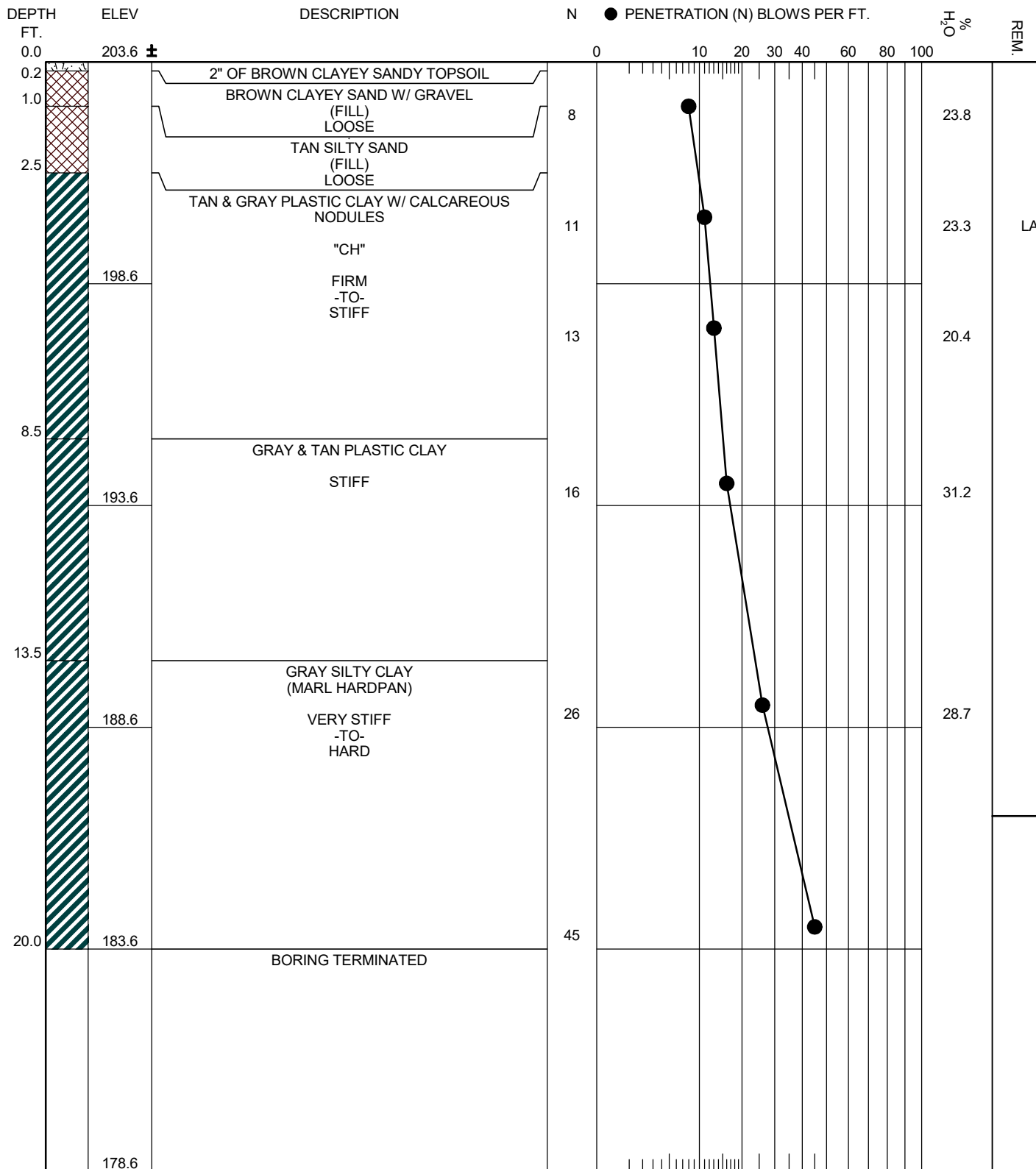
JOB NO. G21-6304

BORING NO. B-201

DATE DRILLED 11/3/21

TYPE BORING SB

**CARMICHAEL**  
 ENGINEERING, INC.



Boring and Sampling Meets ASTM D-1586  
 Penetration (N) is the Number of Blows of 140 lb. Hammer  
 Falling 30 in. Required to Drive 1.4 in I.D. Sampler 1 Ft.

☒ Undisturbed Sample  
 LA Lab Analysis

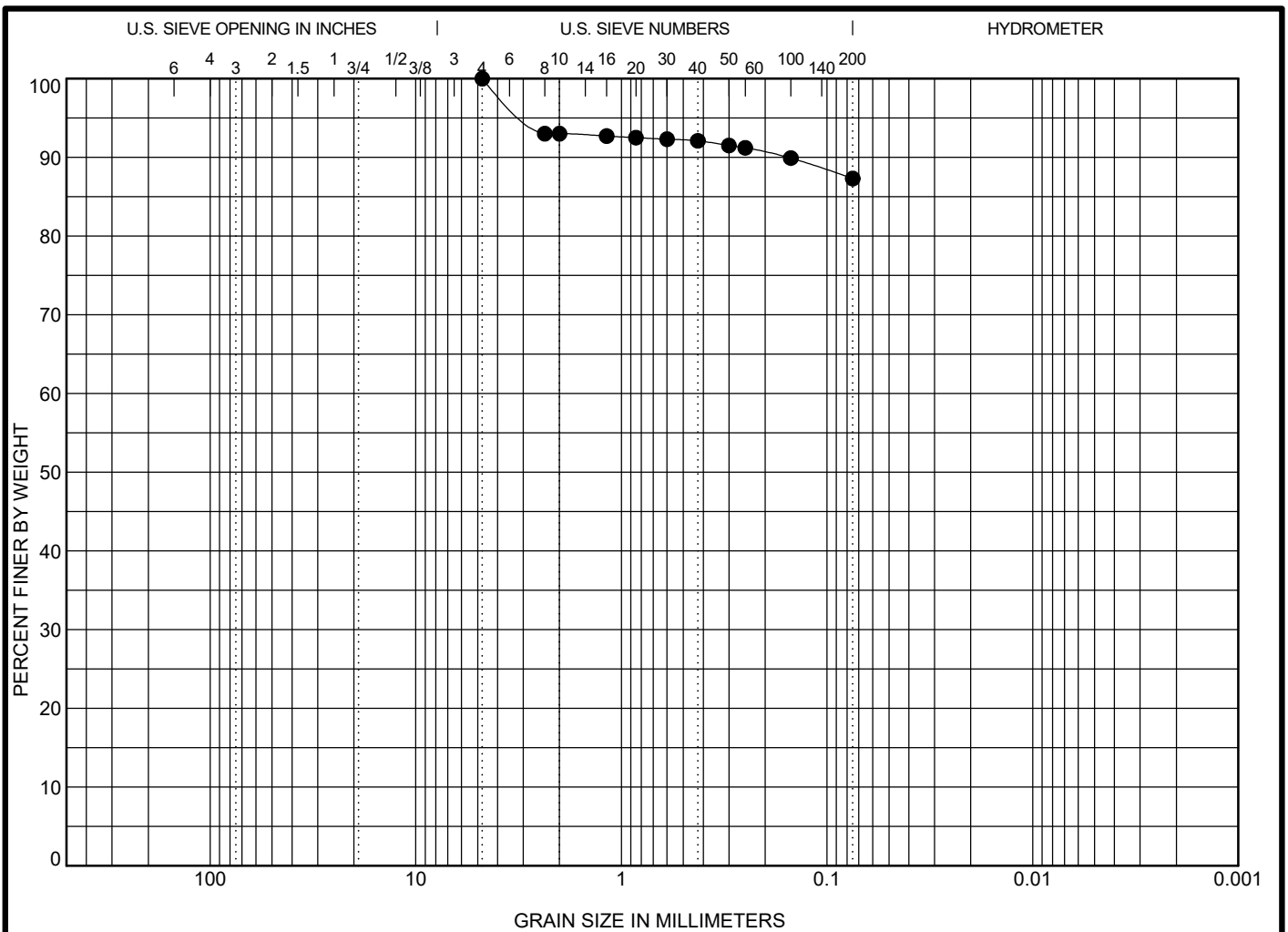


Water Level  
 Water Level  
 Boring Caved 17.0' AFTER 24 HOURS

## TEST BORING LOG

JOB NO. G21-6304  
 BORING NO. B-202  
 DATE DRILLED 11/3/21  
 TYPE BORING SB

**CARMICHAEL**  
 ENGINEERING, INC.



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification			Classification				LL	PL	PI	Cc	Cu
●	2350	B-202 2.5-4'	FAT CLAY CH				52	21	31		
Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay	
●	2350	B-202 2.5-4'	4.75				0.0	12.7	87.3		

Client: Seay, Seay, & Litchfield  
1115 South Court Street  
Montgomery, AL 36104

Test Methods: ASTM D422, ASTM D4318  
Sample Received Date: 11/3/2021  
Test Date(s): Grain Size - 11/5/2021, Atterberg Limits - 11/5/2021

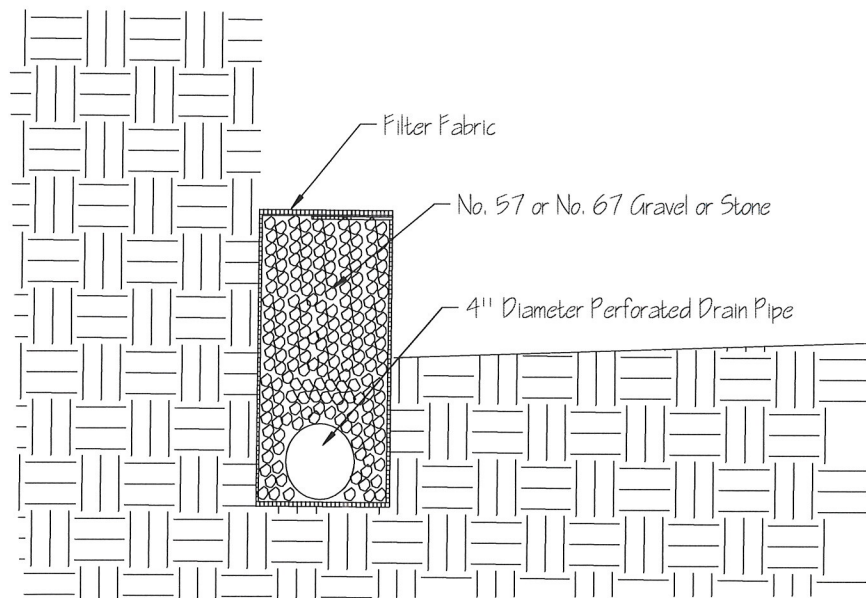
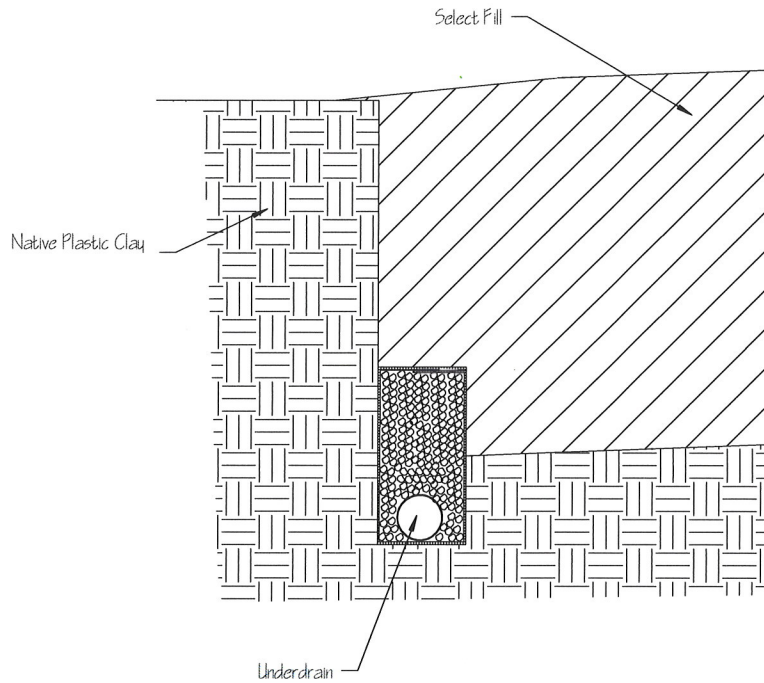


**CARMICHAEL**  
**ENGINEERING, INC.**  
650 Oliver Road  
Montgomery, Alabama 36117

## GRAIN SIZE DISTRIBUTION

Project: Air National Guard Squadron Operations Addition  
Location: Montgomery, AL  
Job No.: G21-6304 Report Date: 11/8/2021  
Reviewed By: Brandon M. Rountree, P.E.

# Typical Underdrain Section



## Typical Underdrain Detail

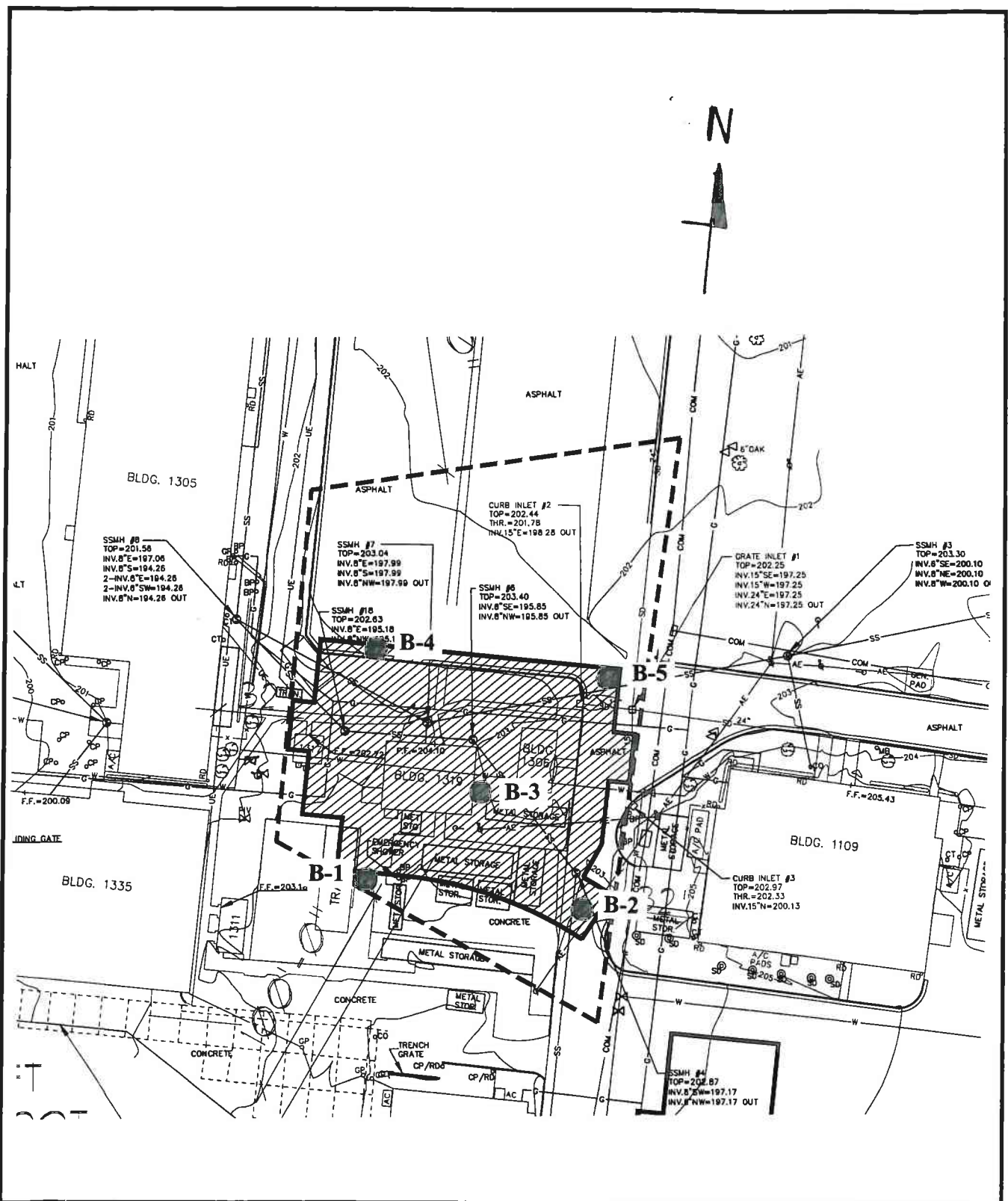


CARMICHAEL

Engineering, Inc.

**ANG Squadron Ops  
Addition  
Montgomery, Alabama  
Our Job No. G21-6304**

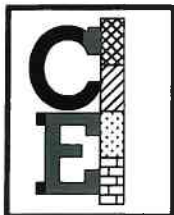
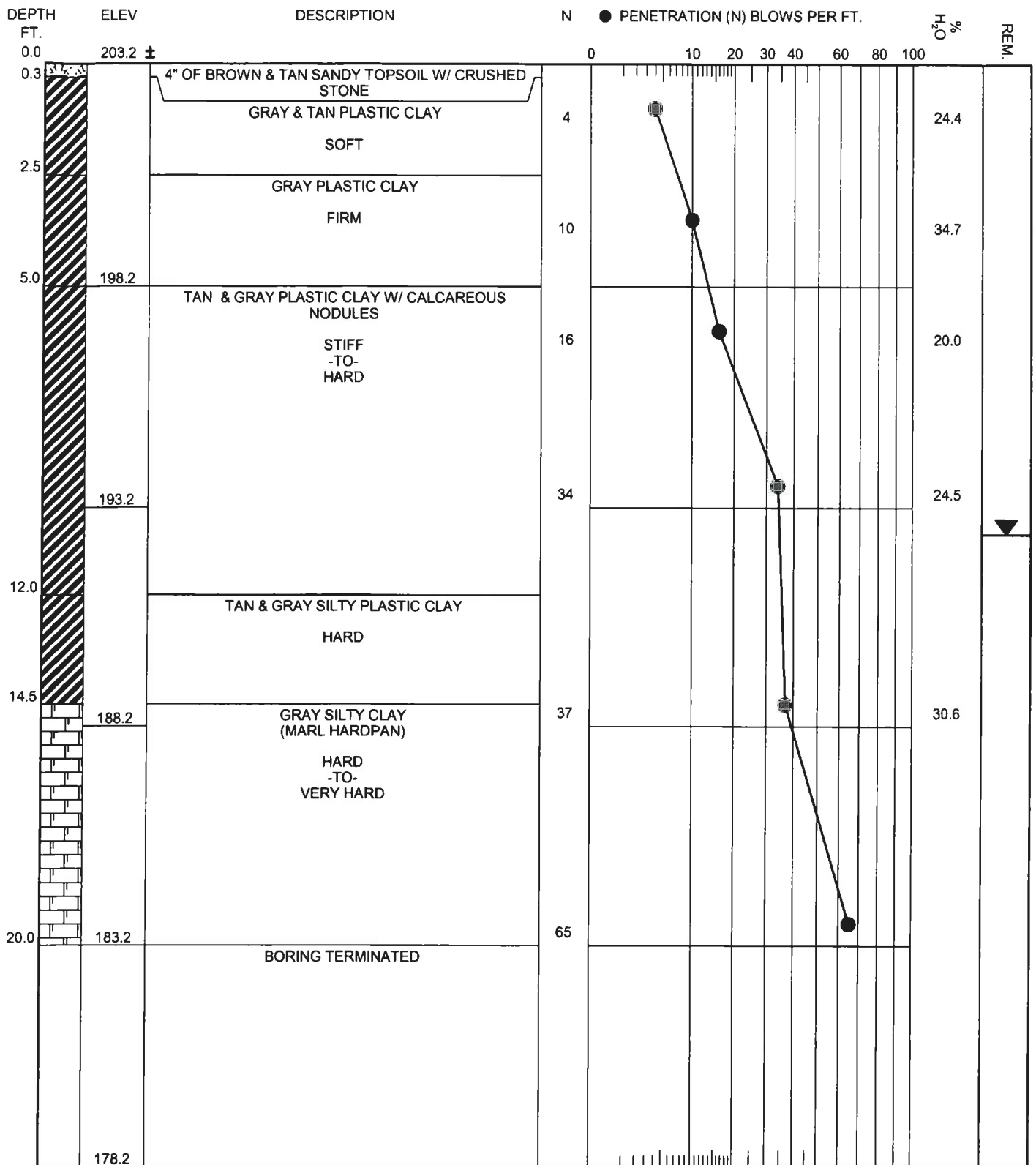




## BORING PLAN

● Boring Location  
Not to Scale

Squadron Operations Building  
Montgomery, AL  
Our Job No. : G11-3264



Boring and Sampling Meets ASTM D-1586  
 Penetration (N) is the Number of Blows of 140 lb. Hammer  
 Falling 30 in. Required to Drive 1.4 in I.D. Sampler 1 Ft.

☒ Undisturbed Sample  
 LA Lab Analysis

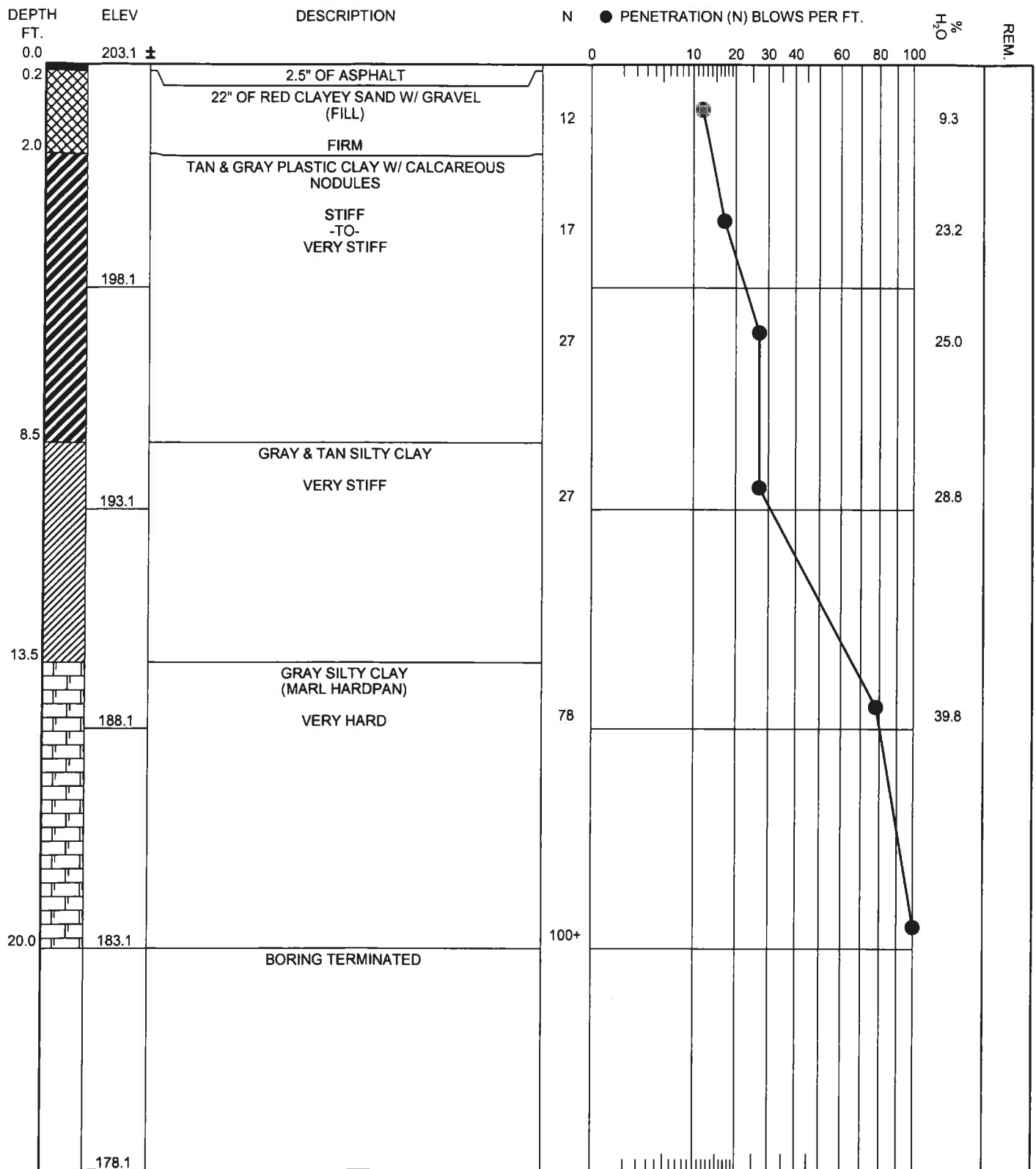


Water Level 10.6' AFTER 24 HOURS  
 Water Level  
 Boring Caved

**CARMICHAEL**  
 ENGINEERING, INC.

## TEST BORING LOG

JOB NO. G11-3264  
 BORING NO. B-1  
 DATE DRILLED 1/19/11  
 TYPE BORING SB



Boring and Sampling Meets ASTM D-1586  
 Penetration (N) is the Number of Blows of 140 lb. Hammer  
 Falling 30 in. Required to Drive 1.4 in I.D. Sampler 1 Ft.

☒ Undisturbed Sample  
 LA Lab Analysis

Water Level  
 Water Level  
 Boring Caved

**CARMICHAEL**  
 ENGINEERING, INC.

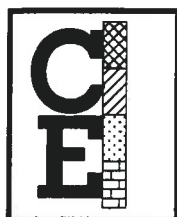
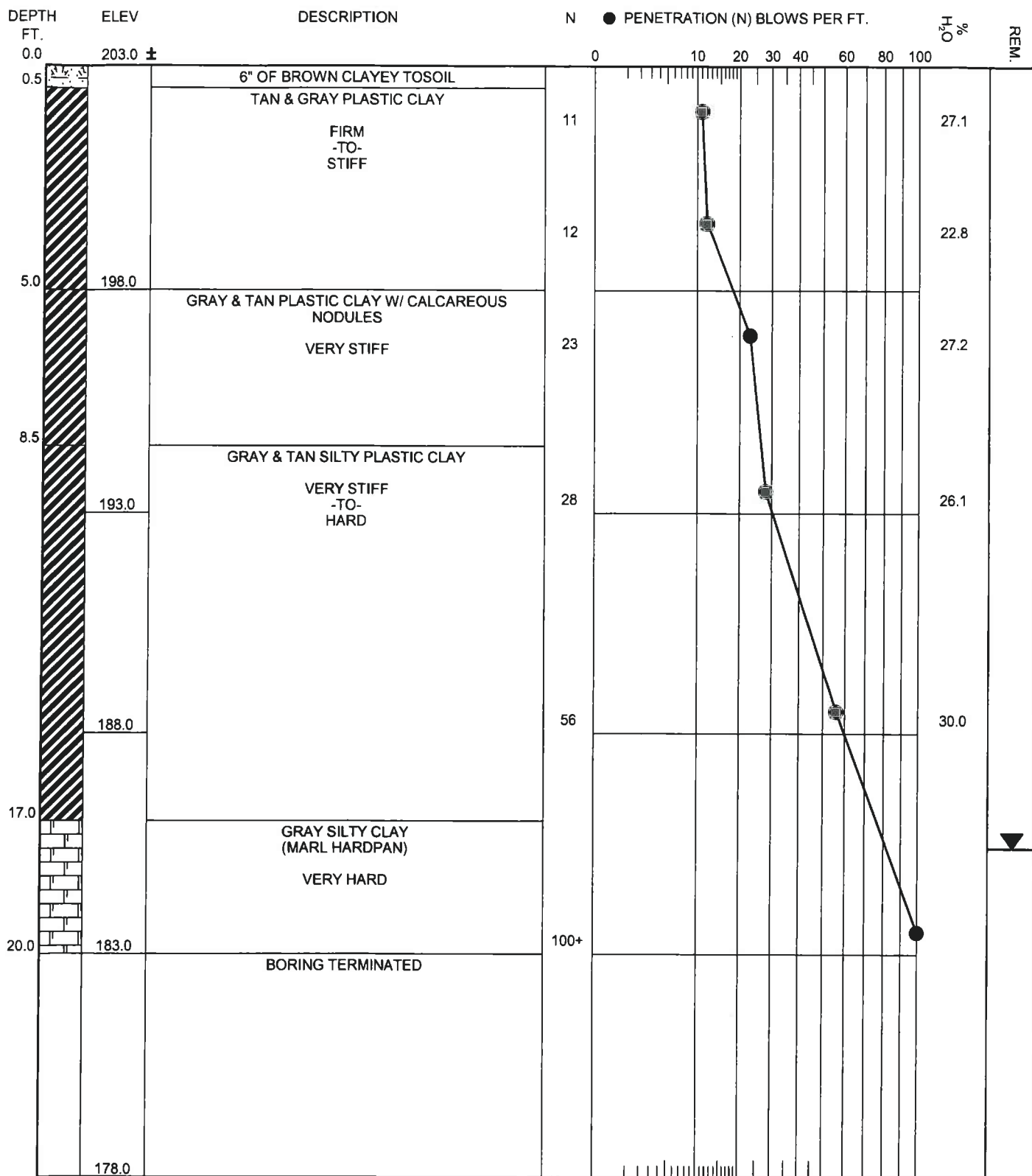
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JOB NO. G11-3264

BORING NO. B-2

DATE DRILLED 1/19/11

TYPE BORING SB



Boring and Sampling Meets ASTM D-1586

Penetration (N) is the Number of Blows of 140 lb. Hammer  
Falling 30 in. Required to Drive 1.4 in I.D. Sampler 1 Ft.

☒ Undisturbed Sample  
LA Lab Analysis



Water Level 17.6' AFTER 24 HOURS



Water Level



Boring Caved

**CARMICHAEL**  
ENGINEERING, INC.

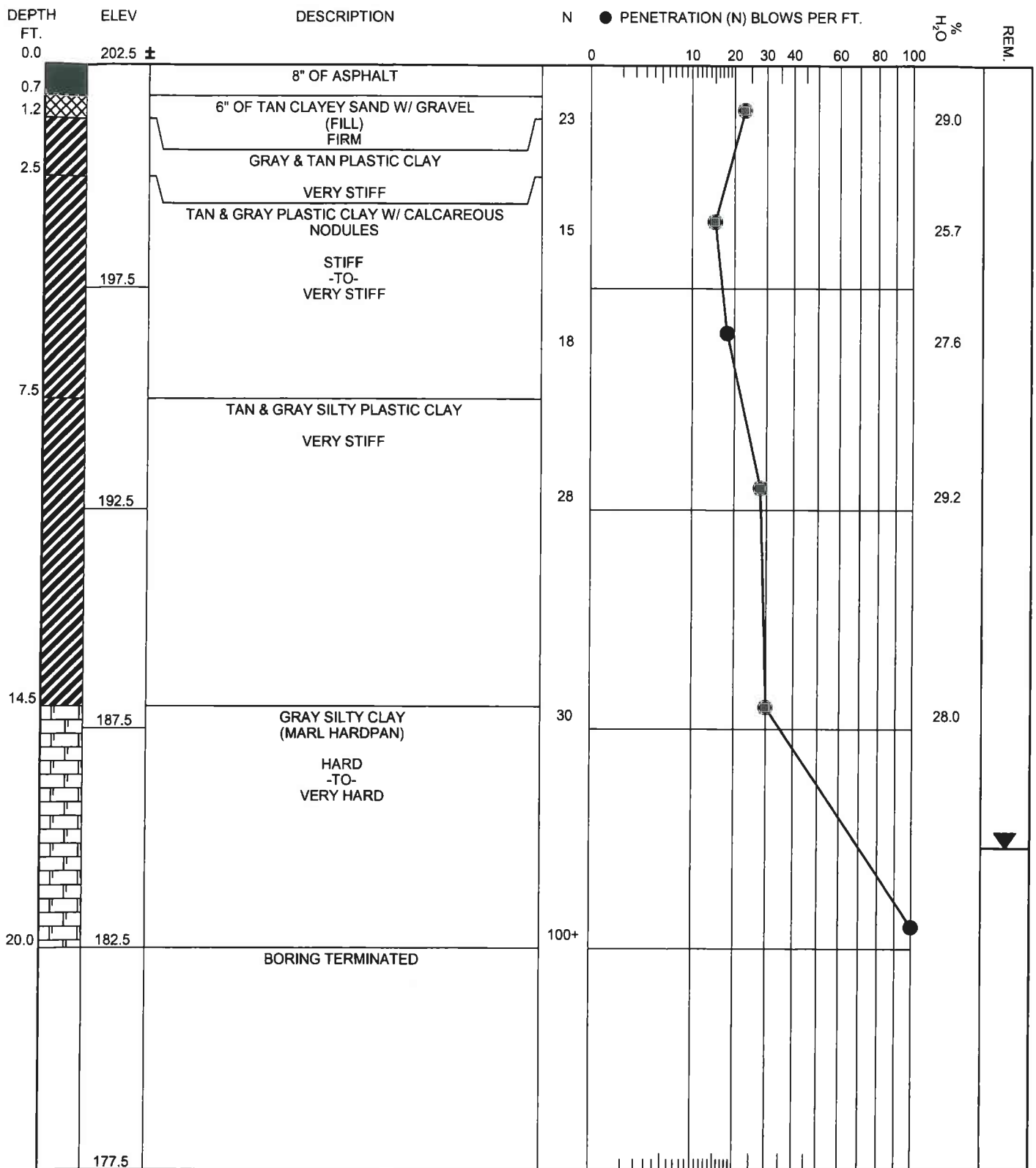
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JOB NO. G11-3264

BORING NO. B-3

DATE DRILLED 1/19/11

TYPE BORING SB



Boring and Sampling Meets ASTM D-1586  
 Penetration (N) is the Number of Blows of 140 lb. Hammer  
 Falling 30 in. Required to Drive 1.4 in I.D. Sampler 1 Ft.

☒ Undisturbed Sample  
 LA Lab Analysis

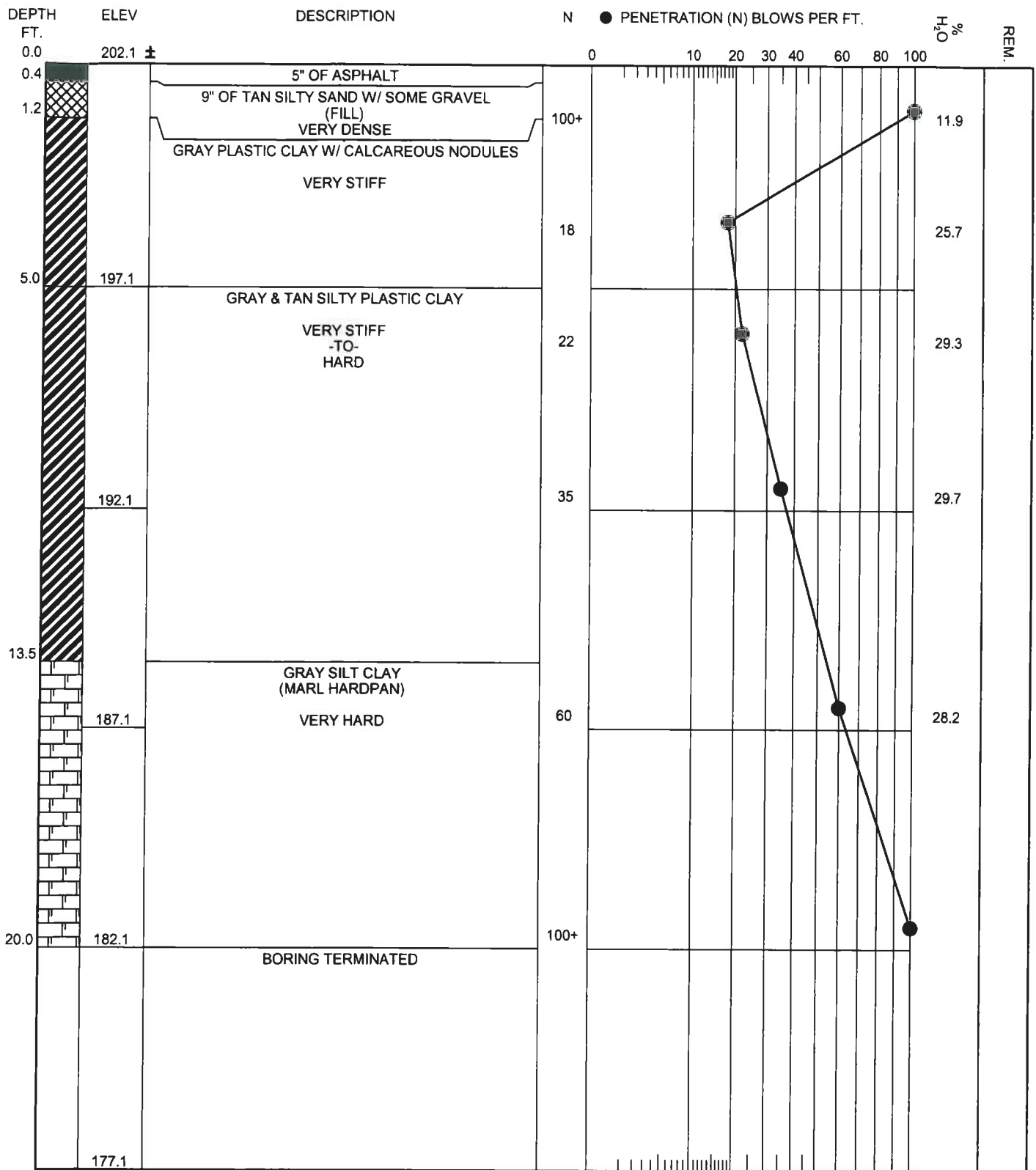


Water Level 17.7' AFTER 24 HOURS  
 Water Level  
 Boring Caved

**CARMICHAEL**  
 ENGINEERING, INC.

## TEST BORING LOG

JOB NO. G11-3264  
 BORING NO. B-4  
 DATE DRILLED 1/19/11  
 TYPE BORING SB



Boring and Sampling Meets ASTM D-1586

Penetration (N) is the Number of Blows of 140 lb. Hammer  
Falling 30 in. Required to Drive 1.4 in I.D. Sampler 1 Ft.

☒ Undisturbed Sample

LA Lab Analysis



Water Level



Boring Caved

**CARMICHAEL**  
ENGINEERING, INC.

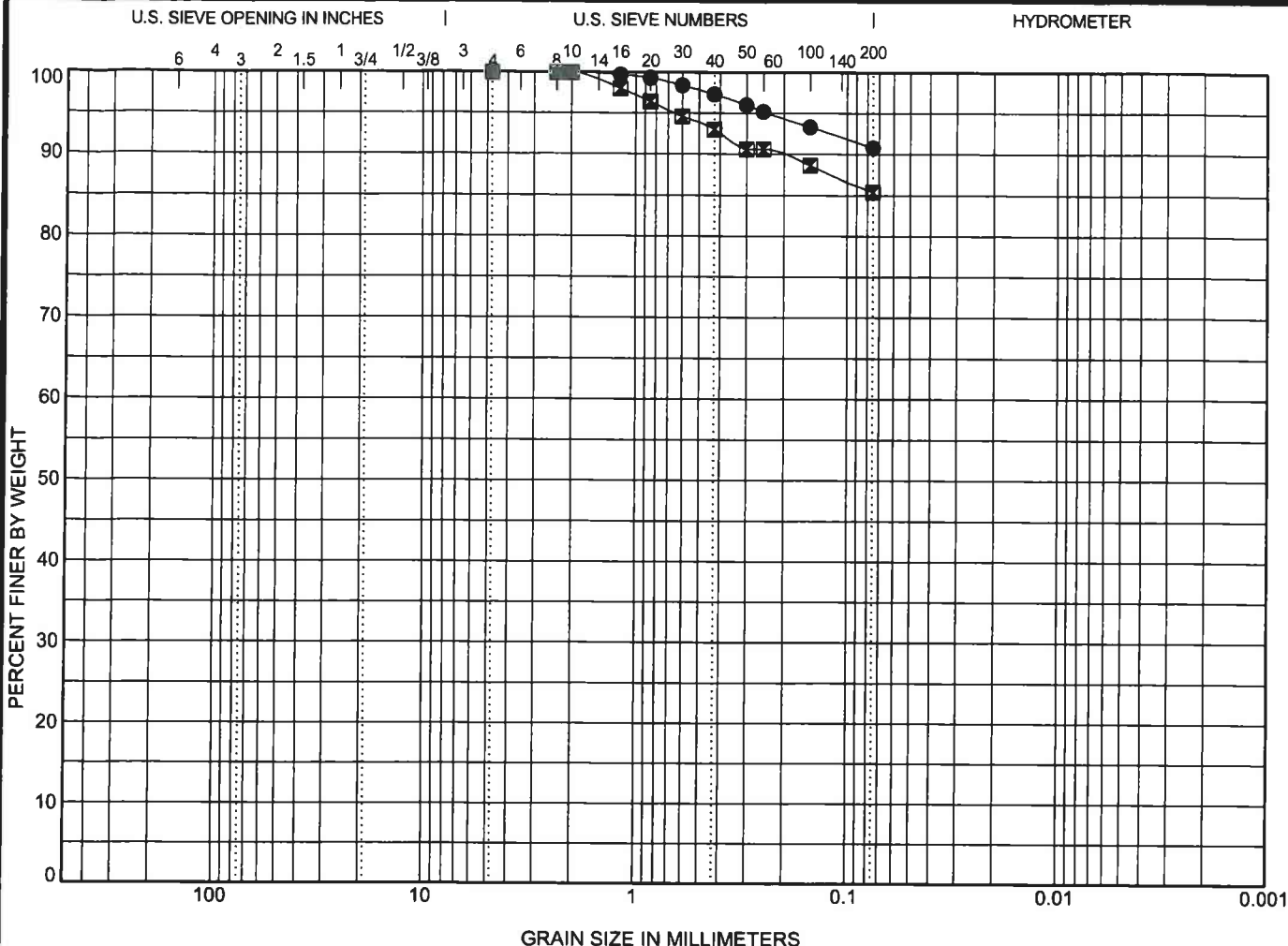
## TEST BORING LOG

JOB NO. G11-3264

BORING NO. B-5

DATE DRILLED 1/19/11

TYPE BORING SB



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	LL	PL	PI	Cc	Cu
● 18451 B-1 2.5-4'	FAT CLAY CH	55	23	32		
☒ 18452 B-4 2.5-4'	FAT CLAY CH	54	24	30		

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● 18451 B-1 2.5-4'	4.75				0.0	9.2	90.8	
☒ 18452 B-4 2.5-4'	4.75				0.0	14.6	85.4	

Client: Seay, Seay & Litchfield  
1115 South Court Street  
Montgomery, AL 36104

Test Methods: ASTM D422, ASTM D4318  
Sample Received Date: 1/19/2011  
Test Date(s): Grain Size - 1/21/2011, Atterberg Limits - 1/24/11



**CARMICHAEL**  
ENGINEERING, INC.

## GRAIN SIZE DISTRIBUTION

Project: Squadron Operations Building

Location: Montgomery, AL

Job No.: G11-3264

Report Date: 1/25/2011

Reviewed By: Brandon M. Rountree, P.E.

## INVESTIGATIVE FIELD PROCEDURES

Penetration Testing & Split Barrel Sampling: A standard 2.0" O.D. (1.4" I.D.) split barrel sampler is first seated 6" to penetrate any loose cuttings and then driven an additional 12" with blows of a 140-pound hammer falling 30". The number of blows required to drive the sampler the final foot is recorded and designated the "penetration resistance" (N). (ASTM D- 1586)

Soil Boring (SB): The test bore is advanced by a drilling rig utilizing 5-5/8" O.D. (2-1/4" I.D.) hollow stem augers. Soil samples are obtained with a standard split-tube sampler by driving the sampler thru the hollow auger. Collected soil specimens are sealed in air tight containers and delivered to the laboratory to confirm the drillers classifications. (ASTM D- 1452 & 1586)

Auger Boring (AB): Steel flight augers are utilized to advance the test bore. The soils are visually classified and sampled from the cuttings which are brought to the surface. (ASTM D-1452)

Undisturbed Sampling (UD): Relatively undisturbed soil samples are obtained by forcing a section of 3" O.D. 16-gauge steel tubing into the soil at the desired sample location. The tube is then sealed from moisture loss and delivered to the laboratory for possible laboratory testing.

Rotary-Wash Boring (RB): The drilling operation is performed by first setting a length of casing and then advancing the test bore by "jetting" a bentonite solution thru drill rods and bit.

Core Drilling (CD): The test bore is advanced thru rock by coring which utilizes a diamond bit and a double tube, swivel type core barrel. (ASTM D-2113)

Monitoring Wells (MW): Temporary or permanent wells may be installed to provide the accurate water table determination and periodic monitoring. The well is constructed with 1.5" to 4" diameter PVC pipe meeting current standards for monitoring well construction.





## NOTES AND REFERENCES

Soil descriptions are based on the predominate constituent of the material and are further described by appropriate modifiers in reverse order of their importance. For example, a predominate sand soil containing clay would be described as “clayey sand”. Additional modifiers may be used, beginning with the least important constituent such as “silty clayey sand”, etc.

Water levels shown on the test boring logs reflect those levels measured at the specified time and date indicated on the logs. These water levels are subject to seasonal fluctuation and can be effected by local surface drainage and/or rainfall during the monitoring period.

The following table describes soil relative densities and consistencies based on penetration resistance values (N) determined by the Standard Penetration Test. The “N” values are estimated for hand tool bores using a portable dynamic cone penetrometer.

	N	Relative Density
Sand	0 – 3	Very Loose
	4 – 9	Loose
	10 – 19	Firm
	20 - 29	Very Firm
	30 - 49	Dense
	50+	Very Dense
	N	Consistency
Clay and Silt	0 - 2	Very Soft
	3 - 5	Soft
	6 - 11	Firm
	12 - 17	Stiff
	18 - 29	Very Stiff
	30 - 49	Hard
	50+	Very Hard

### Laboratory Test References

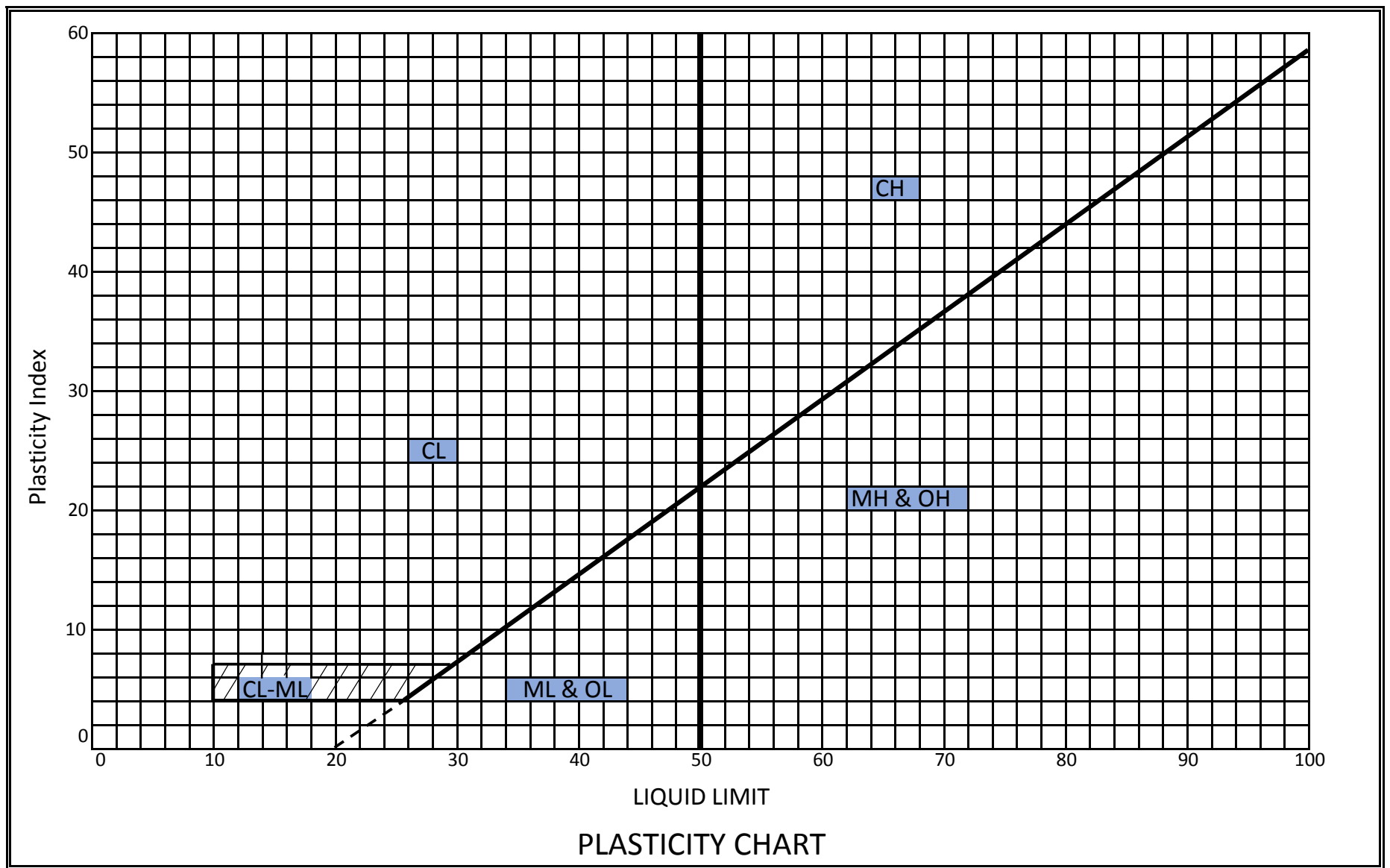
Test	Reference
Moisture Content.....	ASTM D-854
Particle Size Analysis.....	ASTM D-421,422,1140
Atterberg Limit.....	ASTM D-423, 424
Specific Gravity.....	ASTM D-2216
Compaction Test.....	ASTM D-698, 1557
California Bearing Ratio Test.....	AASHTO T-193
Triaxial Shear Test.....	ASTM D-2850
Unconfined Compression Test.....	ASTM D-2166
Consolidation Test.....	ASTM D-2435
Soil Permeability Test.....	ASTM D-2434



# The Unified Soil Classification System

Major divisions			Group symbol	Typical names	Classification criteria for coarse-grained soils		
Coarse-grained soils (more than half of material is larger than No. 200)	Gravels (more than half of coarse fraction is larger than No. 4 sieve size)	Clean gravels (little or no fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines	$C_u \geq 4$ $1 \leq C_c \leq 3$		
			GP	Poorly graded gravels, gravel-sand mixtures, little or no fines	Not meeting all gradation requirements for GW ( $C_u < 4$ or $1 > C_c > 3$ )		
			GM	d/u	Silty gravels, gravel-sand-silt mixtures	Atterberg limits below A line or $I_p < 4$	Above A line with $4 < I_p < 7$ are borderline cases requiring use of dual symbols
			GC		Clayey gravels, gravel-sand-clay mixtures	Atterberg limits below A line with $I_p > 7$	
	Sands (more than half of coarse fraction is smaller than No. 4 sieve size)	Clean sands (little or no fines)	SW		Well-graded sands, gravelly sands, little or no fines	$C_u \geq 6$ $1 \leq C_c \leq 3$	
			SP		Poorly graded sands, gravelly sands, little or no fines	Not meeting all gradation requirements for SW ( $C_u < 6$ or $1 > C_c > 3$ )	
			SM	d/u	Silty sands, sand-silt mixtures	Atterberg limits below A line or $I_p < 4$	Limits plotting in hatched zone with $4 \leq I_p \leq 7$ are borderline cases requiring use of dual symbols
			SC		Clayey sands, sand-clay mixtures	Atterberg limits above A line with $I_p > 7$	
Fine-grained soils (more than half of material is smaller than No. 200)	Silts and clays (liquid limit < 50)	ML		Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity	1. Determine percentages of sand and gravel from grain-size curve. 2. Depending on percentages of fines (fraction smaller than 200 sieve size), coarse-grained soils are classified as follows: Less than 5%-GW, GP, SW, SP More than 12%-GM, GC, SM, SC 5 to 12%-Borderline cases requiring dual symbols.		
		CL		Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays			
		OL		Organic silts and organic silty clays of low plasticity			
	Silts and clays (liquid limit > 50)	MH		Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts	$C_u = D_{60}/D_{10}$ $C_c = D_{30}^2/D_{10}D_{60}$		
		CH		Inorganic clays or high plasticity, fat clays			
		OH		Organic clays of medium to high plasticity, organic silts			
	Highly organic soils	Pt		Peat and other highly organic soils			





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## **SECTION 313116 - TERMITE CONTROL**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Chemical soil treatment.

#### **1.02 REFERENCE STANDARDS**

- A. Title 7, United States Code, 136 through 136y - Federal Insecticide, Fungicide and Rodenticide Act 2019.

#### **1.03 SUBMITTALS**

- A. See Section 01 3001 - Submittals, for submittal procedures.
- B. Product Data: Indicate toxicants to be used, composition by percentage, dilution schedule, intended application rate.
- C. Test Reports: Indicate regulatory agency approval reports when required.
- D. Manufacturer's Application Instructions: Indicate caution requirement.
- E. Record and document moisture content of soil before application.
- F. Maintenance Data: Indicate re-treatment schedule .
- G. Warranty: Submit warranty and ensure that forms have been completed in Owner's name.

#### **1.04 QUALITY ASSURANCE**

- A. Installer Qualifications: Company specializing in performing this type of work and:
  - 1. Having minimum of three (3) years documented experience.
  - 2. Approved by manufacturer of treatment materials.
  - 3. Licensed in the State in which the Project is located.

#### **1.05 WARRANTY**

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year installer's warranty against damage to building caused by termites.

1. Include coverage for repairs to building and to contents damaged due to building damage. Repair damage and, if required, re-treat.
2. Inspect annually and report in writing to Owner. Provide inspection service for 5 years from Date of Substantial Completion.

## **PART 2 PRODUCTS**

### **2.01 CHEMICAL SOIL TREATMENT**

- A. Toxicant Chemical: EPA Title 7, United States Code, 136 through 136y approved; synthetically color dyed to permit visual identification of treated soil.
- B. Diluent: Recommended by toxicant manufacturer.

### **2.02 MIXES**

- A. Mix on-site in presence of General Contractor.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that soil surfaces are unfrozen, sufficiently dry to absorb toxicant, and ready to receive treatment.
- B. Verify final grading is complete.

### **3.02 PREPARATION**

- A. General: Comply with the most stringent requirements of authorities having jurisdiction and with manufacturer's written instructions for preparing substrate.  
Remove all extraneous sources of wood cellulose and other edible materials such as wood debris, tree stumps and roots, stakes, formwork, and construction waste wood from soil and around foundations.
- B. Soil Treatment Preparation: Remove foreign matter and impermeable soil materials that could decrease treatment effectiveness on areas to be treated. Loosen, rake, and level soil to be treated, except previously compacted areas under slabs and footings.  
Termiticides may be applied before placing compacted fill under slabs if recommended by termiticide manufacturer.
- C. Fit filling hose connected to water source at the site with a backflow preventer, complying with requirements of authorities having jurisdiction.

- D. Applicator shall mix all treatment from a sealed package on site with the project construction superintendent in his company during the course of the mixing.

### **3.03 APPLICATION - CHEMICAL TREATMENT**

- A. Comply with requirements of U.S. EPA and applicable state and local codes.
- B. Spray apply toxicant in accordance with manufacturer's instructions.
- C. Apply extra treatment to structure penetration surfaces such as pipe or ducts, and soil penetrations such as grounding rods or posts.
- D. Re-treat disturbed treated soil with same toxicant as original treatment.
- E. If inspection or testing identifies the presence of termites, re-treat soil and re-test.

### **3.04 PROTECTION**

- A. Do not permit soil grading over treated work.

**END OF SECTION**

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## **SECTION 321217 - ASPHALT CONCRETE PAVING**

### **PART 1 GENERAL**

#### **1.01 RELATED DOCUMENTS**

- A. Drawings and requirements of the Government's Solicitation and Division 1 Specification sections, apply to work of this section.

#### **1.02 DESCRIPTION OF WORK:**

- A. Work described in this section includes construction of new asphalt paving for parking areas at locations shown on the plans. Construction work items include a bituminous concrete binder layer, prime coat, tack coat, and bituminous concrete wearing surface. Pavement marking for parking areas is also included in this section.

#### **1.03 SUBMITTALS**

- A. Material Certificates: Provide copies of materials certificates signed by material producer and Contractor, certifying that each material item complies with, or exceeds, specified requirements.

#### **1.04 QUALITY ASSURANCE**

- A. Codes and Standards: Unless otherwise noted, specifications referred to herein shall be the State of Alabama Department of Transportation Standard Specifications for Highway Construction, 2008 Edition.
- B. Soil Testing: Laboratory and field density tests and other soils tests specified herein shall be performed by an independent soils testing laboratory selected and paid by the Contractor.

#### **1.05 SITE CONDITIONS**

- A. Weather Limitations: Construct asphalt concrete binder and surface courses when atmospheric temperature is above 40 degrees F (4 degrees C) and rising, and when subgrade is dry. Spreading operations shall be stopped when the air temperature is below 45 degrees F (7 degrees C) and falling.
- B. Grade Control: Establish and maintain required lines and elevations.

## **PART 2 PRODUCTS**

### **2.01 MATERIALS**

- A. Fine and course aggregates for bituminous concrete binder and wearing surface layer course shall be as specified in Alabama D.O.T. Specifications, Section 424.
- B. Job Mix: Mix shall be as specified in Section 424 for a 424\*-B Superpave Bituminous Concrete Binder Layer, ¾" maximum size aggregate ESAL Range A.
- C. Prime Coat: Bituminous material for prime coat shall be as specified in Section 401.
- D. Tack Coat: Bituminous material for tack coat shall be as specified in Section 405.
- E. Job Mix: Mix shall be as specified in Section 424 for a 424-A Superpave Bituminous Concrete Wearing Surface Layer, ½" maximum size aggregate.
- F. Paint for pavement marking shall conform to the requirements of Federal Specification TT-P-115, Class B, color white for regular parking and blue for handicap parking and shall be non-reflective. It shall be well-ground and shall show easy brushing qualities. Paint shall be delivered to the job in original, unbroken containers, with label and tags intact. The paint shall not be thinned in excess of printed directions of the manufacturer.

## **PART 3 EXECUTION**

### **3.01 PRIME COAT**

- A. Description: The work covers the furnishing and placing of a bituminous prime coat on a compacted granular soil base course which is to be covered by a bituminous binder layer.
- B. Construction Methods: Requirements are specified in section 401 of the Alabama D.O.T. Standard Specifications for Highway Construction.

### **3.02 PLANT MIX BITUMINOUS CONCRETE BINDER LAYER**

- A. Description: The work consists of constructing a layer, composed of an aggregate and bituminous material hot mixed in a central plant and hot laid on the compacted subgrade in accordance with these specifications and at locations shown on the drawings.
- B. Construction Methods: Details and requirements for construction are specified in Section 424, which refers also to Articles 410.03 through 410.07 of the Alabama D.O.T. Specifications.

- C. Compaction shall be as specified in Subarticle 410.03 (g) of the Alabama D.O.T. Specifications. At least three compaction tests will be required for each day of paving operations to determine that density requirements have been attained.

### **3.03 TACK COAT**

- A. Description: The work covers the furnishing and placing of a bituminous tack coat on a new bituminous concrete binder layer which is to be covered by a bituminous concrete wearing surface or on an existing asphalt surface to receive a new bituminous concrete overlay.
- B. Construction Methods: Requirements are specified in Section 405 of the Alabama D.O.T. Standard Specifications for Highway Construction

### **3.04 BITUMINOUS CONCRETE WEARING SURFACE**

- A. Description: The work consists of constructing a hot bituminous concrete wearing surface on the previously constructed plant mix bituminous concrete binder layer in accordance with these specifications at locations shown on the drawings. See details.
- B. Construction Methods: Requirements shall be the same as specified in Section 424 which also refers to Article 410.03 through 410.07 of the Alabama D.O.T. Specifications.
- C. Compaction shall be as specified in Subarticle 410.03(g) of the Alabama D.O.T. Specifications. At least three compaction tests will be required for each day of paving operations to determine that density requirements have been attained.

### **3.05 EXISTING PAVEMENTS**

- A. Broken Pavement: Repair existing pavement where damaged by construction activity. Carefully note and record condition of pavement prior to beginning work. Remove pavement for patching by cutting pavement in straight lines with power saw.
- B. Restore base course with crushed aggregate base course. Backfill in trenches is specified under other Sections; allow initial backfill to settle under traffic for 2 weeks before cutting out for new base course. Install new wearing surface as hereinbefore specified.
- C. All patches shall be placed in straight lines, level with existing pavement, without bumps or sinks.

### **3.06 PAVEMENT MARKINGS**

- A. Application: All surfaces to be painted shall be swept clean of dirt and dust, washed with water if so directed by the Government, and shall be dry and free from "bleeding asphalt". Paint may be applied by brush or mechanical marking equipment. Marking shall conform to the layout and dimensions shown on the drawings. Stripe shall be painted with one coat of paint with a rate of application of not more than 100 square feet per gallon.

### **3.07 FIELD QUALITY CONTROL**

- A. General: Test in-place asphalt concrete courses for compliance with requirements for thickness and surface smoothness. Contractor shall engage a testing company and pay for all testing services. Repair or remove and replace unacceptable paving as directed by the Government.
- B. Thickness: In-place compacted thickness will not be acceptable if exceeding following allowable variation from required thickness:
  - 1. Binder Course:  $\frac{1}{2}$ ", plus or minus.
  - 2. Surface Course:  $\frac{1}{4}$ ", plus or minus.
- C. Surface Smoothness: Test finished surface of each asphalt concrete course for smoothness, using 10' straightedge applied parallel with, and at right angles to centerline of paved area. Surfaces will not be acceptable if exceeding the following tolerances for smoothness.
  - 1. Binder Course Surface:  $\frac{1}{4}$ "
  - 2. Wearing Course Surface:  $\frac{3}{16}$ "
  - 3. Check surface areas at intervals as directed by the Government.

**END OF SECTION**

**SECTION 321314 - CEMENT CONCRETE PAVING**

**PART 1 GENERAL**

**1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including requirements of the Government's Solicitation and Division 01 Specification Sections, apply to this Section.
- B. Materials included in this section shall meet the requirements for High Performance Sustainable Buildings for New Construction points for the following Sections:
  - 1. 2-6.1.1 - Recycled Content
  - 2. The contractor is expected to understand the HPSB requirements for these sections and include all applicable overhead in their base bid for the necessary documentation to achieve the above listed credits.

**1.02 SUMMARY**

- A. This Section includes exterior cement concrete pavement for the following:
  - 1. Curbs and gutters.
  - 2. Walkways.
  - 3. Equipment Pads.
  - 4. Vehicular pavement.
- B. Related Sections include the following:
  - 1. Section 01 3325 - Project Sustainability Summary
  - 2. Section 01 3329 - Sustainable Design Reporting
  - 3. Division 31 Section "Earthwork" for subgrade preparation and grading.
  - 4. Division 32 Section "Pavement Joint Sealants" for joint sealants within concrete pavement and at isolation joints of concrete pavement with adjacent construction.
  - 5. Division 03 Section "Cast-in-Place Concrete" for general building applications of concrete.

### **1.03 DEFINITIONS**

- A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, expansive hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume.

### **1.04 SUBMITTALS**

- A. Product Data: For each type of manufactured material and product indicated.
- B. Design Mixes: For each concrete pavement mix. Include alternate mix designs when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.
- C. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated, based on comprehensive testing of current materials:
- D. Material Certificates: Signed by manufacturers certifying that each of the following materials complies with requirements:
  - 1. Cementitious materials and aggregates.
  - 2. Steel reinforcement and reinforcement accessories.
  - 3. Fiber reinforcement.
  - 4. Admixtures.
  - 5. Curing compounds.
  - 6. Applied finish materials.
  - 7. Bonding agent or adhesive.
  - 8. Joint fillers.
- E. Sustainability Submittals, Product data for HPSB Compliance:
  - 1. For products having recycled content, documentation indicating percentages by weight of postconsumer and pre-consumer recycled content.
    - a. Include statement indicating costs (sell price for each product having recycled content)
    - b. Include total weight of products provided

2. Sustainable Design Submittal: If any fly ash, ground granulated blast furnace slag, silica fume, rice hull ash, or other waste material is used in mix designs to replace Portland cement, submit the total volume of concrete cast in place, mix design(s) used showing the quantity of portland cement replaced, reports showing successful cylinder testing, and temperature on day of pour if cold weather mix is used.

### **1.05 QUALITY ASSURANCE**

- A. Installer Qualifications: An experienced installer who has completed work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.
  1. Manufacturer must be certified according to the National Ready Mix Concrete Association's Plant Certification Program.
- C. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 to conduct the testing indicated, as documented according to ASTM E 548.
- D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant and each aggregate from one source.
- E. ACI Publications: Comply with ACI 301, "Specification for Structural Concrete," unless modified by the requirements of the Contract Documents.
- F. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixes.

### **1.06 PROJECT CONDITIONS**

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

### **1.07 SUSTAINABILITY REQUIREMENTS**

- A. Contractor shall endeavor to provide materials with a high recycled content:
  1. See Part 2 of this specification section for specific recycled content thresholds, if applicable.

## **PART 2 PRODUCTS**

### **2.01 FORMS**

- A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, smooth exposed surfaces.
  - 1. Use flexible or curved forms for curves of a radius 100 feet or less.
- B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

### **2.02 STEEL REINFORCEMENT**

- A. Plain-Steel Welded Wire Fabric: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.
- B. Reinforcement Bars: ASTM A615, Grade 60.
- C. Contractor shall endeavor to provide materials with a high recycled content. A minimum post-consumer recycled content of 30% is required for reinforcing steel.

### **2.03 CONCRETE MATERIALS**

- A. General: Use the same brand and type of cementitious material from the same manufacturer throughout the Project.
- B. Portland Cement: ASTM C 150, Type I or II.
  - 1. Fly Ash: ASTM C 618, Class F or C.
  - 2. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
- C. Aggregate: ASTM C 33, uniformly graded, from a single source, with coarse aggregate as follows:
  - 1. Maximum Aggregate Size:  $\frac{3}{4}$  inch nominal.
  - 2. Do not use fine or coarse aggregates containing substances that cause spalling.
  - 3. Match existing aggregate to the extent possible.
- D. Water: ASTM C 94.
- E. All products (cement and aggregate combined), required a Solar Reflectance Index (SRI) of at least 29 calculated using ASTM E1980, "Standard Practice for Calculating



Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces."

## **2.04 ADMIXTURES**

- A. General: Admixtures certified by manufacturer to contain not more than 0.1 percent water-soluble chloride ions by mass of cement and to be compatible with other admixtures.
- B. Air-Entraining Admixture: ASTM C 260.

## **2.05 FIBER REINFORCEMENT**

- A. Synthetic Fiber: Fibrillated polypropylene fibers engineered and designed for use in concrete pavement, complying with ASTM C 1116, Type III, ½ to 1-1/2 inches long.

## **2.06 CURING MATERIALS**

- A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq.yd. dry.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.
- D. Clear Solvent-Borne Liquid-Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.

## **2.07 RELATED MATERIALS**

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber, or ASTM D 1752, cork or self-expanding cork.
- B. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- C. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class and grade to suit requirements, and as follows:
  - 1. Types I and II, non-load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

## **2.08 CONCRETE MIXES**

- A. Prepare design mixes, proportioned according to ACI 211.1 and ACI 301, for each type and strength of normal-weight concrete determined by either laboratory trial mixes or field experience.
- B. Use a qualified independent testing agency for preparing and reporting proposed mix designs for the trial batch method.
- C. Proportion mixes to provide concrete with the following properties:
  - 1. Compressive Strength (28 Days): 4000 psi for vehicular pavement, 3000 psi for all others.
  - 2. Maximum Water-Cementitious Materials Ratio: 0.45.
  - 3. Maximum Water-Cementitious Materials Ratio: 0.50.
  - 4. Slump Limit: 4 inches.
- D. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
  - 1. Fly Ash: 25 percent.
  - 2. Combined Fly Ash and Pozzolan: 25 percent.
  - 3. Ground Granulated Blast-Furnace Slag: 50 percent.
  - 4. Combined Fly Ash or Pozzolan, and Ground Granulated Blast-Furnace Slag: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.
- E. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content of 2.5 to 4.5 percent.
  - 1. Air Content: 6.0 percent for  $\frac{3}{4}$  inch maximum aggregate.
- F. Synthetic Fiber: Uniformly disperse in concrete mix at manufacturer's recommended rate, but not less than 1.0 lb/cu. yd.

## **2.09 CONCRETE MIXING**

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

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

## **PART 3 EXECUTION**

### **3.01 PREPARATION**

- A. Proof-roll prepared subgrade surface to check for unstable areas and verify need for additional compaction. Proceed with pavement only after nonconforming conditions have been corrected and subgrade is ready to receive pavement.
- B. Remove loose material from compacted subgrade surface immediately before placing concrete.

### **3.02 EDGE FORMS AND SCREED CONSTRUCTION**

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for pavement to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.
- B. Clean forms after each use and coat with form release agent to ensure separation from concrete without damage.

### **3.03 STEEL REINFORCEMENT**

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating reinforcement and with recommendations in CRSI's "Placing Reinforcing Bars" for placing and supporting reinforcement.
  1. Apply epoxy repair coating to uncoated or damaged surfaces of epoxy-coated reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.
- C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.
- D. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

### **3.04 JOINTS**

- A. General: Construct construction, isolation, and contraction joints and tool edgings true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated.
  - 1. When joining existing pavement, place transverse joints to align with previously placed joints, unless otherwise indicated.
- B. Construction Joints: Set construction joints at side and end terminations of pavement and at locations where pavement operations are stopped for more than one-half hour, unless pavement terminates at isolation joints.
  - 1. Provide preformed galvanized steel or plastic keyway-section forms or bulkhead forms with keys, unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.
  - 2. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of pavement strips, unless otherwise indicated.
  - 3. Use epoxy bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting building, concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.
  - 1. Locate expansion joints at intervals of 50 feet, unless otherwise indicated.
  - 2. Extend joint fillers full width and depth of joint.
  - 3. Terminate joint filler less than ½ inch or more than 1 inch below finished surface if joint sealant is indicated.
  - 4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
  - 5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
  - 6. Protect top edge of joint filler during concrete placement with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

- D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows:
  - 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with groover tool to the following radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover marks on concrete surfaces.
    - a. Radius:  $\frac{1}{4}$  inch.
  - 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut  $\frac{1}{8}$ -inch wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.
- E. Edging: Tool edges of pavement, gutters, curbs, and joints in concrete after initial floating with an edging tool to the following radius. Repeat tooling of edges after applying surface finishes. Eliminate tool marks on concrete surfaces.
  - 1. Radius:  $\frac{1}{4}$  inch.

### **3.05 CONCRETE PLACEMENT**

- A. Inspection: Before placing concrete, inspect and complete formwork installation, reinforcement steel, and items to be embedded or cast in. Notify other trades to permit installation of their work.
- B. Remove snow, ice, or frost from subgrade surface and reinforcement before placing concrete. Do not place concrete on frozen surfaces.
- C. Moisten subgrade to provide a uniform dampened condition at the time concrete is placed. Do not place concrete around manholes or other structures until they are at the required finish elevation and alignment.
- D. Comply with requirements and with recommendations in ACI 304R for measuring, mixing, transporting, and placing concrete.
- E. Do not add water to concrete during delivery, at Project site, or during placement.
- F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
- G. Consolidate concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures to consolidate concrete

according to recommendations in ACI 309R.

1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand-spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels, and joint devices.
- H. Place concrete in two operations; strike off initial pour for entire width of placement and to the required depth below finish surface. Lay welded wire fabric or fabricated bar mats immediately in final position. Place top layer of concrete, strike off, and screed.
1. Remove and replace portions of bottom layer of concrete that have been placed more than 15 minutes without being covered by top layer, or use bonding agent if approved by the Government.
- I. Screed pavement surfaces with a straightedge and strike off. Commence initial floating using bull floats or darbies to form an open textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations.
- J. 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 air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F point of placement.
  2. Do not use frozen materials or materials containing ice or snow.
  3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators, unless otherwise specified and approved in mix designs.
- K. Hot-Weather Placement: Place concrete according to recommendations in ACI 305R and as follows when hot-weather conditions exist:
1. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90 deg F. 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.

2. Fog-spray forms, reinforcement steel, and subgrade just before placing concrete.  
Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

### **3.06 CONCRETE FINISHING**

- A. General: Wetting of concrete surfaces during screeding, initial floating, or finishing operations is prohibited.
- B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and the concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats, or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots, and fill low spots. Refloat surface immediately to uniform granular texture.
  1. Medium-to-Fine- Textured Broom Finish: Draw a soft bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.

### **3.07 CONCRETE PROTECTION AND CURING**

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and follow recommendations in ACI 305R for hot-weather protection during curing.
- B. Begin curing after finishing concrete, but not before free water has disappeared from concrete surface.
- C. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows:
  1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
    - a. Water.
    - b. Continuous water-fog spray.
    - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch 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 and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

### **3.08 PAVEMENT TOLERANCES**

- A. Comply with tolerances of ACI 117 and as follows:
  1. Elevation:  $\frac{1}{4}$  inch.
  2. Thickness: Plus  $\frac{3}{8}$  inch, minus  $\frac{1}{4}$  inch.
  3. Surface: Gap below 10-foot- long, unleveled straightedge not to exceed  $\frac{1}{4}$  inch.
  4. Joint Spacing: 3 inches.
  5. Contraction Joint Depth: Plus  $\frac{1}{4}$  inch, no minus.
  6. Joint Width: Plus  $\frac{1}{8}$  inch, no minus.

### **3.09 FIELD QUALITY CONTROL**

- A. Testing Agency: The Contractor will engage a qualified testing and inspection agency to sample materials, perform tests, and submit test reports during concrete placement. Sampling and testing for quality control may include those specified in this Article.
- B. Testing Services: Testing shall be performed according to the following requirements:
  1. Sampling Fresh Concrete: Representative samples of fresh concrete shall be obtained according to ASTM C 172, except modified for slump to comply with ASTM C 94.
  2. Slump: ASTM C 143; one test at point of placement for each compressive-strength test, but not less than one test for each day's pour of each type of concrete. Additional tests will be required when concrete consistency changes.
  3. Air Content: ASTM C 231, pressure method; one test for each compressive-strength test, but not less than one test for each day's pour of each type of air-entrained concrete.
  4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each set of compressive-strength specimens.



5. Compression Test Specimens: ASTM C 31/C 31M; one set of four standard cylinders for each compressive-strength test, unless otherwise indicated. Cylinders shall be molded and stored for laboratory-cured test specimens unless field-cured test specimens are required.
  6. Compressive-Strength Tests: ASTM C 39; one set for each day's pour of each concrete class exceeding 5 cu. yd., but not less than 25 cu. yd., plus one set for each additional 50 cu. yd. One specimen shall be tested at 7 days and two specimens at 28 days; one specimen shall be retained in reserve for later testing if required.
  7. When frequency of testing will provide fewer than five compressive-strength tests for a given class of concrete, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
  8. When total quantity of a given class of concrete is less than 50 cu. yd., the Government may waive compressive-strength testing if adequate evidence of satisfactory strength is provided.
  9. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, current operations shall be evaluated and corrective procedures shall be provided for protecting and curing in-place concrete.
  10. Strength level of concrete will be considered satisfactory if averages of sets of three consecutive compressive-strength test results equal or exceed specified compressive strength by more than 500 psi.
- C. Test results shall be reported in writing to the Government, concrete manufacturer, and Contractor within 24 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing agency, concrete type and class, location of concrete batch in pavement, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
- D. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by the Government but will not be used as the sole basis for approval or rejection.
- E. Additional Tests: Testing agency shall make additional tests of the concrete when test results indicated slump, air entrainment, concrete strengths, or other requirements have not been met, as directed by the Government. Testing agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by

other methods as directed.

### **3.10 REPAIRS AND PROTECTION**

- A. Remove and replace concrete pavement that is broken, damaged, or defective, or does not meet requirements in this Section.
- B. Drill test cores where directed by the Government when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory pavement areas with portland cement concrete bonded to pavement with epoxy adhesive.
- C. Protect concrete from damage. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.
- D. Maintain concrete pavement free of stains, discoloration, dirt, and other foreign material. Sweep concrete pavement not more than two days before date scheduled for Beneficial Occupancy inspections.

**END OF SECTION**

## **SECTION 321413 - PRECAST CONCRETE UNIT PAVING**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Interlocking concrete paver units.
- B. Sand setting bed.
- C. Polymeric sand joint filler.
- D. Edge restraints.

#### **1.02 RELATED REQUIREMENTS**

- A. Section 31 2210 - Earthwork
- B. Section 32 1314 - Cement Concrete Paving

#### **1.03 REFERENCE STANDARDS**

- A. ASTM C33/C33M - Standard Specification for Concrete Aggregates 2018.
- B. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar 2018.
- C. ASTM C936/C936M - Standard Specification for Solid Concrete Interlocking Paving Units 2021b.

#### **1.04 SUBMITTALS**

- A. See Section 01 3001 - Submittals, for submittal procedures.
- B. Product Data: Provide characteristics of paver unit, dimensions, and special shapes.
- C. Product Data: Provide characteristics of polymeric sand, including base material, additive(s), compressive strength, and color.
- D. Samples: Submit two samples of each paver type, illustrating style, size, color range and surface texture of units being provided.
- E. Manufacturer's Installation Instructions: Indicate substrate requirements and installation methods.
- F. Maintenance Materials: Provide the following for Government's use in maintenance of project.

1. See Section 016000 - Product Requirements, for additional provisions.
2. Extra Pavers: 10 of each type and size.

## **PART 2 PRODUCTS**

### **2.01 MATERIALS**

- A. Interlocking Concrete Pavers: Hydraulically pressed concrete, configured for interlocking with adjacent units and complying with ASTM C936/C936M.
  1. Provide Belgard Moduline paver as required to match existing paver at the adjacent Supply and Simulator facilities.
  2. Thickness:
    - a. 2-3/8" (60 mm)
  3. Size: Provide manufacturer's standard sizes to provide pattern indicated on the drawings which utilizes a 12"x12", 6"x6", and 4"x18" size unit.
  4. Color: Provide custom color, if required, to match existing paver at the adjacent Supply and Simulator facilities.
  5. Refer to specification section 01 6000 Product Requirements and the Government's solicitation documents for limited source justification associated with the listed product/manufacturer.
- B. Sand for Setting Bed: Clean washed natural sand or crushed stone complying with gradation requirements of ASTM C33/C33M for fine aggregates.
- C. Polymeric Sand: Fine sand complying with ASTM C144 combined with polymer binders for creating semi-solid joints between pavers.
  1. Color: as selected from manufacturer's full range.
- D. Edging: Concrete curb, as detailed.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that substrate is level or to correct gradient, smooth, capable of supporting pavers and imposed loads, and ready to receive work of this Section.
- B. Verify gradients and elevations of substrate are correct.

- C. Verify dry weather forecast without rain for a minimum of 24 hours with temperatures above 55 degrees Fahrenheit (13 degrees Celsius).
- D. Verify that pavers are completely dry prior to polymeric sand installation.
- E. Install weep holes in concrete substrate in quantities and locations recommended by paver system manufacturer prior to proceeding with installation of paver system.

### **3.02 INSTALLATION OF SOLID PAVER UNITS**

- A. Spread sand bedding evenly over prepared substrate surface to a maximum thickness of 1 inch (25 mm).
- B. Dampen and roller compact sand to level and even surface.
- C. Place paver units in pattern equal to the Belgard HH pattern creating staggered joints, from straight reference edge.
- D. Cut paver units at edges with masonry saw.
- E. Place half units at edge and interruptions. Maintain tight joints.
- F. Spread polymeric sand uniformly over surface. Use a push broom to fill joints and remove excess while not sweeping long distances. Sweep all excess with a fine bristle brush and remove residues with a leaf blower.
- G. Tamp and level paver units with mechanical vibrator until units are firmly bedded, level, and to correct elevation and gradients. Do not tamp unrestrained edges.

### **3.03 CLEANING**

- A. Do not clean pavers until pavers and mortar are dry.
- B. Clean soiled surfaces using cleaning solution. Do not harm pavers, joint materials, or adjacent surfaces.
- C. Use non-metallic tools in cleaning operations.
- D. Rinse surfaces with clean water.
- E. Broom clean paving surfaces. Dispose of excess sand.

### **3.04 PROTECTION**

- A. Do not permit traffic over unprotected paver surface.
- B. Protect paver surface with sheets of plywood.

- C. Do not permit traffic for 48 hours after pavement placement.

**END OF SECTION**

## **SECTION 321720 - PAVEMENT JOINT SEALANTS**

### **PART 1 GENERAL**

#### **1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including requirements of the Government's Solicitation and Division 01 Specification Sections, apply to this Section.

#### **1.02 SUMMARY**

- A. This Section includes the following:
  - 1. Expansion and contraction joints within portland cement concrete pavement.
  - 2. Joints between portland cement concrete and asphalt pavement.
- B. Related Sections include the following:
  - 1. Division 32 Section "Cement Concrete Pavement" for constructing joints in concrete paving.
  - 2. Division 7 Section "Joint Sealants" for sealing non-traffic and traffic joints in locations not specified in this Section.

#### **1.03 SUBMITTALS**

- A. Product Certificates: Signed by manufacturers of joint sealants certifying that products furnished comply with requirements and are suitable for the use indicated.

#### **1.04 QUALITY ASSURANCE**

- A. Installer Qualifications: An experienced installer who has specialized in installing joint sealants similar in material, design, and extent to those indicated for this Project and whose work has resulted in joint-sealant installations with a record of successful in-service performance.
- B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

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

- A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multi-component materials.

- B. Store and handle materials to comply with manufacturer's written instructions to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

## **1.06 PROJECT CONDITIONS**

- A. Environmental Limitations: Do not proceed with installation of joint sealants under the following conditions:
  - 1. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer.
  - 2. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 40 deg F (4.4 deg C).
  - 3. When joint substrates are wet.
- B. Joint-Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than that allowed by joint sealant manufacturer for application indicated.
- C. Joint-Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with their adhesion are removed from joint substrates.

## **PART 2 PRODUCTS**

### **2.01 MATERIALS, GENERAL**

- A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint sealant manufacturer based on testing and field experience.
- B. Colors of Exposed Joint Sealants: As selected by the Government from manufacturer's full range for this characteristic.

### **2.02 HOT-APPLIED JOINT SEALANTS**

- A. Single-Component, elastomeric, self-leveling non-bubbling, premium-grade polyurethane sealant:
- B. Approvals:
  - 1. ASTM C920-11, Type S, Grade P, Class 25



2. Conforms to BS 5212 for determination of resistance to heat, aging, and fuel immersion.
3. Can/CGSC 19.13-M87, Classification C-1-40-B-N and C-1-25-B-N, No. 81028
4. Federal Specification Section TTS-00230C, Type I, Class A
5. ISO 11600 F 25 HM

**C. Product Technical Data**

1. Tensile Strength (Per ASTM D412): 180 psi
2. Tear Strength (Per ASTM D624): 33 lbs/in
3. Elongation (per ASTM D412): 785%
4. Shore A Hardness (Per ASTM D661) 30 +/- 5
5. Movement Capability (per ASTM C719): +/- 25
6. Weathering Resistance (Per ASTM C793): Excellent
7. Stain and Color Change (Per ASTM C510): Pass
8. Peel on Concrete Mortar-Dry (Per ASTM C794): 24 c.f
9. VOC Content: 38 g/L

**2.03 JOINT-SEALANT BACKER MATERIALS**

- A. General: Provide joint-sealant backer materials that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by joint sealant manufacturer based on field experience and laboratory testing.
- B. Round Backer Rod for Cold- and Hot-Applied Sealants: ASTM D 5249, Type 1, of diameter and density required to control sealant depths and prevent bottom-side adhesion of sealant.

**2.04 PRIMERS**

- A. Primers: Product recommended by joint sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint- sealant-substrate tests and field tests.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.02 PREPARATION**

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint sealant manufacturer's written instructions.
- B. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

### **3.03 INSTALLATION OF JOINT SEALANTS**

- A. General: Comply with joint sealant manufacturer's written installation instructions applicable to products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations of ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install backer materials of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
  - 1. Do not leave gaps between ends of backer materials.
  - 2. Do not stretch, twist, puncture, or tear backer materials.
  - 3. Remove absorbent backer materials that have become wet before sealant application and replace them with dry materials.
- D. Install sealants by proven techniques to comply with the following and at the same time backings are installed:
  - 1. Place sealants so they directly contact and fully wet joint substrates.

2. Completely fill recesses provided for each joint configuration.
  3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- E. Provide joint configuration to comply with joint sealant manufacturer's written instructions, unless otherwise indicated.

### **3.04 CLEANING**

- A. Clean off excess sealants or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved by manufacturers of joint sealants and of products in which joints occur.

### **3.05 PROTECTION**

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Beneficial Occupancy. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from the original work.

### **END OF SECTION**

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## **SECTION 321900 - SIDEWALKS**

### **PART 1 GENERAL**

#### **1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of Contract, including requirements of the Government's solicitation and Division 01 Specification Sections, apply to this Section. Complete compliance with all provisions contained therein which affect work or requirements of this Section is mandatory.

#### **1.02 SCOPE**

- A. This division includes all concrete sidewalks and related items required to complete the work shown on the drawings and as specified.

### **PART 2 PRODUCTS**

#### **2.01 MATERIALS**

- A. Materials shall conform to 32 1314 - Cement Concrete Paving

### **PART 3 EXECUTION**

#### **3.01 TESTING AND INSPECTION**

- A. Tests of concrete and materials shall be made under direction of the Engineer who shall have access to all places where concrete materials are stored, proportioned or mixed.

#### **3.02 STORAGE OF MATERIALS**

- A. Cement and aggregate shall be sorted in such a manner as to prevent deterioration or intrusion of foreign matter. Any material which has deteriorated or has been damaged shall not be used for concrete.

#### **3.03 SUBGRADE**

- A. The subgrade shall be constructed or excavated to the required depth below the finished surface as shown on the drawings.
- B. Soft or other unsuitable material, shall be removed and replaced with suitable material, and the subgrade shall be compacted to a density of 95% for the top six (6) inches of subgrade.
- C. Fills in subgrade shall be made in layers not to exceed four (4) inches in thickness and finished to a firm, smooth surface.

### **3.04 FORMS**

- A. Forms shall be of wood or metal, straight and free from warp and of sufficient strength, when staked, to hold the concrete true to line and grade without springing or distorting. Wood forms shall be of at least 2 inches in thickness for straight sections, 1 inch radii of curves, and shall be selected plank surfaced on all sides. Metal forms shall be of approved section and shall have a flat surface on top.
- B. The depth of forms shall be 4 inches unless shown otherwise on the drawings. Forms shall be securely fastened and shall be staked, braced and held together to exact line and grade established. Forms shall be sufficiently tight to prevent the leakage of mortar. Forms shall be cleaned and oiled immediately before concrete is placed.

### **3.05 JOINTS**

- A. Sidewalks shall be cut into separate square or rectangular slabs not to exceed 36 square feet in area, by grooves or division plates. Grooves shall be cut with an approved grooving tool and shall be not less than 1-1/2 inches in depth. Division plates shall be 1/8 inch in thickness and shall extend the full depth of the sidewalk slab. Grooves or division plates shall be perpendicular to the edges of the sidewalk.
- B. Expansion shall be joints filled with pre-molded expansion joint filler not more than 35 feet apart, at junctions with other sidewalks, and at points where sidewalks intersect curb lines. Pre-molded expansion joint filler shall be 3/8 inch in thickness. Pre-molded expansion joint filler shall extend entirely through the expansion joint and shall conform to the cross section of the sidewalk.

### **3.06 PLACING CONCRETE**

- A. Subgrade and forms shall be checked and approved just prior to the placing of concrete. All debris or other foreign material shall be removed from the space to be occupied by the concrete. The subgrade shall be moist but not wet or muddy.
- B. Concrete shall be placed in the forms and shall be tamped, spaded or vibrated sufficiently to produce a dense homogeneous mass and to bring the mortar to the surface. Particular attention shall be given to spading concrete along and against the surface of the forms to prevent honeycombing and to secure a smooth and uniform surface.

### **3.07 FINISHING**

- A. After pouring, the concrete shall be struck off with an approved straight edge resting on the side forms and drawn forward with a sawing motion.

- B. Concrete shall then be floated with a wooden or metal float until the surface is true.  
The surface of the sidewalk shall be checked with a 10 foot straight edge and irregularities more than 1/4 inch in 10 feet shall be corrected. Plastering with mortar to build up or finish will not be permitted.
- C. Edges at joints and sides shall be rounded with 1/4 inch radius edger.
- D. Final finish shall be a wood or carpet float finish.

### **3.08 CURING AND PROTECTION**

- A. After the finishing operation is completed the concrete shall be covered with burlap or straw and kept continuously moist for a period of not less than 5 days.
- B. Sidewalks shall be protected from the elements and damage from other causes until the acceptance of the work.

### **3.09 BACKFILLING**

- A. After the removal of the forms and sufficient setting of the concrete spaces along edges of sidewalk shall be backfilled to the required elevation with suitable material. Backfill shall be placed in layers of not more than 4 inches and shall be tamped until firm and solid.

### **3.10 CLEANING UP**

- A. Upon completion of the work remove all forms, unused materials, excess backfill and put the premises in a neat and clean condition.

### **END OF SECTION**

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## **SECTION 323123 - PLASTIC FENCES AND GATES**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Posts, rails, and frames.
- B. Pickets.
- C. Manual gates with related hardware.

#### **1.02 RELATED REQUIREMENTS**

- A. Section 033000 - Cast-in-Place Concrete: Concrete anchorage for posts.

#### **1.03 REFERENCE STANDARDS**

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2019.
- B. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete 2022a.
- C. ASTM D1784 - Standard Classification System and Basis for Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds 2020.

#### **1.04 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on fence panels, posts, accessories, fittings and hardware.
- C. Shop Drawings: Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, and schedule of components.
- D. Samples: Submit two samples of pickets, 2 inches (51 mm) by 6 inches (152 mm) in size indicating construction and colored finish.
- E. Manufacturer's Installation Instructions: Indicate installation requirements and post foundation anchor bolt templates.
- F. Manufacturer's qualification statement.
- G. Installer's qualification statement.

## **1.05 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
- B. Installer: Company with demonstrated successful experience installing similar projects and products, with not less than five years of documented experience.

## **1.06 WARRANTY**

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
- B. Manufacturer Warranty: Provide 2-year manufacturer warranty for all fencing components. Complete forms in the Government's name and register with manufacturer.
- C. Finish Warranty: Provide 5-year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking. Complete forms in the Government's name and register with warrantor.

## **PART 2 PRODUCTS**

### **2.01 PLASTIC FENCES AND GATES**

- A. PVC Posts, Rails, and Pickets: High-impact, UV-resistant, rigid polyvinyl chloride, complying with ASTM D1784, Class 14344B.
  - 1. Fence Style: as indicated on the drawings. .
  - 2. Line and Corner Posts: 5 by 5 inches (127 by 127 mm), minimum; 0.135-inch (3.4 mm) wall thickness, 3/8-inch (9.5 mm) corner radius.
  - 3. Rails: 1-1/2 by 5-1/2 inches (38 by 140 mm), minimum; 0.090-inch (2.3 mm) wall thickness, 5/16-inch (7.9 mm) corner radius.
  - 4. Pickets: 5/8 by 11-3/8 inches (15.9 by 289 mm), minimum, tongue and groove; 0.050-inch (1.3 mm) wall thickness, 1/16-inch (1.6 mm) corner radius.
  - 5. Gate Posts & Hardware: Refer to section 05 5000.
  - 6. Post Caps: Match cross section of post; 0.095-inch (2.4 mm) wall thickness, four-sided configuration.
  - 7. Stiffener Channels: ASTM A36/A36M, galvanized steel with predrilled holes for drainage; sized to fit within PVC rails.

B. Concrete:

1. See Section 033000.

C. Fasteners: Manufacturer's standard stainless steel fasteners.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verification of Conditions: Verify that areas are clear of obstructions or debris and acceptable to manufacturer and installer.

### **3.02 INSTALLATION**

- A. Install framework, pickets, fence panels, accessories in accordance with manufacturer's instructions.

### **3.03 TOLERANCES**

- A. Maximum Variation From Plumb: 1/4 inch (6 mm).
- B. Maximum Offset From True Position: 1 inch (25 mm).

### **3.04 CLEANING**

- A. See Section 017419 - Construction Waste Management and Disposal for additional requirements.
- B. Leave immediate work area neat at end of each work day.
- C. Clean jobsite of excess materials; scatter excess material from post hole excavations uniformly away from posts. Remove excess material if required.
- D. Clean fence with mild household detergent and clean water; rinse well.
- E. Touch up scratched surfaces using materials recommended by manufacturer. Match touched-up finish to factory-applied finish.

## **END OF SECTION**

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**SECTION 329223 - SODDING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Preparation of subsoil.
- B. Placing topsoil.
- C. Fertilizing.
- D. Sod installation.
- E. Maintenance.

**1.02 RELATED REQUIREMENTS**

- A. Section 312200 - Grading: Topsoil material.
- B. Section 312200 - Grading: Preparation of subsoil and placement of topsoil in preparation for the work of this section.
- C. Section 31 2210 - Earthwork

**1.03 DEFINITIONS**

- A. Weeds: Includes Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Bermuda Grass, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel, and Brome Grass.

**1.04 REFERENCE STANDARDS**

- A. TPI (SPEC) - Guideline Specifications to Turfgrass Sodding 2006.

**1.05 SUBMITTALS**

- A. See Section 01 3001 - Submittals, for submittal procedures.
- B. Certification: Submit certification of grass species and location of sod source.
- C. Maintenance Data: Include maintenance instructions, cutting method and maximum grass height; types, application frequency, and recommended coverage of fertilizer .

## **1.06 QUALITY ASSURANCE**

- A. Sod Producer: Company specializing in sod production and harvesting with minimum five years experience, and certified by the State of Alabama.
- B. Installer Qualifications: Company approved by the sod producer.

## **1.07 REGULATORY REQUIREMENTS**

- A. Comply with regulatory agencies for fertilizer and herbicide composition.

## **1.08 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver sod on pallets. Protect exposed roots from dehydration.
- B. Do not deliver more sod than can be laid within 24 hours.

## **1.09 WARRANTY**

- A. When work is provisionally accepted in parts, the guarantee period extends from each Provisionally Accepted date to the terminal date of the last guarantee period. Thus, all guarantee periods terminate at the same time.
- B. Guarantee all plant material and planting workmanship for a period of one full year beyond the date of Provisional Acceptance. The end of the guarantee period shall coincide with the end of the one year maintenance; however, any replacements made during the maintenance period shall be warranted for an additional growing season, defined as March 15 through October 15. No maintenance shall be done during the guarantee period of the replacement plants beyond the original one year period.
- C. During the period of guarantee, replace, with no additional compensation, and as soon as weather permits, all dead plant materials, and all plant materials not in a thriving condition with materials originally specified and/or installed. Make good any other damage, loss, destruction, or failure to flourish sufficiently as the result of inferior or defective materials or workmanship.
- D. Repair grades and other work necessitated due to planting replacements.

## **PART 2 PRODUCTS**

- A. Sod: TPI (SPEC), Certified Turfgrass Sod quality; cultivated grass sod; type indicated in plant schedule on Drawings; with strong fibrous root system, free of stones, burned or bare spots; containing no more than 5 weeds per 1000 sq ft (100 sq m). Minimum age of 18 months, with root development that will support its own weight without tearing, when suspended vertically by holding the upper two corners.

1. Superior Bermuda Grass Type: 100 percent.
  2. Thickness: "Thick" sod, minimum 1 inch (25 mm) and maximum 1-3/8 inch (35 mm) topsoil base.
  3. Machine cut sod and load on pallets in accordance with TPI (SPEC) Guidelines.
- B. Fertilizer: Commercial 15-15-15 or approved equal; recommended for grass, with fifty percent of the elements derived from organic sources; of proportion necessary to eliminate any deficiencies of topsoil, as indicated by analysis.
- C. Water: Clean, fresh and free of substances or matter that could inhibit vigorous growth of grass.

## **2.02 ACCESSORIES**

- A. Wood Pegs: Softwood, sufficient size and length to ensure anchorage of sod on slope.
- B. Wire Mesh: Interwoven hexagonal metal wire mesh of 2 inch (50 mm) size.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that prepared soil base is ready to receive the work of this section.

### **3.02 PREPARATION**

- A. Prepare subgrade in accordance with Section 312200.
- B. Place topsoil in accordance with Section 312200.

### **3.03 FERTILIZING**

- A. Apply fertilizer in accordance with manufacturer's instructions.
- B. Apply after smooth raking of topsoil and prior to installation of sod.
- C. Apply fertilizer no more than 48 hours before laying sod.
- D. Mix thoroughly into upper 2 inches (50 mm) of topsoil.
- E. Lightly water to aid the dissipation of fertilizer.

### **3.04 LAYING SOD**

- A. Moisten prepared surface immediately prior to laying sod.

- B. Lay sod immediately after delivery to site to prevent deterioration.
- C. Lay sod smooth and tight with no open joints visible, and no overlapping; stagger end joints 12 inches (300 mm) minimum. Do not stretch or overlap sod pieces.
- D. Where new sod adjoins existing grass areas, align top surfaces.
- E. Where sod is placed adjacent to hard surfaces, such as curbs, pavements, etc., place top elevation of sod 1/2 inch (13 mm) below top of hard surface.
- F. On slopes 6 inches per foot (500 mm per m) and steeper, lay sod perpendicular to slope and secure every row with wooden pegs at maximum 2 feet (600 mm) on center. Drive pegs flush with soil portion of sod.
- G. Prior to placing sod, on slopes exceeding 8 inches per foot (666 mm per m) or where indicated, place wire mesh over topsoil. Securely anchor in place with wood pegs sunk firmly into the ground.
- H. Water sodded areas immediately after installation. Saturate sod to 4 inches (100 mm) of soil.
- I. After sod and soil have dried, roll sodded areas to ensure good bond between sod and soil and to remove minor depressions and irregularities.

### **3.05 MAINTENANCE**

- A. Provide maintenance at no extra cost the Government, the Government will pay for water.
- B. Until the site has achieved Beneficial Occupancy, mow grass at regular intervals to maintain at a maximum height of 2-1/2 inches (65 mm). Do not cut more than 1/3 of grass blade at any one mowing.
- C. Neatly trim edges and hand clip where necessary.
- D. Immediately remove clippings after mowing and trimming.
- E. Water to prevent grass and soil from drying out.
- F. Roll surface to remove irregularities.
- G. Control growth of weeds. Apply herbicides in accordance with manufacturer's instructions. Remedy damage resulting from improper use of herbicides.
- H. Immediately replace sod to areas that show deterioration or bare spots.



- I. Protect sodded areas with warning signs during maintenance period.

**END OF SECTION**

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**SECTION 331117 - OUTSIDE WATER SYSTEM**

**GENERAL**

**1.01 RELATED DOCUMENTS:**

- A. Drawings and general provisions of Contract, including requirements of the Government's Solicitation and Division 01 Specification sections, apply to work of this section.
- B. Materials included in this section shall meet the requirements for High Performance Sustainable Buildings for New Construction points for the following Sections:
  - 1. 2-6.1.1 - Recycled Content
  - 2. The contractor is expected to understand the HPSB requirements for these sections and include all applicable overhead in their base bid for the necessary documentation to achieve the above listed credits.

**1.02 DESCRIPTION OF WORK:**

- A. Extent of water systems work is indicated on drawings and schedules, and by requirements of this section.
- B. Refer to Division-31 section "Earthwork" for excavation and backfill required for water systems; not work of this section.
- C. Refer to Division-22 section "Plumbing" for interior building systems including interior piping, fixtures, and equipment; not work of this section.

**1.03 QUALITY ASSURANCE:**

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacturing of water systems materials and products, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer's Qualifications: Firm with at least 3 years of successful installation experience on projects with water piping work similar to that required for project.

**1.04 CODES AND STANDARDS:**

- A. Plumbing Code Compliance: Comply with applicable portions of National Standard Plumbing Code pertaining to selection and installation of water system materials and products.

- B. Water Purveyor Compliance: Comply with requirements of the Montgomery Water Works and Sanitary Sewer Board. Obtain required permits and inspections.

#### **1.05 SUBMITTALS:**

- A. Product Data: Submit manufacturer's technical product data and installation instructions for water system materials and products.
- B. Record Drawings: At project closeout, submit record drawings of installed water system piping and products, in accordance with requirements of Division 1.

#### **1.06 PROJECT CONDITIONS:**

- A. Site Information: Perform site survey, research public utility records, and verify existing utility locations.
- B. Existing Utilities: Do not interrupt utilities serving facilities occupied by the Government or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated.
- C. Notify the Government not less than two days in advance of proposed utility interruptions.
- D. Do not proceed with utility interruptions without the Government's written permission.

#### **1.07 SUSTAINABILITY REQUIREMENTS**

- A. Contractor shall endeavor to provide materials with a high recycled content.
- B. Materials specified shall have a post-consumer content as follows:
  - 1. Steel - Recycled Content: 30% Post-consumer content, minimum.
  - 2. HDPE - Recycled Content: 100% Post-consumer content, minimum.
  - 3. PVC - Recycled Content: 5% Post-consumer content, minimum.

### **PART 2 - PRODUCTS**

#### **2.01 PIPES AND PIPE FITTINGS:**

- A. General: Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, temperature ratings, and capacities as indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide sizes and types matching piping and equipment

connections

- B. Piping: Provide pipe of the following material, of weight/class indicated. Provide pipe fittings and accessories of same material and weight/class as pipes, with joining method as indicated.
- C. Pipe and Fittings:
  - 1. Ductile-Iron, Mechanical-Joint Pipe: AWWA C151, with cement-mortar lining and seal coat according to AWWA C104. Include gland, rubber gasket, and bolts and nuts and according to AWWA C1111. Fittings shall be in accordance with AWWA C110 or AWWA C153.
  - 2. Ductile-Iron, Push-on-Joint Pipe: AWWA C151, with cement-mortar lining and seal coat according to AWWA C104. Include rubber compression gasket according to AWWA C1111.
  - 3. AWWA C900: Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 inch through 12 inch (100 mm - 300 mm) for water distribution.
    - a. Joints: Pipes shall incorporate a formed bell complete with a single rubber gasket conforming to ASTM F 477. Joints shall be designed to meet the zero leakage test requirements of ASTM D 3139
  - 4. Copper Tubing: ASTM B88, seamless water tube, Annealed temper, Type K with soldered joints.
- D. Recycled Content: For Steel Products: A minimum post-consumer recycled content of 30% is required.

## **2.02 FIRE HYDRANTS:**

- A. Comply with AWWA Specification C-502 and shall meet local Fire Department standards and requirements. Hydrants shall have one pumper and two hose nozzles, a valve opening not less than 5 inches, and a 6-inch inlet connection. All fire hydrants shall be valved. All piping and fittings in fire hydrant installation shall be ductile iron. Paint fire hydrant in accordance with local Fire Department requirements.

## **2.03 CONCRETE:**

- A. All concrete including but not limited to thrust blocking, dead men, etc. shall have a 28 day compression strength of not less than 3000 pounds per square inch.

## **2.04 GRAVEL:**

- A. Gravel for drainage shall be washed 3/4 inch crushed rock or graded river gravel and shall be free of organic matter, sand, loam, clay and other particles that will tend to restrict water flow through the gravel.

## **2.05 PIPE SLEEVES:**

- A. Provide cast-iron or zinc coated sleeves built in place where water lines pass through walls. Properly secure in place, with approximately 1/4-inch space between pipe and enclosing sleeve, before concrete is poured. Caulk annular opening between pipe and sleeves, and seal with asphaltic compound consisting of bituminous materials mixed with mineral matter. Install piping so that no joint occurs within a sleeve.
- B. Exterior Protection of Ductile Iron Pipe: Complete encase buried ductile iron pipelines with polyethylene tube or sheet, using polyethylene film as recommended by the manufacturer.

## **2.06 VALVE BOXES**

- A. Cast-iron box with top section and cover with lettering "WATER," bottom section with base of size to fit over valve and barrel approximately 5 inches in diameter, and adjustable cast-iron extension of length required for depth of bury of valve.

## **2.07 TAPPING SLEEVE AND TAPPING VALVE**

- A. Complete assembly, including tapping sleeve, tapping valve, and bolts and nuts. Use sleeve and valve compatible with tapping machine.
- B. Tapping Sleeve: Cast-iron or ductile-iron, 2-piece bolted sleeve flanged outlet for new branch connection. Sleeve may have mechanical-joint ends with rubber gaskets or sealing rings in sleeve body. Include sleeve matching size and type of pipe material being tapped and of outlet flange required for branch connection.

## **PART 3 - EXECUTION:**

### **3.01 INSTALLATION OF PIPE AND PIPE FITTINGS:**

- A. During installation of water lines the Contractor will be required to conduct his operations in a safety conscious manner. The Contractor shall comply with all applicable safety requirements in the location of the construction area. The Contractor alone shall be responsible for the safety, efficiency, and adequacy of his plant, appliances, and methods, and for any damage which may result from their failure or their improper construction, maintenance, or operation.

**3.02 SUPERVISION OF WORK:**

- A. All work in progress shall receive the personal attention either of the Contractor or of a competent and reliable superintendent who shall have a full or final authority to act for him.

**3.03 AUTHORITY AND DUTIES OF INSPECTOR:**

- A. The Governing Authority Inspector shall be authorized to inspect all work done and all material furnished, including preparation, fabrication and manufacture of the materials to be used. The Inspector shall not be authorized to alter or waive any requirements of the specifications without consent of the Government. He shall call the attention of the Contractor to any failure of the work or materials to conform to the specifications. He may reject material or suspend the work until any questions at issue can be referred to and decided by the proper authority. The presence of the Inspector shall in no wise lessen the responsibility of the Contractor.

**3.04 TRENCHES:**

- A. Water mains shall have at least 30 inches and not more than 48 inches of cover over the top of the pipe. Trenches shall be widened and deepened at all points where joints occur to such extent as to facilitate the proper making, tightening, and inspection of joints. The bottom of the trench shall be so shaped that except at "bell holes" the pipe, where laid, shall have a substantially uniform bearing throughout its length.
- B. The maximum width of trench ditches shall be as follows:

<u>Main Size</u>	<u>Width</u>
Laterals	As small width as possible
2"	18"
6"	24"
8"	30"

- C. If an unstable trench bottom is encountered, the trench shall be undercut 4 to 6 inches and a suitable select granular material used to stabilize the trench bottom.
- D. The trenching and pipe laying shall be done in an orderly fashion and in a workman like manner. Excessive water shall be pumped from the trench before the pipe is laid. Back of curb, intersections, and locations where the gate valves will be set, shall be staked before the main is laid.

- E. Pipe shall be handled in such a manner as to protect the lining and the pipe from being damaged. It should NOT be dropped while unloading or while being installed in the trench. The Inspector has the right to reject any damaged material.
- F. The pipe shall be kept clean of dirt, clods, and debris, etc., while being installed. It shall be properly plugged off at the end of the working day or when work is suspended to prevent the entrances of foreign materials (i.e., storm water, dirt, animal, etc.).
- G. Pipe shall be laid true to line and grade except that it may be deflected within the limits of the manufacturer's recommendations for making necessary changes in direction.
- H. Water mains when laid shall have a minimum vertical clearance of 12 inches from other mains, laterals, pipes or other obstructions.

### **3.05 CONCRETE THRUST BLOCK (DEAD MAN):**

- A. A dead man shall be used for rodding on valves and fittings, etc., when other regular means of retention will not work or will be impractical.

### **3.06 FIELD QUALITY CONTROL:**

- A. Before being pressure tested, all lines shall be thoroughly flushed to remove all debris, etc., that may be in the new main.
- B. Lines shall be flushed to achieve a velocity of 2 feet per second.
- C. All valves not required to be closed for isolation of the new line to be tested shall be open during the testing.
- D. After backfilling, all pipes shall be subjected to a hydrostatic test pressure of not less than 150 pounds per square inch by a pressure gauge.
- E. All visible leaks, when pressure is applied, shall be repaired and any pipe valve or fittings which when under the pressure test are found defective shall be replaced.
- F. The section of pipe tested shall be held at 150 psi for a minimum of 2 hours.
- G. Leakage of water shall not be greater than 25 gallons per 24 hours per inch of diameter per mile of pipe.
- H. The contractor shall provide all water, labor and material necessary for conducting the pressure test.
- I. Upon successful passing of the pressure test, the lines shall be chlorinated in accordance with AWWA C651. The contractor will be responsible for the cost of



**F-35 ADAL Squadron Operations Building  
187th Fighter Wing, Dannelly Field, ANG  
Montgomery, AL**

**FAKZ189102**

**November 2022**

**Type B3 (100%) Submittal**

chlorination and water used during construction and testing.

**END OF SECTION**

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## **SECTION 334112 - STORM DRAINAGE**

### **PART 1 GENERAL**

#### **1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including requirements of the Government's Solicitation and Division 01 Specification Sections, apply to this Section.
- B. Materials included in this section shall meet the requirements for High Performance Sustainable Buildings for New Construction points for the following Sections:
  - 1. 2-6.1.1 - Recycled Content
  - 2. The contractor is expected to understand the HPSB requirements for these sections and include all applicable overhead in their base bid for the necessary documentation to achieve the above listed credits.

#### **1.02 SUMMARY**

- A. This Section includes storm drainage outside the building.
- B. Related Sections include the following:
  - 1. Division 3 Section "Cast-in-Place Concrete" for concrete structures.

#### **1.03 PERFORMANCE REQUIREMENTS**

- A. Gravity-Flow, Nonpressure-Piping Pressure Ratings: At least equal to system test pressure.

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

- A. Do not store plastic structures, pipe, and fittings in direct sunlight.
- B. Protect pipe, pipe fittings, and seals from dirt and damage.
- C. Handle precast concrete manholes and other structures according to manufacturer's written rigging instructions.

#### **1.05 PROJECT CONDITIONS**

- A. Site Information: Verify existing utility locations.
- B. Existing Utilities: Do not interrupt utilities serving facilities occupied by the Government or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements

indicated:

1. Notify the Government not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without the Government's written permission.

#### **1.06 SUBMITTALS:**

- A. Project Data: Submit manufacturer's technical product data and installation instructions for proposed materials and products.
- B. Record Drawings: At project closeout, submit record drawings of installed systems piping and products, in accordance with requirements of Division 01.
- C. Sustainability Submittals, Product data for HPSB Compliance:
  1. For products having recycled content, provide documentation indicating percentages by weight of postconsumer and pre-consumer recycled content.
    - a. Include statement indicating costs (sell price for each product having recycled content)
    - b. Include the total weight of products provided
  2. If fly ash, ground granulated blast furnace slag, silica fume, rice hull ash, or other waste materials is used in mix designs to replace Portland cement, submit the total volume of concrete cast in place, mix design(s) used showing the quantity of portland cement replaced, reports showing successful cylinder testing, and temperature on day of pour if cold weather mix is used.

#### **1.07 SUSTAINABILITY REQUIREMENTS**

- A. Contractor shall endeavor to provide materials with a high recycled content:
  1. See Part 2 of this specification section for specific recycled content thresholds, if applicable.

### **PART 2 PRODUCTS**

#### **2.01 PIPES AND FITTINGS**

- A. General: All pipe shall have class designation cast or imprinted on side.

- B. Reinforced-Concrete Sewer Pipe and Fittings: ASTM C 76 Class III, Wall B, for gasketed joints.
  - 1. Gaskets: ASTM C 443 rubber.
  - 2. Recycled Content: 30% Post-consumer content, minimum.
- C. PVC Sewer Pipe and Fittings: ASTM F949 or F794 with an integral bell gasketed joint per manufacturers recommendation.
  - 1. Recycled Content: 5% Post-consumer content, minimum.
- D. Additional approved pipe materials:
  - 1. Polypropylene Pipe meeting the requirements of ASTM F2736 for piping 12"-60" in diameter
  - 2. HDPE (ABS N-12) pipe meeting ASTM 2648 for piping 4" through 60" in diameter.
    - a. Recycled Content: 100% Post-consumer content, minimum

## **2.02 MANHOLES**

- A. Heavy-Traffic Precast Concrete Manholes: ASTM C 913; designed according to ASTM C 890 for A-16, heavy-traffic, structural loading; of depth, shape, and dimensions indicated, with provision for rubber gasketed joints.
  - 1. Gaskets: Rubber.
  - 2. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch total thickness, that match 24-inch- diameter frame and cover.
  - 3. Pipe Connectors: ASTM C 923 (ASTM C 923M), resilient, of size required, for each pipe connecting to base section.
- B. Manhole Frames and Covers: ASTM A 536, Grade 60-40-18, ductile-iron castings designed for heavy-duty service. Include 24-inch ID by 7- to 9-inch riser with 4-inch minimum width flange, and 26-inch- diameter cover. Include indented top design with lettering "STORM SEWER" cast into cover.

## **2.03 CATCH BASINS**

- A. Cast-in-Place Concrete, Catch Basins: Construct of reinforced concrete; designed according to ASTM C 890 for structural loading; of depth, shape, dimensions, and appurtenances indicated.

1. Bottom, Walls, and Top: Reinforced concrete.
2. Channels and Benches: Concrete.
- B. Frames and Grates: ASTM A 536, Grade 60-40-18, ductile iron designed for heavy-duty service. Include flat grate with small square or short-slotted drainage openings.
  1. Size: 24 by 24 inches minimum, unless otherwise indicated.
  2. Grate Free Area: Approximately 50 percent, unless otherwise indicated.

## **2.04 CONCRETE**

- A. General: Cast-in-place concrete according to ACI 318, ACI 350R, and the following:
  1. Cement: ASTM C 150, Type II.
  2. Fine Aggregate: ASTM C 33, sand.
  3. Coarse Aggregate: ASTM C 33, crushed gravel.
  4. Water: Potable.
- B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water-cementitious ratio.
  1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
  2. Reinforcement Bars: ASTM A 615, Grade 60, deformed steel.

## **PART 3 EXECUTION**

### **3.01 EARTHWORK**

- A. Excavating, trenching, and backfilling are specified in Division 2 Section "Earthwork."

### **3.02 INSTALLATION, GENERAL**

- A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical.
- B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab or

drag in line, and pull past each joint as it is completed.

- C. Use manholes for changes in direction, unless fittings are indicated. Use fittings for branch connections, unless direct tap into existing sewer is indicated.
- D. Use proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
- E. Install gravity-flow piping and connect to building's storm drains, of sizes and in locations indicated. Terminate piping as indicated.

### **3.03 PIPE JOINT CONSTRUCTION AND INSTALLATION**

- A. General: Join and install pipe and fittings according to installations indicated.
- B. Hub-and-Spigot, Cast-Iron Soil Pipe and Fittings: With rubber gaskets according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook." Use gaskets that match class of pipe and fittings.
- C. Install with top surfaces of components, except piping, flush with finished surface.
- D. Concrete Pipe and Fittings: Install according to ACPA's "Concrete Pipe Installation Manual." Use the following seals:
  - 1. Round Pipe and Fittings: ASTM C 443 (ASTM C 443M), rubber gaskets.
- E. System Piping Joints: Make joints using system manufacturer's couplings, unless otherwise indicated.
- F. Join piping made of different materials or dimensions with couplings made for this application. Use couplings that are compatible with and that fit both systems' materials and dimensions.

### **3.04 MANHOLE INSTALLATION**

- A. General: Install manholes, complete with appurtenances and accessories indicated.
- B. Form continuous concrete channels and benches between inlets and outlet.
- C. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches above finished surface elsewhere, unless otherwise indicated.
- D. Install precast concrete manhole sections with gaskets according to ASTM C 891.

### **3.05 CATCH-BASIN INSTALLATION**

- A. Construct catch basins to sizes and shapes indicated.
- B. Set frames and grates to elevations indicated.

### **3.06 CONCRETE PLACEMENT**

- A. Place cast-in-place concrete according to ACI 318 and ACI 350R.

### **3.07 TAP CONNECTIONS**

- A. Make connections to existing underground structures so finished Work complies as nearly as practical with requirements specified for new Work.
- B. Protect existing piping and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

### **3.08 FIELD QUALITY CONTROL**

- A. Clear interior of piping and structures of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed.
  - 1. Place plug in end of incomplete piping at end of day and when work stops.
  - 2. Flush piping between manholes and other structures to remove collected debris.
- B. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.
  - 1. Defects requiring correction include the following:
    - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
    - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
    - c. Crushed, broken, cracked, or otherwise damaged piping.
    - d. Infiltration: Water leakage into piping.
    - e. Exfiltration: Water leakage from or around piping.



2. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
3. Reinspect and repeat procedure until results are satisfactory.

**END OF SECTION**

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# **NATIONAL COUNTERINTELLIGENCE AND SECURITY CENTER**

OFFICE OF THE DIRECTOR OF NATIONAL INTELLIGENCE

## **TECHNICAL SPECIFICATIONS FOR CONSTRUCTION AND MANAGEMENT OF SENSITIVE COMPARTMENTED INFORMATION FACILITIES**

**VERSION 1.3**

IC Tech Spec-for ICD/ICS 705

An Intelligence Community Technical Specification  
Prepared by the  
National Counterintelligence and Security Center

September 10, 2015

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Office of the Director of National Intelligence  
Director of the National Counterintelligence and Security Center  
Washington, DC 20511

NCSC-319-15

MEMORANDUM FOR: Distribution

SUBJECT: Technical Specifications for Construction and Management of  
Sensitive Compartmented Information Facilities, Version 1.3

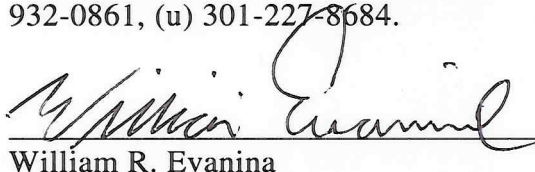
REFERENCES: A. Memorandum, Same Subject dated May 5, 2011  
B. Intelligence Community Directive 705, *Sensitive  
Compartmented Information Facilities*  
C. Intelligence Community Standard (ICS) 705-1, *Physical and  
Technical Security Standards for Sensitive Compartmented  
Information Facilities*  
D. Intelligence Community Standard 705-2, *Standards for the  
Accreditation and Reciprocal Use of Sensitive  
Compartmented Information Facilities*

This memorandum promulgates version 1.3 of the Technical Specifications for Construction and Management of Sensitive Compartmented Information Facilities to the Intelligence Community (IC) and rescinds version 1.2, effective immediately.

These Specifications are designed to be a living document that enables periodic updates to keep up with changing and emerging technology.

Technical experts from both the IC and private industry have collaborated to update the attached version of the Technical Specifications. This update satisfies the needs of the community and enhances the standards identified in ICS 705-1, *Physical and Technical Security Standards for Sensitive Compartmented Information Facilities*.

Questions may be directed to the Physical and Technical Security Expert Working Group Chairs, Jeff Zimmerman, (s) 932-5162, (u) 301-227-8662 or Kacarole Thornton, (s) 932-0861, (u) 301-227-8684.

  
William R. Evanina

9-10-15  
Date

SUBJECT: Technical Specifications for Construction and Management of  
Sensitive Compartmented Information Facilities, Version 1.3

Distribution:

Secretary of Homeland Security, Department of Homeland Security  
Secretary of Housing and Urban Development, Department of Housing and Urban Development  
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Administrator, United States Agency for International Development  
Chairman, United States International Trade Commission  
Director, United States Peace Corps  
Chief Postal Inspector, United States Postal Inspection Service  
Director, United States Secret Service

## Change History

Rev. #	Date	Page	Changes	Approver
1.2	04/23/12	Cover	Banner Graphic, Version, Date	PTSEWG
1.2	04/23/12	4	Added note to warn users of classification when associating threat information and facility location.	PTSEWG
1.2	04/23/12	5	Re-worded approval of CAs to designate the AO as the primary approval authority of Compartmented Areas within SCIFs.	PTSEWG
1.2	04/23/12	9-10	Changed "Type X Gypsum" to "wallboard" to remove the standard of fire resistant gypsum and permit use of other wallboard types.	PTSEWG
1.2	04/23/12	9-10	Changed references to wall design drawings to "suggested" wall types to enable variety of wall construction techniques to meet the security standards.	PTSEWG
1.2	04/23/12	10	Added explanation to glue and screw plywood to ceiling and floor to clarify standard. Stud placement changed to 16 on center to match drawing and correct error.	PTSEWG
1.2	04/23/12	11	Added statement to finish wall and paint from true floor to true ceiling in Walls B and C to clarify and equal Type A Wall.	PTSEWG
1.2	04/23/12	19-20	Replaced drawings to reflect "suggested" wall construction methods and remove references to "Type X gypsum wallboard".	PTSEWG

Rev. #	Date	Page	Changes	Approver
1.2	04/23/12	35	Replaced drawings to reflect “suggested” wall construction methods and remove references to “Type X gypsum wallboard”.	PTSEWG
1.2	04/23/12	57	Updated Federal Information Processing Standards (FIPS) encryption standards and certification to remove a standard that could not be met by commercial alarm systems.	PTSEWG
1.2	04/23/12	59-60 & FFCs	Replaced FIPS 140-2 with Advanced Encryption Standard (AES) to remove a standard that could not be met by commercial alarm systems.	PTSEWG
1.2	04/23/12	117 TEMPEST Checklist	Removed references to “inspectable space” as requested by the TEMPEST Advisory Group (TAG).	PTSEWG
1.2	04/23/12	120 TEMPEST Checklist	Removed references to “Red-SCI” information.	PTSEWG
1.2	04/23/12	121 TEMPEST Checklist	Removed parenthetical reference to cell phones and Bluetooth.	PTSEWG
1.2	04/23/12	127-135	Replaced Compartmented Area Checklist to reflect IC standards.	PTSEWG
1.2	04/23/12	161-163	Replaced Co-Use and MOA Form to include “joint-use” statements.	PTSEWG
1.3	03/26/15	Cover	Banner change, version, date	PTSEWG
1.3	03/26/15	B-C	Appended “D/NCSC Memorandum”	PTSEWG
1.3	03/26/15	D-G	“Appended Change History”	PTSEWG



Rev. #	Date	Page	Changes	Approver
1.3	03/26/15	3	Chapter 2.A (2)(a) Added: “NOTE” regarding prefabricated modular SCIFs.	PTSEWG
1.3	03/26/15	10	Chapter 3.C Corrected wording to match wall drawings on p.17.	PTSEWG
1.3	03/26/15	14-15	Chapter 3.G (7)(c.4) Correction and addition of guidance on vents and ducts perimeter protection.	PTSEWG
1.3	03/26/15	17-19	Reformatted wall types to reflect correct architectural graphics for prescribed materials.	PTSEWG
1.3	03/26/15	55	Chapter 7.A (2)(d) Added requirement for HSS switches.	PTSEWG
1.3	03/26/15	56	Chapter 7.A (2)(k) Changed to reflect restrictions on dissemination of installation plans.	PTSEWG
1.3	03/26/15	56	Chapter 7.A (3)(a.2) Added exception that sensors must be located within SCIF perimeter.	PTSEWG
1.3	03/26/15	57	Chapter 7.A (3)(b.7.e) Replaced “Zones” with “IDE sensor points”.	PTSEWG
1.3	03/26/15	58	Chapter 7.A (3)(c.1) Added language for approval authority.	PTSEWG
1.3	03/26/15	58	Chapter 7.A (3)(c.2) Added language for integrated IDS and Remote Access.	PTSEWG
1.3	03/26/15	58-59	Chapter 7.A (3)(c.2) Added system application software requirements.	PTSEWG
1.3	03/26/15	60-61	Replaced “access/secure” with “arm/disarm” throughout.	PTSEWG
1.3	03/26/15	60	Chapter 7.B (2) Added “A record shall be maintained that identifies the	PTSEWG

Rev. #	Date	Page	Changes	Approver
			person responsible for disarming the system”.	
1.3	03/26/15	87	Chapter 12.G (2) Changed Section header to read “Inspections/Reviews, added same where the term “inspection” or “review” used. The responsibility to perform as such was changed from “IC element head” to the AO, or designee.	PTSEWG
1.3	03/26/15	173-174	Appended Co-Use Request and MOA Form	PTSEWG

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## **Chapter 1. Introduction**

### **A. Purpose**

This Intelligence Community (IC) Technical Specification sets forth the physical and technical security specifications and best practices for meeting standards of Intelligence Community Standard (ICS) 705-1 (Physical and Technical Standards for Sensitive Compartmented Information Facilities). When the technical specifications herein are applied to new construction and renovations of Sensitive Compartmented Information Facilities (SCIFs), they shall satisfy the standards outlined in ICS 705-1 to enable uniform and reciprocal use across all IC elements and to assure information sharing to the greatest extent possible. This document is the implementing specification for Intelligence Community Directive (ICD) 705 (Sensitive Compartmented Information Facilities), ICS 705-1, and ICS 705-2 (Standards for Accreditation and Reciprocal Use of Sensitive Compartmented Information Facilities).

The specifications contained herein will facilitate the protection of Sensitive Compartmented Information (SCI) against compromising emanations, inadvertent observation and disclosure by unauthorized persons, and the detection of unauthorized entry.

### **B. Applicability**

IC Elements shall fully implement this standard within 180 days of its signature.

SCIFs that have been de-accredited but controlled at the SECRET level (IAW 32 Code of Federal Regulations (CFR) parts 2001 and 2004) for less than one year may be reaccredited one time using the previous standard. The IC SCIF repository shall indicate that the accreditation was based upon the previous standards.

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## Chapter 2. Risk Management

### A. Analytical Risk Management Process

1. The Accrediting Official (AO) and the Site Security Manager (SSM) should evaluate each proposed SCIF for threats, vulnerabilities, and assets to determine the most efficient countermeasures required for physical and technical security. In some cases, based upon that risk assessment, it may be determined that it is more practical or efficient to mitigate a standard. In other cases, it may be determined that additional security measures should be employed due to a significant risk factor.

2. Security begins when the initial requirement for a SCIF is known. To ensure the integrity of the construction and final accreditation, security plans should be coordinated with the AO before construction plans are designed, materials ordered, or contracts let.

a) Security standards shall apply to all proposed SCI facilities and shall be coordinated with the AO for guidance and approval. Location of facility construction and or fabrication does not exclude a facility from security standards and or review and approval by the AO. SCI facilities include but are not limited to fixed facilities, mobile platforms, prefabricated structures, containers, modular applications or other new or emerging applications and technologies that may meet performance standards for use in SCI facility construction.

NOTE: Advertised claims by manufactures that their product(s), to include mobile platforms, prefabricated structures, containers and modular structures are built to SCIF standards and can be accredited without modification may not be accurate. AOs are responsible for ensuring security controls spelled out in the ICD/ICS 705 series and this document are implemented to protect the security integrity of the proposed SCIF prior to accreditation.

b) Mitigations are verifiable, non-standard methods that shall be approved by the AO to effectively meet the physical/technical security protection level(s) of the standard. While most standards may be effectively mitigated via non-standard construction, additional security countermeasures and/or procedures, some standards are based upon tested and verified equipment (e.g., a combination lock meeting Federal Specification FF-L 2740A) chosen because of special attributes and could not be mitigated with non-tested equipment. The AO's approval is documented to confirm that the mitigation is at least equal to the physical/technical security level of the standard.

c) Exceeding a standard, even when based upon risk, requires that a waiver be processed and approved in accordance with ICD 705.

3. The risk management process includes a critical evaluation of threats, vulnerability, and assets to determine the need and value of countermeasures. The process may include the following:

a) Threat Analysis. Assess the capabilities, intentions, and opportunity of an adversary to exploit or damage assets or information. For SCI Facilities under Chief of Mission (COM) authority use the Overseas Security Policy Board

(OSPB), Security Environment Threat List (SETL) to determine technical threat to a location. When evaluating for TEMPEST, the Certified TEMPEST Technical Authorities (CTTA) shall use the National Security Agency Information Assurance (NSA IA) list as an additional resource for specific technical threat information. *NOTE: These threat documents are classified. Associating the threat level or other threat information with the SCIF location (including country, city, etc.) will normally carry the same classification level identified in the threat document. Ensure that SCIF planning documents and discussions that identify threat with the country or SCIF location are protected accordingly.* It is critical to identify other occupants of common and adjacent buildings. (However, do not attempt to collect information against U.S. persons in violation of Executive Order (EO) 12333.) In areas where there is a diplomatic presence of high and critical threat countries, additional countermeasures may be necessary.

- b) Vulnerability Analysis. Assess the inherent susceptibility to attack of a procedure, facility, information system, equipment, or policy.
- c) Probability Analysis. Assess the probability of an adverse action, incident, or attack occurring.
- d) Consequence Analysis. Assess the consequences of such an action (expressed as a measure of loss, such as cost in dollars, resources, programmatic effect/mission impact, etc.).

## **B. Security in Depth (SID)**

1. SID describes the factors that enhance the probability of detection before actual penetration to the SCIF occurs. The existence of a layer or layers of security that offer mitigations for risks may be accepted by the AO. An important factor in determining risk is whether layers of security already exist at the facility. If applied, these layers may, with AO approval, alter construction requirements and extend security alarm response time to the maximum of 15 minutes. Complete documentation of any/all SID measures in place will assist in making risk decisions necessary to render a final standards decision.
2. SID is mandatory for SCIFs located outside the U.S. due to increased threat.
3. The primary means to achieve SID are listed below and are acceptable. SID requires that at least one of the following mitigations is applied:
  - a) Military installations, embassy compounds, U.S. Government (USG) compounds, or contractor compounds with a dedicated response force of U.S. persons.
  - b) Controlled buildings with separate building access controls, alarms, elevator controls, stairwell controls, etc., required to gain access to the buildings or elevators. These controls shall be fully coordinated with a formal agreement or managed by the entity that owns the SCIF.
  - c) Controlled office areas adjacent to or surrounding SCIFs that are protected by alarm equipment installed in accordance with manufacturer's instructions. These

controls shall be fully coordinated with a formal agreement or managed by the entity that owns the SCIF.

- d) Fenced compounds with access controlled vehicle gate and/or pedestrian gate.
- e) The AO may develop additional strategies to mitigate risk and increase probability of detection of unauthorized entry.

## **C. Compartmented Area (CA)**

### **1. Definition**

A CA is an area, room, or a set of rooms within a SCIF that provides controlled separation between control systems, compartments, sub-compartments, or Controlled Access Programs.

### **2. Requirements**

- a) The CA shall be approved by the AO with the concurrence of the CA Program Manager or designee. The CA Checklist (Chapter 13) shall be used to request approval.
- b) Any construction or security requirements above those listed herein require prior approval from the element head as described in ICS 705-2.

### **3. Access Control**

- a) Access control to the CA may be accomplished by visual recognition or mechanical/electronic access control devices.
- b) Spin-dial combination locks shall not be installed on CA doors.
- c) Independent alarm systems shall not be installed in a CA.

### **4. Visual Protection of CA Workstations**

If compartmented information will be displayed on a computer terminal or group of terminals in an area where everyone is not accessed to the program, the following measures may be applied to reduce the ability of “shoulder surfing” or inadvertent viewing of compartmented information:

- Position the computer screen away from doorway/cubicle opening.
- Use a polarizing privacy screen.
- Use partitions and/or signs.
- Existing private offices or rooms may be used but may not be a mandatory requirement.

### **5. Closed Storage**

When the storage, processing, and use of compartmented information, product, or deliverables is required, and all information shall be stored while not in use, then all of the following shall apply:

- a) Access and visual controls identified above shall be the standard safeguard.
- b) Compartmented information shall be physically stored in a General Services Administration (GSA) approved safe.

#### 6. Open Storage

In rare instances when open storage of information is required, the following apply:

- a) If the parent SCIF is accredited for open storage, a private office with access control on the door is adequate physical security protection.
- b) If the parent SCIF has been built and accredited for closed storage, then the CA perimeter shall be constructed and accredited to open storage standards.
- c) The CA AO may approve open or closed storage within the CA. Storage requirements shall be noted in both the CA Fixed Facility Checklist (FFC) and, if appropriate, in a Memorandum of Understanding (MOU).

#### 7. Acoustic and Technical Security

- a) All TEMPEST, administrative telephone, and technical surveillance countermeasure (TSCM) requirements for the parent SCIF shall apply to the CA and shall be reciprocally accepted.
- b) When compartmented discussions are required, the following apply:
  - (1) Use existing rooms that have been accredited for SCI discussions.
  - (2) Use administrative procedures to restrict access to the room during conversations.

## Chapter 3. Fixed Facility SCIF Construction

Requirements outlined within this chapter apply to all fixed facility SCIFs. Additional information and requirements for facilities located outside the U.S., its possessions or territories, are found in Chapters 4 and 5. Additional information and requirements for temporary SCIFs are described in Chapter 6.

### A. Personnel

Roles and responsibilities of key SCIF construction personnel are identified in ICS 705-1 and restated here for reference.

1. AO Responsibilities
  - a) Provide security oversight of all aspects of SCIF construction under their security purview.
  - b) Review and approve the design concept, Construction Security Plan (CSP), and final design for each construction project prior to the start of SCIF construction.
  - c) Depending on the magnitude of the project, determine if the Site Security Manager (SSM) performs duties on a full-time, principal basis, or as an additional duty to on-site personnel.
  - d) Accredite SCIFs under their cognizance.
  - e) Prepare waiver requests for the IC element head or designee.
  - f) Provide the timely input of all required SCIF data to the IC SCIF repository.
  - g) Consider SID on USG or USG-sponsored contractor facilities to substitute for standards herein. (SID shall be documented in the CSP and the FFC.)
2. Site Security Managers (SSMs) Responsibilities
  - a) Ensure the requirements herein are implemented and advise the AO of compliance or variances.
  - b) In consultation with the AO, develop a CSP regarding implementation of the standards herein. (This document shall include actions required to document the project from start to finish.)
  - c) Conduct periodic security inspections for the duration of the project to ensure compliance with the CSP.
  - d) Document security violations or deviations from the CSP and notify the AO within 3 business days.
  - e) Ensure that procedures to control site access are implemented.

3. CTTA Responsibilities

- a) Review SCIF construction or renovation plans to determine if TEMPEST countermeasures are required and recommend solutions. To the maximum extent practicable, TEMPEST mitigation requirements shall be incorporated into the SCIF design.
- b) Provide the Cognizant Security Authority (CSA) and AO with documented results of review with recommendations.

4. Construction Surveillance Technicians (CSTs) Responsibilities

- a) Supplement site access controls, implement screening and inspection procedures, as well as monitor construction and personnel, when required by the AO.
- b) In low and medium technical threat countries, begin surveillance of non-cleared workers at the start of SCIF construction or the installation of major utilities, whichever comes first.
- c) In high and critical technical threat countries, begin surveillance of non-cleared workers at the start of: construction of public access or administrative areas adjacent to the SCIF; SCIF construction; or the installation of major utilities, whichever comes first.

**B. Construction Security**

1. Prior to awarding a construction contract, a CSP for each project shall be developed by the SSM and approved by the AO.
2. Construction plans and all related documents shall be handled and protected in accordance with the CSP.
3. For SCIF renovation projects, barriers shall be installed to segregate construction workers from operational activities and provide protection against unauthorized access and visual observation. Specific guidance shall be contained in the CSP.
4. Periodic security inspections shall be conducted by the SSM or designee for the duration of the project to ensure compliance with construction design and security standards.
5. Construction and design of SCIFs should be performed by U.S. companies using U.S. citizens to reduce risk, but may be performed by U.S. companies using U.S. persons (an individual who has been lawfully admitted for permanent residence as defined in 8 U.S.C. § 1101(a)(20) or who is a protected individual as defined by Title 8 U.S.C. § 1324b (a)(3)). The AO shall ensure mitigations are implemented when using non-U.S. citizens. These mitigations shall be documented in the CSP.
6. All site control measures used shall be documented in the CSP. Among the control measures that may be considered are the following:
  - Identity verification.
  - Random searches at site entry and exit points.

- Signs at all entry points listing prohibited and restricted items (e.g., cameras, firearms, explosives, drugs, etc.).
- Physical security barriers to deny unauthorized access.
- Vehicle inspections.

## **C. Perimeter Wall Construction Criteria**

### **1. General**

- a) SCIF perimeters include all walls that outline the SCIF confines, floors, ceilings, doors, windows and penetrations by ductwork, pipes, and conduit. This section describes recommended methods to meet the standards described within ICS 705-1 for SCIF perimeters.
- b) Perimeter wall construction specifications vary by the type of SCIF, location, use of SID, and discussion requirements.
- c) Closed storage areas that do not require discussion areas do not have any forced entry or acoustic requirements.
- d) Open storage facilities without SID require additional protection against forced and surreptitious entry.
- e) When an existing wall is constructed with substantial material (e.g., brick, concrete, cinderblock, etc.) equal to meet the perimeter wall construction standards, the existing wall may be utilized to satisfy the specification.

### **2. Closed Storage, Secure Working Area (SWA), Continuous Operation, or Open Storage with SID - Use Wall A - Suggested Standard Acoustic Wall (see construction drawing for details).**

- a) Three layers  $\frac{5}{8}$  inch-thick gypsum wallboard (GWB), one layer on the uncontrolled side of the SCIF and two on the controlled side of the SCIF, to provide adequate rigidity and acoustic protection (Sound Class 3).
- b) Wallboard shall be attached to 3  $\frac{5}{8}$  inch-wide 16 gauge metal studs or wooden 2 x 4 studs placed no less than 16" on center (o.c.).
- c) 16 gauge continuous track (top & bottom) w/ anchors at 32" o.c. maximum) – bed in continuous bead of acoustical sealant.
- d) The interior two layers of wallboard shall be mounted so that the seams do not align (i.e., stagger joints).
- e) Acoustic fill 3  $\frac{1}{2}$  " (89mm) sound attenuation material, fastened to prevent sliding down and leaving void at the top.
- f) The top and bottom of each wall shall be sealed with an acoustic sealant where it meets the slab.

- g) Fire safe non-shrink grout, or acoustic sealant in all voids above/below track both sides of partition.
  - h) Entire wall assembly shall be finished and painted from true floor to true ceiling.
3. Open Storage without SID -- Use Wall B - Suggested Wall for Expanded Metal or Wall C - Suggested Wall for Plywood.
- a) Three layers of  $\frac{5}{8}$  inch-thick GWB, one layer on the uncontrolled side of the SCIF and two on the controlled side of the SCIF to provide adequate rigidity and acoustic protection (Sound Class 3).
  - b) Wallboard shall be attached to 3  $\frac{5}{8}$  inch-wide 16 gauge metal studs or wooden 2 x 4 studs placed no less than 16" o.c.
  - c) 16 gauge continuous track (top & bottom) w/ anchors at 32" on center (o.c.) maximum) – bed in continuous bead of acoustical sealant.
  - d) Wall B - Suggested Wall for Expanded Metal (see drawing for Wall B-Suggested Construction for Expanded Metal).
    - (1) Three-quarter inch mesh, # 9 (10 gauge) expanded metal shall be affixed to the interior side of all SCIF perimeter wall studs.
    - (2) Expanded metal shall be spot-welded to the studs every six inches along the length of each vertical stud and at the ceiling and floor.
    - (3) Hardened screws with one inch washers or hardened clips may be used in lieu of welding to fasten metal to the studs. Screws shall be applied every six inches along the length of each vertical stud and at the ceiling and floor.
    - (4) Fastening method shall be noted in the FFC.
    - (5) Entire wall assembly shall be finished and painted from true floor to true ceiling.
  - e) Wall C - Suggested Wall for Plywood (see drawing for Wall C-Suggested Construction for Plywood).
    - (1) Three layers of  $\frac{5}{8}$  inch-thick GWB, two layers on the uncontrolled side and one layer GWB over minimum  $\frac{1}{2}$  " plywood on the controlled side of the SCIF.  
NOTE: CTTA recommended countermeasures (foil backed GWB or layer of approved Ultra Radiant R-Foil) shall be installed in accordance with (IAW) best practices for architectural Radio Frequency (RF) shielding. Foil shall be located between the layer of plywood and GWB.
    - (2) 1/2" Plywood affixed 8' vertical by 4' horizontal to 16 gauge studs using glue and #10 steel tapping screws at 12 o.c.
    - (3) GWB shall be mounted to plywood with screws avoiding contact with studs to mitigate any possible acoustic flanking path.
    - (4) 16 gauge continuous track (top & bottom) w/ anchors at 32" o.c. maximum) – bed in continuous bead of acoustical sealant.



(5) Fire safe non-shrink grout, or acoustic sealant in all voids above/below track both sides of partition.

(6) Entire wall assembly shall be finished and painted from true floor to true ceiling.

4. Radio Frequency (RF) Protection for Perimeter Walls

a) RF protection shall be installed at the direction of the CTTA when a SCIF utilizes electronic processing and does not provide adequate RF attenuation at the inspectable space boundary. It is recommended for all applications where RF interference from the outside of the SCIF is a concern inside the SCIF.

b) Installation of RF protection should be done using either the drawings or *Best Practices Guidelines for Architectural Radio Frequency Shielding*, prepared by the Technical Requirements Steering Committee under the Center for Security Evaluation. This document is available through the Center for Security Evaluation, Office of the Director of National Intelligence (NCSC/CSE).

5. Vault Construction Criteria

GSA-approved modular vaults meeting Federal Specification AA-V-2737 or one of the following construction methods may be used:

a) Reinforced Concrete Construction

(1) Walls, floor, and ceiling will be a minimum thickness of eight inches of reinforced concrete.

(2) The concrete mixture will have a comprehensive strength rating of at least 2,500 pounds per square inch (psi).

(3) Reinforcing will be accomplished with steel reinforcing rods, a minimum of  $\frac{5}{8}$  inches in diameter, positioned centralized in the concrete pour and spaced horizontally and vertically six inches on center; rods will be tied or welded at the intersections.

(4) The reinforcing is to be anchored into the ceiling and floor to a minimum depth of one-half the thickness of the adjoining member.

b) Steel-Lined Construction Where Unique Structural Circumstances Do Not Permit Construction of a Concrete Vault

(1) Construction will use  $\frac{1}{4}$  inch-thick steel alloy-type plates having characteristics of high-yield and high-tensile strength.

(2) The steel plates are to be continuously welded to load-bearing steel members of a thickness equal to that of the plates.

(3) If the load-bearing steel members are being placed in a continuous floor and ceiling of reinforced concrete, they must be firmly affixed to a depth of one-half the thickness of the floor and ceiling.

(4) If floor and/or ceiling construction is less than six inches of reinforced concrete, a steel liner is to be constructed the same as the walls to form the floor

and ceiling of the vault. Seams where the steel plates meet horizontally and vertically are to be continuously welded together.

All vaults shall be equipped with a GSA-approved Class 5 vault door.

#### **D. Floor and Ceiling Construction Criteria**

1. Floors and ceilings shall be constructed to meet the same standards for force protection and acoustic protection as walls.
2. All floor and ceiling penetrations shall be kept to a minimum.

#### **E. SCIF Door Criteria**

1. There shall be only one primary SCIF entrance where visitor control is conducted.
  - a) Primary entrance doors shall be equipped with the following:
    - (1) A GSA-approved pedestrian door deadbolt meeting Federal Specification FF-L- 2890.
    - (2) A combination lock meeting Federal Specification FF-L 2740A.
    - (3) An approved access-control device (see Chapter 8).
    - (4) May be equipped with a high security keyway for use in the event of an access control system failure.
  - b) With AO approval, additional entrance doors may be designated for use by SCIF residents provided that the doors are equipped with an approved access control system and are secured with an approved dead bolt or lock when the SCIF is not occupied. The dead-bolt shall not be accessible from the exterior.
2. When practical, entrance doors should incorporate a vestibule to preclude visual observation and enhance acoustic protection.
3. All perimeter SCIF doors shall be equipped with an automatic, non-hold door-closer which shall be installed internal to the SCIF, if possible.
4. Emergency exit doors shall:
  - Be secured with deadlocking panic hardware on the inside.
  - Have no exterior hardware.
  - Be alarmed 24/7.
  - Provide a local audible annunciation when opened.
5. Hinge pins that are accessible from outside of the SCIF door shall be modified to prevent removal of the door, e.g., welded, set screws, etc.
6. SCIF doors and frame assemblies shall meet acoustic requirements as described in Chapter 9 unless declared a non-discussion area.
7. All perimeter doors shall be alarmed in accordance with Chapter 7.

8. Perimeter doors shall comply with applicable building, safety, and accessibility codes and requirements.
9. Perimeter doors shall meet TEMPEST requirements when applicable.
10. Wood doors shall be 1 ¾ inch-thick solid wood core (wood stave).
11. Steel doors shall meet following specifications:
  - 1 ¾ inch-thick face steel equal to 18 gauge.
  - Hinges reinforced to 7 gauge.
  - Door closure reinforced to 12 gauge.
  - Lock area predrilled and/or reinforced to 10 gauge.
12. A vault door shall not be used to control day access to a facility. To mitigate both security and safety concerns, a vestibule with an access control device may be constructed.
13. Roll-up Door Specifications
  - a) A roll-up door cannot be treated for acoustics and shall only be located in an area of the SCIF that is designated as a non-discussion area.
  - b) Roll-up doors shall be 18 gauge steel or greater and shall be secured inside the SCIF using dead-bolts on both the right and left side of the door.
14. Double Door Specifications
  - a) One of the doors shall be secured at the top and bottom with deadbolts.
  - b) An astragal strip shall be attached to one door (could be either the secured or the movable door depending on the inward/outward swing of door assembly) to prevent observation of the SCIF through the cracks between the doors.
  - c) Each door shall have an independent high-security switch.

#### **F. SCIF Window Criteria**

1. Every effort should be made to minimize or eliminate windows in the SCIF, especially on the ground floor.
2. Windows shall be non-opening.
3. Windows shall be protected by security alarms in accordance with Chapter 7 when they are within 18 feet of the ground or an accessible platform.
4. Windows shall provide visual and acoustic protection.
5. Windows shall be treated to provide RF protection when recommended by the CTTA.
6. All windows less than 18 feet above the ground or from the nearest platform affording access to the window (measured from the bottom of the window), shall be protected against forced entry and meet the standard for the perimeter.

## **G. SCIF Perimeter Penetrations Criteria**

1. All penetrations of perimeter walls shall be kept to a minimum.
2. Metallic penetrations may require TEMPEST countermeasures, to include dielectric breaks or grounding, when recommended by the CTTA.
3. Utilities servicing areas other than the SCIF shall not transit the SCIF unless mitigated with AO approval.
4. Utilities should enter the SCIF at a single point.
5. All utility (power and signal) distribution on the interior of a perimeter wall treated for acoustics or RF shall be surface mounted, contained in a raceway, or an additional wall shall be constructed using furring strips as stand-off from the existing wall assembly. If the construction of an additional wall is used, gypsum board may be  $\frac{3}{8}$  inch-thick and need only go to the false ceiling.
6. Installation of additional conduit penetration for future utility expansion is permissible provided the expansion conduit is filled with acoustic fill and capped (end of pipe cover).
7. Vents and Ducts
  - a) All vents and ducts shall be protected to meet the acoustic requirements of the SCIF. (See Figure 4, Typical Air (Z) Duct Penetration, for example.)
  - b) Walls surrounding duct penetrations shall be finished to eliminate any opening between the duct and the wall.
  - c) All vents or duct openings that penetrate the perimeter walls of a SCIF and exceed 96 square inches shall be protected with permanently affixed bars or grills.
    - (1) If one dimension of the penetration measures less than six inches, bars or grills are not required.
    - (2) When metal sound baffles or wave forms are permanently installed and set no farther apart than six inches in one dimension, then bars or grills are not required.
    - (3) If bars are used, they shall be a minimum of  $\frac{1}{2}$  inch diameter steel, welded vertically and horizontally six inches on center; a deviation of  $\frac{1}{2}$  inch in vertical and/or horizontal spacing is permissible.
    - (4) If grilles are used they shall be of:
      - (a)  $\frac{3}{4}$  inch-mesh, #9 (10 gauge), case-hardened, expanded metal; or
      - (b) expanded metal diamond mesh, 1-1/2" #10 (1-3/8" by 3" openings, 0.093" thickness, with at least 80% open design) tamperproof; or
      - (c) welded wire fabric (WWF) 4x4 W2.9xW2.9 (6 gauge smooth steel wire welded vertically and horizontally four inches o.c.).

(5) If bars, grilles, or metal baffles/wave forms are required, an access port shall be installed inside the secure perimeter of the SCIF to allow visual inspection of the bars, grilles, or metal baffles/wave forms. If the area outside the SCIF is controlled (SECRET or equivalent proprietary space), the inspection port may be installed outside the perimeter of the SCIF and be secured with an AO-approved high-security lock. This shall be noted in the FFC.

#### **H. Alarm Response Time Criteria for SCIFs within the U.S.**

Response times for Intrusion Detection Systems (IDS) shall meet 32 CFR Parts 2001 and 2004.

- a) Closed Storage response time of 15 minutes.
- b) Open Storage response time within 15 minutes of the alarm annunciation if the area is covered by SID or a five minute alarm response time if it is not.

#### **I. Secure Working Areas (SWA)**

SWAs are accredited facilities used for discussing, handling, and/or processing SCI, but where SCI will not be stored.

- 1. The SWA shall be controlled at all times by SCI-indoctrinated individuals or secured with a GSA-approved combination lock.
- 2. The SCIF shall be alarmed in accordance with Chapter 7 with an initial alarm response time of 15 minutes.
- 3. Access control shall be in accordance with Chapter 8.
- 4. Perimeter construction shall comply with section 3.C. above.
- 5. All SCI used in an SWA shall be removed and stored in GSA-approved security containers within a SCIF, a vault, or be destroyed when the SWA is unoccupied.

#### **J. Temporary Secure Working Area (TSWA)**

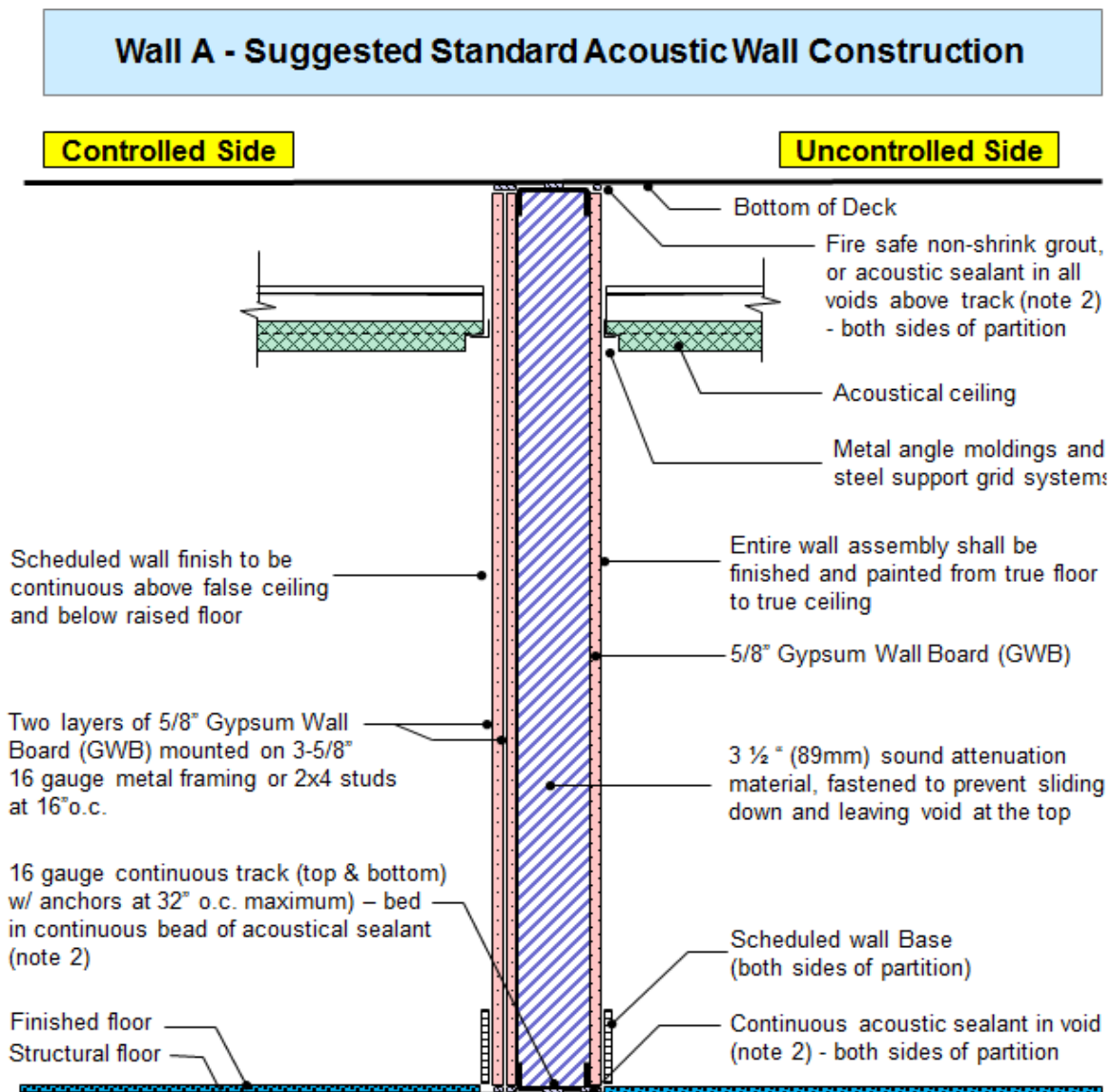
TSWAs are accredited facilities where handling, discussing, and/or processing of SCI is limited to less than 40-hours per month and the accreditation is limited to 12 months or less. Extension requests require a plan to accredit as a SCIF or SWA. Storage of SCI is not permitted within a TSWA.

- 1. When a TSWA is in use at the SCI level, access shall be limited to SCI- indoctrinated persons.
- 2. The AO may require an alarm system.
- 3. No special construction is required.
- 4. When the TSWA is approved for SCI discussions, sound attenuation specifications of Chapter 9 shall be met.
- 5. The AO may require a TSCM evaluation if the facility has not been continuously controlled at the SECRET level.

6. When the TSWA is not in use at the SCI level, the following shall apply:
  - a) The TSWA shall be secured with a high-security, AO-approved key or combination lock.
  - b) Access shall be limited to personnel possessing a minimum U.S. SECRET clearance.

**Figure 1**

**Wall A – Suggested Standard Acoustic Wall Construction**

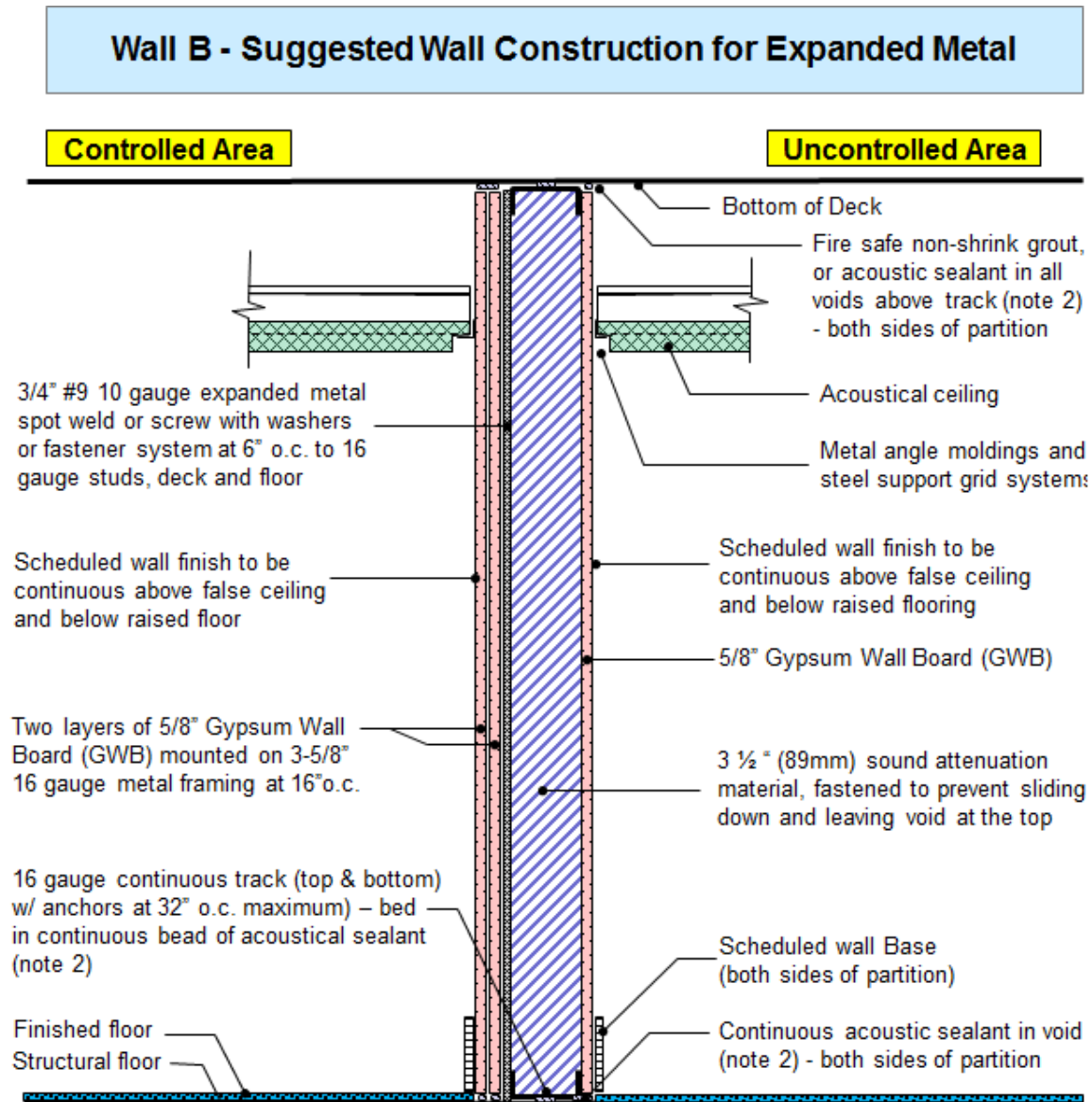


**Notes:**

- 1 CTTA recommended countermeasures (foil backed GWB or layer of approved Ultra Radiant R-Foil) shall be installed IAW best practices for architectural Radio Frequency (RF) shielding. Foil shall be located between the two layers of GWB.
- 2 Partition shall be sealed continuously with acoustical sealant whenever it abuts another element (e.g., wall, column, mullion, etc.)
- 3 Any electrical or communications outlets required on the perimeter wall shall be surface mounted.

**Figure 2**

**Wall B - Suggested Construction for Expanded Metal**

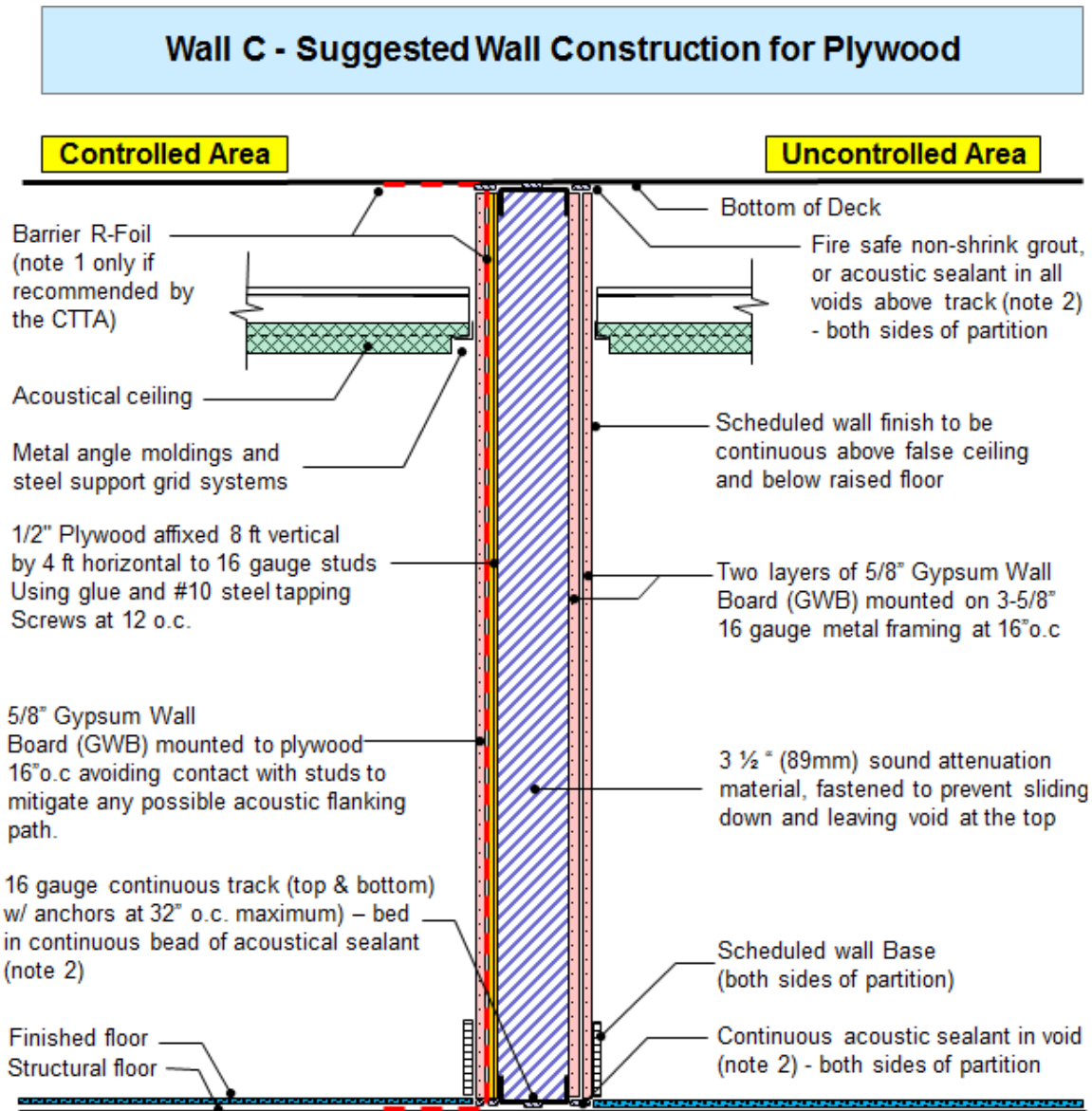


**Notes:**

- 1 CTTA recommended countermeasures (foil backed GWB or layer of approved Ultra Radiant R-Foil) shall be installed IAW best practices for architectural Radio Frequency (RF) shielding. Foil shall be located between the two layers of GWB.
- 2 Partition shall be sealed continuously with acoustical sealant whenever it abuts another element (e.g., wall, column, mullion, etc.)
- 3 Any electrical or communications outlets required on the perimeter wall shall be surface mounted.



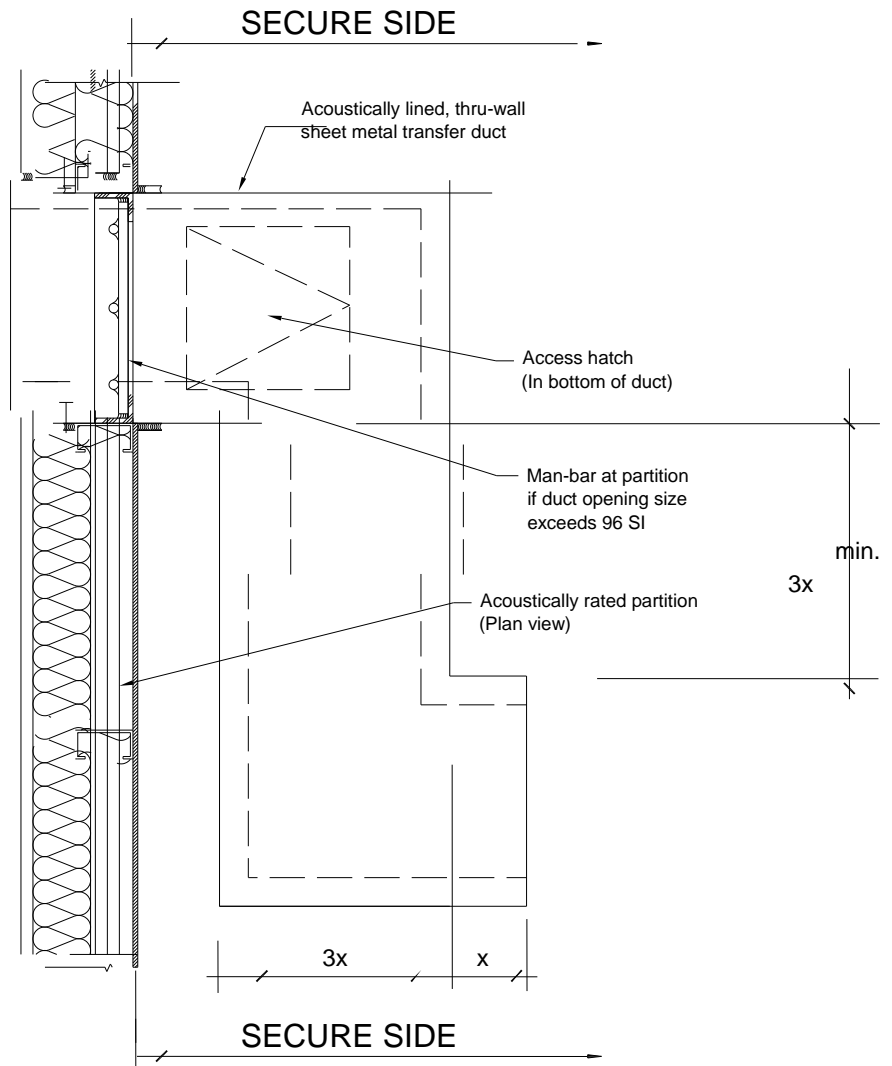
**Figure 3**  
**Wall C – Suggested Construction for Plywood**



**Notes:**

- 1 CTTA recommended countermeasures (foil backed GWB or layer of approved Ultra Radiant R-Foil) shall be installed IAW best practices for architectural Radio Frequency (RF) shielding. Foil shall be located between the layer of plywood and GWB.
- 2 Partition shall be sealed continuously with acoustical sealant whenever it abuts another element (e.g., wall, column, mullion, etc.).
- 3 Any electrical or communications outlets required on the perimeter wall shall be surface mounted.

**Figure 4**  
Typical Perimeter Air (Z) Duct Penetration



Rev. 04-05

## Chapter 7. Intrusion Detection Systems (IDS)

### A. Specifications and Implementation Requirements

#### 1. General SCIF IDS Requirements

- a) SCIFs shall be protected by IDS when not occupied.
- b) Interior areas of a SCIF through which reasonable access could be gained, including walls common to areas not protected at the SCI level, shall be protected by IDS. However, these adjacent areas do not need IDS protection if the AO determines that a facility's security programs consist of layered and complementary controls sufficient to deter and detect unauthorized entry and movement.
- c) Doors without access control systems and that are not under constant visual observation shall be continuously monitored by the IDS.
- d) If any component of the IDS is disrupted to the extent the system no longer provides essential monitoring service (e.g., loss of line security, inoperable Intrusion Detection Equipment (IDE), or loss of power), SCI-indoctrinated personnel shall physically occupy the SCIF until the system is returned to normal operation. As an alternative, the outside SCIF perimeter may be continuously monitored by a response or guard force.
- e) IDS failure shall be addressed in the SCIF emergency plan.

#### 2. System Requirements

- a) IDS installation related components and monitoring stations shall comply with Underwriters Laboratories (UL) Standard for National Industrial Security Systems for the Protection of Classified Material, UL 2050.
- b) Installation shall comply with an Extent 3 installation as referenced in UL 2050.
- c) Systems developed and used exclusively by the USG do not require UL certification, but shall nonetheless comply with an Extent 3 installation as referenced in UL 2050.
- d) Areas of a SCIF through which reasonable access could be gained, including walls common to areas not protected at the SCI level, shall be protected by IDS consisting of UL 639 listed motion sensors and UL 634 listed High Security Switches (HSS) that meet UL Level II requirements and/or other AO-approved equivalent sensors. All new SCIF accreditations shall use UL Level II HSS. Existing UL Level I HSS are authorized until major IDS modifications/upgrades are made.
- e) IDE cabling that extends beyond the SCIF perimeter shall employ Encrypted Line Security or be installed in a closed and sealed metal conveyance defined as a pipe, tube or the like constructed of ferrous Electrical Metallic Tubing (EMT), ferrous pipe conduit or ferrous rigid sheet metal ducting. All joints and connections shall be permanently sealed completely around all surfaces (e.g. welding, epoxy, fusion, etc.). Set screw shall not be used. The seal shall provide a continuous bond between the

components of the conveyance. If a service or pull box must be utilized, it must be secured with a GSA approved combination padlock or AO approved key lock.

f) SCIFs that share common or contiguous perimeter and support the same IC Element, or have an established Co-Use-Agreement (CUA), may have the Premise Control Unit (PCU) programmed into multiple logical units or partitions, of the same PCU, that function as individual control units for the intrusion detection system installed in multiple areas or rooms operated independently of one another. All conditions of compliance that apply to a PCU and IDS apply equally to the partitions of the PCU. The PCU shall be independent of IDS safeguarding non-UL 2050 certified areas.

g) If a monitoring station is responsible for more than one IDS, there shall be an audible and visible annunciation for each IDS.

h) IDS's shall be separate from, and independent of, fire, smoke, radon, water, and other systems.

i) If the IDS incorporates an access control system (ACS), notifications from the ACS shall be subordinate in priority to IDS alarms.

j) System key variables and passwords shall be protected and restricted to U.S. SCI-indoctrinated personnel.

k) IDS technical drawings, installation instructions, specifications, etc., shall be restricted as determined by the AO and documented in the CSP.

l) Systems shall not include audio or video monitoring without the application of appropriate countermeasures and AO approval.

m) Monitoring systems containing auto-reset features shall have this feature disabled.

n) Alarm activations shall remain displayed locally until cleared by an authorized SCI-cleared individual.

o) The AO shall approve all system plans. Final system acceptance testing shall be included as part of the SCIF accreditation package.

p) False alarms shall not exceed one alarm per 30-day period per IDS partition. False alarms are any alarm signal transmitted in the absence of a confirmed intrusion that is caused by changes in the environment, equipment malfunction or electrical disturbances. If false alarms exceed this requirement, a technical evaluation of the system shall be conducted to determine the cause, repaired or resolved, and documented.

### 3. System Components

#### a) Sensors

(1) All system sensors shall be located within the SCIF, except as noted in 3.a.(2) below.

(2) With AO approval, sensors external to the SCIF perimeter may be installed in accordance with paragraph A.2.e.

- (3) Failed sensors shall cause immediate and continuous alarm activation until the failure is investigated and corrected by procedures as documented in the SCIF SOP or Emergency Action Plan.
  - (4) Dual technology sensors are authorized when each technology transmits alarm conditions independent of the other technology.
  - (5) A sufficient number of motion detection sensors shall be installed to meet the requirements of paragraph A.2.d or shall be approved by the AO. However, for facilities outside the U.S. and in Category I and II countries, motion detection sensors above false ceilings or below false floors may be required by the AO.
  - (6) When the primary entrance door employs a delay to allow for changing the system mode of access, the delay shall not exceed 30 seconds.
  - (7) SCIF perimeter doors shall be protected by an HSS and a motion detection sensor.
  - (8) Emergency exit doors shall be alarmed and monitored 24 hours per day.
- b) Premise Control Units (PCUs)
- (1) PCUs shall be located within a SCIF and only SCIF personnel may initiate changes in access modes.
  - (2) Operation of the access/secure switch shall be restricted by using a device or procedure that validates authorized use.
  - (3) Cabling between all sensors and the PCU shall be dedicated to the system, be contained within the SCIF, and shall comply with national and local electric codes and Committee for National Security Systems (CNSS) standards. If the wiring cannot be contained within the SCIF, such cabling shall meet the requirements for External Transmission Line Security 3.b.(10) below.
  - (4) Alarm status shall be continuously displayed with an alphanumeric display at the PCU and/or monitoring station.
  - (5) Every effort shall be made to design and install the alarm-monitoring panel in a location that prevents observation by unauthorized persons.
  - (6) The monitoring station or PCU shall identify and display activated sensors.
  - (7) Immediate and continuous alarm annunciations shall occur for the following conditions.
    - (a) Intrusion Detection
    - (b) Failed Sensor
    - (c) Tamper Detection
    - (d) Maintenance Mode (a maintenance message displayed in place of an alarm)
    - (e) IDE Sensor Points shunted or masked during maintenance mode
  - (8) A change in power status (AC or backup) shall be indicated locally and at the monitoring station.

(9) All system events shall be reset by authorized SCI-indoctrinated personnel after an inspection of the SCIF and a determination for the cause of the alarm. Any auto-alarm reset feature of the IDS shall be disabled.

(10) IDS transmission lines leaving the SCIF to the monitoring station, must meet National Institute of Standards and Technology, Federal Information Processing Standards (FIPS) for certified encrypted lines. The FIPS standard employed must be noted on the UL 2050/CRZH Certificate or other certificate employed. PCUs certified under UL 1610 must meet FIPS 197 or FIPS 140-2 encryption certification and methods. For PCUs certified under UL1076, only FIPS 140-2 is the acceptable encryption certification and method. Alternative methods shall be approved by the AO and noted on the IDS Certificate

(11) The SCI cleared IDS Administrator(s) shall change maintenance and master profiles, PINs or passcodes from their default settings to a unique PIN or passcode.

c) Integrated IDS and Remote Terminal Access.

(1) US government LAN or WAN requires the AO's Chief Information Officer (CIO) to be consulted before connecting an IDS. The system hosting the IDS shall be issued Authority to Operate (ATO) by the agency CIO, following the FISMA Risk Management Framework as outlined in NIST SP 800-53.

(2) For IDS that have been integrated into a networked system (local area network (LAN) or wide area network (WAN)), the requirements below shall be met.

(a) IDS System software shall be installed on a host computing device that is logically and physically restricted to corporate/government security elements cleared to the SCI level. The host device shall be located in a Physically Protected Space, which is defined as a locked room with walls, floor and ceiling that are fixed in place forming a solid physical boundary to which only SCI-cleared personnel have access. If uncleared personnel or personnel with less than SCI indoctrination require access to this space, they shall be escorted by authorized SCI-cleared personnel. The door(s) shall use Commercial Grade 1 hardware fitted with high security key cylinder(s) in compliance with UL 437. This room will be protected by a UL Extent 3 burglar alarm system and access control unless manned 24 hours.

(b) All system components and equipment shall be isolated in a manner that may include, but are not limited to firewalls, Virtual Private Networks, Virtual Routing Tables, Application Level security mechanisms or similar enhancements, that are configured to allow secure and private data transfers only between the PCU, host computer, remote terminal and monitoring station.

(c) If any component of the IDS is remotely programmable, continuous network monitoring is required. Continuous network monitoring includes auditing and reporting of network intrusion detection and prevention systems used in A.3.c.2.b.

(d) A secondary communication path may be utilized to augment an existing data communication link to reduce investigations of data communication failures of less than five minute duration. The supervision provided by the secondary communication path shall be equivalent to that of the primary communication path. The secondary communications path may only be wireless if approved by the AO in consultation with the CTTA and/or the appropriate technical authority.

(e) A unique user ID and password is required for each individual granted access to the system host computing devices or remote terminal. Passwords shall be a minimum of twelve characters consisting of alpha, numeric, and special characters, and shall be changed every six months or utilize US Government Personal Identity Verification (PIV) Card or Common Access Card (CAC) with two factor certificate authentication.

(f) Individuals with IDS administrative access shall immediately notify the AO or designee of any unauthorized modifications.

(g) All transmissions of system information over the LAN/WAN shall be encrypted using National Institute of Standards and Technology (NIST) FIPS 140-2, VPN, or closed and sealed conveyance (see A.2.e). FIPS-197 (AES) may be used with AO approval.

(h) Remote System terminals shall:

- Utilize role based user permissions (e.g. Super User, SO, Guard) as approved by the AO. USG installations shall be in compliance with paragraph 7.A.3.c.1 Prohibit Non SCI Cleared personnel from modifying the IDS or ACS.
- Require an independent user ID and password in addition to the host login requirements. Requirements for IDS Systems Software Passwords shall be: a unique user ID and password for each individual granted access to the remote terminal. Passwords shall be a minimum of twelve characters consisting of alpha, numeric, and special characters and shall be changed every six months or utilize US Government Personal Identity Verification (PIV) Card

or Common Access Card (CAC) with two factor certificate authentication if supported by the application.

- Host systems shall log and monitor failed login attempts. All remote sessions shall be documented and accessible to AO upon request.
- All Host systems and PCUs shall be patched and maintained to implement current firmware and security updates. USG systems shall be in compliance with Information Assurance Vulnerability Alert (IAVA) guidance.

## **B. IDS Modes of Operation**

### **1. General Information**

- a) The system shall operate in either armed or disarmed mode.
- b) There shall be no remote capability for changing the mode of operation by non-SCI cleared personnel.
- c) Changing arm/disarm status of the system shall be limited to SCI-indoctrinated personnel.

### **2. Requirements for Disarmed Mode**

- a) When in disarmed mode, normal authorized entry into the SCIF, in accordance with prescribed security procedures, shall not cause an alarm.
- b) A record shall be maintained that identifies the person responsible for disarming the system.
- c) Tamper circuits and emergency exit door circuits shall remain in the armed mode of operation.
- d) The PCU shall have the ability to allow alarm points to remain in armed status while other points are in disarmed status.

### **3. Requirements for Armed Mode**

- a) The system shall be placed into armed mode when the last person departs the SCIF.
- b) A record shall be maintained identifying the person responsible for arming the system.
- c) Each failure to arm or disarm the system shall be reported to the responsible SCIF Security Manager. Records of these events shall be maintained for two years.
- d) When in the armed mode, any unauthorized entry into the SCIF shall cause an alarm to be immediately transmitted to the monitoring station.

### **4. Requirements for Maintenance and Zone Shunting/Masking Modes**



- a) When maintenance is performed on a system, the monitoring station must be notified and logged. The initiation of system maintenance can only be performed by an SCI cleared IDS administrator or SCIF Security Officer (SO).
  - b) When an IDE point is shunted or masked for reasons other than maintenance, it shall be displayed as such at the monitoring station throughout the period the condition exists.
  - c) Any sensor that has been shunted shall be reactivated upon the next change in status from armed to disarmed.
  - d) All maintenance periods shall be archived in the system.
  - e) A Personal Identification Number (PIN) is required, for maintenance purposes, to be established and controlled by the SCI cleared IDS administrator or SCIF SO. Procedures shall be documented in the SCIF SOP.
  - f) Portable Electronic Devices (PEDs) are allowed attachment to system equipment either temporarily or permanently for the purposes of system maintenance, repair and reporting (See A.3.c). In addition, when utilizing a stand-alone device, the requirements below shall be met.
    - (1) Such devices shall be kept under control of SCI-cleared personnel.
    - (2) When not in use, the PED shall be maintained in a Physically Protected Space (see A.3.c.2.a).
    - (3) Mass storage devices containing SCIF alarm equipment details, configurations, or event data will be protected at an appropriate level approved by the AO.
  - g) After the initial installation, the capability for remote diagnostics, maintenance, or programming of IDE shall be accomplished only by SCI-cleared personnel and shall be logged or recorded.
5. Requirements for Electrical Power
- a) In the event of primary power failure, the system shall automatically transfer to an emergency electrical power source without causing alarm activation.
  - b) Twenty-four hours of uninterruptible backup power is required and shall be provided by batteries, an uninterruptible power supply (UPS), generators, or any combination.
  - c) An audible or visual indicator at the PCU shall provide an indication of the primary or backup electrical power source in use.
  - d) Equipment at the monitoring station shall visibly and audibly indicate a failure in a power source or a change in power source. The individual system that failed or changed shall be indicated at the PCU or monitoring station as directed by the AO.
6. Monitoring Stations
- a) Monitoring stations shall be government-managed or one of the following in accordance with UL 2050:

- (1) AO-operated monitoring station.
- (2) Government contractor monitoring station (formerly called a proprietary central station).
- (3) National industrial monitoring station.
- (4) Cleared commercial central station (see NISPOM, Chap. 5).
- b) Monitoring station employees shall be eligible to hold a U.S. SECRET clearance.
- c) Monitoring station operators shall be trained in system theory and operation to effectively interpret system incidents and take appropriate response action.
- d) Records shall be maintained in accordance with Chapter 12 section L:

## **C. Operations and Maintenance of IDS**

### **1. Alarm Response**

- a) Alarm activations shall be considered an unauthorized entry until resolved.
- b) The response force shall take appropriate steps to safeguard the SCIF, as permitted by a written support agreement, until an SCI-indoctrinated individual arrives to take control of the situation.
- c) An SCI indoctrinated individual must arrive as soon as possible to conduct an internal inspection of the SCIF, attempt to determine the probable cause of the alarm activation and reset the IDS prior to the departure of the response force.

### **2. System Maintenance**

- a) Maintenance and repair personnel shall be escorted if they are not TOP SECRET-cleared and indoctrinated for SCIF access.
- b) Repairs shall be initiated by a service technician within 4 hours of the receipt of a trouble signal or a request for service.
- c) The SCIF shall be continuously manned by SCI-indoctrinated personnel on a 24-hour basis until repairs are completed or alternate documented procedures approved by the AO are initiated.
- d) The following apply to emergency-power battery maintenance:
  - (1) The battery manufacturer's periodic maintenance schedule and procedures shall be followed and documented in the system's maintenance logs and retained for two years. Batteries should be replaced per manufacture's recommendations or as environmental conditions dictate.
  - (2) If the communications path is via a network, the local uninterruptible power source for the network shall also be tested.
  - (3) If a generator is used to provide emergency power, the manufacturers recommended maintenance and testing procedures shall be followed.

### **e) Network Maintenance**

- (1) System administrators shall maintain configuration control, ensure the latest operating system security patches have been applied, and configure the operating system to provide a high level of security.
- (2) Inside the U.S., network maintenance personnel within a SCIF shall be a U.S. person and be escorted by cleared SCIF individuals.
- (3) Outside the U.S., network maintenance personnel shall be U.S. TOP SECRET-cleared or U.S. SECRET-cleared and escorted by SCIF personnel.

## **D. Installation and Testing of IDS**

### **1. Personnel Requirements**

- a) Installation and testing within the U.S. shall be performed by U.S. companies using U.S. citizens.
- b) Installation and testing outside of the U.S. shall be performed by personnel who are U.S. TOP SECRET-cleared or U.S. SECRET-cleared and escorted by SCIF personnel.

### **2. Installation Requirements**

All system components and elements shall be installed in accordance with requirements of this document, UL 2050, and manufacturer's instructions and standards.

### **3. Testing**

- a) Acceptance testing shall be conducted on systems prior to operational use to provide assurance that they meet all requirements of this section prior to SCIF accreditation.
- b) Semi-annual IDS testing shall be conducted to ensure continued performance.
- c) Records of testing and test performance shall be maintained in accordance with documentation requirements.
- d) Motion Detection Sensor Testing
  - (1) All motion detection sensors shall be tested to ensure activation of the sensor at a minimum of four consecutive steps at a rate of one step per second; that is, 30 inches  $\pm$  3 inches or 760 mm  $\pm$  80 mm per second. The four-step movement shall constitute a "trial."
  - (2) The test shall be conducted by taking a four-step trial, stopping for three to five seconds, and taking another four-step trial.
  - (3) Trials shall be repeated throughout the SCIF and from different directions.
  - (4) An alarm shall activate at least three out of every four consecutive trials made by moving progressively through the SCIF.
- e) HSS Testing

All HSS devices shall be tested to ensure that an alarm signal activates before the non-hinged side of the door opens beyond the thickness of the door from the closed position, e.g., the sensor initiates before the door opens 1¾ inch for a 1¾ inch door.

f) Tamper Testing

- (1) Each IDS equipment cover shall be individually removed or opened to ensure there is alarm activation at the PCU or monitoring station in both the secure and access modes.
- (2) Tamper detection devices need only be tested when installed.
- (3) The AO may require more frequent testing of tamper circuits.

## Chapter 8. Access Control Systems (ACS)

### A. SCIF Access Control

#### 1. Guidelines

- a) SCIFs shall be controlled by SCI-indoctrinated personnel or by an AO- approved ACS to ensure access is restricted to authorized personnel.
- b) Personnel access control shall be utilized at all SCIFs.
- c) Visual recognition of persons entering the SCIF by an SCI-indoctrinated person at the entrance to a SCIF is the ideal access control.
- d) Entrances where visitor control is conducted shall be under continuous visual observation unless the SCIF is properly secured.
- e) When the SCIF is an entire building, access control shall occur at the building perimeter.

#### 2. ACS Requirements if Continuous Visual Observation is Not Possible

- a) An automated personnel ACS that verifies an individual's identity before the individual is permitted unescorted access shall be utilized when personal recognition and verification is not used. Automated verification shall employ **two** of the following three technologies:
  - (1) Identification (ID) badge or card used in conjunction with the access control device that validates the identity of the person to whom the card is issued. Compromised or lost access cards shall be reported immediately and updated in the system to reflect "no access."
  - (2) A personal identification number (PIN) that is entered into the keypad by each individual. The PIN shall consist of four or more random digits, with no known or logical association to the individual or which can be derived from the person or system generated. Compromised PINs shall be reported immediately to the facility Security Officer (SO) or SCIF SO and updated in the system to reflect "no access."
  - (3) Biometric personal identity verification using unique personal characteristics such as fingerprint, iris scan, palm print, etc.
- b) The automated personnel ACS shall ensure that the probability of an unauthorized individual gaining access is no more than one in ten thousand while the probability of an authorized individual being rejected access is no more than one in one thousand. Manufacturers must certify in writing that their system meets these criteria.

## **B. ACS Administration**

1. ACS administrators shall be SCI-indoctrinated.
2. Remote release buttons that by-pass the ACS shall be inside the SCIF and in a location that provides continuous visual observation of personnel entering the SCIF.
3. ACSs shall not be used to secure an unoccupied SCIF.
4. When not occupied, SCIFs shall be alarmed and in secure mode in accordance with Chapter 7 and secured with an approved GSA FF-L-2740A combination lock.
5. Authorized personnel who permit another individual to enter the SCIF shall verify the individual's authorized access.
6. SCIF access authorization shall be removed when the individual is transferred, terminated, or the access approval is suspended or revoked.

## **C. ACS Physical Protection**

1. Card readers, keypads, communication interface devices, and other access control equipment located outside the SCIF shall be tamper-protected and be securely fastened to a wall or other fixed structure.
2. Electrical components, associated wiring, or mechanical links shall be accessible only from inside the SCIF.
3. System data that is carried on transmission lines (e.g., access authorizations, personal identification, or verification data) to and from equipment located outside the SCIF shall be protected using FIPS AES certified encrypted lines. If this communication technology is not feasible, transmission lines shall be installed as approved by the AO.
4. Equipment containing access-control software programs shall be located in the SCIF or a SECRET controlled area.
5. Electric door strikes installed in conjunction with a personnel ACS shall have a positive engagement and be approved under UL 1034 for burglar resistance.

## **D. ACS Recordkeeping**

1. Records shall reflect the active assignment of ID badge/card, PIN, level of access, entries, and similar system-related information.
2. Records and information concerning encoded ID data, PINs, Authentication data, operating system software, or any other data associated with the personnel ACS shall be secured in an open-storage facility or, when unattended, secured in a GSA-approved container in a closed-storage facility. Access to such data shall be restricted to only SCI-indoctrinated personnel responsible for the access control system.
3. Records of personnel removed from the system shall be retained for two years from the date of removal.

4. Records of security incidents (violations/infractions) regarding ACS shall be retained by the SO for five years from the date of an incident or until investigations of system violations and incidents have been resolved.

**E. Using Closed Circuit Television (CCTV) to Supplement ACS**

1. CCTV may be used to supplement the monitoring of a SCIF entrance for remote control of the door from within the SCIF. The system shall present no technical security hazard.
2. The remote control device shall be within the interior of the SCIF.
3. The system shall provide a clear view of the SCIF entrance and shall be monitored/operated by SCI-indoctrinated personnel within the SCIF.
4. CCTV communication lines should be located within the SCIF. Communication lines that must run external to the SCIF shall be installed to prevent tampering as approved by the AO.

**F. Non-Automated Access Control**

1. Non-automated access control devices (mechanical, electric, or electromechanical) may be approved by the AO to control access to SCIFs where the number of personnel that require access is low and there is only one entrance.
2. Combinations shall consist of four (4) or more random digits.
3. The use of pass keys to bypass such devices should be avoided except when local fire/safety codes require them. Any pass keys for such devices must be strictly controlled by SCI-indoctrinated personnel.
4. Mechanical access control devices (e.g., UNICAN, Simplex) shall be installed to prevent manipulation or access to coding mechanisms from outside the door.
5. The following shall apply to electric or electromechanical access control devices:
  - a) The control panel or keypad shall be installed in such a manner to preclude unauthorized observation of the combination or the actions of a combination change.
  - b) The selection and setting of combinations shall be accomplished by the SO and shall be changed when compromised or deemed necessary by the SO.
  - c) The control panel in which the combination and all associated cabling and wiring is set shall be located inside the SCIF and shall have sufficient physical security to deny unauthorized access to its mechanism.

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## Chapter 9. Acoustic Protection

### A. Overview

1. This establishes DNI guidelines to protect classified conversations from being inadvertently overheard outside a SCIF.
2. This is not intended to protect against deliberate technical interception of audio emanations.

### B. Sound Group Ratings

The ability of a SCIF structure to retain sound within the perimeter is rated using a descriptive value, the Sound Transmission Class (STC). To satisfy the normal security standards of SCIFs, the following transmission attenuation groups have been established:

- Sound Group 3 - STC 45 or better. Loud speech from within the SCIF can be faintly heard but not understood outside of the SCIF. Normal speech is unintelligible with the unaided human ear.
- Sound Group 4 - STC 50 or better. Very loud sounds within the SCIF, such as loud singing, brass music, or a radio at full volume, can be heard with the human ear faintly or not at all outside of the SCIF.

### C. Acoustic Testing

1. Audio tests shall be conducted to verify standards are met. Tests may be instrumental or non-instrumental as approved by the AO. Test method used shall be detailed in the CSP.
2. Instrumental Acoustic Tests
  - a) Only those with training on audio testing techniques shall conduct instrumental acoustic tests
  - b) With all SCIF doors closed, all perimeter walls and openings (e.g., air returns, doors, windows, etc.) shall be tested along multiple points to ensure that either Sound Group 3 or 4 is met.
  - c) Audio test sources shall have a variable sound level output.
  - d) The output frequency range shall include normal speech.
  - e) Test speakers shall be placed six feet from the test wall and 4 feet off the floor.
  - f) Audio gain of the test source shall produce “loud or very loud speech” as defined by Sound Group 3 and 4 levels respectively.
  - g) As an alternative, instrumented testing may be performed to Noise Isolation Class (NIC) standards. Results shall comply with NIC 40 for Sound Group 3 and NIC 45 for Sound Group 4.
3. Non-Instrumental Acoustic Tests

All non-instrumental tests shall be approved by the AO.

#### **D. Construction Guidance for Acoustic Protection**

1. The SCIF perimeter shall be designed and constructed to meet Sound Group 3 or better standards. (See construction drawings for Wall A, B, or C.)
2. Areas that provide for amplified conversations, such as conference centers, video teleconference (VTC) rooms, or similar areas, shall be designed and constructed to meet Sound Group 4 standards. (See construction drawings for Wall A, B, or C.)
3. Utility (e.g., power, signal, telephone) distribution shall be surface mounted to a sound-treated wall and shall not completely penetrate the sound-engineered structure.

#### **E. Sound Transmission Mitigations**

1. Construction of walls as described in Chapter 3 (Wall types A, B and C) or with brick, concrete, or other substantive material and acoustically treating penetrations, walls and doors should provide the necessary acoustic protection for Sound group 3.
2. When Sound Group 3 or 4 cannot be met with normal construction, supplemental mitigations to protect classified discussions from being overheard by unauthorized persons may include but not be limited to the following:
  - a) Structural enhancements such as the use of high-density building materials (i.e., sound deadening materials) can be used to increase the resistance of the perimeter to vibration at audio frequencies.
  - b) Facility design can include a perimeter location or stand-off distance which prevents non-SCI-indoctrinated person(s) traversing beyond the point where SCI discussions become susceptible to interception. For example, use of a perimeter fence or protective zone between the SCIF perimeter walls and the closest "listening place" is permitted as an alternative to other sound protection measures.
  - c) Sound masking devices, in conjunction with an amplifier and speakers or transducers, can be used to generate and distribute vibrations or noise; noise sources may be noise generators, tapes, discs, or digital audio players.
  - d) Speakers/transducers must produce sound at a higher level than the voice conversations within the SCIF.
  - e) Speakers/transducers shall be placed close to, or mounted on, any paths that would allow audio to leave the area, including doors, windows, common perimeter walls, vents/ducts, and any other means by which voice can leave the SCIF.
  - f) Wires and transducers shall, to the greatest extent possible, be located within the perimeter of the SCIF.
  - g) The sound masking system shall be subject to inspection during TSCM evaluations.
  - h) If the AO determines risk to be low, a speaker may be installed outside the SCIF door if the following conditions are met:

- The cable exiting the SCIF shall be encased within rigid conduit.
  - The sound masking system shall be subject to review during TSCM evaluations.
- i) For common walls, the speakers/transducers shall be placed so the sound optimizes the acoustical protection.
- j) For doors and windows, the speakers/transducers shall be placed close to the aperture of the window or door and the sound projected in a direction facing away from conversations.
- k) Once the speakers or transducers are optimally placed, the system volume shall be set and fixed. The volume level for each speaker shall be determined by listening to conversations outside the SCIF or area to be protected, and the speaker volume adjusted until conversations are unintelligible from outside the SCIF.
- l) Sound-source generators shall be permanently installed and not contain an AM/FM receiver and shall be located within the SCIF.
- m) Any sound-source generator within the SCIF that is equipped with a capability to record ambient sound shall have that capability disabled.
- n) Examples of government-owned or government-sponsored sound-source generators are given below:
- Audio amplifier with a standalone computer (no network connection).
  - Audio amplifier with a cassette tape player, compact disc (CD) player, or digital audio player, or with a digital audio tape (DAT) playback unit.
  - Integrated amplifier and playback unit incorporating any of the above music sources.
  - A noise generator or shift noise source generator using either white or pink noise.

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## Chapter 10. Portable Electronic Devices (PEDs)

### A. Approved Use of PEDs in a SCIF

1. Heads of IC elements may institute and maintain mitigation programs (countermeasures) to allow introduction of PEDs into SCIFs under their cognizance. Such decisions are not applicable to facilities under the cognizance of other heads of IC elements.
2. The AO, and when appropriate the information systems (ISs) authorizing official(s), shall collaborate and approve the introduction and use of PEDs into a SCIF.
3. Outside the U.S., heads of intelligence elements may approve PED usage by waiver and include the following:
  - Defined mission need for PED usage.
  - Defined period of time.
  - Statement of residual risk
4. Within the U.S., if the CSA determines the risk from PEDs to SCI under their cognizance is acceptable, taking a PED into the SCIF may be allowed with the following restrictions:
  - a) A complete risk assessment addressing each component of risk must be completed.
  - b) Only PEDs with low risk may be allowed entry to a SCIF.
  - c) Mitigation shall be applied to PEDs evaluated to be high and medium risk to reduce the PED risk to low before the device may be allowed entry.
  - d) Assessments may result in a CSA determination to prohibit specific PEDs; any determination shall be applied to all SCIFs under the CSA's cognizance.
5. Government-owned PEDs, with physically disconnected wireless capability, may be approved to process and/or be connected to a government classified or unclassified information system (IS) provided the following apply:
  - a) Use and storage of the PED is specified in the System Security Plan for the government system to which it is connected.
  - b) The PED is accredited by the authorizing official for the IS.
6. Contractor-owned and government-sponsored PEDs, with physically disconnected wireless capability, may be approved to process and/or be connected to a government classified or unclassified IS provided the following apply:
  - a) Use and storage is specified in the System Security Plan for the government system to which it is connected.
  - b) The PED is accredited by the Authorizing Official for the IS.
  - c) Use and storage is specified in the appropriate contract(s) to include the government's right to seize if and when necessary.

## **B. Prohibitions**

1. Personally-owned PEDs are prohibited from processing SCI. Connecting personally-owned PEDs to an unclassified IS inside SCIFs may only be done when wireless capability is physically disconnected and has the approval of the AO for the IS.
2. Personally-owned PEDs are prohibited in SCIFs outside the U.S. If the CSA determines that mission requirements dictate a need, government- or contractor-owned PEDs may be permitted in a SCIF by specific exception or if the CSA determines the risk is low.
3. If a PED is transported outside the U.S. and left unattended or physical control is lost, that device shall not be reintroduced into a SCIF.

## **C. PED Risk Levels**

1. General Information
  - a) Levels of risk are based on the functionality of PEDs.
  - b) The CSA and appropriate authorizing official for the IS (when a portable IS is involved) will determine risk level and mitigation requirements for devices not addressed.
2. Low-, Medium-, and High-risk PEDs
  - a) Low-risk PEDs are devices without recording or transmission capabilities and may be allowed into a SCIF by CSAs without mitigation. Low-risk PEDs include, but are not limited to, the following:
    - Electronic calculators, spell checkers, language translators, etc.
    - Receive-only pagers.
    - Audio and video playback devices with volatile storage capability.
    - Radios (receive-only).
    - Infrared (IR) devices that convey no intelligence data (e.g., text, audio, video, etc.), such as an IR mouse or remote control.
  - b) Medium-risk PEDs are devices with built-in features that enable recording or transmitting digital text, digital images/video, or audio data; however, these features can be physically disabled. Medium-risk PEDs may be allowed in a SCIF by the CSA with appropriate mitigations. Examples of medium-risk PEDs include, but are not limited to, the following:
    - Voice-only cellular telephones.
    - Portable ISSs, such as personal digital assistants (PDAs), tablet personal computers, etc.
    - Devices that may contain or be connected to communications modems
    - Devices that have microphones or recording capabilities
    - Optical technologies such as infrared (IR) other than those identified in paragraph 10.C.2. above

c) High-risk PEDs are those devices with recording and/or transmitting capabilities that require more extensive or technically complex mitigation measures to reduce the inherent risk or those that cannot be sufficiently mitigated with current technology. The CSA may approve entry and use of government- and contractor-owned PEDs for official business provided mitigation measures are in place that reduces the risk to low. Examples include, but are not limited to, the following:

- Electronic devices with RF transmitting capabilities including wireless devices (WiFi/IEEE 802.11, Bluetooth, etc.).
- Photographic, video, and audio recording devices.
- Multi-function cellular telephones.

#### **D. Risk Mitigation**

1. Heads of IC elements shall establish risk mitigation programs if high- or medium-risk PEDs are allowed into SCIFs.
2. Risk mitigation programs shall contain the following elements:
  - a) Formal approval process for PEDs.
  - b) Initial and annual refresher training for those individuals with approval to bring PEDs into a SCIF.
  - c) Device mitigation compliance documents listing the specific PEDs, their permitted use, required mitigations, and residual risk after mitigation.
  - d) A user agreement that specifies the following:
    - (1) The USG or a designated representative may seize the PED for physical and forensic examination at the government's discretion.
    - (2) The USG and the designated representative are not responsible for any damage or loss to a device or information stored on personally-owned PEDs resulting from physical or forensic examination.
3. Risk mitigation programs may include the following elements:
  - a) Registration of PED serial numbers.
  - b) PED security training program.
  - c) Reporting procedures for loss or suspected tampering.
  - d) Labeling approved PEDs for easy identification.
  - e) Electronic detection equipment to detect transmitters/cell phones.
4. The following sample table may be used to identify PED capabilities that could be allowed or prohibited, and capabilities that require mitigation and mitigation methods.

PED **Sample** Table

PED Functionalities	Introduction Permitted	Approval &/or Registration Required	Mitigation Required Prior to Use	PED Use Permitted
Single-function RF receiver (Pager, AM/FM Radio, etc.) <sup>1</sup>	Yes	No	None	Yes
CD Player <sup>2</sup>	Yes	No	None	Yes
Medical devices <sup>3</sup>	Yes	Yes	None	Yes
Infrared (IR) capability	Yes	Yes	Metal Tape <sup>4</sup>	Yes
PEDs with microphone ports	Yes	Yes	Disable wiring or use adapter/erase plug <sup>5</sup>	Yes
MP3 players (without record or RF capability)	Yes	Yes	Yes	Yes
Cell phone <sup>6</sup>	Yes	No	Battery removed <sup>7</sup>	No
RF transmitter <sup>8</sup>	<b>Prohibited</b>			<b>Prohibited</b>
Wireless transmitting capabilities	<b>Prohibited</b>			<b>Prohibited</b>
Personally owned laptops	<b>Prohibited</b>			<b>Prohibited</b>
Any device capable of recording images (photographic, video) or audio including devices connected to memory sticks, thumb drives or flash memory.	<b>Prohibited</b>			<b>Prohibited</b>
Personally owned PEDs capable of connecting to systems within the SCIF without interface cables or cradles. <sup>9</sup>	<b>Prohibited</b>			<b>Prohibited</b>

<sup>1</sup> RF Receiver may not have external cabling or contain any internal or external connectivity capabilities.

<sup>2</sup> CD players capable of playing CD, CD-R, CD-RW, and MP3 formats are permitted. Only commercially produced media is allowed. No personally produced CDs are allowed in SCIFs.

<sup>3</sup> Medical devices are exceptions to these requirements.

<sup>4</sup> Metal tape must be a minimum of 3 mils (.003 inch) thick and completely cover the IR port while within SCIF.

<sup>5</sup> Microphone wires must be cut/disabled on non-laptop PEDs. An adapter/erase plug must be inserted into laptop external microphone ports. Any adaptor that is designed for the external microphone port may be used provided that the adapter does not provide any functionality other than disabling the internal microphone.

<sup>6</sup> Single-function cell phone is defined as a cellular phone with no additional capabilities (can only be used for voice communications over a cellular network, storage of speed dial and caller ID information is permitted).

<sup>7</sup> Cell phones must be turned off and the battery removed while in the SCIF. In addition, multi-function cell phones must be approved and meet all other mitigation requirements.

<sup>8</sup> RF transmitter is defined as any radio frequency transmitter, except single-function cell phones that are addressed separately.

<sup>9</sup> Excludes mitigated IR function. Cables and cradles for personally owned PEDs are prohibited.



## Chapter 11. Telecommunications Systems

### A. Applicability

1. This guidance is compatible with, but may not satisfy, security requirements of other disciplines such as Information Systems Security, Communications Security (COMSEC), Operational Security (OPSEC), or TEMPEST.
2. This section outlines the security requirements that shall be met to ensure the following:
  - Protection of information.
  - Configuration of unclassified telecommunications systems, devices, features, and software.
  - Access control.
  - Control of the cable infrastructure.

### B. Unclassified Telephone Systems

1. A baseline configuration of all unclassified telephone systems, devices, features, and software shall be established, documented, and included in the SCIF FFC.
2. The AO shall review the telephone system baseline configuration and supporting information to determine if the risk of information loss or exploitation has been suitably mitigated.
3. When security requirements cannot be met, unclassified telephone equipment shall be installed and maintained in non-discussion areas only.
4. When not in use, unclassified telephone systems shall not transmit audio and shall be configured to prevent external control or activation, technical exploitation, or penetration.
5. Unclassified telephone systems shall incorporate physical and software access controls to prevent disclosure or manipulation of system programming and data. The following specific requirements shall be met:
  - a) On-hook and off-hook audio protection shall be provided by equipment identified by the National Telephone Security Working Group within CNSSI 5006, National Instruction for Approved Telephone Equipment, or an equivalent TSG 2 system configuration within an AO-approved controlled space.
  - b) If a Computerized Telephone System (CTS) is selected for isolation, it shall be installed and configured as detailed in TSG 2 with software and hardware configuration control and audit reporting (such as station message detail reporting, call detail reporting, etc.).
  - c) System programming shall not include the ability to place, or keep, a handset off-hook.
  - d) Configuration of the system shall ensure that all on-hook and off-hook vulnerabilities are mitigated.

- e) Equipment used for administration of telephone systems shall be installed inside the SCIF or a controlled area where access is limited to authorized personnel.
- f) When local or remote CTS administration terminals are not contained within a controlled area and safeguarded against unauthorized manipulation, the use of CNSSI 5006 approved telephone instruments shall be required, regardless of the CTS configuration.
- g) Speakerphones and audio conferencing systems shall not be used on unclassified telephone systems in SCIFs. Exceptions to this requirement may be approved by the AO when these systems have sufficient audio isolation from other classified discussion areas in the SCIF and procedures are established to prevent inadvertent transmission outside the SCIF.
- h) Features used for voice mail or unified messaging services shall be configured to prevent access to remote diagnostic ports, internal dial tone, and dial plans.
- i) Telephone answering devices and facsimile machines shall not contain features that introduce security vulnerabilities, e.g., remote room monitoring, remote programming, or other similar features that may permit off-premise access to room audio.
- j) All unclassified telephone systems and associated infrastructure shall be physically isolated from classified information and telecommunications systems in accordance with DNI and CNSS TEMPEST guidance.
- k) The security requirements and installation guidelines contained in the National Telecommunications Security Working Group (NTSWG) publication CNSSI 5000 shall be followed for Voice over Internet Protocol (VoIP) systems installed in a SCIF.

### **C. Unclassified Information Systems**

1. Unclassified information systems shall be safeguarded to prevent hardware or software manipulation that could result in the compromise of data.
2. Information systems equipment with telephonic or audio features shall be protected against remote activation and/or removal of audio (analog or digitized) information.
3. Video cameras used for unclassified video teleconferencing and video recording equipment shall be deactivated and disconnected when not in use.
4. Video devices shall feature a clearly visible indicator to alert SCIF personnel when recording or transmitting.

**D. Using Closed Circuit Television (CCTV) to Monitor the SCIF Entry Point(s)**

1. CCTV may be used to supplement the monitoring of a SCIF entrance and to record events for investigation.
2. The system shall present no technical security hazard to the SCIF.
3. The system and all components, including communications and control lines, shall be exterior to the SCIF perimeter.
4. The system may provide a clear view of the SCIF entrance but not enable the viewer to observe classified information when the door is open nor external control pads or access control components that would enable them to identify PINs.

**E. Unclassified Wireless Network Technology**

1. The use of devices or systems utilizing wireless technologies pose a high risk and require approval from the AO, CTTA, and IT systems approving authority prior to introduction into the SCIF.
2. Wireless systems shall meet all TEMPEST and TSCM requirements and shall be weighed against the facilities overall security posture (i.e., facility location, threat, as well as any compensatory countermeasures that create SID) when evaluating these systems.
3. All separation and isolation standards provided in TEMPEST standards are applicable to unclassified wireless systems installed or used in SCIFs.

**F. Environmental Infrastructure Systems**

1. The FFC shall include information on whether or not environmental infrastructure systems (also referred to as building maintenance systems) are located in the SCIF. Examples include the following:
  - Premise management systems
  - Environmental control systems
  - Lighting and power control units
  - Uninterrupted power sources
2. The FFC shall identify all external connections for infrastructure systems that service the SCIF. Examples of the purpose of external connections include the following:
  - Remote monitoring
  - Access and external control of features and services
  - Protection measures taken to prevent malicious activity, intrusion, and exploitation

## **G. Emergency Notification Systems**

1. The introduction of electronic systems that have components outside the SCIF perimeter is prohibited, with the following exceptions:
  - a) The system is approved by the AO.
  - b) The system is required for security purposes.
  - c) The system is required under life safety regulations.
2. If required, and speakers or other transducers are part of a system that is not wholly contained in the SCIF but are installed in the SCIF for life safety or fire regulations, the system must be protected as follows:
  - a) All incoming wiring shall breach the SCIF perimeter at one point. TEMPEST or TSCM concerns may require electronic isolation and shall require review and approval by the CTTA.
  - b) One-way (audio into the SCIF) communication systems shall have a high gain amplifier.
  - c) Two-way communication systems shall only be approved when absolutely necessary to meet safety/security requirements. They shall be protected so that audio cannot leave the SCIF without the SCIF occupants being alerted when the system is activated.
  - d) All electronic isolation components shall be installed within the SCIF and as close to the point of SCIF penetration as possible.

## **H. Systems Access**

1. Installation and maintenance of unclassified systems and devices supporting SCIF operations may require physical or remote access. The requirements outlined in this section shall apply to telecommunications devices located within the SCIF or in a controlled area outside the SCIF.
2. Installation and maintenance personnel requiring physical access shall possess the appropriate clearance and access, or will be escorted and monitored at all times within the SCIF by technically knowledgeable, U.S. SCI-indoctrinated personnel.
3. Remote maintenance shall be protected against manipulation or activation.
4. All capabilities for remote maintenance and diagnostic services shall be specified in the FFC.
5. The FFC shall identify all procedures and countermeasures to prevent unauthorized system access, unauthorized system modification, or introduction of unauthorized software.
6. Remote maintenance and diagnosis may be performed from a SCIF or an adjacent controlled area over a protected link in accordance with FIPS AES standards.
7. Telephone systems only may be accessed over an unclassified telephone line as specified in TSG 2 Standard, Section 4.c.

## **I. Unclassified Cable Control**

1. To the extent possible, all telecommunications cabling shall enter the SCIF through a single opening and allow for visual inspection.
2. Cable, either fiber or metallic, shall be accounted for from the point of entry into the SCIF.
  - a) The accountability shall identify the precise use of every cable through labeling.
  - b) Log entries may also be used.
  - c) Designated spare conductors shall be identified, labeled, and bundled together.
3. Unused conductors shall be removed. If removal is not feasible, the metallic conductors shall be stripped, bound together, and grounded at the point of ingress/egress.
4. Unused fiber shall be uncoupled from the interface within the SCIF, capped, and labeled as unused fiber.

## **J. References**

1. Overview
  - a) The NTSWG publishes guidance for the protection of sensitive information and unclassified telecommunications information processing systems and equipment.
  - b) NTSWG documents are currently in transition from TSG/NTSWG documents to Committee on National Security Systems (CNSS) publications.
  - c) The List of References is provided for use by personnel concerned with telecommunications security.
2. List of References
  - a) TSG Standard 1 (Introduction to Telephone Security). Provides telephone security background and approved options for telephone installations in USG sensitive discussion areas.
  - b) TSG Standard 2 (TSG Guidelines for Computerized Telephone Systems) and Annexes. Establishes requirements for planning, installing, maintaining, and managing CTS, and provides guidance for personnel involved in writing contracts, inspecting, and providing system administration of CTS.
  - c) TSG Standards 3, 4, 5, and CNSSI 5001. Contains design specifications for telecommunication manufacturers and are not necessarily applicable to facility security personnel.
  - d) CNSSI 5000. Establishes requirements for planning, installing, maintaining, and managing VoIP systems.
  - e) CNSSI 5006. Lists approved equipment which inherently provide on-hook security.

- f) NTSWG Information Series (Computerized Telephone Systems). A Review of Deficiencies, Threats, and Risks, December 1994). Describes deficiencies, threats, and risks associated with using computerized telephone systems.
- g) NTSWG Information Series (Executive Overview, October 1996). Provides the salient points of the TSG standards and presents them in a non-technical format.
- h) NTSWG Information Series (Central Office (CO) Interfaces, November 1997). Provides an understanding of the types of services delivered by the local central office and describes how they are connected to administrative telecommunications systems and devices.
- i) NTSWG/NRO Information Series (Everything You Always Wanted to Know about Telephone Security...but were afraid to ask, 2nd Edition, December 1998). Distills the essence of the TSG standards (which contain sound telecommunications practices) and presents them in a readable, non-technical manner.
- j) NTSWG/NRO Information Series (Infrastructure Surety Program...securing the last mile, April 1999). Provides an understanding of office automation and infrastructure system protection that contributes to SCIF operation.
- k) NTSWG Information Series (Computerized Telephone Systems Security Plan Manual, May 1999). Assists to implement and maintain the “secure” operation of CTSs as used to support SCIF operations. (The term “secure” relates to the safe and risk-free operation, not the use of encryption or a transmission security device.)
- l) Director of National Intelligence, Intelligence Community Directive 702, Technical Surveillance Countermeasures.
- m) Director of National Intelligence, Intelligence Community Directive 503, Intelligence Community Information Technology Systems Security Risk Management, Certification and Accreditation.
- n) SPB Issuance 00-2 (18 January 2000). Infrastructure Surety Program and the Management Assessment Tool.

## Chapter 12. Management and Operations

### A. Purpose

To establish safeguards and procedures necessary to prevent the unauthorized disclosure of SCI and other classified national security information in SCIFs. To define administrative processes that shall provide a secure operating environment and enable adequate security oversight, management, and operations of SCIFs

### B. SCIF Repository

1. As required by ICD 705, the DNI shall manage an inventory of information on all SCIFs which shall be reported to the DNI via the SCIF repository not later than 180 days after the effective date of ICD 705 and updated no later than 30 days after changes occur thereafter.

2. Reportable SCIF Administrative Information:

- SCIF ID
- AO ID
- Location of SCIF
  - In U.S.
  - Outside U.S.
  - Under COM
- SCIF Type
  - Closed Storage
  - Open Storage
  - SWA
  - TSWA
  - T-SCIF
- SID
- Initial Accredited Date
- Re-Accreditation Date
- Review date
- Waivers
- Date waiver approved
- Waiver approval authority/ID
- Exceeded standards
- Does not meet standards
- Date waiver expires

## C. SCIF Management

### 1. SO Responsibilities:

- a) The SCIF SO shall be responsible for all aspects of SCIF management and operations to include security policy implementation and oversight.
- b) The SO shall prepare a comprehensive Standard Operating Procedure (SOP) that documents management and operations of the SCIF.
- c) The SO shall review the SOP at least annually and revise it when any aspect of SCIF security changes.
- d) The SO shall issue and control all SCIF keys. Locks shall be changed when a key is lost or is believed to be compromised.
- e) The SO shall conduct annual self-inspections to ensure the continued security of SCIF operations, identify deficiencies, and document corrective actions taken. Inspection results shall be forwarded to the AO and copies retained by the SO until the next inspection.
- f) The SO shall create an emergency plan to be approved by the AO. Plans shall be reviewed and updated annually and all SCIF occupants shall be familiar with the plans. Drills shall be conducted as circumstances warrant, but at least annually. The emergency plan may be an extension of an overall department, agency, or installation plan.

#### (1) For SCIFs within the U.S., emergency plans shall address the following:

- Fire
- Natural disaster
- Civil unrest
- Intrusion detection system failures
- Admittance of emergency personnel
- The protection of SCIF occupants and classified information
- Evacuation requirements and emergency destruction

#### (2) For SCIFs outside the U.S., emergency plans shall address all of the above and shall include instructions for the emergency destruction or removal of SCI where political instability, terrorism, host country attitudes, or criminal activity suggest the possibility that a SCIF may be overrun.

- g) The SO shall control passwords to access the maintenance mode of copiers and other office equipment.
- h) The SO shall develop an SOP that addresses actions to be taken when IDS maintenance access is required.

### 2. Required SCIF Documentation

- a) Copies of all documents relating to SCIF accreditation shall be maintained by the SCIF SO and include, but not limited to, the following:



- SCIF accreditation
  - Fixed facility checklist
  - Construction security plan
  - CTTA evaluation
  - IS accreditation
  - SOPs
  - The results of the final acceptance test of the original system installation and any tests to system modifications made thereafter
  - Emergency plan
- b) As applicable, the following documents shall be maintained by the SCIF SO:
- TSCM reports
  - Co-utilization agreements
  - Memoranda of agreement
  - Self-inspection reports
  - Compartmented area checklist
  - Shipboard SCIF checklist
  - Aircraft/UAV checklist
  - A copy of the CRZH certificate (UL 2050)

#### **D. SOPs**

1. A comprehensive SOP that documents management and operations of the SCIF shall be prepared by the SO.
2. The SOP shall be included in the accreditation package and approved by the AO.
3. All individuals assigned to, or having unescorted access to, the SCIF shall be familiar with and adhere to the SOP.
4. All SOP revisions shall be provided to the AO for approval.
5. SOPs shall be tailored to a specific SCIF.
6. SOPs shall include specific areas of security concern as defined by program or mission requirements.
7. The following are examples of subjects that should be addressed in an SOP:
  - Self-inspections
  - Security incidents and violations
  - Alarm systems and response requirements
  - Opening and closing procedures
  - Access controls
  - Visitor access
  - Escort procedures
  - Equipment maintenance procedures
  - Handling, processing, and destruction of classified material
  - Badge procedures

- End-of-day security procedures
- Personnel and package inspection procedures
- Secure communications device instructions

#### **E. Changes in Security and Accreditation**

1. Changes affecting the security posture of the SCIF shall be immediately reported by the SO to the AO to include any corrective or mitigating actions taken.
2. If an AO determines that SCIF security conditions are unsatisfactory, SCIF accreditation may be suspended or revoked.
  - a) All appropriate authorities and SCIF occupants shall be immediately notified and the SCIF closed until deficient conditions are corrected.
  - b) All SCI material shall be relocated to another SCIF.

#### **F. General**

1. Except for law enforcement officials or other personnel required to be armed in the performance of their duties, firearms and other weapons are prohibited in SCIFs.
2. Photography, video, and audio recording equipment are restricted but may be authorized for official purposes as documented in the SOP.
3. Procedures shall be established to control IT storage media upon entering or exiting a SCIF in accordance with ICD 503 (Intelligence Community Information Technology Systems Security Risk Management, Certification and Accreditation).
4. SCIF perimeter doors shall remain closed and controlled at all times. When a door needs to be open, it shall be continually monitored by an SCI-indoctrinated individual.
5. All SCIF occupants shall be familiar with emergency plans and drills shall be conducted as circumstances warrant, but at least annually.
6. Where the risk of hostile action is significant, SCI materials shall be maintained at an absolute minimum.

## **G. Inspections/Reviews**

1. SCIF inspections shall be performed by the AO, or designee, prior to accreditation.
2. The AO, or designee, shall conduct periodic security inspections/reviews to ensure the efficiency of SCIF operations, identify deficiencies, and document corrective actions taken. All relevant documentation associated with SCIF accreditation, inspections, and security administration may be subject to review.
3. Periodic inspections/reviews shall be conducted based on threat, facility modifications, sensitivity of programs, past security performance, or at least every five years.
4. SOs shall conduct annual self-inspections to ensure the continued security of SCIF operations, identification of deficiencies, and to document corrective actions taken. Inspection results shall be forwarded to the AO and copies retained by the SO until the next inspection.
5. Authorized inspectors shall be admitted to a SCIF without delay or hindrance when inspection personnel are properly certified to have the appropriate level of security clearance and SCI indoctrination for the security level of the SCIF.
6. Short-notice or emergency conditions may warrant entry without regard to the normal SCIF duty hours.
7. Government-owned equipment needed to conduct SCIF inspections will be admitted into the SCIF without delay. Specifically, equipment for TEMPEST or Technical Surveillance Countermeasures (TSCM) testing shall be admitted to a SCIF as long as the personnel operating the equipment are certified to have the appropriate level of security clearance and SCI indoctrination.

## **H. Control of Combinations**

1. Combinations to locks installed on security containers/safes, perimeter doors, windows, and any other opening should be changed in the following circumstances:
  - a) When a combination lock is first installed or used.
  - b) When a combination has been subjected, or believed to have been subjected, to compromise.
  - c) Whenever a person knowing the combination no longer requires access to it unless other sufficient controls exist to prevent access to the lock.
  - d) At other times when considered necessary by the SO.
2. When the lock is taken out of service, it will be reset to 50-25-50.
3. All combinations to the SCIF entrance doors should be stored in a different SCIF. When this is not feasible, alternative arrangements shall be made in coordination with the AO.

## **I. De-Accreditation Guidelines**

SCIF closeouts and de-accreditations shall comply with the following procedures:

1. Inspect all areas, storage containers, and furniture for the presence of classified, sensitive, or proprietary information, and remove any found.
2. Reset safe combinations to 50-25-50 and lock the containers.
3. Affix written certification to all storage containers that the container does not contain classified, sensitive, or proprietary information. The certification shall include the date of inspection and the name and signature of the inspector.
4. Ensure that reproduction and printing equipment is decertified or disposed of in accordance with AO guidance.
5. Dispose of, or relocate, SCI computer equipment, media, hard drives, and portable storage media as approved by the AO.
6. Request revocation of Automated Information Systems (AIS) accreditation.
7. Request revocation of SCIF accreditation.
8. If the SCIF will be used for another mission or project that requires alarms, transfer alarm service to the new activity.
9. If the SCIF will not be used for another mission or project and all classified, sensitive, or proprietary information has been removed, the following shall occur:
  - a) Alarm service shall be discontinued.
  - b) Combinations on the entrance door and any GSA containers shall be changed to 50-25-50.
  - c) All keys shall be accounted for.

## **J. Visitor Access**

1. General Requirements
  - a) Visitor logs shall be used to record all SCIF visitors and include the following information:
    - Visitor's full name
    - Organization
    - Citizenship
    - Purpose of the visit
    - Point of contact
    - Date/time of the visit
  - b) Government-issued identification shall be required as a means of positive identification.
  - c) Visitor logs shall be retained for two years after the date of the last entry.
  - d) Visitor clearance verification shall be accomplished using the DNI Scattered Castles database to the greatest extent possible.

- e) Visitors whose clearances have not been verified may be permitted, under escort, entry into the SCIF; however, access to and/or discussion of classified information shall be denied pending clearance verification.
  - f) Visitors, SCIF occupants, and their possessions may be subject to screening and inspections to deter the unauthorized removal of classified material or the introduction of prohibited items or contraband.
  - g) Screening and inspection procedures shall be documented and approved by the AO.
2. SCIF Access by Uncleared and Emergency Personnel
- a) Uncleared personnel shall be escorted at all times by cleared personnel.
  - b) The ratio of cleared escorts to uncleared personnel shall be determined on a case-by-case basis by the SO.
  - c) Prior to assuming escort duties, all escorts shall receive a briefing by the SO or designee outlining their responsibilities.
  - d) Uncleared personnel shall be kept under observation at all times while in the SCIF. Escorts shall ensure precautions are taken to preclude inadvertent access to classified information.
  - e) Lights, signs, or other alerting mechanisms or procedures shall be used to alert SCIF occupants of the presence of uncleared personnel.
  - f) Emergency personnel and equipment shall be allowed access to SCIFs and be escorted to the degree practical. If exposed to classified information, they shall sign an inadvertent disclosure statement when feasible.

## **K. Maintenance**

1. SCI-indoctrinated maintenance personnel shall be used to the extent possible.
2. Procedures for performing maintenance on office equipment, including the use of diagnostic equipment, shall be documented in the SCIF SOP.
3. Computerized diagnostic equipment, to include associated hardware and software, shall be kept under control within a SCIF and shall be managed to prohibit the migration of classified data when connected to classified systems. Procedures shall be documented in the SOP.
4. Passwords to access the maintenance mode of copiers and other office equipment shall be controlled by the SO.
5. Office equipment that is no longer serviceable, such as copiers and classified fax machines, shall be sanitized by having volatile memory erased and non-volatile memory and disk storage removed for terminal destruction.

## **L. IDS and ACS Documentation Requirements**

The following documents and records shall be maintained within the SCIF:

1. System Plans such as system design, equipment, and installation documentation.
2. MOAs established for external monitoring, response, or both, and which shall include the following information:
  - Response time for response forces and SCIF personnel.
  - Responsibilities of the response force upon arrival.
  - Maintenance of SCIF points of contact.
  - Length of time response personnel are required to remain on-site.
3. Monitoring Station SOP and/or a copy of the monitoring station UL certificate.
4. Maintenance access SOP.
5. Records, logs, and archives.
6. Records of system testing (for two years) shall include the following information:
  - Testing dates
  - Names of individuals performing the test
  - Specific equipment tested
  - Malfunctions detected
  - Corrective actions taken
7. Records of guard or response force personnel testing.
8. The PCU shall contain a secured, non-volatile event (alarm) log capable of storing at least six months of events, or a printer shall be installed that provides real-time recording of openings, closings, alarms, trouble alarms, and loss of communications.
  - a) If the system has no provision for automatic entry into archive, the AO may authorize a manual logging system.

- b) Monitoring personnel shall record the time, source, type of alarm, and action taken.
  - c) The SCIF SO shall routinely review the historical records.
  - d) Results of investigations and observations by the response force shall also be maintained at the monitoring station.
  - e) Records of alarm annunciations shall be retained for two years.
  - f) Shunting or masking of any zone or sensor shall be logged in the system archives.
  - g) All maintenance periods shall be archived into the system.
  - h) An archive shall be maintained for all remote service mode activities.
9. Access Control Systems Records which include:
- a) The active assignment of ID badge/card, PIN, level of access, entries, and similar system-related information
  - b) Records of personnel removed from the system which shall be retained for two years from the date of removal.
10. Records of security incidents (violations/infractions) regarding automated systems shall be retained by the SO for five years from the date of an incident or until investigations of system violations and incidents have been resolved.

#### **M. Emergency Plan**

1. The SO shall create an emergency plan.
2. The emergency plan shall be approved by the AO and maintained on-site for each accredited SCIF.
3. The emergency plan may be an extension of an overall department, agency, or installation plan.
4. The emergency plan shall address the following:
  - Fire
  - Natural disaster
  - Civil unrest
  - Admittance of emergency personnel into a SCIF
  - The protection of SCIF occupants and classified information
  - Evacuation requirements
  - Emergency destruction
5. Plans shall be reviewed at least annually and updated as necessary.
6. All SCIF occupants shall be familiar with the plans and drills shall be conducted as circumstances warrant, but at least annually.
7. Where political instability, terrorism, host country attitudes, or criminal activity suggests the possibility that a SCIF may be overrun, emergency plans shall include instructions for the secure destruction or removal of SCI under adverse circumstances and

include contingencies for loss of electrical power and non-availability of open spaces for burning or chemical decomposition of material.

8. Where the risk of hostile actions are significant, SCI holdings and reference materials shall be maintained at an absolute minimum required for current working purposes. If reference or other material is needed, it shall be obtained from other activities and returned or destroyed when no longer needed.



## Chapter 13. Forms and Plans

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**CLASSIFY ACCORDING TO FACILITY SPONSOR**  
**CLASSIFICATION GUIDANCE**

## **Fixed Facility Checklist**

**[Insert Org Name]**

**[Date]**

**[Address]**

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CHECK Applicable blocks			
<input type="checkbox"/> Domestic	<input type="checkbox"/> Overseas Not COM	<input type="checkbox"/> Overseas COM	
<input type="checkbox"/> Pre-construction, Complete Sections as Required by A/O	<input type="checkbox"/> Final FFC Accreditation	<input type="checkbox"/> Update/Page Change	

### Checklist Contents

**Section A: General information**

**Section B: Security-in-Depth**

**Section C: SCIF Security**

**Section D: Doors**

**Section E: Intrusion Detection Systems (IDS)**

**Section F: Telecommunication Systems and Equipment Baseline**

**Section G: Acoustical Protection**

**Section H: Classified Destruction Methods**

**Section I: Information Systems/TEMPEST/Technical Security**

### List of Attachments

-- TEMPEST Checklist

-- Other Attachments as Required

*(Diagrams must be submitted )*

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Section A: General Information				
<b>1.</b>	<b>SCIF Data</b>			
	Organization/Company Name			
	SCIF Identification Number <i>(if applicable)</i>			
	Organization subordinate to <i>(if applicable)</i>			
	Contract Number & Expiration Date <i>(if applicable)</i>			
	Concept approval Date/by <i>(if applicable)</i>			
	Cognizant Security Authority (CSA)			
	<b>Defense Special Security Communication System Information <i>(if applicable)</i></b>			
	DSSCS Message Address			
	DSSCS INFO Address			
	If no DSSCS Message Address, please provide passing instructions			
<b>2.</b>	<b>SCIF Location</b>			
	Street Address			
	Building Name/ #		Floor(s)	
	Suite(s)		Room(s) #	
	City		Base/Post	
	State/Country		Zip Code	
<b>3.</b>	<b>Mailing Address (if different from SCIF location)</b>			
	Street or Post Office Box			
	City		State	
			Zip Code	
<b>4.</b>	<b>Responsible Security Personnel</b>			
		<b>PRIMARY</b>		<b>ALTERNATE</b>
	Name			
	Commercial Phone			
	DSN Phone			
	Secure Phone			
	STE Other Phone			
	Home			

	Secure Fax		
	<b>Command or Regional Special Security Office/Name (SSO) (if applicable)</b>		
	Commercial Phone		
	Other Phone		
<b>5.</b>	<b>E-Mail Address of Responsible Security Personnel</b>		
	Classified		(Network/System Name & Level)
	Unclassified		(Network/System Name)
	Other		(Network/System Name)
<b>6.</b>	<b>Accreditation Data (Ref Chapter: 12E)</b>		
	a. Category/ Compartments of SCI Requested: 1) Indicate storage requirement:		
	<input type="checkbox"/> Open	<input type="checkbox"/> Closed	<input type="checkbox"/> Continuous Operation <input type="checkbox"/> None
	2) Indicate the facility type		
	<input type="checkbox"/> Permanent	<input type="checkbox"/> Temporary	<input type="checkbox"/> Secure Working Area <input type="checkbox"/> TSWA
	3) Co-Use Agreements	<input type="checkbox"/> Yes <input type="checkbox"/> No	If yes, provide sponsor:
	b. SAP(s) co-located within SCIF	<input type="checkbox"/> Yes <input type="checkbox"/> No	If yes, identify SAP Classification level (check all that apply)
	<input type="checkbox"/> SCI	<input type="checkbox"/> Top Secret	<input type="checkbox"/> Secret <input type="checkbox"/> Confidential
	c. SCIF Duty Hours	Hours to Hours:	Days Per Week:
	d. Total square footage that the SCIF occupies:		
	e. Has or will CSA requested any waivers?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	If yes, attach a copy of approved waiver
	<b>Construction/Modification (Ref: Chapter 3B)</b>		
	Is construction or modification complete?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	If no, enter the expected date of completion
	Was all construction	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	If not, explain changes.



	completed in accordance with the CSP?				
<b>7.</b>	<b>Inspections (Ref: Chapter 12G)</b>				
	<b>Has a TSCM Inspection been performed</b>	<input type="checkbox"/> Yes		<input type="checkbox"/> No	
	<b>If yes, provide the following</b>				
	a. TSCM Service completed by				On _____ (Attach a copy of report)
	Were deficiencies corrected?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A	If no, explain
	b. Last physical security inspection by				On _____ (Attach a copy of report)
	Were deficiencies corrected?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A	If no, explain
	c. Last Staff Assistance Visit by:				On _____ (Attach a copy of report)
<b>8.</b>	<b>REMARKS:</b>				

Section B: Security-in-Depth				
1.	Describe building exterior Security (Ref: Chapter 2B)			
	a. Is the SCIF located on a military installation, embassy compound, USG compound or contractor compound with a dedicated U.S. person response force?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
	b. Is the SCIF located in an entire Building	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
	c. Is the SCIF located on a single floor of Building	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
	d. Is the SCIF located in a secluded area of Building	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
	e. Is the SCIF located on a fenced compound with access controlled vehicle gate and/or pedestrian gate?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
	Fence Type		Height	Does it surround the compound? How is it controlled? How many gates? Hours of usage? How are they controlled when not in use?
	1) Is the Fence Alarmed?	If so, describe alarm systems (i.e. – Microwave)		
	2) Fence Lighting			
	3) Building Lighting			
	f. Is there external CCTV coverage? If so, describe the CCTV system. <i>(include monitor locations on map)</i>			
	g. Guards	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Static <input type="checkbox"/> Roving
	■ Clearance level of guards <i>(if applicable)</i>			
	■ During what hours/days?			
	Any SCIF duties?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	If yes, describe duties

<b>2.</b>	<b>Describe Building Security</b> <i>(Please provide legible general floor plan of the SCIF perimeter)</i>									
	Is the SCIF located in a controlled building with separate access controls, alarms, elevator controls, stairwell control, etc. required to gain access to building or elevator?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	If yes, is SCIF controlled by bldg owners?		If controlled by SCIF owners, is alarm activation reported to SCIF owners by agreement?				
				<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Yes	<input type="checkbox"/> No			
	b. Construction Type									
	c. Windows									
	d. Doors									
	e. Describe Bldg Access Controls	<input type="checkbox"/> Continuous	<input type="checkbox"/> Yes	<input type="checkbox"/> No	If no, during what hours?					
	<input checked="" type="checkbox"/> Clearance level of guards <i>(if applicable)</i>	Any SCIF duties? If yes, describe duties?		During what hours/days?						
		<input type="checkbox"/> Yes	<input type="checkbox"/> No							
<b>3.</b>	<b>Describe Building Interior Security</b>									
	Are office areas adjacent to the SCIF controlled and alarmed? If yes, describe adjacent areas and types of alarm systems.	<input type="checkbox"/> Yes	<input type="checkbox"/> No	Controlled by SCIF Owner?		If controlled by Bldg owner, alarm activation reported to SCIF owner by agreement?				
				<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Yes	<input type="checkbox"/> No			

<b>4.</b>	<b>Security In-Depth</b>			
	What external security attributes and/or features should the AO consider before determining whether or not this facility has Security In-Depth? Please identify/explain all factors:			
<b>Section C: SCIF Security</b>				
<b>1.</b>	<b>How is access to the SCIF controlled (Ref: Chapter 8)</b>			
	a. By Guard Force	<input type="checkbox"/> Yes	<input type="checkbox"/> No	If yes, what is their minimum security clearance level?
	b. Is Guard Force Armed?	<input type="checkbox"/> Yes		<input type="checkbox"/> No <input type="checkbox"/> N/A
	c. By assigned personnel?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	If yes, do personnel have visual control of SCIF entrance door?
	d. By access control device?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	If yes, what kind?
	<input type="checkbox"/> Automated access control system		<input type="checkbox"/> Non-Automated	
	<b>If Non-Automated</b>			
	1. Is there a by-pass key?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
	■ If yes, how is the by-pass key protected?			
	2. Manufacturer:		Model:	
	<i>(Attach sheet if additional space is required for this information)</i>			
	<b>If Automated</b>			
	1. Is there a by-pass key?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
	■ If yes, how is the by-pass key protected?			
	2. Manufacturer:		Model:	
	<i>(Attach sheet if additional space is required for this information)</i>			
	3. Are access control transmission lines protected by 128-bit encryption/FIBS 140?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	If no, explain the physical protection provided.
	4. Is automated access control system located within a SCIF or an alarmed area controlled at the <b>SECRET</b> level?			<input type="checkbox"/> Yes <input type="checkbox"/> No

	5. Is the access control system encoded and is ID data and PINs restricted to SCI-indoctrinated personnel?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	6. Does external access control outside SCIF have tamper protection?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	7. Is the access control device integrated with IDS	<input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
	8. Is the access control device integrated with a LAN/WAN System?	<input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
<b>2.</b>	<b>Does the SCIF have windows? (Ref: Chapter 3F)</b>		
	a. Are they acoustically protected?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	If yes, how? Please explain
	b. Are they secured against forced entry?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	If yes, how? Please explain
	c. Are they protected against visual surveillance?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	If yes, how? Please explain
<b>3.</b>	<b>Do ventilation ducts penetrate the SCIF perimeter? (Ref: Chapter 3G)</b>	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	<i>(Indicate all duct penetrations and their size on a separate floor plan as an attachment)</i>		
	a. Any ducts over 96 square inches that penetrate perimeter walls?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	■ If yes, how are they protected?		
	<input type="checkbox"/> IDS (Describe in Section E)	<input type="checkbox"/> Bars/Grills/Metal Baffles	<input type="checkbox"/> Other, please explain
	■ Describe Protection:		
	b. Inspection ports?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	■ If yes, are they within the SCIF?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	■ If no, are they secured?	<input type="checkbox"/> Yes <input type="checkbox"/> No	Please explain
	c. Do all ventilation ducts penetrating the perimeter meet acoustical requirements?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	<i>(NOTE: All ducts and vents, regardless of size may require acoustical protection)</i>		
	■ If yes, how are they protected?		

	<input type="checkbox"/> Metal Baffles	<input type="checkbox"/> Noise Generator	<input type="checkbox"/> Z-Duct	<input type="checkbox"/> Other (Describe)
	<b>Describe the method of ventilation and duct work protection</b> <i>(if applicable)</i>			
<b>4.</b>	<b>Construction (Ref: Chapter 3B)</b>			
	a. Describe Perimeter Wall Construction:			
	b. True ceiling (material and thickness)?			<input type="checkbox"/> Yes <input type="checkbox"/> No
	c. False ceiling?			<input type="checkbox"/> Yes <input type="checkbox"/> No
	■ If yes, what is the type of ceiling material?			
	■ What is the distance between false and true ceiling?			
	d. True floor (material and thickness)?			<input type="checkbox"/> Yes <input type="checkbox"/> No
	e. False floor?			<input type="checkbox"/> Yes <input type="checkbox"/> No
	■ If yes, what is the type of false flooring?			
	■ What is the distance between false and true floor?			
<b>5.</b>	<b>REMARKS:</b>			

Section D: Doors				
1.	<b>Describe SCIF primary entrance door construction (indicate on floor plan) (Ref: Chapter 3E)</b>			
	a. Does the door and doorframe meet sound attenuation requirements?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
	■ If no, have acoustical countermeasures been employed?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
	b. Describe SCIF perimeter doors to include thickness and type of door.			
	c. Is an automatic door closer installed?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	If no, please explain
	d. Is a door sweep/thresholds installed?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	If no, please explain
	e. Is an acoustical/astragal strip installed?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	If no, please explain
2.	<b>Describe number and type of doors used for SCIF emergency exits and other perimeter doors including day access (show on floor plan)</b>			
	a. Do the doors and doorframes meet sound attenuation requirements?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
	■ If no, have acoustical countermeasures been employed?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
	b. Has exterior hardware been removed?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
	c. Has local enunciator been installed?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
	■ Describe how the door hinges exterior to the SCIF are secured against removal (if in an uncontrolled area).			
3.	<b>Locking Devices</b>			
	a. Is the primary entrance door equipped with a GSA-approved pedestrian door deadbolt meeting Federal Specification FF-L-2890 including lock meeting FF-L-2740A	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
	b. List combination lock manufacturer, model number and group rating			
	Manufacturer:		Model Number:	

	c. Does the entrance door stand open into an uncontrolled area?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	If yes, please describe tamper protection.		
	d. Emergency exits and other perimeter doors: Describe (locks, metal strip/bar, deadbolts, local annunciation, and panic hardware).		
	e. Where is the lock combination(s) filed? (Please identify the SCIF AO and SCIF ID#)		
4.	<b>REMARKS:</b>		



Section E: Intrusion Detection Systems					
<b>1.</b>	<b>General IDS Description (Ref: Chapter 7A)</b>				
	a. Has the IDS configuration been approved by the AO?			<input type="checkbox"/> Yes	<input type="checkbox"/> No
	b. Identity of IDS installer:		Identity of IDS monitoring firm:		
	c. Premise Control Unit (PCU)				
	Manufacturer	Model Number	Tamper Protection	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	d. Is the PCU located inside the SCIF perimeter (indicated on floor plan)?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	If no, please explain	
	e. Location of interior motion detection protection				
	■ Accessible points of entry/perimeter?			<input type="checkbox"/> Yes	<input type="checkbox"/> No
	■ Any others? Specify			<input type="checkbox"/> Yes	<input type="checkbox"/> No
	f. Has the IDS alarm monitor station been installed to Underwriters Laboratories certified standards?			<input type="checkbox"/> Yes	<input type="checkbox"/> No
	Contractor facility submit copy of Certificate				
	g. Has the IDS passed AO or UL 2050 installation and acceptance tests?			<input type="checkbox"/> Yes	<input type="checkbox"/> No
	■ If yes, attach a copy of certificate (Non-commercial proprietary system must answer all questions)				
	h. High Security Switches Type I			<input type="checkbox"/> Yes	<input type="checkbox"/> No
	i. High Security Switches Type II			<input type="checkbox"/> Yes	<input type="checkbox"/> No
	j. Motion sensor (indicate sensor placement on a legible floor plan; 8 ½ x 11" or 11" x 17" paper)				
	k. Are any other intrusion detection equipment sensors/detectors in use?			<input type="checkbox"/> Yes	<input type="checkbox"/> No
	■ Please identify make, model and manufacturer and function (indicate on floor plan)				
	Make	Model	Manufacturer	Function	
	l. Does the IDS extend beyond the SCIF perimeter?			<input type="checkbox"/> Yes	<input type="checkbox"/> No

	m. Can the status of PCU be changed from outside IDS protection?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	■ If yes, is an audit conducted daily?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	n. Do any intrusion detection equipment components have audio or video capabilities?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	■ If yes, please explain.		
	o. PCU Administrator SCI indoctrinated?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	p. External Transmission Line Security:		
	q. What is the method of line security? National Institute of Standards and Technology (NIST) FIBS AES encryption?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	1) If yes, has the encryption been certified by NIST or another independent testing laboratory?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	2) If not NIST standard, is there an alternate?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	3) If yes, please explain		
	4) Does the alternate line utilize any cellular or other Radio Frequency (RF) capability?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	Manufacturer	Model Number	
	r. Does any part of the IDS use local or wide area network (LAN/WAN)?	<input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
	1) Is the host computer dedicated solely for security purposes?	<input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
	2) Is the host computer secured within an alarmed area controlled at the <b>SECRET</b> or higher level?	<input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
	3) Is the host computer protected through firewalls or similar devices?	<input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
	4) Is the password for the host computer unique for each user and at least 8-characters long consisting of alpha, numeric, and special characters?	<input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
	5) Is the password changed semi-annually?	<input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
	6) Are remote security terminals protected the same as the host computer?	<input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
	■ If no, please explain:		
2.	Is emergency power available for the IDS?	<input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
	Generator?	<input type="checkbox"/> Yes	<input type="checkbox"/> No

	■ If yes, how many hours?		
	Battery?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	■ If yes, how many hours?		
3.	<b>Where is the IDS alarm monitor station located?</b>		
4.	<b>Does the monitor station have any remote capabilities (i.e., resetting alarms, issuing PINs, accessing/securing alarms, etc.?)</b>	<input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
	■ If yes, please explain:		
5.	<b>Does the IDS have any automatic features (i.e., timed auto-secure, auto-access capabilities?)</b>	<input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
6.	<b>Does the PCU/keypad have dial out capabilities?</b>	<input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
7.	<b>IDS response personnel</b>	<input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
	a. Who provides initial alarm response?		
	b. Does the response force have a security clearance?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	■ If yes, what is the clearance level?		
	c. Do you have a written agreement with external response force?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	d. Emergency procedures documented?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	e. Response to alarm condition:	_____ Minutes	
	f. Are response procedures tested and records maintained?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	■ If no, please explain:		
	g. Has a catastrophic failure plan been approved by the CSA?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
8.	<b>Does the IDS undergo semiannual testing?</b>	<input type="checkbox"/> Yes	<input type="checkbox"/> No
9.	<b>Have IDS records been maintained?</b>	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	■ If no, please explain:		
10.	<b>REMARKS:</b>		

Section F: Telecommunication Systems and Equipment Baseline				
1.	Is the facility declared a "No Classified Discussion Area"? (Ref: Chapter 11A)		<input type="checkbox"/> Yes	<input type="checkbox"/> No
	<p>■ If yes, then the audio protection questions within this section may be identified as N/A</p>			
	<p>■ If the facility is declared a "No Classified Discussion Area", are warning notices posted prominently within the facility?</p>	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
2.	Does the facility have any unclassified telephones that are connected to the commercial public switch telephone network (PSTN)?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
	<p>■ What is the method of on-hook protection?</p>			
	1) CNSSI 5006 (TSG-6) approved telephone or instrument	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
	(Please identify all telephone equipment/stations and/or instruments being used either below or as an attachment)			
	Manufacturer	Model Number	TSG Number (if applicable)	
	2) CNSSI 5006 (TSG-6) approved disconnect device?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
	a. Line disconnect?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
	b. Ringer protection?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
	Manufacturer	Model Number	TSG Number (if applicable)	
	3) CNSSI 5002 (TSG-2) configured computerized telephone system (CTS)?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
	a. If yes, please provide the following information about the CTS			
	Manufacturer	Model		
	b. If yes, please provide specific location of the CTS			
	c. How is the facility protecting the CTS physically controlled?			
	d. If yes, what is the clearance level (if any) of facility or area where the switch is located and how is area controlled?			
	e. How are all cables, signal lines and intermediate wiring frames between the SCIF telephones and the CTS physically protected within a physically controlled space?			

	f. Are all program media, such as tapes and/or disks, from the CTS afforded physical protection from unauthorized alterations?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	g. Is an up-to-date master copy of the CTS software program maintained for confirmation and/or reloading of the operating system?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	h. Does the CTS have the capability to force or hold a telephone station off-hook?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	i. Does the CTS use remote maintenance and diagnostic procedures or other remote access features?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	■ If yes, explain maintenance procedures		
	j. Do the CTS installers and programmers have security clearances?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	■ If yes, at what access level (minimum established by AO)		
	■ If no, are escorts provided?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	4) Is it a Voice over Internet Protocol (VOIP) phone system (IPS) (Ref CNSSI 5000)?	<input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
	a. If yes, please provide the following information about the IPS		
	Manufacturer	Model Number	IPS Location
	b. Do all unclassified telephones within the facility have a hold, mute and/or push-to-talk [handset] capability, (for off-hook audio protection)?	<input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
	■ If no, please explain?		
	c. Is access to the facility housing the IPS physically controlled?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	d. If yes, what is the clearance level (if any) of facility or area where the switch is located and how is the area controlled?		
	e. Are all cables, signal lines and intermediate wiring frames between the SCIF telephones and the IPS physically protected or contained within a physically controlled space?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	■ If no, please explain?		
	f. Are all program media, such as tapes and/or disks, from the IPS afforded physical protection from unauthorized alterations?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	g. Is an up-to-date master copy of the IPS software program maintained for confirmation and/or reloading of the operating system?	<input type="checkbox"/> Yes	<input type="checkbox"/> No

	h. Does the IPS have the capability to force or hold a telephone station off-hook?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	i. Does the IPS use remote maintenance and diagnostic procedures or other remote access features?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	j. Do the IPS installers and programmers have security clearances?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	■ If yes, at what access level (minimum established by AO)?		
	■ If no, are escorts provided?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
<b>3.</b>	<b>Automatic telephone call answering</b>		
	a. Are there any automatic call answering devices for the telephones in the SCIF?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	1) If yes, please identify the type		
	■ Voicemail/unified message service?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	■ Standalone telephone answering device (TAD)?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	2) Provide manufacturer and model number of the equipment		
	Manufacturer	Model	
	a. Are speakerphones/microphones enabled?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	■ If yes, has the remote room monitoring capability been disabled?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	■ Has this been approved for use by the AO?	<input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
	Provide detailed configuration procedures		
	■ If applicable, is the voice mail or unified messaging services configured to prevent unauthorized access from remote diagnostic ports or internal dial tone?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
<b>4.</b>	<b>Are any multi-function office machines (M-FOMs) used within the SCIF (M-FOMs are electronic equipment that can be used at network or standalone printers, facsimiles, and copiers)?</b>	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	a. If yes, please identify the device to include (Please identify all M-FOM devices in use, either below or as an attachment) - Include a manufacture Volatile statement for each M-FOM.		
	Make	Model	Serial Number
	b. If yes, please identify all features and information processing level of each M-FOM		

	1) Copier?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
	■ If yes, level(s) of information			
	2) Facsimile?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
	■ If yes, level(s) of information			
	3) Printer? (connected to a standalone computer or network)	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
	■ If yes, please explain and identify the system(s) and the level(s) of information			
	c. Does the M-FOM have memory storage capability?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
	If yes, what kind?	<input type="checkbox"/> Volatile (information in memory clears/erases when powered off)	<input type="checkbox"/> Non-volatile (information in memory that remains when powered off)	
	d. Does the M-FOM have a digital hard drive?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
	e. Have maintenance and disposition procedures been established?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
	f. Does the M-FOM have voice transmission capability and/or a telephone handset?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
	■ If yes, how is this feature protected? Please describe			
5.	Are there any video teleconference (VTC) systems installed?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
	■ If yes, what level(s) of information is the VTC system processing?			
	Which room(s) contain VTC systems?			
6.	Are there any commercial television receivers installed?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
	■ If yes, provide a separate annotated floor plan of the commercial television system			
7.	Does the SCIF have any automated environmental infrastructure systems?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
	■ If yes, describe what countermeasures have been taken to provide against malicious activity, intrusion, and exploitation. (Example: premise management systems, environmental control systems, lighting and power control units, uninterrupted power sources)			
8.	REMARKS:			

Section G: Acoustical Protection				
1.	Do all areas of the SCIF meet AO required acoustical protection standards"? (Ref: Chapter 9A)			<input type="checkbox"/> Yes <input type="checkbox"/> No
	<p>■ If no, describe additional measures taken to provide conforming acoustical protection (e.g., added sound insulation, door and windows coverings, no discussion areas, sound masking, etc.)</p>			
2.	Are there any amplified audio systems used for classified information? (Example VTC, PA systems, etc.)			<input type="checkbox"/> Yes <input type="checkbox"/> No
	<p>■ If yes, are the walls/ceilings/floor of the room where the amplified audio system resides acoustically treated to meet a Sound Group 4 or STC 50?</p>	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
3.	Is there a public address or music system entirely contained within the SCIF?			<input type="checkbox"/> Yes <input type="checkbox"/> No
	<p>■ If yes, provide a separate annotated floor plan for each system</p>			
4.	Is the SCIF equipped with a public address, emergency/fire announcement or music system originating outside the SCIF?			<input type="checkbox"/> Yes <input type="checkbox"/> No
Section H: Classified Destruction Methods				
1.	Destruction methods? (Ref: Chapter 12M)			
	a. Describe the method and equipment used for destruction of classified/sensitive material (if more than one method or device, use Remarks to describe). List all manufacturer and models			
	Method	Device Manufacturer	Model	
	b. Is a secondary method of destruction available?			<input type="checkbox"/> Yes <input type="checkbox"/> No
	c. Describe the location of destruction site(s) in relation to the secure facility			
	d. Describe method or procedure used for handling non-soluble classified/sensitive material at this facility			
	e. Do you have a written Emergency Action Plan (EAP) approved by AO (if required)?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
2.	REMARKS:			



Section I: INFOSEC/TEMPEST/Technical Security			
1.	Does the facility electronically process classified information? (Ref: Chapter 13)	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	<input checked="" type="checkbox"/> If yes, complete TEMPEST CHECKLIST FOR SCIF Form		

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**CLASSIFY ACCORDING TO FACILITY SPONSOR**  
**CLASSIFICATION GUIDANCE**

**TEMPEST Checklist**

**[Insert Org Name]**

**[Date]**

**[Address]**

## **TEMPEST CHECKLIST**

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*(Classified when filled in)*

**DATE:** \_\_\_\_\_

*(Select the appropriate block)*

**SECTION A - SCIF Identification Data**

**1. SCIF Data:**

Organization/Company Name: \_\_\_\_\_

Organization subordinate to: \_\_\_\_\_

Office E-mail address: \_\_\_\_\_ (C) \_\_\_\_\_ (U)

**2. SCIF Location:**

Street Address: \_\_\_\_\_

Bldg. Name/Number: \_\_\_\_\_ Floor(s): \_\_\_\_\_

Room No(s): \_\_\_\_\_

City: \_\_\_\_\_ State/Country: \_\_\_\_\_ Zip Code: \_\_\_\_\_

Military Base/Installation Name: \_\_\_\_\_

GPS Coordinates: \_\_\_\_\_

**3. Primary SCIF Point(s) of Contact:**

Name(s): \_\_\_\_\_

DSN/Commercial Telephone: \_\_\_\_\_

Secure Telephone: \_\_\_\_\_

Secure Fax No: \_\_\_\_\_

Unclassified Fax No: \_\_\_\_\_

Secure E-mail Address: \_\_\_\_\_

Unclassified E-mail Address: \_\_\_\_\_

**4. Alternate SCIF Point(s) of Contact:**

Name(s): \_\_\_\_\_

DSN/Commercial Telephone: \_\_\_\_\_

Secure Telephone: \_\_\_\_\_

Secure Fax No: \_\_\_\_\_

Unclassified Fax No: \_\_\_\_\_

Secure E-mail Address: \_\_\_\_\_

Unclassified E-mail Address: \_\_\_\_\_

## SECTION B - SCIF Equipment/Systems

### 1. Signal Lines and Signal Distribution Systems:

a. Are there any Signal Lines/Signal Distribution systems that exit the SCIF?

☐ Yes     ☐ No (skip to 2)

b. If Yes, what type of lines exit the SCIF? If yes, give a diagram identifying the location and line types. Clearly identify any usage of a Protected Distribution System.

☐ Fiber Optic (Skip to 2.)   ☐ Coaxial   ☐ Copper Wires

c. If they are Coaxial or Copper wires, is there any kind of Filter or Isolation device installed on them?

☐ YES   ☐ NO (Skip to e.)

d. If Yes, what type of device is used in the system? *If needed, use additional sheets.*

Make \_\_\_\_\_ Model # \_\_\_\_\_ Location \_\_\_\_\_

Make \_\_\_\_\_ Model # \_\_\_\_\_ Location \_\_\_\_\_

Make \_\_\_\_\_ Model # \_\_\_\_\_ Location \_\_\_\_\_

e. If No, describe each Signal Lines/Signal Distribution Systems. Detail where it goes, what it connects to outside the SCIF, the composition of line, the number of lines, etc. *If needed, use additional sheets.*

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*Submit floor plans of the SCIF that show the location, routing and identity of all signal lines and signal distribution systems within the SCIF. Identify them as BLACK or RED and include all telephone lines, signal lines, alarm lines, etc. If applicable, indicate where they leave the SCIF area and show the locations of all filters, Isolators and amplifiers*

## **2. Power Lines and Power Distribution Systems:**

a. Are there any Power Lines/Power Distribution Systems that exit the SCIF?

☐ YES ☐ NO (Skip to 3.) *If yes, provide a diagram showing where it exits the SCIF.*

b. Describe each Power Lines/Power Distribution Systems. Detail where it leaves the SCIF, what it connects to outside the SCIF, does the power come from a Host Nation source, does the power come from a US controlled generator, describe the material composition of the line, the number of lines, voltages involved, etc. *If needed, use additional sheets.*

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*Submit floor plans of the SCIF showing the location, routing and identity of all power lines and power distribution systems within the SCIF. Identify them as BLACK or RED. If applicable, indicate where they leave the SCIF area and show the locations of all filters, Isolators and amplifiers.*

## **3. Heating, Ventilation and Air Conditioning (HVAC) Systems; Water Pipes; Gas Pipes, Sprinkler Systems, etc.:**

a. Describe each HVAC Systems or pipe. Please explain in detail: path, connections in/outside of the SCIF, composition of the vent or pipe, size, accessibility, etc. Provide a diagram indicating their exits from the SCIF. If there are any grounding mitigations, please indicate on the diagram. Are wave guides installed? *If needed, use additional sheets.*

---

*Submit floor plans of the SCIF showing the location, routing and identity of all HVAC systems and pipes within the SCIF. If applicable, indicate where they leave the SCI area and show the locations of all isolators and non-conductive breaks.*

## **4. Radio Transmission/Reception Device:**

a. Are there any Radio Transmitters or Receivers located in the SCIF or within three meters of the SCIF's perimeter wall?

☐ YES (*Go to Device #1.*)    ☐ NO (*Skip to 5.*)

**Device #1:**

a. Type of equipment                      Make                      Model number

\_\_\_\_\_

b. List how many hours the equipment is used? Hours per: day\_\_\_\_\_ week\_\_\_\_\_ month\_\_\_\_\_

c. Prior to encryption, what is the highest classification level of the information transmitted?

☐ SCI    ☐ TOP SECRET    ☐ SECRET    ☐ CONFIDENTIAL    ☐  
UNCLASSIFIED

d. List the room number(s) where the equipment is located: \_\_\_\_\_

e. List the distance between the radio transmission/reception device and the nearest RED equipment or crypto gear \_\_\_\_\_

f. Is the power for the radio transmission/reception equipment isolated from the power for the RED processing equipment?

☐ YES    ☐ NO (*Skip to h.*)

g. If Yes, how are they isolated?

☐ Separate power circuit (*Skip to 5.*)    ☐ Power line filters (*Should be annotated in 2d.*)

h. If No, describe each transmitter power source. Please explain in detail: path, connections in/outside of the SCIF, composition of the line, voltage, size/gauge, accessibility, etc. *If needed, use additional sheets.*

\_\_\_\_\_  
\_\_\_\_\_

**For Additional Devices** (*use additional sheets*)

*Submit floor plans of the SCIF showing the transmitter locations, signal and power line routing and the identity of all system components installed within the SCIF. If applicable, indicate where they leave the SCI area, where the antenna is and show the locations of all Isolators and filters.*



**5. Multilevel Systems:**

a. Are there any multi-level systems (e.g, equipment that processes different classification levels) located in the SCIF or within one meter of the SCIF's perimeter wall?

{ } YES { } NO (*Skip to 6*) *If so, describe the level in detail.*

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**6. Telecommunications Systems:**

a. What kind of telecommunications systems are in the SCIF? (VoIP, DSM) Please describe.

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**7. Existing TEMPEST Countermeasures:**

a. List any existing TEMPEST countermeasures such as shielded enclosures, supplemental shielding, filters (power, signal, telephone, etc...), and non-conductive sections in metallic distribution systems (pipes, a/c ducts, etc...).

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b. Describe construction method and materials used in:

Perimeter wall:

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Floor:

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Ceiling:

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c. Does the SCIF perimeter have windows?

☐ YES (*Answer below.*)    ☐ NO (*Go to SECTION C.*)

List quantity, size, and any countermeasures used and pertinent information about your windows.

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**SECTION C - Information Processing**

Volume of Information Processed- Describe the percentage and volume of information processed at the UNCLASSIFIED, SENSITIVE, CONFIDENTIAL, SECRET, and TOP SECRET levels.

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## SECTION D - Maps/Diagrams

Submit these drawings even if you submitted them with your FFC for physical security accreditation. The FFC is routed to different sections and are considered separate actions. Soft copies are preferred and while most formats are acceptable, Power Point is recommended.

**1. External:** (Please indicate on all external maps a compass heading that displays North at a minimum.)

- a. Submit scale drawings or maps of the location of your SCIF's building within the base/post/compound/city in which it is located.
- b. If you are on a military base/post, a government controlled facility/area or a compound/campus that is solely controlled by your company with a 24 hour guard force, indicate the distance between the building and the closest boundary of the compound in meters. Also indicate the distance in meters to the boundaries in each cardinal direction (i.e. East, West, North and South). Submit scale drawings or maps of the location of the post/base/facility/area/campus/compound in relationship to the nearest city.
- c. If you are not in a controlled area, show on the map/drawings the distances in meters from the SCIF perimeter to the closest limit of SCIF's inspect able space boundary (those areas where the U.S. government or your company does not have the legal authority to identify and/or remove a TEMPEST exploitation or where it would be impractical to conduct a TEMPEST attack).
- d. Show the locations of any areas within 100 meters of the SCIF which are occupied by Foreign Nationals or controlled by Foreign Entities/Companies that are not readily accessible by SCIF personnel identify the occupants and their distance in meters from the SCIF perimeter.

**2. Internal:**

Submit scale drawings or maps of the location of your SCIF within the building or facility that it resides. Provide floor plans of the SCIF itself and provide the following:

- a. Location and identify by manufacture, model, type, and level of classification of any equipment that is electronically processes unencrypted National Security Information (NSI). For large facilities, this list can be placed on a separate spread sheet and numbers/symbols can be used in the drawing.
- b. Location of all Signal Line Distribution Systems, telephone instruments, line and power filters and/or isolators, signal ground points, etc...
- c. Routing and identity of lines, cables and other metallic conductors which leave the SCI area, including telephone, power, signal, alarm lines, pipes, air ducts, etc...

- d. If the SCIF is located in a Multi-story building NOT entirely controlled by the US government, submit a floor plan of the entire floor and identify the occupants of the other spaces. In addition, provide the names of the occupants on the floors above and below and, if possible, identify any foreign nationals. GSA facilities are not exempt from the above requirement.
- e. Indicate whether the SCIF shares a common wall with any non-government organizations. If so, list them and show their locations on the diagram and maps.

**CLASSIFY ACCORDING TO FACILITY SPONSOR**  
**CLASSIFICATION GUIDANCE**

## **Compartmented Area Checklist**

**[Insert Org Name]**

**[Date]**

**[Address]**

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CHECK Applicable blocks		
<input type="checkbox"/> Initial Approval	<input type="checkbox"/> Re-approval	<input type="checkbox"/> Modified Facility
<input type="checkbox"/> Pre-construction	<input type="checkbox"/> New Facility	<input type="checkbox"/> Page Change

**Checklist Contents**

**Section A: General information**

**Section B: Compartmented Area Security**

**Section C: Compartmented Area Type Descriptions**

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**List of Attachments**

*(Diagrams must be submitted on 8 ½" x 11" or 11" x 17" format)*

Section A: General Information							
1.	<b>SCIF Information</b>						
	Organization/Company Name						
	SCIF Identification Number <i>(if applicable)</i>						
	Organization subordinate to <i>(if applicable)</i>						
	Cognizant Security Authority (CSA)						
	<b>Defense Special Security Communication System Information <i>(if applicable)</i></b>						
	DSSCS Message Address						
	DSSCS INFO Address						
	If no DSSCS Message Address, please provide passing instructions						
	<b>b. Existing SCIF Accreditation Information</b>						
	<input type="checkbox"/> Open Storage	<input type="checkbox"/> Closed Storage	<input type="checkbox"/> IT Processing	<input type="checkbox"/> Discussions	<input type="checkbox"/> Continuous Operation	<input type="checkbox"/> Fixed <input type="checkbox"/> SWA <input type="checkbox"/> TSWA <input type="checkbox"/> Other	
	2) Accreditation granted by:				on:		
	c. If automated information system (AIS) is used, has an accreditation been granted?					<input type="checkbox"/> Yes	<input type="checkbox"/> No
	If yes, identify compartment classification level (check all that apply)						
<input type="checkbox"/> SCI	<input type="checkbox"/> Top Secret	<input type="checkbox"/> Secret	<input type="checkbox"/> Confidential				
d. SCIF duty hours: _____ (hours to hours), _____ days per week.							
e. Total square footage that the SCIF occupies: _____							
f. Any waivers?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A	If yes, attach a copy of approved waiver			
2.	<b>Location of Proposed Compartmented Area</b>						
	Street Address						
	Building Name/ #		Floor(s)				
	Suite(s)		Room(s) #				
	City		Base/Post				
	State/Country		Zip Code				
	Contract number and expiration date <i>(if applicable)</i>		Contract Number:		Expiration Date:		



3.	<b>Mailing Address (if different from SCIF location)</b>					
	Street or Post Office Box					
	City		State		Zip Code	
4.	<b>Requestor Contact Information</b>					
	Name					
	Phone	Open:				
	E-Mail	Unclass:		Classified:		
	Additional E-mail					
5.	<b>Responsible Security Personnel</b>					
		<b>PRIMARY</b>			<b>ALTERNATE</b>	
	Name					
	Commercial Telephone					
	DSN Telephone					
	Secure Telephone					
	STE Telephone					
	Other Telephone					
	Home Telephone					
	Facsimile	Classified:			Unclassified:	
	Command or Regional Special Security Office/ name (SSO): <i>(if applicable)</i>					
	Commercial Telephone					
	Other Telephone					
	Information System Security Officer					
	Commercial Telephone					
	Secure Telephone					

6.	<b>Compartmented Area Information</b>			
<b>a. Compartmented area accreditation level desired:</b> 1) Indicate CA requirements				
<input type="checkbox"/> Open Storage		<input type="checkbox"/> Closed Storage	<input type="checkbox"/> IT Processing	<input type="checkbox"/> Discussions  <input type="checkbox"/> Continuous Operation
2) Indicate the CA Type Requested (See Section C)				
<input type="checkbox"/> Type 1		<input type="checkbox"/> Type 2		<input type="checkbox"/> Type 3
<b>Section B: Compartmented Area Security</b>				
1.	Are all equipment (computers, copiers, printers, scanners, fax, etc.) used to process compartmented information approved to process compartmented program information or a system security plan (SSP) submitted for approval to the appropriate information system authorizing official?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	Provide a copy of the approval documentation or a copy of the SSP submitted.
2.	<b>Workstations in a cubicle or office configuration - Type 1:</b>			
Is the CA in a cubicle or other open environment?		<input type="checkbox"/> Yes	<input type="checkbox"/> No	
Is the workstation in a closable office?		<input type="checkbox"/> Yes	<input type="checkbox"/> No	
If the office is closable, is there an access control device?		<input type="checkbox"/> Yes	<input type="checkbox"/> No	If yes, please provide manufacturer and model
<b>MANUFACTURER</b>			<b>MODEL</b>	
Are display screens positioned to avoid "shoulder-surfing"?		<input type="checkbox"/> Yes	<input type="checkbox"/> No	
Are polarized privacy screens installed?		<input type="checkbox"/> Yes	<input type="checkbox"/> No	
Is printing of CA material required?		<input type="checkbox"/> Yes	<input type="checkbox"/> No	If yes, explain printer location, connectivity and procedures to retrieve printed material.

	Is scanning/copying of CA material required?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	If yes, explain copier/scanner location, connectivity and procedures to protect CA material.
	Is storage of CA material required within the CA?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	If yes, do only individuals briefed to the CA program have access to the GSA approved storage container? <input type="checkbox"/> Yes <input type="checkbox"/> No
	Describe procedures to secure the workstation when the individual leaves the CA (for any length of time).			
	Describe procedures to secure the CA at the end of day.			
<b>3.</b>	<b>CAs with a requirement for discussions of compartmented information- Type 2:</b>			
	Are all individuals within the CA briefed to the compartment?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	If No, describe procedures to prevent inadvertent disclosure of compartmented information.
	Is the CA constructed to meet ICS 705-1 acoustic standards?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	If Yes, describe acoustic protection method used.
	Is secure teleconferencing equipment to be used?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
	Describe the procedures for controlling access during program discussions and control of meeting material used (if applicable) during and after the discussions.			
<b>4.</b>	<b>CAs with a requirement for strict accountability of compartmented information- Type 3:</b>			
	Are all personnel who have unescorted access to the CA briefed to the compartmented program?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	

	Does the CA meet ICS 705-1 standard for acoustic protection? <i>(if applicable)</i>	<input type="checkbox"/> Yes	<input type="checkbox"/> No	If Yes, describe acoustic protection method used.
	Are storage containers GSA approved?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
	Are all equipment (computers, copiers, printers, scanners, fax, etc.) used to process compartmented information approved or a system security plan (SSP) submitted for approval?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
5.	Describe the procedures for controlling access during program discussions and control of meeting material used (if applicable) during and after the discussions. In addition, include any remarks to assist in the approval process.			
6.	<b>Additional security measures (locks, alarms, dedicated reading rooms, etc.) are considered waivers (above) to the standards and require approval of the IC Element Head. Identify any additional security requirements requested:</b>			
<b>Section C: Compartmented Area Type Descriptions</b>				
1.	Compartmented Area Types:			

	<p><b>a. Type I: A workstation environment that is used to view and process compartmented information.</b></p> <p>Type I comprises open bays, open spaces, or a set of rooms with multiple cubicles in an accredited SCIF where compartmented information may be securely viewed and/or processed, i.e., via an approved computer workstation by authorized personnel. Workstations in these environments may include computers with single or multiple monitors. Polarized privacy screens may be used on a computer monitor to prevent persons other than the authorized user to view the material, i.e., shoulder surfing, or when a monitor faces a primary door or common work area. In addition to processing compartmented information on approved computer workstations, Type I CAs may include the use of printers, copiers, and scanners with prior approval.</p>
2.	<p><b>b. Type II: An area where discussions of compartmented information may take place. If so equipped and approved, compartmented information may also be viewed and processed.</b></p> <p>This CA comprises a room, e.g., office or conference room, inside an accredited SCIF where compartmented discussions may be held by authorized personnel. All Type II CAs must meet existing sound transmission class (STC) requirements per ICS 705-1 to ensure that the room or office retains sound within its perimeter. In addition to compartmented discussions, Type II CAs may be used for secure video teleconferencing (SVTC) and related communication conferencing and the use of secure telephones for compartmented discussions. The use of printers, scanners, and copiers, and the secure transfer of data to approved removable media or and the use of secure facsimile machines require prior approval.</p>

3.	<p><b>c. Type III: A restricted discussion area used for viewing, processing, printing, copying, storage and control of accountable compartmented information.</b></p> <p>This CA is intended for storing and retaining compartmented information when accountability and strict control of compartmented program information is required. This includes, but is not limited to: notes, briefs, slides, electronic presentations, analytic papers, removable hard drives, field packs, thumb drives, laptops, personal electronic devices (PEDs) or hand-held devices that store compartmented information. In addition to the storage of compartmented material in a GSA-approved container, Type III CAs may be used for processing compartmented information on approved computer workstations; the use of printers, scanners, and copiers; the secure transfer of data to approved removable media; the use of secure facsimile machines; and the use of secure telephone equipment (STE) for compartmented discussions. All personnel residing within or who have unfettered access to a Type III CA must be formally briefed into all compartments that reside within the Type III CA. Visitors are permitted within Type III areas only when all compartmented information (for which the visitor is not briefed) is stored within containers, out of sight, and while the visitor is under constant observation by a fully briefed person.</p>
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**CLASSIFY ACCORDING TO FACILITY SPONSOR**  
**CLASSIFICATION GUIDANCE**

## **Shipboard Checklist**

**[Insert Org Name]**

**[Date]**

**[Address]**

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CHECK Applicable blocks		
<input type="checkbox"/> Initial Accreditation	<input type="checkbox"/> Re- Accreditation	<input type="checkbox"/> Modified Facility
<input type="checkbox"/> Pre-construction	<input type="checkbox"/> New Facility	<input type="checkbox"/> Page Change

### Checklist Contents

**Section A: General information**

**Section B: Physical Security**

**Section C: Intrusion Detection Systems (IDS)**

**Section D: Telecommunication Systems and Equipment Baseline**

**Section E: Classified Destruction Methods**

**Section F: TEMPEST/Technical Security**

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### List of Attachments

*(Diagrams must be submitted on 8 ½" x 11" or 11" x 17" format)*

Section A: General Information			
1.	<b>SCIF Data</b>		
	a. Organization/Company Name		
	b. Name of Ship and Hull number		
	c. Home Port		
	d. SCIF ID Number		
	e. Contract Number and Expiration Date <i>(if applicable)</i>		
	f. Concept Approval Date		
	g. Cognizant Security Authority (CSA)		
	<b>Defense Special Security Communication System Information <i>(if applicable)</i></b>		
	h. DSSCS Message Address		
	DSSCS INFO Address		
	If no DSSCS Message Address, please provide passing instructions		
i. Location of Compartments			
2.	<b>Complete Mailing Address</b>		
	Street Address		
	Building Name/ #	Floor(s)	
	Suite(s)	Room(s) #	
	City	Base/Post	
	State/Country	Zip Code	
3.	<b>E-Mail Addresses</b>		
	Classified	(Network/System Name & Level)	
	Unclassified	(Network/System Name)	
	Other	(Network/System Name)	
	Additional Address	(Network/System Name)	
4.	<b>Responsible Security Personnel</b>		
		<b>PRIMARY</b>	<b>ALTERNATE</b>
	Name		
	Commercial Telephone		
	DSN Telephone		

	Secure Telephone		
	/STE Telephone		
	Other Telephone		
	Home (optional)		
	Facsimile Number:		
	Classified		Unclassified
	Command or Regional Special Security Office/Name (SSO) (if applicable)		
		PRIMARY	ALTERNATE
	Commercial Telephone		
	Other Telephone		
	Information System Security Officer Name		
		PRIMARY	ALTERNATE
	Commercial Telephone		
	Secure Telephone		
5.	<b>Accreditation Data</b>		
	<b>a. Category/Compartments of SCI Requested:</b>		
	1) Indicate storage requirement:		
	<input type="checkbox"/> Open	<input type="checkbox"/> Closed	<input type="checkbox"/> Continuous Operation <input type="checkbox"/> None
	2) Indicate the facility type		
	<input type="checkbox"/> Permanent	<input type="checkbox"/> Temporary Secure Working Area	<input type="checkbox"/> Secure Working Area <input type="checkbox"/> Tactical
	<b>b. Existing Accreditation Information (if applicable)</b>		
	1) SCIF accesses required		
	2) Accreditation granted by:		On:
	3) Waivers:		
	4) Co-Use Agreements	<input type="checkbox"/> Yes <input type="checkbox"/> No	If yes, provide sponsor/compartment:
	<b>c. SAP(s) co-located within SCIF</b>	<input type="checkbox"/> Yes <input type="checkbox"/> No	If yes, identify SAP Classification level (check all that apply)

	<input type="checkbox"/> SCI	<input type="checkbox"/> Top Secret	<input type="checkbox"/> Secret	<input type="checkbox"/> Confidential
	d. SCIF duty hours	(hours to hours)		days per week
	e. Total square footage that the SCIF occupies			
	f. Has CSA requested any waivers?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
	If yes, attach a copy of the approved waiver			
<b>6.</b>	<b>Construction/Modification</b>			
	Is construction or modification complete?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
	If no, enter the expected date of completion			
<b>7.</b>	<b>Inspections</b>			
	a. TSCM Service completed by			On _____ (Attach a copy of report)
	b. Were deficiencies corrected?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
	If no, explain			
	c. Last physical security inspection by			On _____ (Attach a copy of report)
	Were deficiencies corrected?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
	If no, explain			
<b>8.</b>	<b>Remarks</b>			

Section B: Physical Security				
<b>1.</b>	<b>Decks, bulkheads and overhead construction</b>			
	Are the decks, bulkheads and overhead constructed of aluminum plate or standards shipboard material true floor to ceiling?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
<b>2.</b>	<b>Security In-Depth</b>			
	What external security attributes and/or features should the CSA consider before determining whether or not this facility has Security In-Depth? <i>Please identify/explain all factors:</i>			
<b>3.</b>	<b>Access Controls: How is access to the SCIF controlled?</b>			
	a. By Guard Force	<input type="checkbox"/> Yes	<input type="checkbox"/> No	If yes, what is their minimum security clearance level?
	b. Is Guard Force Armed?	<input type="checkbox"/> Yes		<input type="checkbox"/> No
	c. By assigned personnel	<input type="checkbox"/> Yes	<input type="checkbox"/> No	If yes, do personnel have visual control of SCIF entrance door?
	<input type="checkbox"/> Yes	<input type="checkbox"/> No		<input type="checkbox"/> N/A

d. By access control device	<input type="checkbox"/> Yes	<input type="checkbox"/> No	If yes, what kind?	
<input type="checkbox"/> Automated access control system		<input type="checkbox"/> Non-automated		
<b>If non-automated</b>				
1. Is there a by-pass key	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A	
If yes, how is the by-pass key protected?				
2. Manufacturer		Model		
(Attach sheet if additional space is required for this information)				
<b>If automated</b>				
1. Are access control transmission lines protected by FIPS AES encryption?				
<input type="checkbox"/> Yes	<input type="checkbox"/> No	If no, explain the physical protection provided		
2. Are automated access control system locations within a SCIF or an alarmed area controlled at the <b>SECRET</b> level?			<input type="checkbox"/> Yes	<input type="checkbox"/> No
3. Is the access control system encoded and is ID data and PINs restricted to SCI-indoctrinated personnel?			<input type="checkbox"/> Yes	<input type="checkbox"/> No
4. Does external access control outside SCIF have tamper protection?			<input type="checkbox"/> Yes	<input type="checkbox"/> No
5. Is the access control device integrated with an IDS:		<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
Is the access control device integrated with a network system?		<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
<b>4.</b>	<b>Primary Entrance Door</b>			
a.	Is routine ingress and egress to the space through one door?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
b.	Is the shipboard type door constructed IAW ICS 705-1,?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
c.	Is door constructed of aluminum/steel plate or standard shipboard materials?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
d.	Is door equipped with a combination lock that meets requirements of a Pedestrian Deadbolt Federal Specifications FF-L-2890?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
Include lock manufacturer, model and group				
<b>Manufacturer</b>		<b>Model</b>	<b>Group Rating</b>	
e.	Is door equipped with an access control device		<input type="checkbox"/> Yes	<input type="checkbox"/> No
f.	Is door constructed in a manner which will preclude unauthorized removal of hinge pins and anchor bolts, as well as obstruct access to lock-in bolts between door and frame?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
g.	Remarks:			
<b>5.</b>	<b>Emergency Exit</b>			

	a. Is space equipped with an emergency exit?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	b. Has the emergency exit been fabricated of aluminum/steel plate or standard shipboard materials?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	c. Has door(s) been mounted in a frame braced and welded in place in a manner commensurate with structural characteristics of the bulkhead, deck or overhead in which it is located?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	d. Has the emergency exit been constructed in a manner which will preclude unauthorized removal of hinge pins and anchor bolts, as well as obstructs access to lock-in bolts between door and frame?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	e. Remarks		
<b>6.</b>	<b>Restrictions on Damage Control Fittings and Cable</b>		
	a. Are any essential damage control fittings or cables located within or pass through the SCIF?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	b. Remarks		
<b>7.</b>	<b>Removable Hatches and Deck Plates</b>		
	a. Are hatches and deck plates less than 10 square feet that are secured by exposed nuts and bolts (external to SCIF) secured with high security padlocks?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	b. If key padlocks are used, are the keys stored in a security container located with a space under appropriate security control?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	c. Remarks:		
<b>8.</b>	<b>Vent and Duct Barriers</b>		
	a. Are vents, ducts, louvers, or other physical perimeter barrier openings with a cross sectional dimension greater than 96 square inches protected at the perimeter with a fixed barrier or security grill?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	b. If gratings or bars are used, are they welded in place?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	c. Remarks:		
<b>9.</b>	<b>Acoustical Isolation</b>		
	a. Is the physical perimeter of the SCIF sealed or insulated with non-hardening caulking material so as to prevent inadvertent disclosure of SCI discussions or briefings from within the SCIF?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	b. In instances where the physical perimeter barrier is not sufficient to control voices or sounds, is the use of sound deadening material installed?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	c. Do air handling units have continuous duty blowers or provide an effective level of sound masking in each air path?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	d. Remarks:		
<b>10.</b>	<b>Visual Isolation</b>		
	a. Are doors or other openings in the physical perimeter barrier through which the interior may be viewed screened or curtailed?	<input type="checkbox"/> Yes	<input type="checkbox"/> No

	b. Remarks			
11.	<b>Passing Windows and Scuttles</b>			
	a. Have passing windows and scuttles been eliminated from the SCIF?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
	b. Remarks:			
12.	<b>Secure Storage Equipment</b>			
	a. Is the SCIF equipped with a sufficient number of GSA approved security containers?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
	b. Have they been welded in place or otherwise secured to a foundation for safety?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
	c. Remarks:			
<b>Section C: Intrusion Detection Systems (IDS)</b>				
1.	<b>Are SCIF access door(s) and emergency exit(s) protected by a visual and audible alarm system:</b>	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
	a. Does alarm installation consist of sensors at each door and alerting indicators located within the SCIF?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
	b. Does the emergency exit door(s) alarm have a different feature?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
	c. Does the system have an alarm monitor station which is continuously manned by personnel capable of responding to or directing a response to an alarm violation of the SCIF when it is unmanned?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
	d. Remarks:			
<b>Section D: Telecommunication Systems and Equipment Baseline</b>				
1.	<b>Is the facility declared a "No classified Discussion Area"?</b>	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
	If yes, then the audio protection questions within this section may be identified as N/A			
	If the facility is declared a No Classified Discussion Area, are warning notices posted prominently within the facility?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
2.	<b>Does the facility have any unclassified telephones that are connected to the commercial public switch telephone network (PSTN)?</b>	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
	What is the method of on-hook protection?			
	1) CNSS 5006 (TSG-6) approved telephone or instrument	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
	<i>(Please identify all telephone equipment/stations and/or instruments being used either below or as an attachment)</i>			
	<b>Manufacturer</b>	<b>Model Number</b>	<b>TSG Number</b> <i>(if applicable)</i>	
	2. CNSS 5006 approved disconnect device?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A

Chapter 13  
Forms and Plans

a) Line disconnect		<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
b) Ringer protection		<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
<b>Manufacturer</b>	<b>Model Number</b>	<b>TSG Number</b> <i>(if applicable)</i>		
3) CNSS 5002 (TSG-2) configured computerized telephone system (CTS)?		<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
a) If yes, please provide the following information about the CTS				
<b>Manufacturer</b>		<b>Model</b>		
b) If yes, please provide specific location of the CTS				
c) How is the facility protecting the CTS physically controlled?				
d) If yes, what is the clearance level (if any) of facility or area where the switch is located and how is area controlled?				
e) Are all cables, signal lines and intermediate wiring frames between the SCIF telephones and the CTS physically protected within a physically controlled space?			<input type="checkbox"/> Yes	<input type="checkbox"/> No
If no, please explain				
f) Are all program media, such as tapes and/or disks, from the CTS afforded physical protection from unauthorized alterations?			<input type="checkbox"/> Yes	<input type="checkbox"/> No
g) Is an up-to-date master copy of the CTS software program maintained for confirmation and/or reloading of the operating system?			<input type="checkbox"/> Yes	<input type="checkbox"/> No
h) Does the CTS have the capability to force or hold a telephone station off-hook?			<input type="checkbox"/> Yes	<input type="checkbox"/> No
i) Does the CTS use remote maintenance and diagnostic procedures or other remote access features?			<input type="checkbox"/> Yes	<input type="checkbox"/> No
If yes, explain maintenance procedures				
j) Do the CTS installers and programmers have security clearances?			<input type="checkbox"/> Yes	<input type="checkbox"/> No
If yes, at what access level (minimum established by CSA)				
If no, are escorts provided?			<input type="checkbox"/> Yes	<input type="checkbox"/> No
4) Is it Voice over Internet Protocol (VoIP) phone system ?		<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
a) If yes, please provide the following information about the IPS				
<b>Manufacturer</b>	<b>Model</b>	<b>IPS Location</b>		



b) Do all unclassified telephones within the facility have a hold, mute and/or push-to-talk [handset] capability, (for off-hook audio protection)?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
If no, please explain			
c) Is access to the facility housing the IPS physically controlled?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
d) If yes, what is the clearance level (if any) of facility or area where the switch is located at and how is the area controlled?			
e) Are all cables, signal lines and intermediate wiring frames between the SCIF telephones and the IPS physically protected or contained within a physically controlled space?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
If no, please explain			
f) Are all program media, such as tapes and/or disks, from the IPS afforded physical protection from unauthorized alterations?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
g) Is an up-to-date master copy of the IPS software program maintained for confirmation and/or reloading of the operating system?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
h) Does the IPS have the capability to force or hold a telephone station off-hook?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
i) Does the IPS use remote maintenance and diagnostic procedures or other remote access features?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
j) Do the IPS installers and programmers have security clearances?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
If yes, at what access level (minimum established by CSA?			
If no, are escorts provided?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
<b>3. Automatic telephone call answering</b>			
Are there any automatic call answering devices for the telephones in the SCIF?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
1) If yes, please identify the type			
a. Voice mail/unified message service	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
b. Standalone telephone answering device (TAD)	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
2) Provide manufacturer and model number of the equipment			
<b>Manufacturer</b>	<b>Model Number</b>		
Are speakerphones/microphones enabled?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
If yes, has the remote room monitoring capability been disabled?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	

	Has this been approved for use by the CSA?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
	Provide detailed configuration procedures			
	If applicable, is the voice mail or unified messaging services configured to prevent unauthorized access from remote diagnostic ports or internal dial tone?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
4.	<b>Are any Multi-Function Office Machines (M-FOMs) used within the SCIF (M-FOMs are electronic equipment that can be used as network or standalone printers, facsimiles, and copiers)</b>	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
	a. If yes, please identify the device to include (Please identify all M-FOM devices in use, either below or as an attachment (include a manufacture Volatile statement for each M-FOM)			
	<b>Make</b>	<b>Model</b>	<b>Serial Number</b>	
	b. If yes, please identify all features and information processing level of each M-FOM			
	1) Copier	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
	If yes, level(s) of information			
	2) Facsimile	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
	If yes, level(s) of information			
	3) Printer (connected to a standalone computer or network)	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
	If yes, please explain and identify the system(s) and the level(s) of information)			
	c. Does the M-FOM have memory storage capability?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
	If yes, what kind?	<input type="checkbox"/> Volatile (information in memory clears/erases when powered off?	<input type="checkbox"/> Non-volatile (information in memory that remains when powered off)	
	d. Does the M-FOM have a digital hard drive?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
	e. Have maintenance and disposition procedures been established?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
	f. If reproduction of classified/sensitive materials take place outside the SCIF, describe equipment and security procedures used to reproduce documents			
	g. Does the M-FOM have voice transmission capability and/or a telephone handset?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
	If yes, how is this features protected? Please describe			
5.	<b>Are there any video teleconference (VTC) systems installed?</b>	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
	If yes, what level(s) of information is the VTC system processing?			

6.	<b>Are all telecommunications systems, devices, features, and software documented?</b> <i>(Attached telecommunication baseline)</i>		<input type="checkbox"/> Yes	<input type="checkbox"/> No
7.	<b>Sound Powered Telephones</b>			
	Have all sound powered telephones been eliminated from the SCIF?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
	If no, answer the following questions			
	a. Are there sound powered or other telephone systems in the facility which cannot connect to locations outside the SCIF?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	How Many?
	b. Are they installed and protected IAW ICS 705-1, Section E?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
	Remarks			
8.	<b>General Announcing System</b>			
	Do general announcing system loudspeakers have an audio amplifier and are the output signal line installed within the SCIF?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
	Remarks			
9.	<b>SCI Intercommunications Announcing Systems</b>			
	Do any intercommunication type announcing systems that process SCI pass through areas outside the SCIF?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
	If yes, list type, manufacturer and model			
	Type	Manufacturer	Model	
	Remarks			
10.	<b>Commercial Interconnection Equipment</b>			
	Are any commercial intercommunications equipment installed within the SCIF?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
	Remarks			
11.	<b>Pneumatic Tube Systems</b>			
	a. Are there any pneumatic tube systems installed in the SCIF?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
	b. Are they installed IAWICS 705-1, Section E??		<input type="checkbox"/> Yes	<input type="checkbox"/> No
	c. Remarks			

Section E: Classified Destruction Methods				
1.	<b>Destruction methods</b>			
	a. Describe the method and equipment used for destruction of classified/sensitive material (if more than one method or device, use Remarks to describe. (If more than one device, use remarks to list all manufacturer and model)			
	<b>Method</b>	<b>Device Manufacturer</b>	<b>Model</b>	
	b. Is a secondary method of destruction available?			<input type="checkbox"/> Yes <input type="checkbox"/> No
	c. Describe the location of destruction site(s) in relation to the secure facility:			
	d. Describe method or procedure used for handling non-soluble classified/sensitive material at this facility:			
	e. Do you have a written Emergency Action Plan (EAP) approved by CSA (if required)?		<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	
	Remarks			
Section F: TEMPEST/Technical Security				
1.	Does the facility electronically process classified information?			<input type="checkbox"/> Yes <input type="checkbox"/> No
	If yes, what is the highest level of information processed?			
2.	<b>For the last TEMPEST Accreditation (if applicable), provide the following information</b>			
	Accreditation granted by:		On	
3.	Has the CSA's Certified TEMPEST Technical Authority (CTTA) required any TEMPEST countermeasures?		<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	
	If yes, please identify the countermeasures that have been installed (i.e. non-conductive sections, Radio Frequency (RF) shielding, power/signal line filters, window film, etc.)			
4.	Are there any other systems installed within or in close proximity to the SCIF that have RF capability (e.g., fire alarm, ground-to-air-radio, cellular tower, RF networks, etc)?			<input type="checkbox"/> Yes <input type="checkbox"/> No
	If yes, please explain			

**CLASSIFY ACCORDING TO FACILITY SPONSOR**  
**CLASSIFICATION GUIDANCE**

## **Submarine Checklist**

**[Insert Org Name]**

**[Date]**

**[Address]**

DERIVED FROM: DoDM 510.21-V2  
DECLASSIFY ON: Upon withdrawal of  
SCIF Accreditation

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CHECK Applicable blocks		
<input type="checkbox"/> Initial Accreditation	<input type="checkbox"/> Re- Accreditation	<input type="checkbox"/> Modified Submarine
<input type="checkbox"/> Pre-construction	<input type="checkbox"/> New Submarine	<input type="checkbox"/> Page Change

### Checklist Contents

**Section A: General information**

**Section B: Physical Security**

**Section C: Telecommunication Systems and Equipment Baseline**

**Section D: Classified Destruction Methods**

**Section E: TEMPEST/Technical Security**

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### List of Attachments

*(Diagrams must be submitted on 8 ½" x 11" or 11" x 17" format)*

Section A: General Information			
1.	<b>SCIF Data</b>		
	a. Organization		
	b. Name of Submarine and Hull number		
	c. Home Port		
	d. SCIF ID Number		
	e. Concept Approval Date		
	f. Location of Compartments		
	g. Cognizant Security Authority (CSA)		
	<b>Defense Special Security Communication System Information (if applicable)</b>		
	h. DSSCS Message Address		
	DSSCS INFO Address		
	If no DSSCS Message Address, please provide passing instructions		
	i. GENSER Address		
	2.	<b>Complete Mailing Address</b>	
Street Address			
Building Name/#		P.O.Address	
City		Base/Post	
State/Country		Zip Code	
3.	<b>E-Mail Addresses</b>		
	Classified	(Network/System Name & Level)	
	Unclassified	(Network/System Name)	
	Other	(Network/System Name)	
	Additional Address	(Network/System Name)	
4.	<b>Responsible Security Personnel</b>		
		<b>PRIMARY</b>	<b>ALTERNATE</b>
	Name		
	Rank/Rate/Title		
	Commercial Telephone		
	DSN Telephone		



	Secure Telephone		
	/STE Telephone		
	Other Telephone		
	Home ( <i>optional</i> )		
	Facsimile Number:		
	Classified		Unclassified
	<b>Command or Regional Special Security Office/Name (SSO) (<i>if applicable</i>)</b>		
		<b>PRIMARY</b>	<b>ALTERNATE</b>
	Commercial Telephone		
	Other Telephone		
	<b>Information System Security Officer/Information Assurance Manager Name</b>		
		<b>PRIMARY</b>	<b>ALTERNATE</b>
	Commercial Telephone		
	E-Mail Address		
Secure Telephone			
<b>5.</b>	<b>Accreditation Data</b>		
	<b>a. Category/Compartments of SCI Requested:</b>		
	1) Indicate storage requirement: Radio Room/ESM will always be Continuous Operations		
	<input type="checkbox"/> Open	<input type="checkbox"/> Closed	<input type="checkbox"/> Continuous Ops
	<input type="checkbox"/> Security in Depth		
	2) Indicate the Submarine Type		
	<input type="checkbox"/> Permanent	<input type="checkbox"/> Temporary Secure Working Area (TSWA)	<input type="checkbox"/> Secure Working Area (SWA)
	<input type="checkbox"/> Temporary (TSCIF)		
	<b>b. Existing Accreditation Information (<i>if applicable</i>)</b>		
	1) SCIF accesses required		
	2) Accreditation granted by:		On:
	3) Waivers:		
	c. SCIF duty hours	(hours to hours)	days per week
	d. Total square footage that the SCIF occupies		
	e. Last physical security inspection by		On _____ (Attach a copy of report)

	Were deficiencies corrected?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A	If no, explain
6.	Remarks				

Section B: Physical Security					
1.	<b>Decks, bulkheads and overhead construction</b>				
	Are the decks, bulkheads and overhead constructed of aluminum plate or standard submarine material true floor to ceiling?	<input type="checkbox"/> Yes	<input type="checkbox"/> No		
2.	<b>Security In-Depth</b>				
	What external security attributes and/or features should the CSA consider before determining whether or not this facility has Security In-Depth? <i>Please identify/explain all factors:</i>				
3.	<b>Access Controls: How is access to the SCIF controlled?</b>				
	a. By Guard Force	<input type="checkbox"/> Yes	<input type="checkbox"/> No	If yes, what is their minimum security clearance level?	
	b. Is Guard Force Armed?	<input type="checkbox"/> Yes		<input type="checkbox"/> No	
	c. By assigned personnel	<input type="checkbox"/> Yes	<input type="checkbox"/> No	If yes, do personnel have visual control of SCIF entrance door?	
	<input type="checkbox"/> Yes	<input type="checkbox"/> No			<input type="checkbox"/> N/A
	d. By access control device	<input type="checkbox"/> Yes	<input type="checkbox"/> No	If yes, what kind?	
	<input type="checkbox"/> Automated access control system		<input type="checkbox"/> Non-automated		
	<b>If non-automated</b>				
	1. Is there a by-pass key	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A	
	If yes, how is the by-pass key protected?				
	2. Manufacturer		Model		
	<i>(Attach sheet if additional space is required for this information)</i>				
4.	<b>Primary Entrance Door</b>				
	a. Is routine ingress and egress to the space through one door?	<input type="checkbox"/> Yes	<input type="checkbox"/> No		
	b. Is the submarine type door constructed & installed IAW ICD 705?	<input type="checkbox"/> Yes	<input type="checkbox"/> No		
	c. Is door constructed of aluminum/steel plate or standard submarine construction materials?	<input type="checkbox"/> Yes	<input type="checkbox"/> No		

	d. Is door equipped with a combination lock that meets requirements of a Pedestrian Deadbolt Federal Specifications FF-L-2740A?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	Include lock manufacturer, model and group		
	<b>Manufacturer</b>	<b>Model</b>	<b>Group Rating</b>
	e. Is door equipped with an access control device	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	f. Is door constructed in a manner which will preclude unauthorized removal of hinge pins and anchor bolts, as well as obstruct access to lock-in bolts between door and frame?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	g. Remarks:		
<b>5.</b>	<b>Emergency Exit</b>		
	a. Is space equipped with an emergency exit?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	b. Has the emergency exit been fabricated of aluminum/steel plate or standard submarine construction materials?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	c. Has door(s) been mounted in a frame braced and welded in place in a manner commensurate with structural characteristics of the bulkhead, deck or overhead in which it is located?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	d. Has the emergency exit been constructed in a manner which will preclude unauthorized removal of hinge pins and anchor bolts, as well as obstructs access to lock-in bolts between door and frame?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	e. Remarks		
<b>6.</b>	<b>Restrictions on Damage Control Fittings and Cable</b>		
	a. Are any essential damage control fittings or cables located within or pass through the SCIF?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	b. Remarks		
<b>7.</b>	<b>Vent and Duct Barriers</b>		
	a. Are vents, ducts, louvers, or other physical perimeter barrier openings with a cross sectional dimension greater than 96 square inches protected at the perimeter with a fixed barrier or security grill?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	b. If gratings or bars are used, are they welded in place?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	c. Remarks:		
<b>8.</b>	<b>Acoustical Isolation</b>		
	a. Is the physical perimeter of the SCIF sealed or insulated with non-hardening caulking material so as to prevent inadvertent disclosure of SCI discussions or briefings from within the SCIF?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	b. In instances where the physical perimeter barrier is not sufficient to control voices or sounds, is the use of sound deadening material installed?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	c. Do air handling units have continuous duty blowers or provide an effective level of sound masking in each air path?	<input type="checkbox"/> Yes	<input type="checkbox"/> No

	d. Remarks:		
9.	<b>Visual Isolation</b>		
	a. Are doors or other openings in the physical perimeter barrier through which the interior may be viewed screened or curtailed?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	b. Remarks		
10.	<b>Secure Storage Equipment</b>		
	a. Is the SCIF equipped with a sufficient number of CSA approved security containers? And Built to Ships Plan?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	b. Have they been welded in place or otherwise secured to a foundation for safety?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	c. Remarks:		
	d. Have all classified systems been secured using Tamper Evident Tape	<input type="checkbox"/> Yes	<input type="checkbox"/> No

Section C: Telecommunication Systems and Equipment Baseline				
1.	Is the Submarine declared a "No classified Discussion Area"?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
	Location of "No Classified Discussion Area"			
	If yes, then the audio protection questions within this section may be identified as N/A			
	If the Submarine is declared a No Classified Discussion Area, are warning notices posted prominently within the submarine?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
2.	Does the Submarine have any unclassified telephones that are connected to the commercial public switch telephone network (PSTN)?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
	What is the method of on-hook protection?			
	1) CNSS 5006 (TSG-6) approved telephone or instrument	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
	(Please identify all telephone equipment/stations and/or instruments being used either below or as an attachment)			
	<b>Manufacturer</b>	<b>Model Number</b>	<b>CNSS Number</b> (if applicable)	
	If no, please explain			
	Are there any automatic call answering devices for the telephones in the SCI?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
	1) If yes, please identify the type			
	a. Voice mail/unified message service	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
	b. Standalone telephone answering device (TAD)	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
	2) Provide manufacturer and model number of the equipment			
	<b>Manufacturer</b>		<b>Model Number</b>	

	Are speakerphones/microphones enabled?	<input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
	If yes, has remote room monitoring capability been disabled?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
8.	<b>General Announcing System 1MC/7MC/27MC ETC</b>		
	Do general announcing system loudspeakers have an audio amplifier and are the output signal line installed within the SCIF?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	Remarks		

Section D: Classified Destruction Methods			
1.	<b>Destruction methods</b>		
	a. Describe the method and equipment used for destruction of classified/sensitive material (if more than one method or device, use Remarks to describe. (If more than one device, use remarks to list all manufacturer and model)		
	<b>Method</b>	<b>Device Manufacturer</b>	<b>Model</b>
	b. Is a secondary method of destruction available?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	c. Describe the location of destruction site(s) in relation to the secure Submarine:		
	d. Describe method or procedure used for handling non-soluble classified/sensitive material on the Submarine:		
	e. Do you have a written Emergency Action Plan (EAP) approved by CSA (if required)?	<input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
	Remarks		
Section E: TEMPEST/Technical Security			
1.	Does the Submarine electronically process classified information?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	If yes, what is the highest level of information processed?		
2.	<b>For the last TEMPEST Accreditation (if applicable), provide the following information</b>		
	Accreditation granted by:	On	
3.	Has the CSA's Certified TEMPEST Technical Authority (CTTA) required any TEMPEST countermeasures?	<input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
	If yes, please identify the countermeasures that have been installed (i.e. non-conductive sections, Radio Frequency (RF) shielding, power/signal line filters, window film, etc.)		
4.	Are there any other systems installed within or in close proximity to the SCIF that have RF capability (e.g., fire alarm, ground-to-air-radio, cellular tower, RF networks, etc)?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	If yes, please explain		

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**CLASSIFY ACCORDING TO FACILITY SPONSOR**  
**CLASSIFICATION GUIDANCE**

## **Aircraft/UAV Checklist**

**[Insert Org Name]**

**[Date]**

**[Address]**

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CHECK Applicable blocks		
<input type="checkbox"/> Initial Accreditation	<input type="checkbox"/> Re- Accreditation	<input type="checkbox"/> Modified Facility
<input type="checkbox"/> Pre-construction	<input type="checkbox"/> New Facility	<input type="checkbox"/> Page Change

### Checklist Contents

**Section A: General information**

**Section B: Physical Security**

**Section C: Intrusion Detection Systems (IDS)**

**Section D: Classified Destruction Methods**

**Section E: TEMPEST/Technical Security**

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### List of Attachments

*(Diagrams must be submitted on 8 ½" x 11" or 11" x 17" format)*

Section A: General Information			
1.	<b>SCIF Data</b>		
	a. Organization/Company Name		
	b. Type of Aircraft and Tail Number		
	c. Home Station		
	d. SCIF ID Number		
	e. Contract Number and Expiration Date <i>(if applicable)</i>		
	f. Concept Approval Date		
	g. Cognizant Security Authority (CSA)		
	<b>h. Defense Special Security Communication System Information <i>(if applicable)</i></b>		
	DSSCS Message Address		
	DSSCS INFO Address		
	If no DSSCS Message Address, please provide passing instructions		
2.	<b>Complete Mailing Address</b>		
3.	<b>E-Mail Address</b>		
	Classified		(Network/System Name & Level)
	Unclassified		(Network/System Name)
	Additional		(Network/System Name)
4.	<b>Responsible Security Personnel</b>		
		<b>PRIMARY</b>	<b>ALTERNATE</b>
	Name		
	Commercial Telephone		
	DSN Telephone		
	Secure Telephone		
	STE Telephone		
	Other Telephone		
	Home Telephone <i>(Optional)</i>		

	FAX #	Classified		Unclassified	
	<b>Command or Regional Special Security Office/Name (SSO):</b> <i>(if applicable)</i>				
	Commercial				
	Other Telephone				
	PRIMARY		ALTERNATE		
	<b>Information System Security Officer Name:</b>				
	Commercial				
	Secure				
5.	<b>Accreditation Data</b>				
	<b>a. Category/Compartments of SCI Requested:</b>				
	<b>b. Existing Accreditation Information</b> <i>(if applicable)</i>				
	(1) Category/Compartments of SCI:				
	(2) Accreditation granted by:			On:	
	(3) Co-Use Agreements	<input type="checkbox"/> Yes	<input type="checkbox"/> No	If yes, provide sponsor/compartment:	
	<b>c. Is there a SAP(s) co-located within the aircraft?</b>			<input type="checkbox"/> Yes	<input type="checkbox"/> No
	SAP Classification Level <i>(check all that apply)</i>				
	<input type="checkbox"/> SCI	<input type="checkbox"/> Top Secret	<input type="checkbox"/> Secret	<input type="checkbox"/> Confidential	
	d. Has CSA requested any waivers?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A	If yes, attach a copy of the approved waiver
	<b>Construction/Modification</b>				
	Is construction or modification complete?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A	If no, enter the expected date of completion
6.	<b>Inspections</b>				
	a. Last physical security inspection performed by				On _____ <i>(Attach a copy of report)</i>
	Were deficiencies corrected?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A	If no, explain
	<b>REMARKS:</b>				

Section B: Physical Security			
1.	<b>Stationary Aircraft/UAV</b>		
	a. Is the aircraft located within a controlled area?	<input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
	If no, explain:		
	b. When not performing a SCI mission is all SCI removed from the aircraft and stored in an accredited SCIF?	<input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
	If yes, SCIF ID:	If no, explain how SCI is protected when the aircraft is unoccupied:	
2.	<b>Access Control:</b> How is access to the aircraft controlled?		
	a. By Guard Force	<input type="checkbox"/> Yes <input type="checkbox"/> No	If yes, what is their security clearance level?
	b. Is Guard Force Armed?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	c. By Assigned Personnel:	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	If Yes, do personnel have visual control of the entrance door?	<input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
	d. When processing SCI, are all personnel aboard the aircraft cleared for all the SCI compartments that the aircraft is accredited for?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	If not, what are the procedures for segregating/protecting SCI compartments from unauthorized disclosure?		
3.	<b>Hatches and Doors Leading Inside the Aircraft:</b>		
	a. Are doors equipped with GSA approved locks?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	<b>Manufacturer</b>	<b>Model</b>	<b>Group</b>
	b. Are tamper serialized seals used when aircraft is unoccupied?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	If yes, are seals installed and a log book maintained by SCI cleared personnel?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	c. Remarks		
4.	<b>Acoustical Isolation</b>		
	a. Is a physical perimeter established around the aircraft at a distance so as to prevent inadvertent disclosure of SCI discussions or briefings from within the aircraft	<input type="checkbox"/> Yes	<input type="checkbox"/> No

	b. In instances where the physical perimeter barrier is not sufficient to control voices or sounds, are sound countermeasure devices or sound generating devices used?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	c. Remarks		
5.	<b>Visual Isolation</b>		
	a. Are doors or other openings in the aircraft through which the interior may be viewed screened or curtained?	<input type="checkbox"/> Yes	<input type="checkbox"/> Yes
	b. Remarks		
6.	<b>Procedures For Protecting SCI When The Aircraft Is Parked In Friendly/Unfriendly Territories</b>		

Section C: Intrusion Detection Systems (IDS)				
1.	Is the aircraft equipped or located within a structure or area that has an IDS?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
	If yes, please provide the following:			
	a. IDS Company provider name <i>(if applicable)</i>			
	b. Premise Control Unit (PCU)			
	<b>Manufacturer</b>	<b>Model Number</b>	<b>Tamper Protection</b>	<input type="checkbox"/> Yes <input type="checkbox"/> No
	c. Where is the PCU located?			
	d. Location of interior motion detection protection: Accessible points of entry/perimeter?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
	e. Has the IDS Alarm Monitor Station been installed to Underwriters Laboratories certified standards?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
	If yes, please provide certification number and expiration date of UL certification			
	<b>Certification Number</b>	<b>Expiration Date</b>		
	f. Has the IDS passed CSA or UL 2050 installation and acceptance tests?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
	If yes, please attach a copy of certificate and skip to question 2 below. (Non-commercial proprietary system must answer all questions)			
	g. Motion Sensors (Indicate sensor placement on a legible floor plan; 8.5" x 11" or 11" x 17" paper			

	<b>Manufacturer</b>	<b>Model Number</b>	<b>Tamper Protection</b>	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	h. Are motion sensors installed above the false ceiling?		<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
	i. Are motion sensors installed below the false floors?		<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
	j. Are there any other intrusion detection equipment sensors/detectors in use?			<input type="checkbox"/> Yes	<input type="checkbox"/> No
	If yes, please identify make, model, and manufacturer and function (indicate on floor plan)				
	<b>Make</b>	<b>Model</b>	<b>Manufacturer</b>	<b>Function</b>	
	k. Does the IDS extend beyond the SCIF perimeter?			<input type="checkbox"/> Yes	<input type="checkbox"/> No
	Can the status of PCU be changed from outside IDS protection?			<input type="checkbox"/> Yes	<input type="checkbox"/> No
	If yes, is an audit conducted daily?			<input type="checkbox"/> Yes	<input type="checkbox"/> No
	Has the IDS configuration been approved by the CSA?			<input type="checkbox"/> Yes	<input type="checkbox"/> No
	l. Do any intrusion detection equipment components have audio or video capabilities?			<input type="checkbox"/> Yes	<input type="checkbox"/> No
	If yes, please explain:				
	Has the CSA mitigated this capability?			<input type="checkbox"/> Yes	<input type="checkbox"/> No
	m. IDS Administrator SCI indoctrinated?			<input type="checkbox"/> Yes	<input type="checkbox"/> No
	n. External Transmission Line Security: What is the method of line security? Meets NIST; FIPS AES Encryption?			<input type="checkbox"/> Yes	<input type="checkbox"/> No
	If yes, has the encryption been certified by National Institute of Standards and Technology (NIST) or another independent testing laboratory?			<input type="checkbox"/> Yes	<input type="checkbox"/> No
	If not NIST FIPS AES, is there an alternate?			<input type="checkbox"/> Yes	<input type="checkbox"/> No
	If yes, please explain:				
	Does the alternate line utilize any cellular or other Radio Frequency (RF) capability?			<input type="checkbox"/> Yes	<input type="checkbox"/> No
	If yes, provide manufacturer and model				
	<b>Manufacturer</b>		<b>Model</b>		
	o. Does any part of the IDS use a local or Wide Area Network?		<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A

(1) Is the Network Intrusion Detection Software (NIDS) administrator at least Top Secret (collateral) cleared?		<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
(2) Is the host computer dedicated solely for security purposes?		<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
(3) Is the host computer secured within an alarmed area controlled at the Secret or higher level?		<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
(4) Is the host computer protected through firewalls or similar devices?		<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
Are the firewalls/ devices configured to only allow data transfers between IDS components?		<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
(5) Is the password for the host computer unique for each user and at least 8 characters long?		<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
(6) Is the password changed semi-annually?			<input type="checkbox"/> Yes	<input type="checkbox"/> No
(7) Are remote security terminals protected the same of the host computer?		<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
If no, please explain:				
p. Was the IDS installed by U.S. citizens:		<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
If no, please explain:				
q. Is emergency power available for the IDS?		<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
What type? Generator	<input type="checkbox"/> Yes	<input type="checkbox"/> No	If yes, how many hours? _____	
What type? Battery	<input type="checkbox"/> Yes	<input type="checkbox"/> No	If yes, how many hours? _____	
r. If applicable, describe the method of ventilation and duct work protection:				
s. Where is the IDS Alarm Monitor Station located?				
t. Does the Monitor Station have any remote capabilities (i.e., resetting alarms, issuing PINs, accessing/securing alarms, etc)?		<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
If yes, please explain:				
u. Does the IDS have any automatic features (i.e., timed auto-secure, auto-access capabilities)?		<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
v. Does the PCU/keypad have dial out capabilities?			<input type="checkbox"/> Yes	<input type="checkbox"/> No
w. IDS Response Personnel				
(1) Who provides initial alarm response?				

(2) Does the response force have a security clearance?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
If yes, what is the clearance level:			
(3) Do you have a written agreement for external response force?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
(4) Emergency procedures documented?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
(5) Reserve security force available?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
(6) Response to an alarm condition	_____ minutes		
x. Are response procedures tested and records maintained?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
If no, please explain:			
y. If required, has a Catastrophic Failure Plan been approved by the CSA?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
z. Does the IDS undergo semiannual testing?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
aa. Have IDS records been maintained:		<input type="checkbox"/> Yes	<input type="checkbox"/> No
bb. Remarks			

Section D: Classified Destruction Methods			
1.	For home station, describe the method and equipment used for destruction of classified/sensitive material (if more than one method or device, use Remarks section to describe (if more than one, use Remarks section to list all manufacturer and model)		
	Method	Device Manufacturer	Model
2.	Is a secondary method of destruction available		<input type="checkbox"/> Yes <input type="checkbox"/> No
3.	Describe the location of destruction site(s) in relation to the aircraft?		
4.	Describe the method or procedure used for handling non-soluble classified/sensitive material at your facility?		
5.	Do you have a written Emergency Action Plan (EAP) approved by CSA?		<input type="checkbox"/> Yes <input type="checkbox"/> No
6.	Describe procedures for in-flight emergency destruction:		
7.	Remarks		



Section E: TEMPEST/Technical Security				
1.	Does the aircraft electronically process classified information?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
	If yes, what is the highest level of information processed?			
2.	Has it received TEMPEST accreditation?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
	Date	Accreditation granted by:		

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# SCIF Co-Use Request and MOA

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CLASSIFICATION

## SCIF CO-UTILIZATION or JOINT-UTILIZATION Request and MOA Form

1. To: Addressee Government CSA:
2. From: Requesting Government CSA:  Date:
- POC:   
Name/Title/Telephone:
- POC:   
Name/Title/Telephone:
3. Facility Location where CUA Desired :
- Company/Department Name:   
Complete SCIF Address:
- SCIF ID:
- Room Numbers:
- Site POC:   
Name/Title/Telephone:   
Email Address:
4. Does Facility have Waivers? ☐ No ☐ Yes (If yes, list waivers in item 9)
5. Classification: (Provide classification level, SCI compartments, and storage requirements for Co-Use)
- Highest Classification: ☐ Confidential ☐ Secret ☐ Top Secret
- SCI Compartments:
- Storage Requirements: ☐ Open ☐ Closed
6. Information System (IS) Processing Requested: (Provide POC for IS coordination if Co-Utilization or Joint-Utilization)
- IS POC:   
Name/Title/Telephone:
- ☐ Information System Processing Not Required
- ☐ Co-Utilization:
- ☐ Use a system that will not be connected to system(s) for which the agency with cognizance for the SCIF is the accreditor or,
- ☐ use for period processing only an existing system for which the agency with cognizance for the SCIF is the accreditor
- ☐ Joint-Utilization: Use an existing system for which the agency with cognizance for the SCIF is the accreditor
- ☐ Such use will consist of: Logical separation of data (via software) or
- ☐ co-mingle data, no separation. (Detailed justification required in item 9.)

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**7. Duration:**

A. Contractor Facility:

RFP Date: (if applicable):

Expiration Date of Contract:

Contract Number:

B. Government Facility:

Expiration Date: (enter date or "Indefinite")

**8. Type of Effort:**      ☐ Intel Related      ☐ Other (describe)

**9. Comments/Justification:**

**REQUESTER:**

Digital Signature

**CONCUR:**

Digital Signature

\* **Notice:** Email or other exchange and receipt of this form, completed and concurred, constitutes a formal *Memorandum of Agreement* (MOA). Co-Use means two or more organizations sharing the same SCIF. All personnel involved with Co-Use SCIFs must be approved to ICD 704 standards.

CL BY:   
CL REASON:   
DECL ON:

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## Construction Security Plan (CSP)

**Definition:** A plan outlining security protective measures that will be applied to each phase of the construction project. The requirements set forth in this plan provide the baseline for construction security activities and may be supplemented as required but may not be reduced without coordination and approval from the Accrediting Official (AO).

The contents below are suggested topics. The plan format and content shall be developed by the element accrediting official (AO) based upon the size, purpose and location of the SCIF.

- 
- a. **Site Security Manager:** (identify the SSM and contact information)
  - b. **Statement of Construction Project:** (provide a description of the proposed work)
  - c. **Existing SCIF ID** (if project is associated with currently accredited SCIF)
  - d. **Cognizant Security Authority/ Accrediting Official:** (element)
  - e. **Location of Work:** (address/location)
  - f. **Estimated Start Date:** (estimated date construction will begin)
  - g. **Estimated Completion Date:** (estimated date construction will end)

- h. Has a Risk Assessment Been Completed:** (if yes attach copy)
- i. Security in Depth (SID) Documentation:** (Document the layers of protection offered at the site, such as security fencing or walls, roving guards, marine security guards, CCTV coverage, and controlled and/or limited access buffers to facility)
- j. Adjacencies to Consider:** (include a description of adjacent facilities to include other classified agencies, activities, and presence of foreign nationals operating in adjacent spaces on all six sides of the proposed SCIF)
- k. Control of Construction Plans and Documents:** (Describe how construction plans and all related documents shall be handled and protected)
- l. Control of Operations if a Renovation Project** (describe barriers that will be installed to segregate construction workers from operational activities )
- m. Procurement, Shipping and Storage of Building/Finishing Material:** (If required by AO, describe security measures to ensure integrity of building materials and/or finishing materials.)
- n. Construction Workers** (Depending upon the standards required (within U.S., outside U.S., etc), for construction workers, provide information to verify worker status, clearances if required, and/or mitigations employed.)
- o. Site Security** (Identify plans to secure construction site, to include any proposed fences, guards, CSTs, escorts, etc.)
- p. Security Administration:** (list security documentation and retention requirements that shall be maintained by the SSM (i.e. visitor logs, names of construction workers, security incidents, etc.)