BUILDING 56 2nd FLOOR NRCS CONSOLIDATION

AH Project # 2017360

100% CONSTRUCTION DOCUMENTS

July 25, 2019

GENERAL SERVICE ADMINISTRATION
D.F.C. Building 56
Suite 330
Denver, CO 80255

Anderson Hallas Architects, PC
715 14th Street
Golden, CO 80401

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SECTION 00 01 07

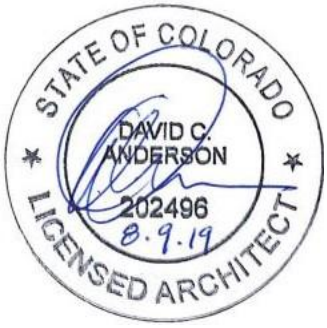
SEALS PAGES

PART 1 – GENERAL

1.1 SUMMARY

A. Professional seals by Design Professionals and others responsible for preparing Construction Documents:

1. Architect:



2. Mechanical Engineer:

3. Electrical Engineer:

4. Fire Protection Engineer:

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PROCUREMENT AND CONTRACTING DOCUMENTS GROUP

90% GSA Comment Responses, dated 6/4/19

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SECTION 01 2300
ALTERNATES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Description of Alternates.

B. Procedures for pricing Alternates.

1.02 ACCEPTANCE OF ALTERNATES

A. Alternates quoted on Bid Forms will be reviewed and accepted or rejected at Government's option.

B. Coordinate related work and modify surrounding work to integrate the Work of each Alternate.

1.03 SCHEDULE OF ALTERNATES

A. Alternate No. 1 - Install wall-mounted acoustic panels as described in specification section 09 84 14 Acoustic Stretched Fabric Wall Systems, and shown on Sheet A9 0.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

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SECTION 01 25 00

SUBSTITUTION PROCEDURES

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
1. Product substitution procedures during construction.
2. Execution substitution procedures.

B. Related Sections:
1. Section 00 43 25: “Substitution Request Form (During Procurement).”
2. Federal Acquisition Regulation (FAR).

1.2 DEFINITIONS

A. Definitions used in this Article are not intended to change or modify meaning of other terms used in Contract Documents.

B. Substitutions: Requests for changes in products, materials, equipment, and methods of construction required by Contract Documents proposed by Contractor after award of Contract.

1.3 SUBMITTALS

A. After award of Contract, requests for substitution will be considered at the discretion of the Government.

B. Submittals:
1. Submit a copy of each request for substitution for consideration.
2. Submit requests in form and in accordance with Government procedures.
3. Identify product, or fabrication or installation method to be replaced in each request.
4. Include related Specification Section and Drawing numbers.
5. Provide complete documentation showing compliance with requirements for substitutions, and following information, as appropriate:
    a. Product data, including drawings and descriptions of products, fabrication and installation procedures.
    b. Samples, where applicable or requested.
    c. A detailed comparison of significant qualities of proposed substitution with those of Work specified.
    d. Significant qualities may include elements such as size, weight, durability, performance and visual effect.
    e. Coordination information, including a list of changes or modifications needed to other parts of Work and to construction performed by government and separate Contractors that will become necessary to accommodate proposed substitution.
    f. A statement indicating substitution's effect on Contractor's Construction Schedule compared to schedule without approval of substitution.
    g. Indicate effect of proposed substitution on overall Contract Time.
    h. Cost information, including a proposal of net change and impact to other trades, if any in Contract Sum.
    i. Certification by Contractor that substitution proposed is equal-to or better in every significant respect to that required by Contract Documents, and that it will perform adequately in application indicated.

1.4 PRODUCT SUBSTITUTION PROCEDURES (DURING CONSTRUCTION)

A. Contractor shall promptly notify Government when need for product substitution is discovered.

B. Government will notify Consultants whose design may be affected and Government.

C. Contractor's substitution request will be received and considered by Government when one or more of following conditions are satisfied, as determined by Government; otherwise requests will be returned without action except to record noncompliance with these requirements:
   1. Extensive revisions to Contract Documents are not required.
   2. Proposed changes are in keeping with general intent of Contract Documents.
   3. Request is timely, fully documented and properly submitted.
   1. Request is directly related to an "equivalent product" clause or similar language in Contract Documents.
   2. A substantial advantage is offered Government, in terms of cost, time, energy conservation or other considerations of merit, after deducting offsetting responsibilities Government may be required to bear.
   6. Where a proposed substitution involves more than one prime Contractor, each Contractor shall cooperate with other Contractors involved to coordinate Work, provide uniformity and consistency, and to assure compatibility of products.

D. Contractor's submittal of Shop Drawings, Product Data or Samples that relate to construction activities not complying with Contract Documents does not constitute an acceptable or valid request for substitution, nor does it constitute approval even though Government may have accepted submittal.

1.5 GOVERNMENT'S ACTION

A. Government may request additional information or documentation from the Contractor regarding availability, constructability, and scheduling effects as necessary for evaluation of request.

B. Government will notify Contractor of acceptance or rejection of proposed substitution.

C. Request for substitution not conforming to all requirements will be rejected.

PART 2 – PRODUCTS (NONE)

PART 3 – EXECUTION (NONE)

END OF SECTION 01 25 00

SECTION 01 29 00

PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Schedule of values.
   2. Progress payment procedures.

B. Related Sections:
   1. Section 01 33 00: “Submittal Procedures.”
   2. Federal Acquisition Regulation (FAR).

1.2 SCHEDULE OF VALUES

A. Submit up-dated or revised Schedule of Values to Government at earliest feasible date, but in no case later than seven days before date scheduled for submittal of initial Application for Payment.

B. Coordinate preparation of Schedule of Values with preparation of Contractor's Construction Schedule.

C. Provide sub-schedules showing values correlated with each phase of payment where Work is separated into phases that require separately phased payments.

D. Provide a breakdown per GSA forms.

E. Break principal Contract amounts down into several line items including, RPO Issue, following: 1. General Requirements; 2. Existing Conditions; 5. Metals; 6. Wood, Plastics and Composites; 7. Thermal and Moisture Protection; 8. Openings; 9. Finishes; 10. Specialties; 12. Furnishings; 13. Special Construction; 21. Fire Suppression; 22. Plumbing; 23. Heating Ventilating and Air Conditioning; 26. Electrical 27. Communications; and 28. Fire Protection.

F. Provide additional detail as required by Government.

1.3 APPLICATIONS FOR PAYMENT

A. Each Application for Payment shall be consistent with previous applications and payments as certified by Government and paid for by Government.

B. Each progress payment date is as indicated in Agreement.

C. Submit one draft Application for Payment to Government for review prior to official submittal.

D. One copy shall include attachments.
   1. Transmit each copy with a transmittal form listing attachments, and recording appropriate information related to application in a manner acceptable to Government.
   2. Contractor and government shall receive a draft of next application at a project meeting to review and establish conditions of agreement for approval of application and each line item.

E. Administrative actions and submittals that shall proceed or coincide with final application include:
   1. Occupancy permits and similar approvals.
   2. Warranties (guarantees) and maintenance agreements.
   3. Test/adjust/balance records.
   4. Maintenance instructions.
   5. Start-up performance reports.
   6. Change-over information related to Government 's occupancy, use, operation and

maintenance.
7. Final cleaning.
8. Application for reduction of retainage, and consent of surety.
9. Completion of Deficiencies and Omissions (D&O) punchlist.

F. Final Payment Application: Administrative actions and submittals which must precede or coincide with submittal of final payment Application for Payment include following:
1. Completion of Project closeout requirements.
2. Completion of items specified for completion after Substantial Completion.
3. Transmittal of required Project construction records to Government.
4. Removal of temporary facilities and services.
5. Removal of surplus materials, rubbish and similar elements.

PART 2 – PRODUCTS (NONE)

PART 3 – EXECUTION (NONE)

END OF SECTION 01 29 00

SECTION 01 31 00

PROJECT MANAGEMENT AND COORDINATION

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Project management and coordination.
   2. Multiple contract coordination.
   3. Project meetings.

B. Related Sections:
   1. Section 01 10 00: “Summary.”
   2. Section 01 43 00: “Quality Assurance.”
   3. Section 01 45 00: “Quality Control.”
   4. Federal Acquisition Regulation (FAR).

1.2 PROJECT MANAGEMENT AND COORDINATION

A. Coordinate construction activities included under various Specification Sections to:
   1. Assure efficient and orderly installation, connection, and operation of each part of Work.
   2. Obtain best results, and that operations are carried out with consideration given to conservation of energy, water, and materials.

B. Coordinate installation of different components to assure maximum accessibility for required maintenance, service and repair where availability of space is limited.

C. Make adequate provisions to accommodate items scheduled for later installation.

D. Prepare memoranda for distribution to each party involved outlining special procedures required for coordination; include such items as required notices, reports, and attendance at meetings.

E. Coordinate temporary enclosures with required inspections and tests to minimize necessity of uncovering completed construction for that purpose.

F. Coordination Drawings:
   1. Prepare and submit coordination Drawings where close and careful coordination is required for installation of products and materials fabricated off-site by separate entities, and where limited space availability necessitates maximum utilization of space for efficient installation of different components.
      a. Show interrelationship of components shown on separate Shop Drawings.
      b. Indicate required installation sequences.
      c. Comply with requirements contained in Section 01 33 00, “Submittal Procedures.”
      d. Refer to Division 23 Section "Basic Mechanical Requirements," and Division 26 Section "Basic Electrical Requirements" for specific coordination drawing requirements for mechanical and electrical installations.

1.3 PROJECT MEETINGS

A. Pre-Construction Conference:
   1. Coordinated by Government.

B. Pre-Installation Conferences:
   1. Conduct a pre-installation conference at Project site before each construction activity specifically required by construction documents.
   2. Installer and representatives of manufacturers and fabricators involved in or affected by installation, and its coordination or integration with other materials and installations that have

preceded or will follow, shall attend meeting.
3. Advise Government of scheduled meeting dates.
4. Pre-installation conferences are required for Division 21 Fire Suppression, Division 23 Heating Ventilating and Air Conditioning and Division 26 Electrical and others required by individual specification section.
5. Review progress of other construction activities and preparations for the particular activity under consideration at each pre-installation conference, including requirements for:
   a. Contract Documents.
   b. Deliveries.
   c. Shop Drawings, Product Data and quality control Samples.
   d. Possible conflicts.
   e. Time schedules.
   f. Weather limitations.
   g. Manufacturer's recommendations.
   h. Acceptability of substrates.
   i. Space and access limitations.
   j. Inspection and testing requirements.
   k. Required performance results.
   l. Recording requirements.
   m. Protection.

6. Record significant discussions and agreements and disagreements of each conference, along with approved schedule.
7. Distribute record of meeting to everyone concerned, promptly, including Government.

C. Progress Meetings:
1. Conduct progress meetings at Project site weekly.
2. Coordinate with Government for scheduled meeting dates.
3. Coordinate dates of meetings with preparation of payment request.
4. Review and correct or approve minutes of previous progress meeting.
5. Review other items of significance that could affect progress.
6. Include topics for discussion as appropriate to current status of Project:
7. Contractor's Construction Schedule:
   a. Project weekly up-date, reviewed weekly (minimum 2 week forecast).
   b. Determine where each activity is in relation to Contractor's Construction Schedule, whether on time or ahead or behind schedule.
   c. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so.
   d. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within Contract Time.

8. Review present and future needs of each entity present, including such items as:
   a. Site utilization, deliveries, working hours, access.
   b. Housekeeping.
   c. Quality and Work standards.
   d. Change Orders and construction change directives.
   e. Unresolved field changes and cost changes.
   f. Delivery of government supplied items.

9. Reporting:
   a. Distribute copies of minutes of previous meeting to each party present and to other parties who should have been present.
   b. Include a brief summary, in narrative form, of progress since previous meeting and report.

10. Schedule Updating:
   a. Revise construction schedule after each progress meeting where revisions to schedule have been made or recognized.
   b. Issue revised schedule with report of previous meeting.

1.4 PROJECT SITE ADMINISTRATION

A. Obtain all permits, inspections, approvals, and certificates required by law.

B. Conform to all laws, ordinances, rules and regulations applicable to the location of Work.

C. Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and ensure orderly progress of Work.

D. Require Installer of each major component to inspect both substrate and conditions under which Work is to be performed.

E. Do not proceed until unsatisfactory conditions have been corrected in an acceptable manner.

F. Comply with manufacturer's installation instructions and recommendations to extent that those instructions and recommendations are more explicit or stringent than requirements contained in Contract Documents.

G. Inspect Deliveries:
   1. Inspect materials or equipment immediately upon delivery and again prior to installation.
   2. Reject damaged and defective items.

H. Coordinate existing air intake systems temporary shutdown with Government in advance of odor producing construction processes.

PART 2 – PRODUCTS (NONE)

PART 3 – EXECUTION (NONE)

END OF SECTION 01 31 00

SECTION 01 32 00

CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
1. Scheduling of work.
2. Construction progress schedule.
3. Submittals schedule.
4. Survey and layout data.
5. Construction progress reporting.
6. Periodic work observation.
7. Photographic documentation.
8. Purchase order tracking.

B. Related Sections:
1. Section 01 10 00: “Summary.”
2. Section 01 43 00: “Quality Assurance.”
3. Section 01 45 00: “Quality Control.”
4. Federal Acquisition Regulation (FAR).

1.2 SCHEDULING OF WORK

A. Contractor shall schedule his work and that of all other trades so as to facilitate general progress of work.

B. Contractor shall schedule work to assure efficient and orderly installation, connection, and operation of each part of Work to obtain best results.

1.3 CONSTRUCTION PROGRESS SCHEDULE

A. Within 14 calendar days after receipt of Notice To Proceed, Contractor shall submit for Government’s review, two copies of Project Schedule.

B. Failure to submit original Project Schedule within fourteen calendar days after receipt of Notice To Proceed, or to up-date Schedule monthly shall result in withholding of payments due to Contractor until these provisions are complied with.

C. Construction Progress Schedule:
1. Schedule shall reflect Contractor’s proposed plan for completion of Work and include:
   a. Proposed sequencing of and duration for construction activities of Contractor, as well as Subcontractor and Sub-subcontractor work.
   b. Work sequences that are logical and coordinated.
   c. Project milestones, such as sub-phases, substantial completion, completion, and occupancy.

2. Schedule shall be up-dated:
   a. On a monthly basis for purpose of recording and monitoring progress of Work.
   b. Whenever ratio of work completed to contract time is affected by work progress.
   c. Provide up-dated progress schedule with progress payment request.

3. Contractor shall institute corrective measures to remain on schedule.

1.4 SUBMITTALS SCHEDULE

A. Refer to Section 01 33 00, “Submittal Procedures.”

1.5 CONSTRUCTION PROGRESS REPORTING

A. Contractor shall meet with Government's representative each month at a project schedule update meeting to review actual progress made through status date of project schedule update, including dates activities were started and/or completed and percentage of work completed on each activity started and/or completed.

B. The monthly updating of project schedule shall be an integral part of process upon which progress payments will be made under this contract.

1.6 PERIODIC WORK OBSERVATION

A. Contractor and Government's Representative shall observe Work on a weekly basis.

1.7 PHOTOGRAPHIC DOCUMENTATION

A. Progress Photographs:
   1. Photographically document site conditions prior to start of construction operations.
   2. Take bi-weekly photographs throughout entire project.
   3. Photographs shall be provided for unrestricted use by Government.
   4. Submit minimum twenty photographs via email with each application for payment.
   5. Organize photographs by date and description.

PART 2 – PRODUCTS (NONE)

PART 3 – EXECUTION (NONE)

END OF SECTION 01 32 00

SECTION 01 33 00

SUBMITTAL PROCEDURES

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
1. Certificates.
2. Design data.
3. Field test reporting.
4. Shop drawings, product data, and samples.
5. Source quality control reporting.

B. Related Sections:
1. 01 43 00: “Quality Assurance.”
2. 01 78 00: “Closeout Submittals.”
3. Federal Acquisition Regulation (FAR).

1.2 SUBMITTALS

A. Contractor shall:
1. Coordinate preparation and processing of submittals with performance of construction activities.
2. Transmit each submittal to Government sufficiently in advance of performance of related construction activities to avoid delay.
3. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals and related activities that require sequential activity.
4. Allow sufficient review time so that installation will not be delayed as a result of time required to process submittals, including time for re-submittals.

B. Submittal Preparation:
1. Place a permanent label or title block on each submittal for identification.
2. Indicate name of entity that prepared each submittal on label or title block.
3. Include following information on label for processing and recording action taken.
   a. Project name.
   b. Date.
   c. Name and address of Government.
   d. Name and address of Contractor.
   e. Name, address and phone number of subcontractor.
   f. Name, address and phone number of supplier.
   g. Name of manufacturer including phone numbers.
   h. Number and title of appropriate Specification Section.
   i. Drawing number and detail references, as appropriate.

C. General Contractor Submittal Checking:
1. Check each submittal for conformance to contract documents (each specification page, item by item), show field dimension verifications and actual field conditions and dimensions.
2. Stamp and sign each submitted "APPROVED, CONFORMING TO ALL CONTRACT REQUIREMENTS (EXCEPT AS NOTED)."
3. Submittals not checked, stamped, and approved by Contractor will be returned, marked "REJECTED-INCOMPLETE."

D. Submittal Transmittal:
1. Transmit each submittal from Contractor to Government using a transmittal form.
2. Record on transmittal record relevant information and requests for data

H. Identification of Submittals:
1. Consecutively number submittals.

2. Accompany each submittal with a letter of transmittal showing transmittal number, date of transmittal, Specification Section or Drawing Number to which submittal pertains, brief description of material submitted and company name of submittal originator.
3. Identification: Mark submittal number on at least first page of each copy of each submittal.
4. Submittal Log: Maintain in construction site office an accurate submittal log for duration of construction period, showing status of all submittals of all types.
5. Engineering data:
   a. Provide submittal drawings and calculation of products requiring engineering designs by manufacturer or fabricator.
   b. These drawings and calculations are to be "wet stamped" and signed by a licensed professional engineer licensed in Colorado (except as agreed by Government prior to submission).

I. Administrative Submittals: Refer to other Division 01 Sections and other Contract Documents for requirements for administrative submittals.
1. Applications for payment.
2. Performance and payment bonds.
3. Insurance certificates.
4. List of Subcontractors

J. Submittal Schedule:
1. After development and acceptance of Contractor's construction schedule, prepare a complete schedule of submittals.
2. Submit schedule within 14 calendar days of date required for establishment of Contractor's construction schedule.
3. Coordinate submittal schedule with list of subcontracts, schedule of values and list of products as well as Contractor's construction schedule.
4. Prepare schedule in chronological order; include submittals required during first ninety days of construction.
5. Provide following information:
   a. Scheduled date for first submittal.
   b. Related Section number.
   c. Submittal category.
   d. Name of subcontractor.
   e. Description of part of Work covered.
   f. Scheduled date for re-submittal
   g. Scheduled date of Government’s final release or approval.

6. Distribution: Following response to initial submittal, print and distribute copies to Government, subcontractors, and other parties required to comply with submittal dates indicated.

1.3 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

A. Shop Drawings:
1. Shall include fabrication and installation drawings, setting diagrams, schedules, patterns, templates and similar drawings.
2. Include following information:
   a. Dimensions.
   b. Identification of products and materials included.
   c. Detailed plans and sections as required.
   d. Necessary details, including connections with other work.
   d. Compliance with specified standards.
   e. Notation of coordination requirements.
   f. Notation of dimensions established by field measurement.
   g. Sheet Size: Except for templates, patterns and similar full- size Drawings, submit Shop Drawings on sheets at least 8-1/2 inches by 11 inches but no larger than 36 inches by 48 inches.

3. Coordination drawings are a special type of Shop Drawing that show relationship and integration of different construction elements that require careful coordination during

fabrication or installation to fit in space provided or function as intended.

4. Contractor Checking:
   a. Check each shop drawing for conformance to contract documents.
   b. Stamp and sign each shop drawing “APPROVED, CONFORMING TO ALL CONTRACT REQUIREMENTS (EXCEPT AS NOTED).”
   c. Shop drawings not checked, stamped, and approved will be returned, marked “REJECTED – INCOMPLETE.”

B. Product Data:
1. Product Data includes printed information such as manufacturer's installation instructions, catalog cuts, standard color charts, roughing-in diagrams and templates, standard wiring diagrams and performance curves.
2. Where Product Data must be specially prepared because standard printed data is not suitable for use, submit as "Shop Drawings."
3. Mark each copy to show applicable choices and options.
4. Where printed Product Data includes information on several products, some of which are not required, mark copies to indicate the applicable information.
5. Submit five copies to Government.

C. Samples:
1. Submit full-size, fully fabricated Samples cured and finished as specified and physically identical with the material or product proposed.
2. Samples include partial sections of manufactured or fabricated components, cuts or containers of materials, color range sets, and swatches showing color, texture and pattern.
3. Submit one set of each color, texture, and pattern.

1.4 NUMBER OF SUBMITTAL COPIES

A. Certificates and Product Data: Five copies required to be submitted to Government.

B. Samples: Three sets of each color, texture, and pattern required to be submitted to Government.

C. Shop Drawings: One electronic file (Portable Document Format - PDF) and one black-line set of prints required to be submitted to Government.

1.5 GOVERNMENT’S ACTION

A. Except for submittals for record, information or similar purposes, where action and return is required or requested, Government will review each submittal, mark to indicate action taken, and return promptly.

B. Government’s checking is only for general conformance with design concept of Project and information given in Contract Documents. Contractor shall be responsible for dimensions to be confirmed and correlated at job site: information that pertains solely to fabrication process or to means and methods of construction; coordination of work of all trades; and performing all work in a safe and satisfactory manner. This review does not modify Contractor’s duty to comply with Contract Documents.

C. Compliance with specified characteristics shall be Contractor's responsibility.

D. Government Action:
1. Government will annotate each submittal with one or more of the following:
2. Stamp will be appropriately marked, as follows, to indicate action taken:
   a. “NO EXCEPTION TAKEN:” Fabrication, installation and/or application may be undertaken. That part of Work covered by submittal may proceed provided it complies with requirements of Contract Documents; final acceptance will depend on that compliance.
   b. “MAKE CORRECTIONS NOTED:” Action does not authorize changes to the Contract Sum or Contract Schedule. That part of Work covered by submittal may proceed provided it complies with notations or corrections on submittal and requirements of

Contract Documents; final acceptance will depend on that compliance.

c. "REJECTED:" Reason(s) for rejection shall be noted on submittal or in an accompanying letter. Do not proceed with that part of Work covered by submittal, including purchasing, fabrication, delivery, or other activity until "NO EXCEPTION TAKEN" or "MAKE CORRECTIONS NOTED" action has been indicated by Government. Do not permit submittals marked with this action to be used at Project site, or elsewhere where Work is in progress.

d. "REVISE AND RESUBMIT:" Fabrication, installation and/or application shall not be undertaken. In resubmitting, limit corrections to items marked. Do not proceed with that part of Work covered by submittal, including purchasing, fabrication, delivery, or other activity. Do not permit submittals marked with this action to be used at Project site, or elsewhere where Work is in progress.

e. "SUBMIT SPECIFIED ITEM:" Fabrication, installation and/or application shall not be undertaken. Do not proceed with that part of Work covered by submittal, including purchasing, fabrication, delivery, or other activity until specified item is submitted and "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED" action has been indicated by Government.

1.6 DISTRIBUTION

A. Government will keep three copies of reviewed and acted upon submittals:
   1. Government will retain one copy for his use.
   2. Government will distribute one copy each to Project File and Government's Consultant for their use.

B. Government will return two copies of reviewed and acted upon submittals to Contractor for his use.

C. Refer to individual Specification Sections for specific submittal requirements.

PART 2 – PRODUCTS (NONE)

PART 3 – EXECUTIONS (NONE)

END OF SECTION 01 33 00

SECTION 01 41 00

REGULATORY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Codes.
2. Laws.
3. Rules.
4. Fees.
5. Permits.

1.2 CODES

A. Obtain all permits, inspections, approvals, and certificates required by law.

B. Conform to all laws, ordinances, rules and regulations applicable to location of Work which shall include but not be limited to:
1. Environmental Protection Agency (EPA).
2. Life Safety Code (LSC).
3. National Fire Protection Association (NFPA).
    a. NFPA 70 National Electric Code
    b. NFPA 101 Life Safety Code
4. Occupational, Safety and Health Act (OSHA).
5. International Building Code (IBC) 2015.
6. International Fire Code (IFC) 2015.
7. General Services Administration (GSA) Facilities Standards (P-100), July 2018.
8. Federal Acquisition Regulation (FAR).
9. The Architectural Barriers Act Accessibility Standards (ABAAS)

C. Publication Dates: Comply with codes and standards in effect at date of Contract Documents, except where a standard or a specific date or edition is indicated.

1.3 LAWS

A. The Americans with Disabilities Act of 1990 (ADA)

B. Architectural Barriers Act of 1968 (ABA)

D. Colorado Safety Glazing Act, 30-2-17.

1.4 FEES

A. State of Colorado; paid by Contractor.

B. State Electrical Board; paid by Contractor.

1.5 AUTHORITY HAVING JURISDICTION

A. GSA Regional Fire Protection/Fire Marshal, shall be the Authority Having Jurisdiction (AHJ)

B. AHJ shall be responsible for final acceptance.

PART 2 – PRODUCTS (NONE)

PART 3 – EXECUTION (NONE)

END OF SECTION 01 41 00

SECTION 01 42 00

REFERENCES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Abbreviations and acronyms.
2. Definitions.
3. Reference Standards.

B. Related Sections:
1. Federal Acquisition Regulation (FAR).

1.2 ABBREVIATIONS AND ACRONYMS AND CONVENTIONS

A. Specification Conventions:
1. This Specification uses certain conventions regarding style of language and intended meaning of certain terms, words, and phrases when used in particular situations or circumstances.
2. These conventions are explained as follows:
   a. Abbreviated Language:
      1) Language used in Specifications and other Contract Documents may be abbreviated.
      2) Words and meanings shall be interpreted as appropriate.
      3) Words that are implied, but not stated, shall be interpolated as sense requires.
      4) Singular words will be interpreted as plural and plural words interpreted as singular where applicable as context of Contract Documents indicates.

   b. Imperative and streamlined language is used generally in Specifications.
   c. Requirements expressed in imperative mood are to be performed by Contractor.
   d. At certain locations in Text, subjective language is used for clarity to describe responsibilities that must be fulfilled indirectly by Contractor, or by others when so noted.
   e. Omission of words or phrases, such as "Contractor shall," "in conformity with," "shall be," "as noted on Drawings," "according to Drawings," "a," "an," "all," and “the” are intentional.
   f. Omitted words or phrases shall be supplied by inference.

B. Abbreviations/acronyms used in Specifications:

BTU	British thermal unit	OSF	ounces-per-square-foot
C	Celsius	OSI	ounces-per-square-inch
CF	cubic feet (foot)	OSY	ounces-per-square-yard
CFM	cubic-feet-per-minute	PCF	pounds-per-cubic-foot
CY	cubic yard(s)	PCY	pounds-per-cubic-yard
F	Fahrenheit	PDF	Portable Document Format
FPM	feet-per-minute	PPM	parts-per-million
GPM	gallons-per-minute	PSF	pounds-per-square-foot
GSC	grams-per-square-centimeter	PSI	pounds-per-square-inch
HP	horse power	PSY	pounds-per-square-yard
KSI	kips-per-square-inch	RPM	revolutions-per-minute
LF	linear feet (foot)	SF	square feet (foot)
LY	linear yard(s)	SI	square inch(es)
MPH	miles-per-hour	SY	square yard(s)
OC	on center	VOC	volatile organic compounds
OLY	ounces-per-linear-yard	WSC	watts-per-square-centimeter

1.3 DEFINITIONS

A. Basic Contract definitions are included in the Federal Acquisition Requirements (FAR) clauses.

B. Indicated:
   1. Graphic representations, notes, or schedules on Drawings, or other Paragraphs or Schedules in Specifications, and similar requirements in Contract Documents.
   2. Other terms such as “shown,” “noted,” “scheduled,” and “specified” are also used to help reader locate reference.
   3. There is no limitation on location.

C. Directed: Term and others such as “requested,” “authorized,” “selected,” “approved,” “required,” and “remitted” mean directed by Government, requested by Government, and similar phrases.

D. Approved: When used in conjunction with Government’s action on Contractor's submittals, applications, and requests, is limited to Government's duties and responsibilities as stated in Conditions of Contract.

E. Regulations: Laws, ordinances, statutes, and lawful orders issued by entities having jurisdiction, as well as rules, conventions, and agreements within construction industry that control performance of Work.

F. Furnish: Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

G. Install: Operations at Project site including actual unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, making operational, and similar operations.

H. Provide: To furnish and install, complete and ready for intended use.

I. Installer:
   1. Contractor or another entity engaged by Contractor, either as an employee, subcontractor, or contractor of lower tier, to perform a particular construction activity, including installation, erection, application, and similar operations.
   2. Installers are required to be experienced in operations they are engaged to perform.

J. Experienced: When used with term “Installer,” means having a minimum of five previous projects similar in size and scope to this Project, being familiar with special requirements indicated, and having complied with requirements of authority having jurisdiction.

K. Trades:
   1. Using terms such as “carpentry” is not intended to imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as carpenter.
   2. It also does not imply that requirements specified apply exclusively to tradespersons of corresponding generic name.

L. Project Site:
   1. Space available to Contractor for performing construction activities either exclusively or in conjunction with others performing other work as part of Project.
   2. Extent of Project site is shown on Drawings and may or may not be identical with description of land on which Project is to be built.

M. Testing Agency: Independent entity engaged to perform specific inspections or tests, at Project site or elsewhere, and to report on and, if required, to interpret results of those inspections or tests.

1.4 REFERENCE STANDARDS

A. Applicability of Standards:
   1. Except where Contract Documents include more stringent requirements, referenced construction industry standards have same force and effect as if bound or copied directly into Contract Documents to extent referenced.
   2. Such standards are made a part of Contract Documents by reference.

B. Publication Dates: Comply with standards in effect as of date of Contract Documents.

C. Conflicting Requirements: Where compliance with two or more standards is specified and where standards may establish different or conflicting requirements for minimum quantities or quality levels, refer requirements that are different but apparently equal and other uncertainties to Government for a decision before proceeding.

D. Minimum Quantity or Quality Levels:
   1. Quantity or quality level shown or specified shall be minimum provided or performed.
   2. Actual installation shall comply exactly with or exceed minimum quantity or quality specified.
   3. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for context of requirements.
   4. Refer uncertainties to Government for a decision before proceeding.

E. Copies of Standards:
   1. Each entity engaged in construction on Project is required to be familiar with industry standards applicable to its construction activity.
   2. Copies of applicable standards are not bound with Contract Documents.
   3. Where copies of standards are needed to perform a required construction activity, Contractor shall obtain copies directly from publication source.
   4. A copy of 2006 International Building Code shall be maintained in construction office.

F. Abbreviations and Names:
   1. Trade association names and titles of general standards are frequently abbreviated.
   2. Where such acronyms or abbreviations are used in Specifications or other Contract Documents, they mean recognized name of trade association, standards-generating organization, authority having jurisdiction, or other entity applicable to context of Text provision.
   3. Refer to "Encyclopedia of Associations," published by Gale Research Co., available in most libraries.

1.5 REFERENCES

AAMA	American Architectural Manufacturers Assoc. 1540 E. Dundee Road, Suite 310 Palatine, IL 60067	(708) 202-1350
ABA	Architectural Barriers Act	
ADAAG	Americans with Disabilities Act Accessibility Guidelines US Architectural & Transportation Barriers Compliance Board 1111 18th Street, NW Suite 501 Washington, D.C. 20036-3894	(202) 653-7834
AGC	Association of General Contractors of America www.agc.org	(703) 548-3118
AIA	American Institute of Architects 1735 New York Ave., NW Washington, DC 20006	(202) 626-7300

AISC	American Institute of Steel Construction 1 East Wacker Drive, Suite 3100 Chicago, Illinois 60601-2001	
AISI	American Iron and Steel Institute 1101 17th Street, NW Washington D.C. 20036-4700	
ALSC	American Lumber Standards Committee P.O. Box 210 Germantown, Maryland 20875	
ANSI	American National Standards Institute 11 West 42nd Street, 13th Floor New York, NY 10036	(212) 642-4900
APA	American Plywood Association (See EWA)	
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers 1791 Tullie Circle, NE Atlanta, GA 30329	(404) 636-8400
ASME	American Society of Mechanical Engineers 345 East 47th St. New York, NY 10017	(212) 705-7722
ASC	Associated Specialty Contractors	
ASTM	American Society for Testing and Materials 1916 Race St. Philadelphia, PA 19103-1187	(215) 977-9679
AWI	Architectural Woodwork Institute P.O. Box 1550 13924 Braddock Rd., Suite 100 Centreville, VA 22020	(703) 222-1100
AWS	American Welding Society, Inc. 550 NW LeJeune Road Miami, Florida 33126	
BHMA	Builders' Hardware Manufacturers Assoc. 355 Lexington Ave., 17th Floor New York, NY 10017	(212) 661-4261
CFR	Code of Federal Regulations http://law.justia.com/us/cfr/index.html	
CPSC	Consumer Product Safety Commission U.S. Consumer Product Safety Commission 4330 East West Highway Bethesda, MD 20814	(301) 504-7923
CRI	Carpet and Rug Institute 310 S. Holiday Avenue Dalton, Georgia 30722-2048	

DHI	Door and Hardware Institute 14170 New Brook Drive Chantilly, VA 22022	(703) 222-2010
EWA	APA - The Engineered Wood Association P.O. Box 11700 Tacoma, Washington 98411-0700	
FAR	Federal Acquisition Regulation	
FGMA	Flat Glass Marketing Assoc. White Lakes Professional Bldg. 3310 S.W. Harrison Topeka, KS 66611-2279	(913) 266-7013
FM	Factory Mutual Research Organization 1151 Boston-Providence Turnpike P.O. Box 9102 Norwood, MA 02062	(617) 762-4300
GA	Gypsum Association 810 First Street, NE, Suite 510 Washington, DC 20002	(202) 289-5440
GS	Green Seal 1001 Connecticut Avenue, NW Suite 827; Washington, DC 20036-5525 greenseal@greenseal.org	(202) 872-6400
HMA	Hardwood Manufacturers Assoc. 400 Penn Center Blvd. Pittsburgh, PA 15235	(412) 829-0770
HPMA	Hardwood Plywood Manufacturers Assoc. 1825 Michael Farraday Drive P.O. Box 2789 Reston, VA 22090-2789	(703) 435-2900
IBC	International Building Code (by IBCO)	
ICC	International Code Council	
IESNA	Illuminating Engineering Society of North America 345 E. 47th St. New York, NY 10017	(212) 705-7926
NAAMM	The National Association of Architectural Metal Manufacturers 8 South Michigan Avenue, Suite 1000 Chicago, Illinois 60603	
NEMA	National Electrical Manufacturers Assoc. 2101 L St., NW, Suite 300 Washington, DC 20037	(202) 457-8400
NFPA	National Fire Protection Assoc. One Batterymarch Park P.O. Box 9101 Quincy, MA 02269-9101	(617) 770-3000 (800) 344-3555

NIOSH	National Institute for Occupational Safety and Health NIOSH Building 1, Room 3007 1600 Clifton Road, NE Atlanta, Georgia 30333	
NSF	NSF International (Formerly National Sanitation Foundation) 3475 Plymouth Road P.O. Box 130140 AnnArbor, Michigan 48113-0140	
NWWDA	National Wood Window & Door Association 1400 E. Touhy Avenue Suite G54 Des Plaines, IL 60018	(708) 299-5200
SDI	Steel Door Institute 30200 Detroit Road Cleveland, Ohio 44145-1967	
SEMS	Sustainability & Environmental Management System Rocky Mountain Region Public Buildings Service Denver Federal Center, Building 41 Denver, CO 80225	(888)999-4777
SIGMA	Sealed Insulating Glass Manufacturers Association 401 N. Michigan Avenue Chicago, Illinois 60611-4267	
SMAW	Shielded Metal Arc Welding	
SMACNA	Sheet Metal and Air Conditioning Contractors National Assoc. 4201 Lafayette Center Dr. Chantilly, VA 22021	(703) 803-2980
SSPC	Steel Structures Painting Council 40 24th Street, 6th Floor Pittsburg, Pennsylvania 15222-4643	
TCA	Tile Council of America 100 Clemson Research Boulevard Anderson, South Carolina 29625	
UL	Underwriters Laboratories, Inc. 333 Pfingsten Rd. Northbrook, IL 60062	(708) 272-8800
WCLIB	West Coast Lumber Inspection Bureau (Grading Rules) P.O. Box 23145 Portland, Oregon 97281-3145	
WDMA	Window and Door Manufacturers Association www.wdma.com	(800) 223-2301 (847) 299-5200
WHI	Warnock Hersey International 211 Schoolhouse Street Coquitlam, British Columbia V3K, 4X9	

Canada

WWPA Western Wood Products Association (Grading Rules)
Yeon Building
522 SW 5th Avenue
Portland, Oregon 97204-2122

G. Federal Government Agencies:
1. Names and titles of Federal Government Standard- or Specification-producing agencies are often abbreviated.
2. Following acronyms or abbreviations referenced in Contract Documents indicate names of standard- or Specification-producing agencies of federal government:

CS	Commercial Standard (U.S. Department of Commerce) Washington, DC 20230	(202) 482-2000
DOT	Department of Transportation 400 Seventh St., SW Washington, DC 20590	(202) 366-4000
EPA	Environmental Protection Agency 401 M St., SW Washington, DC 20460	(202) 382-2090
FS	Federal Specification (from GSA) Specifications Unit (WFSIS) 7th and D St., SW Washington, DC 20407	(202) 708-9205
GSA	General Services Administration F St. and 18th St., NW Washington, DC 20405	(202) 708-5082
OSHA	Occupational Safety and Health Administration (U.S. Department of Labor) N3647 200 Constitution Ave., NW Washington, DC 20210	(202) 219-8148
UFAS	Uniform Federal Accessibility Standards General Services Administration 18th and F Avenues, NW Room 3044 Washington, D.C. 20405	(202) 566-0038

PART 2 – PRODUCTS (NONE)

PART 3 – EXECUTION (NONE)

END OF SECTION 01 42 00

SECTION 01 43 00

QUALITY ASSURANCE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Manufacturer qualifications.
2. Supplier qualifications.
3. Fabricator qualifications.
4. Installer qualifications.
5. Testing and inspecting agency qualifications.
6. Code-required special inspector qualifications.
7. Manufacturer's field services.
8. Field samples.
9. Mockups.

B. Related Sections:
1. Section 01 33 00: "Submittal Procedures."
2. Section 01 45 00: "Quality Control."
3. Federal Acquisition Regulation (FAR).

C. Abbreviations:
1. American Society for testing Materials (ASTM)

1.2 MANUFACTURER QUALIFICATIONS

A. Company specializing in manufacturer of materials specified.

B. Shall have a minimum of five years of production experience with material manufacturing, and whose published product literature clearly indicates general compliance of products with requirements of Specification Section.

1.3 FABRICATOR QUALIFICATIONS

A. Regularly engaged in production of materials.

B. Shall have a minimum of five years of fabrication experience with materials similar in size and scope to this project.

1.4 INSTALLER QUALIFICATIONS

A. Shall have a minimum of five previous projects similar in size and scope to this project.

B. Shall be familiar with special requirements indicated in appropriate Specification Sections.

1.5 TESTING AND INSPECTING AGENCY QUALIFICATIONS

A. Independent entity engaged to perform specific inspections or tests, at Project site or elsewhere, and to report on and, if required, to interpret results of those inspections or tests.

B. Shall have a minimum of five years experience in specific type of testing to be performed.

C. Laboratory shall be capable of performing all tests and inspections specified in Contract Documents according to appropriate ASTM standards.

1.6 MANUFACTURER'S FIELD SERVICES

A. When specified, requires material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions and to initiate instructions when necessary.

B. Report observations and site decisions or instructions that are supplemental or contrary to manufacturer's written instructions.

PART – PRODUCTS (NONE)

PART 3 – EXECUTION (NONE)

END OF SECTION 01 43 00

SECTION 01 45 00

QUALITY CONTROL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Source quality control procedures.
2. Field quality control procedures.
3. Testing and inspection services.
4. Plant inspection procedures.
5. Testing laboratory services.
6. Code-required special inspections and procedures.

B. Related Sections:
1. Section 01 43 00: “Quality Assurance.”
2. Federal Acquisition Regulation (FAR).

1.2 SOURCE QUALITY CONTROL PROCEDURES

A. All materials are subject to Government’s approval prior to, during, and after installation.

B. Replace rejected materials with satisfactory materials.

1.3 FIELD QUALITY CONTROL PROCEDURES

A. Work Quality Level: Project’s intent is that all existing materials correction and finish Work, and new materials installation and finish Work shall achieve a quality level similar to industry standards acceptable to Government.

B. Examinations:
1. Verify that existing site conditions and substrate surfaces are acceptable for subsequent Work.
2. Beginning new Work means acceptance of existing conditions.
3. Government’s representative inspections of in installed materials does not release Contractor from his/her responsibility to provide all work in accordance with Contract Documents.

C. Tolerances:
1. Monitor tolerance control of installed products over suppliers, manufacturers, site conditions, and workmanship, to produce acceptable Work.
2. Do not permit tolerances to accumulate.

D. Existing Utilities:
1. Existence and location of underground utilities and construction indicated as existing are not guaranteed.
2. Before starting any work disturbing, moving or penetrating ground, Contractor must have all existing utilities located, staked, and depth identified by appropriate entity.

E. Securing Work:
1. Provide attachment and connection devices and methods necessary for securing Work.
2. Secure Work true to line and level.
3. Allow for expansion and building movement.

F Joints:
1. Provide uniform joint widths in exposed Work.
2. Arrange joints in exposed Work to obtain best visual effect.

3. Refer questionable choices to Government for final decision.

G Installation:

1. Recheck measurements and dimensions, before starting each installation.
2. Install each component during weather conditions and Project status that will ensure best possible results.
3. Contractor shall follow best practices to ensure absence of mold in final building.
4. Isolate each part of completed construction from incompatible material as necessary to prevent deterioration.
5. Coordinate temporary enclosures with required inspections and tests to minimize necessity of uncovering completed construction for that purpose.
6. Provide space to permit removal of coils, tubes, fan shafts, filters, and other parts which may require replacement.
7. Locate operating and control equipment and devices for easy access.
8. Furnish access panels where units are concealed by finishes and similar work.
9. Integrate mechanical work in ceiling plenums with suspension system, light fixtures and other work, so that required performances of each will be achieved.
10. Give right-of-way to piping systems required to slope for drainage over other service lines and ductwork.
11. Access panels for concealed valves, controls, dampers, pull boxes, and other devices requiring access and located in concealed positions other than above lift-out ceilings will be furnished by installer of item needing access.
12. Furnish panels as specified in Divisions 22 and 23.
13. Coordinate locations with other trades and with Government.
14. Insure that required sleeves and anchors required in other Work are properly installed.
15. Protection:
    a. During handling and installation, protect construction in progress and adjoining materials in place.
    b. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
    c. Maintain completed construction as frequently as necessary through remainder of construction period.
    d. Adjust and lubricate operable components to ensure operability without damaging effects.
    e. Supervise construction activities to ensure that no part of construction completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during construction period.
    f. Where applicable, such exposures include, but are not limited to, following:
        1) Excessive static or dynamic loading, internal or external pressures, high or low temperatures, and high or low humidity.
        2) Thermal shock.
        3) Air contamination or pollution.
        4) Water, ice, weathering, unprotected storage.
        5) Solvents, Chemicals.
        6) Light.
        7) Radiation.
        8) Abrasion and/or puncture.
        9) Heavy traffic.
        10) Soiling, staining and corrosion.
        11) Bacteria.
        12) Rodent and insect infestation.
        13) Combustion.
        14) Electrical current.
        15) Unusual wear, misuse, misalignment.

    g. Contact between incompatible materials.
    h. Destructive testing.
    i. Theft.
    j. Vandalism.

1.4 TESTING AND INSPECTION SERVICES

A. Contractor Responsibilities:
   1. Contractor shall be responsible for all testing. When specified, requires supplier or manufacturer to provide qualified personnel to observe field conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, testing, adjusting and balancing of equipment as applicable and to make appropriate recommendations.
   2. Manufacturer's representative shall submit written report to Government listing observations and recommendations.
   3. Re-testing where results of required inspections, tests or similar services prove unsatisfactory and do not indicate compliance with Contract Document requirements, regardless of whether original test was Contractor's responsibility
   4. Cost of re-testing construction revised or replaced by Contractor shall be Contractor's responsibility, where required tests were performed on original construction.
   5. Cooperate with agencies performing required inspections, tests and similar services and provide reasonable auxiliary services as requested.
   6. Notify agency sufficiently in advance of operations to permit assignment of personnel.
   7. Auxiliary services required include but are not limited to:
      a. Provide access to Work and furnish incidental labor and facilities necessary to facilitate inspections and tests.
      b. Take adequate quantities of representative samples of materials that require testing or assisting agency in taking samples.
      c. Provide facilities for storage and curing of test samples, and delivery of samples to testing laboratories.
      d. Provide agency with a preliminary design mix proposed for use for materials mixes that require control by testing agency.
      e. Security and protection of samples and test equipment at Project site.

   8. Schedule times for inspections, tests, taking samples, and similar activities.

B. Coordination:
   1. Contractor and each agency performing inspections, tests and similar services shall coordinate sequence of activities to accommodate required services with a minimum of delay.
   2. In addition, Contractor and each agency shall coordinate activities to avoid necessity of removing and replacing construction to accommodate inspections and tests.

C. Reports:
   1. Independent testing agency shall submit certified written reports of each inspection, test, re-test or similar service, to Government and Contractor.
   2. Submit additional copies of each written report directly to governing authority, when authority so directs.
   3. Written reports of each inspection, test or similar service shall include, but not be limited to:
      a. Date of issue.
      b. Project title and number.
      c. Name, address and telephone number of testing agency.
      d. Dates and locations of samples and tests or inspections.
      e. Names of individuals making inspection or test.
      a. Work designation and test method.
      b. Product identification and Specification Section.
      c. Complete inspection or test data.
      d. Test results and an interpretation of test results.
      e. Ambient conditions at time of sample-taking and testing.
      f. Comments or professional opinion as to whether inspected or tested Work complies with Contract Document requirements.
      g. Laboratory inspector’s name and signature.
      h. Re-testing recommendations.

D. Inspection and testing services do not relieve Contractor of the responsibility for compliance with

Contract Document requirements.

1.5 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. See Section 01 31 00, “Project Management and Coordination.”

1.6 DELIVERY, STORAGE AND HANDLING

A. Properly carton, crate, cover and protect materials, products and equipment for shipping, handling and storing.

B. Use appropriate means for hoisting and loading which will prevent damage or overstress to items being handled or shipped.

C. Store them under roof in controlled environment whenever feasible otherwise store off the ground under suitable coverings properly secured against wind and weather.

D. Protect all items from rain, snow moisture, wind, cold, heat, frost, sun, staining, discoloration, deterioration and physical damage from any cause.

E. Refer to individual sections for specific requirements.

PART 2 – PRODUCTS (NONE)

PART 3 – EXECUTION (NONE)

END OF SECTION 01 45 00

SECTION 01 50 00

TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Temporary utilities.
2. Construction facilities.
3. Temporary construction.
4. Construction aids.
5. Vehicular access and parking.
6. Temporary barriers and enclosures.

B. Related Sections:
1. Section 01 58 00: “Project Identification.”
2. Section 01 74 00: “Cleaning and Waste Management.”
3. Federal Acquisition Regulation (FAR).

C. Abbreviations:
1. American Society for testing Materials (ASTM)
2. National Electrical Manufacturers Assoc. (NEMA)
3. National Fire Protection Assoc. (NFPA)
4. American National Standards Institute (ANSI)
5. National Electrical Contractors Assoc. (NECA)
6. General Contractors (AGC)
7. Associated Specialty Contractors (ASC)
8. Underwriter’s Laboratory (UL)

1.2 TEMPORARY UTILITIES

A. Provide new equipment; or undamaged, previously used equipment in serviceable condition that is suitable for use intended.

B. Electrical Outlets:
1. Provide properly configured National Electrical Manufacturers Assoc. (NEMA) polarized outlets to prevent insertion of 110-120 volt plugs into higher voltage outlets.
2. Provide receptacle outlets equipped with ground-fault circuit interrupters, reset button and pilot light, for connection of power tools and equipment.

C. Electrical Power Cords:
1. Provide grounded extension cords; use "hard-service" cords where exposed to abrasion and traffic.
2. Provide waterproof connectors to connect separate lengths of electric cords, if single lengths will not reach areas where construction activities are in progress.

D. Comply with industry standards and applicable laws and regulations if authorities have jurisdiction, including but not limited to:
1. Building Code requirements.
2. Health and safety regulations.
3. Utility company regulations.
4. Police, Fire Department and Rescue Squad rules.
1. Environmental protection regulations.

E. Comply with National Fire Protection Assoc. (NFPA) Code 241, "Building Construction and Demolition Operations", American National Standards Institute (ANSI)-A10 Series standards for

"Safety Requirements for Construction and Demolition", and National Electrical Contractors Assoc. (NECA) Electrical Design Library "Temporary Electrical Facilities."
1. Refer to "Guidelines for Bid Conditions for Temporary Job Utilities and Services", prepared jointly by Association of General Contractors (AGC) and Associated Specialty Contractors (ASC), for industry recommendations.

F. Obtain required certifications and permits.

I. Fire Extinguishers:
1. Provide hand-carried, portable UL-rated, class "A" fire extinguishers for temporary offices and similar spaces.
2. In other locations provide hand-carried, portable, UL-rated, class "ABC" dry chemical extinguishers, or a combination of extinguishers of NFPA recommended classes for exposures.
3. Comply with NFPA 10 and 241 for classification, extinguishing agent and size required by location and class of fire exposure.

1.3 CONSTRUCTION FACILITIES

A. Construction Office: Provide telephone, fax, computer and copier and sufficient office space for project superintendent and subcontractor administrative requirements.

B. Temporary Field Office:
1. Well-lighted.
2. Shall be acceptable to Government for use of Contractor and Government.
3. Locate office in building where directed by Government.
4. Remove when work is completed.

C. Storage Lock Boxes: Contractor and each trade contractor may provide, at his option, suitable lockable storage boxes located on site where directed by Government.

D. First Aid Supplies: Comply with governing regulations.

E. Smoking shall not be permitted within building. Contractor shall ensure that all federal requirements are enforced.

1.4 TEMPORARY CONSTRUCTION

A. Provide adequate protective structures to assure safe passage by persons using existing adjacent sidewalks, public ways, and facilities.

B. Structures may include covered/enclosed walkways.

C. Building Interior Dust and Air Contamination Control:
1. Provide temporary dust and weatherproof enclosures for doors, windows, and other openings where necessary.
2. Provide temporary dust and air contamination enclosures between new construction and existing building.
3. Protect all installed permanent fire alarm smoke detectors from construction dust.
4. Provide temporary ventilation to prevent any dust, fumes, and vapors related to construction do not contaminate surfaces or air in occupied areas of building to be reused.

1.5 CONSTRUCTION AIDS

A. Contractor shall provide all scaffolding and platforms as required by Project.

1.6 TEMPORARY BARRIERS AND ENCLOSURES

A. Barricades, Warning Signs and Lights:
   1. Comply with standards and code requirements for erection of structurally adequate barricades.
   2. Paint with appropriate colors, graphics and warning signs to inform personnel and public of the hazard being protected against.
   3. Provide lighting, including flashing red or amber lights where appropriate and needed.

B. Environmental Protection:
   1. Provide protection, operate temporary facilities and conduct construction in ways and by methods that comply with environmental regulations, and minimize possibility that air, waterways and subsoil might be contaminated or polluted, or that other undesirable effects might result.
   2. Restrict use of noise making tools and equipment to hours that will minimize complaints from persons near site.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Provide new materials; or undamaged previously used materials in serviceable condition.

B. Provide materials suitable for use intended.

C. Paint: Comply with requirements of Section 09 90 00, “Painting and Coating.”

D. Tarpaulins:
   1. Provide waterproof, fire-resistant, UL labeled tarpaulins with flame-spread rating of 15 or less.
   2. Provide translucent nylon reinforced laminated polyethylene or polyvinyl chloride fire retardant tarpaulins for temporary enclosures.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Use qualified personnel for installation of temporary facilities.

B. Locate facilities where they will serve Project adequately and result in minimum interference with performance of Work.

C. Relocate and modify facilities as required.

D. Provide each facility ready for use when needed to avoid delay.

E. Maintain and modify as required.

F. Do not remove until facilities are no longer needed, or are replaced by authorized use of completed permanent facilities.

G. Limit availability of temporary facilities to essential and intended uses to minimize waste and abuse.

H. Maintenance:
   1. Maintain facilities in good operating condition until removal.
   2. Protect from damage by freezing temperatures and similar elements.
   3. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation and similar facilities on a twenty-four-hour day basis where required to achieve indicated results

and to avoid possibility of damage.

I. Remove each temporary facility when the need has ended, or when replaced by authorized use of a permanent facility, or no later than Substantial Completion.

J. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility.

K. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

END OF SECTION 01 50 00

SECTION 01 61 00

COMMON PRODUCT REQUIREMENTS

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Products used in construction.

B. Related Sections:
   1. Federal Acquisition Regulations (FAR)

1.2 DEFINITIONS

A. Products:
   1. New material, machinery, components, equipment, fixtures, and systems forming Work, but does not include machinery and equipment used for preparation, fabrication, conveying and erection of Work.
   2. May also include existing materials or components specifically identified for reuse.

B. Materials: Products that are substantially shaped, cut, worked, mixed, finished, refined or otherwise fabricated, processed, or installed to form a part of Work.

C. Named Products: Items identified by manufacturer's product name, including make or model designation, indicated in manufacturer's published product literature that is current as of date of Contract Documents.

D. Equipment: A product with operational parts, whether motorized or manually operated, that requires service connections such as wiring or piping.

E. Definitions used in this Article are not intended to change meaning of other terms used in Contract Documents, such as "specialties," "systems," "structure," "finishes," "accessories," and similar terms.

F. Such terms such are self-explanatory and have well recognized meanings in construction industry.

1.3 SUBMITTALS

A. Product List:
   1. Prepare a schedule showing products specified in a tabular form.
   2. Include generic names of products required.
   3. Include manufacturer's name and proprietary product names for each item listed.
   4. Refer to Section 01 33 00, “Submittal Procedures.”

1.4 QUALITY ASSURANCE

A. Provide products of same kind, from a single source to fullest extent possible.

B. When specified products are available only from sources that do not or cannot produce a quantity adequate to complete project requirements in a timely manner, consult with Government for a determination of most important product qualities before proceeding.

C. Qualities may include attributes relating to visual appearance, strength, durability, or compatibility.

D. Select products from sources that produce products that possess these qualities, to fullest extent

possible.

1.5 PRODUCT SELECTION

A. Provide products that comply with Contract Documents, that are undamaged and, unless otherwise indicated, unused at time of installation.

B. Provide products complete with all accessories, trim, finish, safety guards and other devices and details needed for a complete installation and for intended use and effect.

C. Product selection is governed by Contract Documents and governing regulations, not by previous Project experience.

D. Procedures governing product selection include following:
   1. Proprietary Specification Requirements:
      a. Provide product indicated where only a single product or manufacturer is named.
      b. No substitutions will be permitted.
   2. Semi-proprietary Specification Requirements:
      a. Provide one of products indicated where two or more products or manufacturers are named.
      b. No substitutions will be permitted.
      c. Approval must be included in Addenda, prior to bidding where term "an equivalent product of an approved manufacturer."
   3. Non-Proprietary Specifications:
      a. Contractor may propose any available product that complies with Contract requirements when Specifications list products or manufacturers that are available and may be incorporated in Work, but do not restrict Contractor to use of these products only.
      b. Comply with Section 01 35 00, “Special Procedures” concerning substitutions to obtain approval for use of an unnamed product.
   4. Descriptive Specification Requirements: Provide a product or assembly that provides characteristics and otherwise complies with Contract requirements where Specifications describe a product or assembly, listing exact characteristics required, with or without use of a brand or trade name.
   5. Performance Specification Requirements:
      a. Provide products that comply with these requirements, and are recommended by manufacturer for application indicated where Specifications require compliance with performance requirements.
      b. General overall performance of a product is implied where product is specified for a specific application.
      c. Manufacturer's recommendations may be contained in published product literature.
   6. Compliance with Standards, Codes and Regulations: Select a product that complies with standards, codes or regulations specified where Specifications only require compliance with an imposed code, standard or regulation.
   7. Visual Matching: Government’s decision will be final on whether a proposed product matches satisfactorily where Specifications require matching an established Sample.
   8. Visual Selection:
      a. Select a product and manufacturer that complies with other specified requirements where specified product requirements include phrase "...as selected from manufacturer's standard colors, patterns, textures “...or a similar phrase.
      b. Government will select color, pattern and texture from product line selected.

PART 2 – PRODUCTS (NONE)

PART 3 – EXECUTION (NONE)

END OF SECTION 01 61 00

SECTION 01 73 29

CUTTING AND PATCHING

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes: Administrative and procedural requirements for cutting and patching.

B. Related Sections:
1. Refer to Divisions 21, 22, 23 and 26 sections for additional requirements and limitations applicable to cutting and patching for mechanical and electrical installations.
2. Federal Acquisition Regulation (FAR).

C. Abbreviations:
1. Heating, Ventilating and Air Conditioning (HVAC).

1.2 SUBMITTALS

A. Cutting and Patching Proposal:
1. Submit a proposal describing procedures well in advance of time cutting and patching will be performed and request approval to proceed where approval of procedures for cutting and patching is required before proceeding.
2. Include following information, as applicable, in proposal:
   a. Describe extent of cutting and patching required and how it is to be performed; indicate why it cannot be avoided.
   b. Describe anticipated results in terms of changes to existing construction; include changes to structural elements and operating components as well as changes in building's appearance and other significant visual elements.
   c. List products to be used and firms or entities that will perform Work.
   d. Indicate dates when cutting and patching is to be performed, and how long service will be disrupted.
   e. List utilities that will be disturbed or affected, including those that will be relocated and those that will be temporarily out of service.
   f. Approval by Government to proceed with cutting and patching does not waive Government’s right to later require complete removal and replacement of a part of Work found to be unsatisfactory.

1.3 QUALITY ASSURANCE

A. Do not cut and patch structural elements in a manner that would reduce their load-carrying capacity or load-deflection ratio.

B. Obtain approval of cutting and patching proposal before cutting and patching following structural elements:
1. Bearing walls.
2. Structural concrete.
3. Structural steel.
4. Lintels.
5. Structural decking.
6. Stair systems.
7. Miscellaneous structural metals.
8. Equipment supports.
9. Piping, ductwork, vessels and equipment
10. Walls: Fire resistive, smoke proof enclosures, separation.

C. Do not cut and patch operating elements or safety related components in a manner that would

result in reducing their capacity to perform as intended, or result in increased maintenance, or decreased operational life or safety.

D. Obtain approval of cutting and patching proposal before cutting and patching following operating elements or safety related systems:
   1. Primary operational systems and equipment.
   2. Air or smoke barriers.
   3. Water, moisture, or vapor barriers.
   4. Membranes and flashings.
   5. Fire protection systems.
   6. Noise and vibration control elements and systems.
   7. Control systems.
   8. Communication networking systems.
   9. Conveying systems.
   10. Electrical wiring systems.

E. Do not cut and patch construction exposed on exterior or in occupied spaces, in a manner that would, in Government's opinion, reduce building's aesthetic qualities, or result in visual evidence of cutting and patching.

F. Remove and replace Work cut and patched in a visually unsatisfactory manner.

G. Original installer or fabricator shall cut and patch following categories of exposed Work, or if it is not possible to engage original installer or fabricator, engage another recognized experienced and specialized firm:
   1. HVAC enclosures, cabinets or covers.

1.4 MATERIALS

A. Use materials that are identical to existing materials.

B. Use materials that match existing adjacent surfaces to fullest extent possible with regard to visual effect if identical materials are not available or cannot be used where exposed surfaces are involved.

C. Use materials whose installed performance will equal or surpass that of existing materials.

1.5 EXAMINATION

A. Examine existing surfaces to be cut and patched and conditions under which cutting and patching is to be performed.

B. Take corrective action before proceeding if unsafe or unsatisfactory conditions are encountered.

1.6 PREPARATION

A. Provide temporary support of Work to be cut.

C. Protect existing construction during cutting and patching to prevent damage.

D. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

E. Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

F. Take all precautions necessary to avoid cutting existing pipe, conduit or ductwork serving building, but scheduled to be removed or relocated until provisions have been made to bypass them.

1.7 PERFORMANCE

A. Employ skilled workers to perform cutting and patching.

B. Proceed with cutting and patching at earliest feasible time and complete without delay.

C. Cut existing construction using methods least likely to damage elements to be retained or adjoining construction:
   1. Use hand or small power tools designed for sawing or grinding, not hammering and chopping where cutting is required.
   2. Cut holes and slots neatly to size required with minimum disturbance of adjacent surfaces.
   3. Temporarily cover openings when not in use.
   4. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
   5. Cut through concrete and masonry using a cutting machine, such as a carborundum saw or diamond core drill.
   7. By-pass utility services such as pipe or conduit, before cutting, where services are required to be removed, relocated or abandoned.
   8. Cut-off pipe or conduit in walls or partitions to be removed.
   9. Cap, valve or plug and seal the remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after by-passing and cutting.

D. Patch with durable seams that are as invisible as possible.

E. Comply with specified tolerances.
   1. Inspect and test patched areas to demonstrate integrity of installation, where feasible.
   2. Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.

1.8 CLEANING

A. Thoroughly clean areas and spaces where cutting and patching is performed or used as access.

B. Completely remove paint, mortar, oils, putty and items of similar nature.

C. Thoroughly clean piping, conduit and similar features before painting or other finishing is applied.

D. Restore damaged pipe covering to its original condition.

PART 2 – PRODUCTS (NONE)

PART 3 – EXECUTION (NONE)

END OF SECTION 01 73 29

SECTION 01 74 00

CLEANING AND WASTE MANAGEMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Progress cleaning.
2. Site maintenance.
3. Construction waste management and disposal.
4. Final cleaning.

B. Related Sections:
1. Section 01 77 00: “Closeout Procedures.”
2. Section 02 41 00: “Demolition.”
3. Federal Acquisition Regulation (FAR).

C. Abbreviations:
1. United States Department of Agriculture (U.S.D.A.)
2. Sustainability and Environmental Management System – Operational Controls (SEMS)
3. Environmental Protection Agency (EPA)
4. Construction Materials Recycling Association (CMRA)
5. National Fire Protection Association (NFPA)
6. Comprehensive Procurement Guidelines (CPG)
7. Chromated copper arsenate (CCA)
8. Polyethylene Terephthalate (PET)
9. Portable Document Format (PDF)

1.2 DEFINITIONS

A. Waste:
1. Any material that has reached end of its intended use.
2. Waste includes salvageable, returnable, recyclable and reusable material.

B. Construction Waste: Solid wastes including, but not limited to, building materials, packaging materials, debris and trash resulting from construction operations.

C. Salvage: Waste material removed from Project site to another site for resale or reuse by others.

D. Hazardous Waste: Any material or byproduct of construction that is regulated by Environmental Protection Agency and that may not be disposed in any landfill or other waste end-source without adherence to applicable laws.

E. Trash: Any product or material unable to be returned, reused, recycled or salvaged.

F. Landfill: Any public or private business involved in practice of trash disposal.

G. Waste Management Plan: Project-related plan for collection, transportation, and dispensation of waste generated at construction site.

H. Sustainability and Environmental Management System – Operational Controls (SEMS): Federal directives for environmental and sustainable issues. Individual requirements for each separate discipline are available at the website www.gsa.gov/sems.

1.3 RESPONSIBILITIES

A. Contractor, each Subcontractor, and Installer are responsible for specific cleaning operations of his work to extent specified in appropriate specification sections.

B. Contractor shall employ processes which ensure the generation of as little waste as possible and avoid the generation of waste due to over-packaging, error, poor planning, layout, breakage, contamination, damage from weather, etc. Of the inevitable waste that is generated, as many of the waste materials as economically feasible shall be reused, salvaged, or recycled. Waste disposal to a landfill shall be minimized to the greatest extent possible. Contractor shall provide documentation indicating the nature and quantities for disposal of all materials that are generated during the course of the Project.

C. Pollution Control:
   1. Conduct clean-up and disposal operations to comply with applicable anti-pollution laws and local ordinances.
   2. Burning or burying of waste materials on project site is not permitted.
   3. Disposal of volatile fluids and wastes in storm sewers, sanitary sewers, septic systems, or into streams or waterways is not permitted.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Use only cleaning materials recommended by manufacturer of surface to be cleaned.

PART 3 - EXECUTION

3.1 PROGRESS CLEANING

A. At time each unit of work or element of construction is substantially completed in each area of Project, clean unit or element to a condition suitable for occupancy and use as intended, and restore minor or superficial damage.

B. Replace units and elements which are damaged beyond successful restoration.

C. Provide appropriate protective covering or other provisions where subsequent construction activities could result in damage to other work in place.

D. Repeat cleaning and protection operations during remainder of construction period, wherever work might otherwise be damaged by sustained soiling or exposure.

E. During Construction:
   1. Oversee cleaning and ensure that building, grounds and public properties are maintained free from accumulation of waste materials and rubbish.
   2. Take measures to prevent spread of trash, debris, cartons, packaging or other waste materials on or off Project Site by wind.
   3. Clean up site and access and dispose of waste materials, rubbish and debris at reasonable intervals during progress of work.
   4. Clean adjacent and nearby streets of dirt occasioned by construction operations; frequency and by methods to insure thorough cleaning.

3.2 WASTE MANAGEMENT

A. Contractor shall employ processes which ensure the generation of as little waste as possible and avoid the generation of waste due to over-packaging, error, poor planning, layout, breakage, contamination, damage from weather, etc.

B. Waste materials, wherever feasible, shall be reused, salvaged, or recycled.

C. Waste disposal to a landfill shall be minimized to the greatest extent possible.

D. Contractor shall provide documentation indicating the nature and quantities for disposal of all materials that are generated during the course of the Project.

3.3 RECYCLING

A. All steel construction waste and other acceptable construction waste will be segregated and shipped off to appropriate recyclers.

B. Contractor shall provide documentation indicating the nature and quantities for disposal of all materials that are generated during the course of the Project.

C Major Construction waste recycling opportunities include the following:

1. Gypsum
   a. Gypsum Drywall Recycling.org provides online resources for those interested in recycling gypsum drywall including processing information, markets, environmental and permitting issues, case studies, technical reports, and factsheets. This site was developed through a grant from EPA Region 5 to the Construction Materials Recycling Association (CMRA), with technical support from the University of Florida.
   b. The Gypsum Association offers brief guidance on ground drywall land application.
   c. WasteCap Wisconsin's website provides numerous studies and resources related to gypsum recycling.
2. Steel
   a. The Steel Recycling Institute, an industry association, provides information about recycling and buying , recycled steel building products.
3. Wood
   a. USDA Forest Products Laboratory conducts research on the recycling of wood and other forest products:
      1) Recovering Wood for Reuse and Recycling: A United States Perspective (PDF) (13 pp, 224K)
      2) Wood-Framed Building Deconstruction: A Source of Lumber for Construction (PDF) (8 pp, 157K)
      3) Forest Products Laboratory (PDF) (13 pp, 156K) - overview including recycling of wood waste
      4) The Properties of Lumber and Timber Recycled From Deconstructed Buildings (PDF) (4 pp, 96K)
      5) Considerations in Recycling of Wood-Plastic Composites (PDF) (9 pp, 81K)
   b. Directory of Wood-Framed Building Deconstruction and Reused Building Materials Companies (2005). Developed by the USDA Forest Products Laboratory, this directory provides information on companies involved in wood-framed building deconstruction, dismantling, and utilization of reused building materials, with an emphasis on those that use, resell, and/or re-manufacture salvaged wood. The majority of companies listed are those that either salvage or sell building materials.
      1) CCAResearch.org, a Hinkley Center for Solid and Hazardous Waste Web site, provides research findings from studies of chromated copper arsenate (CCA) treated wood.
4. Carpet
   a. EPA's Product Stewardship Program's Carpet page provides information on carpet reuse, refurbishing, and recycling and additional carpet resources. Under EPA's Comprehensive Procurement Guidelines (CPG), Federal agencies are required to purchase items containing recovered materials. EPA is considering a proposal for nylon carpet and nylon carpet containing recovered content backing in the next CPG. Polyester carpet is already one of the 54 items listed in the CPG. The recommended recovered material content for polyester face fiber is listed as 25 to 100 percent PET resin (from recycled plastic beverage bottles).
   b. Carpet and Padding: Reuse and Recycling Opportunities (PDF) (2 pp, 301K)
   Produced by National Association of Home Builders (NAHB) Research Center, this brochure provides an overview of carpet and padding recycling for retailers, installers, solid waste planners, recyclers, and consumers.

3.4 SITE MAINTENANCE

A. Comply with requirements of NFPA 241 for removal of combustible waste material and debris and enforce requirements strictly.

B. Provide daily sweeping and clean-up of dust, debris, litter, trash containers and other items required to maintain a clean, orderly and accessible site.

C. Do not hold materials more than seven days during normal weather or three days when temperature is expected to rise above 80 degrees F.

D. Hauling of debris to legal dump or landfill is required.

E. Handle hazardous, dangerous or unsanitary waste materials separately from other waste by containerizing properly.

F. Dispose of materials in a lawful manner.

G. Use of Government’s or neighbor's existing dumpster is forbidden.

3.3 FINAL CLEANING

A. Employ experienced workers or professional cleaners for final cleaning.

B. Use only cleaning materials and equipment that are compatible with surface being cleaned, as recommended by manufacturer of material.

C. Complete following cleaning operations before requesting final inspection:
1. Remove temporary protection and facilities installed for protection of Work during construction.
2. Comply with regulations of authorities having jurisdiction and safety standards for cleaning.
3. Remove waste and surplus materials, rubbish, and construction facilities from site in a lawful manner.
4. Where extra materials of value remaining after completion of associated Work have become Government’s property, arrange for disposition of these materials as directed.

D. Site:
1. Clean site, including landscape development areas, of rubbish, litter and other foreign substances.
2. Sweep paved areas broom clean; remove stains, spills and other foreign deposits.
3. Rake grounds that are neither paved nor planted, to a smooth even-textured surface.
4. Hose down all paved areas and sidewalks on site or directly adjacent to site.
5. Remove all resultant debris along with other debris and turn over to Government a neat and orderly site.

E. Structures:
1. Interior:
   a. Remove all traces of soil, waste materials, smudges, splashed materials, paint droppings, spots, stains, dirt, and other foreign matter from finished surfaces.
   b. Use only appropriate cleaning materials and equipment for surfaces to be cleaned.
   c. Clean exposed interior hard-surfaced finishes to a dust-free condition, free of stains, films and similar foreign substances.
   d. Restore reflective surfaces to their original reflective condition.
   e. Leave concrete floors broom clean.
   f. Vacuum carpeted and soft surfaces.
   g. Wipe surfaces of mechanical and electrical equipment.
   h. Replace filters of operating equipment.
   i. Remove excess lubrication and other substances.

j. Clean plumbing fixtures to a sanitary condition.
k. Clean light fixtures and lamps.
l. Clean all glass.
m. Clean all surfaces exposed to circulating air and areas exposed to moisture to lessen risk of absorbed off-gassed contaminants and re-emitted pollutants.
n. Polished Surfaces: Apply polish recommended by manufacturer of materials being polished, to all surfaces requiring routine application of buff polish.

END OF SECTION 01 74 00

SECTION 01 77 00

CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Preliminary closeout reviews.
2. Final closeout review.
3. Closeout requirements.

B. Related Sections:
1. Section 01 50 00: “Temporary Facilities and Controls.”
2. Section 01 74 00: “Cleaning and Waste Management.”
3. Section 01 78 00: “Closeout Submittals.”
4. Federal Acquisition Regulations (FAR)

1.2 PRELIMINARY CLOSEOUT REVIEWS

A. Substantial Completion:
1. Complete following before requesting inspection for certification of Substantial Completion, (List exceptions in request):
   a. Show 100 percent completion for portion of Work claimed as substantially complete in Application for Payment that coincides with, or first follows, date Substantial Completion is claimed.
   b. Include supporting documentation for completion as indicated in these Contract Documents and a statement showing an accounting of changes to Contract Sum.
   e. Submit specific warranties, workmanship bonds, maintenance agreements, final certifications and similar documents.
   f. Obtain and submit Certificates of Occupancy enabling Government unrestricted use of Work and access to services and utilities; include occupancy permits, operating certificates and similar releases.
   g. Submit record drawings, maintenance manuals, and similar final record information.
   h. Deliver tools, spare parts, extra stock, and similar items.
   i. Make final change-over of permanent locks and transmit keys to Government and advise Government personnel of change-over in security provisions.
   j. Complete start-up testing of systems, and instruction of Government's operating and maintenance personnel.
   k. Remove temporary facilities from site, along with construction tools and similar elements.
   l. Complete final clean up requirements, including touch-up painting.
   m. Touch-up and otherwise repair and restore marred exposed finishes.
   n. Submit Contractor’s comprehensive list of items to be completed or corrected to Government.
2. Substantial Completion Review:
   a. Notify Government by letter that Work is substantially complete at least 5 calendar days before inspection.
   b. Contractor shall state in writing that “the Work, or a portion thereof which the Government agrees to accept separately, is substantially complete; that all work and items are in place and functioning as intended to function; that all items contained on the Contractor’s comprehensive list have been completed or corrected; and the Work is ready for the Government’s inspection.”
   c. Government will proceed with inspection upon receipt of notice that Work has been substantially completed.
   d. If Government’s inspection of Work discloses any item that is not in place or functioning as intended, or more than twenty items whether included or not on contractor’s comprehensive list are incomplete or not corrected, Work will be deemed by Government

to be incomplete.
e. Contractor shall bear all costs of additional services of Government and Government's Consultants for all additional inspections until Work is deemed by Government to be substantially complete.
f. Funds will be withheld from final payment and/or retainage to Contractor, in an amount equal to additional time and expenses required by Government and Government's Consultants to conduct and document additional inspections necessary to insure compliance with Contract Documents.

1.3 FINAL CLOSEOUT REVIEW

A. Final Acceptance:
1. General:
a. Before requesting final inspection for certification of final acceptance and final payment, complete following: (List exceptions in request):
1). Submit final payment request with releases and supporting documentation not previously submitted and accepted.
2). Include certificates of insurance for products and completed operations where required.
3). Submit a certified copy of Government 's final inspection list of items to be completed or corrected, stating that each item has been completed or otherwise resolved for acceptance, and list has been endorsed and dated by Government.
4). Submit consent of surety to final payment.
5). Submit evidence of final, continuing insurance coverage complying with insurance requirements.

2. Final Acceptance Review:
a. Notify Government by letter that Work is complete at least 3 calendar days before inspection.
b. Contractor shall state in writing that "the entire Work is complete; all items contained on the Contractor's comprehensive list, the Government's list, and those items identified by additional inspections have been completed or corrected; and the entire Work is ready for the Government's final inspection."
c. Government will proceed with final inspection upon receipt of notice that Work has been completed.
d. If Government's final inspection of entire Work discloses that any item, whether included or not on Contractor's comprehensive list, Government's list, or identified by additional inspections, is incomplete or not corrected, Work will be deemed by Government to be incomplete.
e. Contractor shall bear all costs of additional services of Government and Government's Consultants for all additional inspections until entire Work is deemed by Government to be acceptable under Contract Documents and Contract is fully performed.
f. Funds will be withheld from final payment and/or retainage to Contractor, in an amount equal to additional time and expenses required by Government and Government's Consultants to conduct and document additional inspections necessary to insure compliance with Contract Documents.

1.4 CLOSEOUT REQUIREMENTS

A. Start Up Instructions:
1. Fully instruct Government's designated operating and maintenance personnel in operation, adjustment and maintenance of products, equipment and systems prior to final inspection or acceptance.
2. Test and start up all systems as specified in appropriate sections.
3. Arrange for each Installer to provide instructions to Government's personnel in operations of such systems where so specified.
4. Notify Government, in writing, at least seven days in advance of such start-ups, tests, and demonstrations.

5. Include instructions by manufacturer's representatives when so specified or where installers are not expert in required procedures.
6. Include detailed review of following:
    a. Maintenance manuals.
    b. Record documents.
    c. Spare parts and materials.
    d. Tools.
    e. Lubricants.
    f. Fuels.
    g. Identification systems.
    h. Control sequences.
    i. Hazards.
    j. Cleaning.
    k. Warranties and bonds.
    l. Maintenance agreements and similar continuing commitments.

B. Demonstrate following procedures:
1. Start up.
2. Shut-down.
3. Seasonal change-over.
4. Emergency operations.
5. Noise and vibration adjustments.
6. Safety procedures.
7. Economy and efficiency adjustments.
8. Effective energy utilization.

C. Testing, Adjusting, and Balancing:
1. Government will appoint, employ, and pay for services of an independent firm to perform testing, adjusting, and balancing.
2. Reports will be submitted by independent firm to Government indicating observations and results of tests and indicating compliance or non-compliance with specified requirements and with requirements of Contract Documents.
3. Cooperate with independent firm; furnish assistance as requested.
4. Re-testing required because of non-conformance to specified requirements will be charged to Contractor.

D. Final Cleaning: Complete in conformance with Section 01 74 00, “Cleaning and Waste Management.”

1.6 FINAL ACCEPTANCE

A. Prior to requesting inspection for verification of completion of all outstanding items:
1. Complete commissioning requirements, unless approved in writing by Government.
2. Exceptions to this are required seasonal and approved deferred testing.

PART 2 – PRODUCTS (NONE)

PART 3 – EXECUTION (NONE)

END OF SECTION 01 77 00

SECTION 01 78 00

CLOSEOUT SUBMITTALS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Completion and correction list.
2. Maintenance contracts.
3. Operation and maintenance data.
4. Final site survey.
5. Bonds.
6. Warranties.
7. Project record documents.
8. Spare parts.
9. Extra stock materials.

B. Related Sections:
1. Section 01 33 00: “Submittal Procedures.”
2. Section 01 77 00: “Closeout Procedures.”
3. Federal Acquisition Regulation (FAR)

1.2 SUBMITTAL FORMAT

A. Prepare data in form of a neatly typewritten instructional manual for use by Government's personnel.

B. Format:
1. Size: 8-1/2 inches by 11 inches, either manufacturer's printed data, or neatly typewritten.
2. Drawings:
   a. Provide reinforced punched binder tab, bind in with text.
   b. Fold larger drawings to size of text pages.
   c. Provide indexed tabs and fly-leaf for each separate product, or each piece of operating equipment.
   d. Include typed description of product, and major component parts of equipment.

C. Cover: Identify each volume with typed or printed title listing following:
1. Title of project.
2. Identity of general subject matter covered in the manual.

D. Binders:
1. Commercial quality three-ring binders with durable and cleanable plastic covers.
2. When multiple binders are used, correlate data into related consistent groupings.

E. Manuals:
1. Contents:
   a. Table of contents for each volume, arranged in systematic order.
   b. Contractor, name of responsible principal, address and telephone number.
   c. Include emergency telephone numbers for critical systems.
   d. List each product required to be included, indexed to content of volume, providing:
      1) Product equipment name.
      2) Manufacturer’s address and telephone number.
      3) Subcontractor or Installer.
      4) Maintenance contractor, as appropriate.
      5) Identify area of responsibility of each.
      6) Local source of supply for parts and replacement.

2. Identify each product by product name and other identifying symbols as set forth in Contract Documents.

F. Equipment Data:
1. Include only those sheets which are pertinent to specific product.
2. Annotate each sheet to clearly identify specific product or part installed, data applicable to installation.

G. Product Data:
1. Maintain two copies of each Product Data submittal.
2. Mark these documents to show significant variations in actual Work performed in comparison with information submitted.
3. Include variations in products delivered to site, and from manufacturer's installation instructions and recommendations.
4. Give particular attention to concealed products and portions of Work which cannot otherwise be readily discerned later by direct observation.
5. Note related Change Orders and mark-up of record drawings and Specifications.
6. Submit complete sets of record Product Data to Government for Government's records upon completion of mark-up.

H. Drawings:
1. Supplement product data with drawings as necessary to clearly illustrate relations of component parts of equipment or systems and control and flow diagrams.
2. Coordinate drawings with information in Project Record Documents to assure correct illustration of completed installation.

I. Written Text:
1. As required to supplement product data for particular installation organized into consistent format under separate headings for different procedures.
2. Provide logical sequence of instructions for each procedure.

J. Other Data:
1. Copy of each warranty, bond and service contract issued.
2. Provide information sheet for Government’s personnel, covering proper procedures in event of failure and instances which might affect validity of warranties or bonds.

1.3 OPERATION AND MAINTENANCE DATA

A. Submit three copies of complete manual in final form.

B. Provide complete Trade Contractor information at beginning of each specification section of Work including:
1. Contractor’s name.
2. Contractor’s address.
3. Contractor’s phone number.

C. Provide complete information for products specified in:
1. Electrical distribution system: Division 26.
2. Other equipment, special construction, etc. where specified in individual sections.

D. Unit and component parts description, including:
1. Function.
2. Normal operating characteristics.
3. Limiting conditions.
4. Performance curves.
5. Engineering data and tests.
6. Complete nomenclature and commercial number for replacement parts.

E. Operating and Maintenance Data:
   1. Organize operating and maintenance data into multiple sets as required for manageable size.
   2. Bind properly indexed data in individual heavy-duty, 2-inch, three-ring vinyl-covered binders, with pocket folders for folded sheet information.
   3. Mark appropriate identification on front and spine of each binder.
   4. Include following types of information:
      a. Emergency instructions.
      b. Spare parts list.
      c. Copies of warranties.
      d. Wiring diagrams.
      e. Recommended "turn around" cycles.
      f. Inspection procedures.
      g. Shop Drawings and Product Data.
      h. Fixture lamping schedule.

F. Operating Procedures: Start-up, break-in, routine and normal operating instructions; regulation, control, stopping, shut-down and emergency instructions; summer and winter operating instructions; special operating instructions.

G. Maintenance Procedures:
   1. Include routine operations, guide to “trouble-shooting,” disassembly, repair and reassembly, alignment, adjusting and checking.
   2. Include lubrication schedule, lubricants required and filter cleaning or replacement schedule.

H. Instructions:
   1. Submit manufacturer's printed operating and maintenance instructions with description of sequence of operation, original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance covering predicted life of parts subject to wear and items recommended to be stocked as spare parts.
   2. Prepare and include additional data when the need for such data becomes apparent during instruction of Government's personnel or when specified in respective sections.

1.4 MATERIALS AND FINISHES MANUAL

A. Submit three copies of complete manual in final form covering maintenance and cleaning procedures for materials specified in Divisions 02 through 14.

B. Include:
   1. Catalog number, material, composition.
   2. Color and texture designations.
   3. Information required for re-ordering special manufactured products.
   4. Manufacturer's recommendations for types of cleaning agents and methods.
   5. Cautions against cleaning agents and methods which are detrimental to product.
   6. Recommended schedule for cleaning and maintenance.
   7. Provide instructions for inspection, maintenance and repair.

1.5 WARRANTIES

A. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of warranty on Work that incorporates products, nor does it relieve suppliers, manufacturers, and subcontractors required to countersign special warranties with Contractor.

B. Warranty Requirements:
   1. Provide written two-year warranty for all work under this contract in addition to special warranties required in individual specification sections.
   2. Warranty date for entire project shall be date of final acceptance.
   3. Remove and replace other Work that has been damaged or that must be removed and replaced to provide access for correction of warranted Work that has failed.

4. Reinstate warranty by written endorsement when Work covered by a warranty has failed and been corrected by replacement or rebuilding.
5. Reinstated warranty shall be equal to original warranty with an equitable adjustment for depreciation.
6. Replace or rebuild Work to an acceptable condition complying with requirements of Contract Documents upon determination that Work covered by a warranty has failed.
7. Contractor shall be responsible for cost of replacing or rebuilding defective Work regardless of whether Government has benefited from use of Work through a portion of its anticipated useful service life.
8. Written warranties made to Government are in addition to implied warranties, and shall not limit duties, obligations, rights and remedies otherwise available under law, nor shall warranty periods be interpreted as limitations on time in which Government can enforce such other duties, obligations, rights, or remedies.

C. Special Warranties:
1. Special warranties are those specified in Divisions 02 through 33 to be used by a manufacturer or by Contractor or his subcontractors or combinations thereof.
2. All such special warranties must conform to specification requirements and be signed by persons having authority to commit issuing entity to warranty.
3. Subcontractor issued warranties must be signed by Subcontractor and Contractor.
4. All such special warranties are in addition to and not a limitation of other rights Government may have against Contractor under Contract Documents.

D. Rejection of Warranties: Government reserves right to reject warranties.
1. Government reserves right to reject warranties.
2. Government reserves right to refuse to accept Work for Project where a special warranty, certification, or similar commitment is required until entities required to countersign such commitments are willing to do so.

1.6 PROJECT RECORD DOCUMENTS

A. Maintain on site one set of Contract Documents to be utilized for record documents.

B. Record actual revisions to Work.

C. Record information concurrent with construction progress.

D. Do not use record documents for construction purposes; protect from deterioration and loss in a secure, fire-resistive location; provide access to record documents for Government's reference during normal working hours.

E. Project Drawings:
1. Give particular attention to concealed elements that would be difficult to measure and record at a later date.
2. Mark record sets with red erasable pencil; use other colors to distinguish between variations in separate categories of Work.
3. Mark new information that is important to the Government, but was not shown on Contract Drawings or Shop Drawings.
4. Note related Change Order numbers where applicable.
5. Organize record drawing sheets into manageable sets, bind with durable paper cover sheets, and print suitable titles, dates and other identification on the cover of each set.
6. Submit record drawings to Government for review and for Government's records upon completion of Work.

F. Project Manual:
1. Maintain one complete copy of Project Manual, including addenda, and one copy of other written construction documents such as Change Orders and modifications issued in printed form during construction.

2. Mark these documents to show substantial variations in actual Work performed in comparison with text of Specifications and modifications.
3. Give particular attention to substitutions, selection of options and similar information on elements that are concealed or cannot otherwise be readily discerned later by direct observation.
4. Note related record drawing information and Product Data.
5. Submit record Specifications to Government for Government's records upon completion of Work.

G. Provide two copies of approved submittals and shop drawings.

PART 2 – PRODUCTS (NONE)

PART 3 – EXECUTION (NONE)

END OF SECTION 01 78 00

SECTION 02 41 00

SELECTIVE DEMOLITION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Selective structure demolition.

B. Related Sections:
   1. Section 01 73 29: “Cutting and Patching.”
   2. Federal Acquisition Regulation (FAR).

1.2 DEFINITIONS

A. Remove: Where word “remove” or a remove indication occurs on drawings, or is referred to, it shall mean removal from site, unless it is specified that material or equipment shall be re-used in project or delivered to Government.

1.3 SUBMITTALS

A. Schedule:
   1. Describe demolition, removal procedures, sequence and schedule.
   2. Include schedule for shutting off and capping utilities and re-establishing utility services.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with safety requirements for demolition, American National Standards Institute (ANSI) A10.6-90.

B. Contractor shall be responsible for repair/replacement of undocumented damage.

1.5 PROJECT/SITE CONDITIONS

A. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
   1. Obtain required permits.
   2. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
   3. Provide, erect, and maintain temporary barriers and security devices.
   4. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
   5. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
   6. Do not close or obstruct roadways or sidewalks without permit.
   7. Conduct operations to minimize obstruction of public and private entrances and exits; do not obstruct required exits at any time; protect persons using entrances and exits from removal operations.

B. Do not begin removal until receipt of notification to proceed from Government.

C. Do not begin removal until built elements to be salvaged or relocated have been removed.

D. Protect existing structures and other elements that are not to be removed.
   1. Provide bracing and shoring.
   2. Prevent movement or settlement of adjacent structures.
   3. Stop work immediately if adjacent structures appear to be in danger.

E. Minimize production of dust due to demolition operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.

F. If hazardous materials are discovered during removal operations, stop work and notify Government; hazardous materials include regulated asbestos containing materials, lead, PCB's, and mercury.

G. Perform demolition in a manner that maximizes salvage and recycling of materials.
   1. Dismantle existing construction and separate materials.
   2. Set aside reusable, recyclable, and salvageable materials; store and deliver to collection point or point of reuse.

PART 2 – PRODUCTS (NONE)

PART 3 - EXECUTION

3.1 PREPARATION

A. Provide, erect, and maintain temporary barriers and security devices.
B. Notify adjacent owners of work which may affect their property, potential noise, utility outage, or disruption.
C. Coordinate with Government.
D. Provide bracing and shoring to prevent movement or settlement of adjacent structures.
E. Protect existing structures, walls, ceilings, fixtures, and equipment which are not to be demolished.
F. Protect all existing floors, over which workmen or equipment will travel, by a suitable covering.
G. Erect and maintain temporary partitions to prevent spread of dust, odors and noise to permit continued Government occupancy.
H. Protect existing items which are not indicated to be removed.
I. Erect temporary covered passageways as required by authorities having jurisdiction.
J. Coordinate proposed methods and operations of demolition with Government and Government prior to start of demolition.
K. Coordinate with Government for shut-off, capping, and continuation of utility services as required.

3.2 EXISTING UTILITIES

A. Coordinate work with utility companies and Government owned utilities; notify before starting work and comply with their requirements; obtain required permits.
B. Protect existing utilities to remain from damage.
C. Do not disrupt public utilities without permit from authority having jurisdiction.
D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Government.
E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Government.
F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.

3.3 DEMOLITION REQUIREMENTS

A. Conduct demolition to minimize interference with adjacent structures, public and private accesses.
B. Maintain protected egress and access at all times.
C. Cease operations immediately if adjacent structures appear to be in danger.
D. Notify authority having jurisdiction, Government.

3.4 SELECTIVE DEMOLITION FOR ALTERATIONS

A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
   1. Verify that construction and utility arrangements are as indicated.
   2. Report discrepancies to Government before disturbing existing installation.

3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.

B. Separate areas in which demolition is being conducted from other areas that are still occupied.
   1. Provide, erect, and maintain temporary dustproof partitions of construction specified in Section 01 5000 in locations indicated on drawings.

C. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage.

D. Remove existing work as indicated and as required to accomplish new work.
   1. Remove items indicated on drawings.

E. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove existing systems and equipment as indicated.
   1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components.
   2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
   3. Verify that abandoned services serve only abandoned facilities before removal.
   4. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification.

F. Protect existing work to remain.
   1. Prevent movement of structure; provide shoring and bracing if necessary.
   2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
   3. Repair adjacent construction and finishes damaged during removal work.
   4. Patch as specified for patching new work.

3.5 DISPOSAL

A. Dispose of unsuitable and excess material in an approved manner.

3.6 CLEANING

A. Remove demolished materials from site as work progresses.
B. Leave areas of work in clean condition, ready for subsequent work.
C. Repair existing or new work which is not to be removed and which is damaged due to Contractor's operations, by and at expense of Contractor.
D. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION 02 41 00

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SECTION 05 40 00

COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Structural metal stud framing.
2. Non-structural metal stud framing.

B. Related Sections:
1. Section 05 50 00: “Metal Fabrication.”
2. Section 06 10 00: “Rough Carpentry.”
3. Federal Acquisition Regulation (FAR).

C. Abbreviations:
1. American Welding Society (AWS)
2. American Iron and Steel Institute (AISI)
3. American Society for Testing Materials (ASTM)
4. Shielded Metal Arc Welding (SMAW)

1.2 SUBMITTALS

A. Product Data: Prior to starting erection of studs, submit copies of manufacturer's specifications covering all materials to be used with all materials and accessories plainly identified.

1.3 QUALITY ASSURANCE

A. Erector Qualifications: Minimum of three years successful experience on comparable cold-formed metal framing work.

B. Welder Qualifications: Currently qualified in accordance with AWS D1.1.

C. Reference Standards:
1. Design and Manufacturer: Meet requirements of AISI Specification for the Design of Cold-Formed Steel Structural Members, latest edition.
2. Welding: Meet requirements of AWS Structural Welding Code, D1.1 and 1.3.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original, unopened bundles or containers and store in a clean, dry area until ready for use.

B. Deliver and store shop fabricated panels in a manner to prevent twisting.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

C. Provide cold-formed metal framing materials by one of following:
1. Dietrich Industries, Inc.
2. Keene/Penn Metal.
3. Western Metal Lath Co.
4. Or an equivalent product of an approved manufacturer.

2.2 MATERIALS

A. General: Type, size, gauge, spacing and fasteners as shown on Drawings and required by these

Specifications.

B. Studs and Track:
   1. Studs as called for on Drawings.
   2. Head and sill track and header members to be un-punched track, same gauge as studs or one gauge heavier.

C. Steel: All framing members to be formed from steel and conform to following:
   1. 18 gauge and lighter, ASTM A611, Grade C, 33 KSI yield.
   2. 16 gauge and heavier, ASTM A570, Grade 50.

D. Finish: All framing members to have galvanized protective coating conforming to ASTM A653/A653M, G60 minimum.

E. Stud Bridging: Provide 18 gauge or heavier channel studs of same width as studs.

F. Diagonal Corner Bracing: Two rows 2-inch or wider, by 16 gauge strap.

G. Framing Connections: Shall meet ASTM A 653 and may be provided by a different manufacturer than framing member manufacturer.

2.3 FASTENERS

B. Self-drilling, Self-tapping Screws, Bolts, Nuts and Washers: ASTM A90, Hot-Dip Galvanized.

B. Anchorage Devices: Power driven or powder actuated; drilled expansion bolts; screws with sleeves.

C. Welding: Comply with AWS D1.3, latest edition.

D. Welding Electrodes: Conform to SMAW AWS A5.1 or A5.5, E60XXor E70XX.

PART 3 - EXECUTION

3.1 ERECTION

A. Studs:
   1. Place studs as noted on Drawings, and not more than 2 inches from abutting walls and at each side of openings.
   2. Bottom of stud webs shall be seated tightly onto web of bottom track.
   3. Connect studs to tracks with screws in accordance with drawings and manufacturer's recommendations.
   4. Construct corners using minimum of three studs.
   5. Double studs at all openings greater than 24 inches wide.
   6. Install intermediate studs above and below openings to match wall stud spacing.
   7. Erect load-bearing studs one piece full length and set top and bottom tracks tight to stud web.
   8. Splicing or wire tying of framing components is not permitted.
   9. Erect load-bearing studs, brace and reinforce to develop full strength to meet design requirements.

B. Bridging and Diagonal Bracing:
   1. Install bridging and bracing of types and in locations indicated on Drawings.
   2. Attach all bridging and diagonal bracing by welding capable of resisting a force of five-hundred pounds minimum.

C. Tolerance: Combined fabrication and erection tolerance of studs and joists shall be 1/8 inch in 10 feet for stud plumb ness and joist straightness.

3.2 CONSTRUCTION WASTE MANAGEMENT:

A. Manage construction waste in accordance with provisions of Section 01 7 4 19. Submit

documentation to satisfy the requirements of that section.

3.3 FIELD QUALITY CONTROL

A. Testing Agency shall inspect all cold-formed metal framing work prior to being covered with other materials.

B. Inspection shall include visual examination of all welds.

END OF SECTION 05 40 00

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SECTION 06 10 00

ROUGH CARPENTRY

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Wood framing and blocking

B. Related Sections:
   1. None

C. Abbreviations:
   1. American Society for Testing Materials (ASTM)
   2. American Plywood Association (APA)
   3. Voluntary Product Standard (PS)
   4. Federal Specifications (FS)
   5. American Iron and Steel Institute (AISI)
   6. American National Standards Institute (ANSI)
   7. National Fire Protection Association (NFPA)
   8. Indoor Environmental Quality (IEQ)

1.2 DEFINITIONS

A. Rough Carpentry: Includes carpentry work not specified as part of other Sections and generally not exposed.

1.3 QUALITY ASSURANCE

A. Comply with 20012 International Building Code and National Design Specification for Wood Construction, latest edition, as published by the National Forest Products Association.

B. Composite wood and agrifiber products shall contain no added urea-formaldehyde resins.

C. Identify lumber and structural wood panels by official grade mark.

D. Lumber: Grade stamp containing, where applicable, symbol of grading agency, rules under which graded, mill number or name, grade of lumber, species or species grouping, and condition of seasoning.

E. Plywood Panels and Underlayments: APA grade trademark, including type, grade, class, identification or span rating, and inspection and testing agency mark.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store materials a minimum of 6 inches above ground in area protected from weather.

B. Protect with waterproof covering allowing adequate air circulation.

C. Do not store seasoned materials in wet or damp environments.

D. Store engineered wood products in accordance with manufacturer's instructions.

E. Stack lumber as well as plywood and other panels; provide for air circulation within and around stacks and under temporary waterproof coverings.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Lumber:
1. Comply with PS 20 (latest edition) “American Softwood Lumber Standard” and with applicable grading rules of inspection agencies certified by American Lumber Standards Committee’s (ALSC) Board of Review.
2. Inspection agencies and abbreviations used to reference them with lumber grades and species include following:
   a. WCLIB – West Coast Lumber Inspection Bureau.
   b. WWPA – Western Wood Products Association.
3. Moisture Content: 19 Percent maximum (dry) at time of manufacture for lumber 2 inches or less in thickness.
4. Surfacing: S4S, unless otherwise specified.
5. Dimensions: All dimensions are nominal.
6. Species: Any commercial softwood species may be used, unless a particular species is specified or shown.

B. Non-Structural Lumber:
1. Non-Load Bearing Plates, Bracing, and Nailers: Stud grade.
2. Blocking and Miscellaneous Lumber: Utility grade.
3. Grounds and Bracing: Southern Pine No. 3 Common, any species.

D. Plywood Panels:
1. Comply with PS 1 “U.S. Product Standard for Construction and Industrial Plywood” for plywood construction panels and, for products not manufactured under PS 1 provisions, with APA PRP-108.
2. Subflooring: APA Rated Sheathing EXP 1 APA Rated Sheathing EXT with appropriate span rating.

E. Oriented Strand Board (OSB):
1. Layered composite panel.
2. Certification: Voluntary Product Standard VPS PS2-92.
3. Grade: Single floor Sheathing.
4. Exposure Designation: Exposure 1 (short-term exposure to weather elements).
5. Panel Thickness: 3/4-inch.
6. Panel Size: 4 feet by 8 feet.

2.2 ACCESSORIES

A. Adhesive Toxicity/Indoor Environmental Quality (IEQ): Comply with applicable regulations regarding toxic and hazardous materials, GS-36 for Commercial Adhesive.

B. Fasteners:
1. Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
2. Use hot-dip galvanized coating per ASTM A153 or aluminum hardware for exterior use and AISI Type 304 stainless steel for fire-retardant treated wood.
3. Types:
   a. Nails, Wire, Brads, and Staples: FS FF-N-105.
   b. Power Driven Fasteners: National Evaluation Report NER0272.
   c. Wood Screws: ANSI B18.6.1.
   d. Lag Bolts: ANSI B18.2.1.
   e. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and where indicated, flat washers.

C. Corrosion Resistant Fasteners and Connecting Hardware:
1. Provide hot-dipped galvanized connecting hardware, nails, and fasteners when attaching to or

penetrating preservative treated wood products.
2. ASTM A276, Type 304 or 316, stainless steel nails and fasteners may also be used.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify that surfaces to receive rough carpentry materials are prepared to exact grade and dimensions.

3.2 INSTALLATION

A. General:
1. Discard units of material with defects that impair quality of rough carpentry construction and that are too small to use in fabricating rough carpentry with minimum joints or optimum joint arrangement.
2. Set rough carpentry to required levels and lines, with members plumb and true to line and cut and fitted.
3. Fit rough carpentry to other construction; scribe and cope as required for accurate fit.
4. Correlate location of nailers, blocking, grounds, and similar supports to allow attachment of other construction.
5. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, or as per Building Code.
6. Countersink nail heads on exposed carpentry work and fill holes.
7. Select fasteners of size that will not penetrate members where opposite side will be exposed to view or will receive finish materials.
8. Make tight connections between members.
9. Install fasteners without splitting of wood; pre-drill as required.

B. Framing:
1. Comply with NFPA “Manual for Wood Frame Construction.”
2. Construct framing members full length without splice.

C. Nailers, Blocking, and Sleepers:
1. Install wood grounds, nailers, blocking, and sleepers where shown and where required for attachment of other work.
2. Form to shapes as shown and cut as required for true line and level of work to be attached.
3. Coordinate location with other work involved.
4. Attach to substrates as required to support applied loading.
6. Countersink bolts and nuts flush with surfaces.

D. Construction Waste Management

1. Manage construction waste in accordance with provisions of Section 01 74 19. Submit documentation to satisfy the requirements of that section.

END OF SECTION 06 10 00

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SECTION 07 92 00

JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Elastomeric joint sealants.
2. Rigid joint sealants.
3. Acoustical joint sealants.

B. Related Sections:
1. Section 09 20 16: “Gypsum Board Assemblies.”
2. Federal Acquisition Regulation (FAR).

C. Abbreviations:
1. American Society for Testing Materials (ASTM)

1.2 SYSTEM DESCRIPTION

A. Provide elastomeric joint sealants that have been produced and installed to establish and to maintain watertight and airtight continuous seals without causing staining or deterioration of joint substrates.

B. Provide joint sealants for interior applications that have been produced and installed to establish and maintain airtight continuous seals that are water resistant and cause no staining or deterioration of joint substrates.

1.3 SUBMITTALS

A. Product Data: Manufacturers printed data for each joint sealant product required.

B. Samples:
1. Manufacturer's standard bead samples, consisting of strips of actual products showing full range of colors available, for each product exposed to view.
2. Provide a sample joint for approval, 8 inches long minimum, in each material condition present on project.

C. Fire rating test data including conditions at installation.

D. Mock-Up: Provide for each typical installation for review by Government prior to proceeding with sealant work.

1.4 QUALITY ASSURANCE

A. Engage an experienced Installer who has completed joint sealant applications similar in material, design, and extent to that indicated for Project that have resulted in construction with a record of successful in-service performance.

1.5 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 period for use, pot life, curing time, and mixing instructions for multi-component materials.

B. Store and handle materials in compliance with manufacturer's recommendations to prevent their

deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.6 PROJECT CONDITIONS

A. Environmental Conditions: Do not proceed with installation of joint sealants when joints are wet.

B. Joint Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than or greater than 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

2.1 MANUFACTURERS

A. Provide materials as manufactured by following:
1. Dow Chemical Company, Midland, Michigan.
2. Sika Chemical Corporation, Lyndhurst, New Jersey.
3. Tremco, Cleveland, Ohio.

2.2 MATERIALS

A. Provide joint sealants, joint fillers, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

B. Provide color of exposed joint sealants as selected by Government from manufacturer's full range of standard colors for products of type indicated.

C. Interior Sealants:
1. Vertical Surfaces, Movement Anticipated:
   a. Silicone or polyurethane.
   b. ASTM C920, Type S, Grade NS, Class 25, Use M, A, or O, as applicable.
2. Horizontal Surfaces in Traffic Areas:
   a. Urethane.
   b. ASTM C920, Type S or M, Grade P, Class 25, Use T.
   c. Grade NS, Use T, in areas with slopes exceeding 1 percent.
3. Horizontal Surfaces in Nontraffic Areas:
   a. ASTM C920, Type S, Grade P, Class 25, Use NT.
   b. Grade NS, Use NT, in areas with slopes exceeding 1 percent.
4. Vertical and Horizontal Surfaces, Dry Areas Only, No Movement Anticipated: Single component water-based latex, paintable, ASTM C834.

D. Acoustical Joint Sealants:
1. Manufacturer's standard non-sag, paintable, non-staining latex sealant complying with ASTM C 834 and following requirements:
   a. Product is effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies per ASTM E 90.
   b. Product has flame spread and smoke developed ratings of less than 25 per ASTM E 84.
2. Acoustical Sealant for Concealed Joints: Manufacturer's standard, nondrying, non-hardening, non-skinning, non-staining, gunnable, synthetic rubber sealant recommended for sealing interior concealed joints to reduce transmission of airborne sound.
3. Products:
   a. "SHEETROCK Acoustical Sealant," United States Gypsum Co.
   b. "AC-20 FTR Acoustical and Insulation Sealant," Pecora Corp.

E. Joint Fillers:
   1. ASTM, Type A, rod stock closed cell polyethylene foam, closed cell neoprene foam, or open cell urethane foam, recommended by sealant manufacturer for compatibility with sealant.
   2. Polyethylene: Ethafoam SB, as manufactured by Dow Chemical Company.
   3. Neoprene: Neocord, as manufactured by Williams Products.
   4. Urethane: Denverfoam, as manufactured by Backer Rod Manufacturing and Supply.

PART 3 - EXECUTION

3.1 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. Do not proceed with installation of joint sealants until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Joint Surface Cleaning:
   1. Clean out joints immediately before installing joint sealants to comply with recommendations of joint sealant manufacturer.
   2. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.

B. Joint Priming:
   1. Prime joint substrates where indicated or where recommended by joint sealant manufacturer based on preconstruction joint sealant-substrate tests or prior experience.
   2. Apply primer to comply with joint sealant manufacturer's recommendations.

3.4 APPLICATION

A. Comply with joint sealant manufacturer's printed installation instructions applicable to products and applications indicated, except where more stringent requirements apply.

B. Install sealants in accordance with ASTM C1193.

C. Install latex sealants in accordance with ASTM C790.

D. Install elastomeric sealants in accordance with ASTM C962.

E. Install acoustical sealants in accordance with ASTM C919.

F. Sealant Backing Installation: Install joint fillers of type indicated to provide support of 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; and install without gaps.

G. Sealant Installation: Install sealants by proven techniques that result in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration, and providing uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

H. Non-Sag Sealant Tooling:
   1. Immediately after sealant application and prior to time skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated, to eliminate air pockets, and to

ensure contact and adhesion of sealant with sides of joint.
2. Remove excess sealants from surfaces adjacent to joint.
3. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.
4. Provide concave joint configuration per Figure 5A in ASTM C 1193.

I. Remove and reinstall joints which do not conform to approved samples.

3.5 CLEANING

A. Clean off excess sealants or sealant smears adjacent to joints as work progresses by methods and with cleaning materials approved by manufacturers of joint sealants and of products in which joints occur.

3.6 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes so that they are without deterioration or damage at time of Substantial Completion.

B. Cut out and remove damaged or deteriorated joint sealants immediately so that installations with repaired areas are indistinguishable from original work.

END OF SECTION 07 92 00

SECTION 08 11 00

METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Hollow metal frames for doors and windows.

B. Related sections:
1. Section 08 14 00: “Wood Doors.”
2. Section 08 71 00: “Door Hardware.”
3. Section 08 80 00: “Glazing”
4. Section 09 90 00: “Painting and Coating.”
5. Federal Acquisition Regulation (FAR).

C. Abbreviations:
1. American Society for Testing Materials (ASTM)
2. Steel Door Institute (SDI)
3. Underwriters Laboratories (UL)
4. Steel Structures Painting Council (SSPC)
5. American National Standards Institute (ANSI)

1.2 REFERENCES

A. References Standards:
1. SDI - 100
2. ANSI A115 Specification for Door and Frame Preparation for Hardware.
3. ANSI A123 Nomenclature for Steel Doors and Steel Door Frames.
4. ASTM International E 2074 Standard Test Method for Fire Tests of Door Assemblies, Including Positive Pressure Testing of Side-Hinged and Pivoted Swinging Door Assemblies.
5. Underwriters Laboratories (UL) 10B, Standard for Fire Tests of Door Assemblies.
6. Underwriters Laboratories (UL) 10C, Standard for Positive Pressure Fire Tests of Door Assemblies.
7. ASTM A 1008M – Standard for Cold-Rolled Material.
8. ASTM D 2197 – Standard Test Method for Adhesion of Organic Coatings by Scrape Adhesion.
9. ASTM D 2247 – Practice for Testing Water Resistance Coatings in 100 percent Relative Humidity.

1.3 SUBMITTALS

A. Product Data: Manufacturer’s catalog cuts and installation recommendations.

B. Samples: Submit two standard frame samples, illustrating factory finish for color and surface texture.

C. Shop Drawings:
1. Show elevations and details of each frame type, including jamb anchors, cutouts, reinforcements, joints, and welds.
2. Provide a schedule of doors and frames using same reference numbers for details and openings as shown.

D. Templates:
1. Hardware templates for hardware mounted on hollow metal manufacturer immediately after acceptance of hardware schedule.

2. Report failure to receive templates with reasonable promptness to General Contractor.

1.4 QUALITY ASSURANCE

A. Submit complete manuals covering maintenance and cleaning procedures.

B. Regulatory Requirements: Work in this Section shall be accomplished under direct, on-site supervision of thoroughly trained and experienced journeymen who are completely familiar with requirements of this work and recommendations contained in reference standards.

1.5 DELIVERY, STORAGE AND HANDLING

A. Ship frames in cartons or crates.

B. Store frames under cover on raised supports.

C. Inspect frames upon delivery for damage.

D. Minor damages may be repaired provided refinished items are equal in all respects to new work and acceptable to Government.

E. Unacceptable damaged items are to be removed and replaced as directed.

1.6 PROJECT CONDITIONS

A. General Contractor and Door Manufacturer are to verify by field measurements as necessary all doors and frame openings prior to fabrication.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Hollow metal frames shall be product of one manufacturer of following:
1. Amweld Building Products. LLC.
2. Curries Company; an ASSA ABLOY Group Company.
3. Steelcraft; an Ingersoll-Rand Company.

2.2 HOLLOW METAL FRAMES

A. General: Frames for hollow metal and wood doors, windows and borrowed lights, etc., indicated to be hollow metal shall be of design sections as detailed and assembled as indicated.

B. Gauges:
1. Interior Door Frames Greater than 3 Feet in Width: 14 gauge steel.
2. Interior Door Frames 3 Feet or Less in Width: 16 gauge steel.

C. Tolerances:
1. Allow 1/8 inch tolerance beyond layer of finish wall both sides of frame.
2. Verify plumb of walls before scheduling frames.

D. Construction:
1. Joints and connection including job-fabricated joints shall be welded and ground and entire assembly reinforced and braced as required to insure absolute rigidity.
2. Provide channel stiffening within and securely welded to frame member full length between hardware reinforcements.
3. Do not use exposed screws except where specifically accepted.

E. Accessories:

1. Hardware Reinforcement:
    a. Machine frames for attachment of hardware, including mortising, reinforcing, drilling and tapping for hinges.
    b. Butt Hinges: 7 gauge, 12 inches, long.
    c. Closers: 10 gauge, 12 inches long, full width frame.
    d. Strikes, Flush Bolts and Other Surface Mounted Hardware: 12 gauge strikes, 14 gauge on all others.
2. Anchors:
    a. Furnish anchors of type and number required for anchoring frames to structure, partitions, etc.
    b. Fire-Rated Openings: One-hour, UL labeled
    c. Steel Stud Wall: Minimum 16 gauge "Z" shape
    d. Three jamb anchors on 7 feet high or less jamb.
    e. Four jamb anchors on jambs over 7 feet high.
    f. Wire anchors will not be allowed.
    g. Provide such installation instructions as are necessary to insure proper installation of anchors.
3. Silencers:
    a. Drill stop of lock jamb of each interior frame for installation of pneumatic rubber door silencers.
    b. Silencers shall be furnished under Section 08 71 00, “Door Hardware” number as indicated on schedule.

2.4 FINISH

A. Thoroughly clean surfaces of grease, rust and scale to insure paint adherence.

B. Apply filler to frames where required to produce a smooth surface.

C. Frames to be Painted:
1. Apply pretreatment to cleaned metal surfaces, using cold phosphate solution (SSPC-TR2), hot phosphate solution (SSPC-PT4), or basic zinc chromate-vinyl butyryl solution (SSPC-PT3).
2. Apply shop coat of prime paint within time limits recommended by pretreatment manufacturer.
3. Primer must be compatible with paint finishes specified in Section 09 90 00, “Painting and Coating.”
4. Finish to match existing frames.

PART 3 - EXECUTION

3.1 INSPECTION

A. Prior to installation of metal doors and frames, carefully inspect installed work of other trades and verify that such work is complete to point where this installation may properly commence.

B. Verify that metal doors and frames may be installed in accordance with pertinent codes and regulations, original design, accepted Shop Drawings, and manufacturer's recommendations.

3.2 INSTALLATION

A. Frames:
1. Set steel frames accurately in accordance with details, straight and free of twist with head level and jambs plumb.
2. Rigidly anchors to walls and partition and securely brace until surrounding work is completed.
3. Provide deflection clearances at frame heads where indicated.
4. Wherever possible leave spreader bars in place until frames are securely anchored.
5. Touch-up blemishes on factory-finished frames, paint others as per Section 09 90 00, “Painting and Coating.”

B. Doors:
   1. Apply hardware in conformance with hardware manufacture's templates and instructions.
   2. Hang doors to be free of binding with hardware functioning properly.
   3. Clearance Tolerances:
      a. Head: 1/8 inch maximum.
      b. Jamb: 1/8 inch maximum.
      c. Between Doors (pair): 1/8 inch maximum
      d. Sill without Threshold: 1/2 inch maximum

3.3 ADJUSTING

A. At completion of job, adjust doors and hardware as required and leave in proper operating condition.

B. Eliminate all hinge-bound conditions and have all items smoothly operating and firmly anchored into position.

END OF SECTION 08 11 00

SECTION 08 14 00

WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Flush wood doors.

B. Related Sections:
1. Section 08 11 00: “Metal Doors and Frames.”
2. Section 08 71 00: “Door Hardware.”
3. Section 09 90 00: “Painting and Coating.”
4. Federal Acquisition Regulation (FAR).

C. Abbreviations:
1. American Society for Testing Materials (ASTM)
2. American Plywood Association (APA)
3. National Wood Window and Door Association (NWWDA)
4. Architectural Woodwork Institute (AWI)
5. American National Standards Institute (ANSI)
6. Underwriters Laboratory (UL)
7. National Fire Protection Association (NFPA)
8. Window and Door Manufacturing Association (WDMA)
9. Consumer Product Safety Commission (CPSC)

1.2 REFERENCES

A. Reference Standards:
1. AWI - "Architectural Woodwork Institute Quality Standards."
2. NWWDA I.S. 1 “Industry Standard for Wood Flush Doors."
3. NWWDA "Care and Finishing of Wood Doors."
4. ANSI I.S. 1A-97, “Quality Standard for Architectural Wood Flush Doors.”
5. WDMA – “Window and Door Manufacturers Association Quality Standards.”
6. CPSC – “Consumer Product Safety Commission Safety Standard for Architectural Glazing Materials.”

B. Installed Doors and Panels: Conform to NFPA 80 for fire-rated doors as indicated.

C. Fire-Rated Doors:
1. All doors, door lites, and sidelites shall be positive pressure type with adhesive backed strips applied to door frame.
2. Provide doors labeled by UL or Warnock Hersey; one-hour rated.
3. ASTM E2074, “Standard Test Method for Fire Tests of Door Assemblies, Including Positive Pressure Testing of Side-Hinged and Pivoted Swinging Door Assemblies.”
4. Underwriters Laboratories (UL):
   a. 10B, “Standard for Fire Tests of Door Assemblies.”
   b. 10C, “Standard for Positive Pressure Fire Tests of Door Assemblies.”
   c. When doors are required to meet smoke control requirements, they shall be provided with listed smoke gaskets tested in compliance with 1784.

1.3 DEFINITIONS

A. Heavy Duty: Doors where usage is moderate—requires intermediate minimum performance standards.

1.4 SUBMITTALS

A. Product Data: Indicate door core materials and construction; veneer species, type and characteristics and include manufacturer's installation instructions and recommendations.

B. Samples: Submit two samples of door veneer, minimum 8 inches by 8 inches in size, illustrating wood grain, and edging.

C. Shop Drawings: Show elevations, door and frame locations, door swings, dimensions, fire rating, construction details, glazing, hardware, and installation details.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver doors and frames in labeled, protective packaging.

B. Store doors and frames on raised supports to prevent damage.

C. Cover stored doors with opaque covering material where sunlight might bleach veneer.

D. Seal top and bottom edges if stored more than one week.

E. Break seal at job site to permit ventilation.

1.5 COORDINATION

A. Coordinate work with door opening construction, door frame and door hardware installation, and field finishing. Operational/ installation requirements of this section also apply to reused doors.

1.6 WARRANTY

A. Specific Product Warranty: Submit two copies of written agreement on door manufacturer's standard form signed by Manufacturer, Installer, and Contractor, agreeing to repair or replace defective doors which have warped (bow, cup, or twist) or which show telegraphing of core construction below in face veneers, or do not conform to tolerance limitations of referenced quality standards.

B. Warranty shall also include refinishing and reinstallation which may be required due to repair or replacement of defective doors.

C. Warranty for solid core flush interior doors shall be in effect for lifetime of installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Supply all doors from same manufacturer as follows:
1. Algoma Hardwoods, Inc.
2. Eggers Industries.
3. Marshfield Door Systems, Inc.

2.2 MATERIALS

A. Flush Wood Doors:
1. Type: AWI "PC-5."
2. Core:
   a. Solid: Mineral composition for fire-rated doors.
3. Faces:
   a. AWI Custom Grade.

b. Birch veneer, both sides.
c. Match existing adjacent veneers in remodel work.
4. Edge Stiles: Solid hardwood to match face veneers without finger jointing.
5. Adhesives: NWWDA I.S. 1.6 Type I.
6. Finish Preparation:
a. Transparent stain.
b. Refer to Section 09 90 00, “Painting and Coating.”

2.3 FABRICATION

A. Fabricate doors in accordance with specified manufacturers' requirements.
B. Provide flush doors with stiles of wood species to match face veneer.
C. Bond stiles and rails to cores.
D. Sand the assembled core for uniform thickness.
E. Factory sand assembled door leaf.
F. Factory machine doors for finish hardware in accordance with hardware requirements and dimensions.
G. Do not machine for surface hardware.
H. Factory cut light openings.
I. Provide inner blocking at where required for positive attachment of hardware.
J. Hardware Reinforcement:
1. Provide hardware blocking at head and sill rails and lock block on all doors.
2. Provide hardware blocking only when exit devices are specified for door.
3. Provide hardware blocking for pivots or when floor bolts are specified.

2.4 FACTORY PREFIT DOORS

A. Comply with tolerance requirements of AWI for pre-fitting.
B. Before machining, verify hardware locations and hand of door.
C. Using hardware manufacturer’s templates, mortise, drill, and machine each door as required for finish hardware.
D. Pre-drill holes for screws.
E. Bevel both stile edges of each door 1/8 inch per 2 inches.

PART 3 - EXECUTION

3.1. EXAMINATION

A. Before installation, verify that frames are proper size and type for door and are installed as required for proper installation of doors.
B. Notify General Contractor of unsatisfactory conditions in writing with a copy to Government.
C. Beginning of work means acceptance of existing conditions by installer.

3.2 PREPARATION

A. Condition doors to Colorado and do not install until all wet work is complete and dry in areas to receive door.

3.3 INSTALLATION

A. Follow manufacturer’s recommendations, install doors plumb to provide free swinging operation with easy closing and secure latching.
B. In no case shall door be cut down to opening sizes smaller than those for which they were manufactured
C. Installation shall be by skilled finish carpenters or factory authorized installers.
D. Installer shall be thoroughly familiar with requirements of manufacturer's door warranty as currently in affect and assure compliance with all provisions.
E. Clearances:

1. Doors:
    a. At jambs and head, provide uniform clearance of 1/16 to 1/8 inch.
    b. Except at undercut doors, bottom clearance shall be 3/8 inch maximum above finish flooring.
    c. Comply with NFPA 80.

F. Hanging:
1. After sizing doors, fit for hardware as scheduled.
2. Hang Doors to be straight, true, and plumb, and free of binding with hardware functioning properly.

3.4 ADJUSTING AND PROTECTION

A. At completion of job, adjust doors and hardware as required and leave in proper operating condition.
B. Advise General Contractor of proper procedures required to protect installed wood doors from damage or deterioration until acceptance of entire project.
C. Refinish or replace doors that are chipped, scratched, or have gouges in the veneer or otherwise damaged during installation.

END OF SECTION 08 14 00

SECTION 08 71 00

DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Door hardware.

B. Related Sections:
   1. Section 06 40 00: “Architectural Woodwork.”
   3. Section 08 11 00: “Metal Doors and Frames.”
   4. Section 08 14 00: “Wood Doors.”
   5. Federal Acquisition Regulation (FAR).

C. Abbreviations:
   1. American Society for Testing Materials (ASTM)
   2. General Services Administration (GSA)
   3. Public Building Service (PBS)
   4. National Fire Protection Association (NFPA)
   5. Warnock Hersey International (WHI)
   6. Underwriters Laboratory (UL)
   7. American National Standards Institute (ANSI)
   8. Architectural Hardware Consultant (AHC)
   9. Architectural Barrier Act Accessibility Standards (ABAAS)
   10. National Wood Window and Door Association (NWWDA)
   11. International Code Council (ICC)

1.2 REFERENCES

A. American National Standards for Making Buildings and facilities Accessible to and Usable by Physically Handicapped People, ICC/ANSI A117.1, Architectural Barriers Act (ABA) and Uniform Federal Accessibility Standards (UFAS).

B. All doors and hardware shall meet the requirements of NFPA 101 Life Safety Code, 2006 Edition, GSA PBS Facility Standards (P-100) and Builders' Hardware Manufacturers Assoc. (BHMA).

C. Fire-Rated Openings:
   1. National Fire Protection Association (NFPA) Standard No. 80 (this requirement takes precedence over other requirements for such hardware.)
   2. Underwriters Laboratory (UL) 10C, Positive Pressure Fire Tests of Door Assemblies.
   3. Warnock Hersey International (WHI).

D. Emergency Exit Devices: Fire-Rated Doors: Provide UL or WHI label on exit devices indicating “Fire Exit Hardware.”

1.3 SUBMITTALS

A. Product Data: Submit manufacturer’s technical product data for each hardware item along with hardware schedule.

B. Hardware Schedule: Show item number, manufacturer, symbols and finish, kind, size, and hand of door, keying, frame dimensions, and mounting height for door knows, push and pull bars, hinges, and related items.

C. Templates: After hardware schedule has been approved, furnish templates as soon as possible

to Contractor.

1.4 QUALITY ASSURANCE

A. Obtain each type of hardware (hinges, etc.) from a single manufacturer, where possible.

B. Supplier Qualifications:
1. Recognized Builders Hardware supplier, with warehousing facilities, who has been furnishing hardware for a period of not less than three years.
2. Employs an experienced certified Architectural Hardware Consultant (AHC), available for consultation during course of work.

C. Fire-Rated Openings:
1. Provide door hardware for fire-rated openings that complies with NFPA Standard No. 80 and requirements of authorities having jurisdiction.
2. Provide only items of door hardware that are listed and are identical to products tested by UL, Warnock-Hersey or other testing and inspection organization acceptable to authorities having jurisdiction for use on types and sizes of door indicated in compliance with requirements of fire-rated door and door frame labels.

D. Pre-Installation Conference:
1. Contractor shall hold a meeting prior to installation with manufacturer's representatives to instruct the installing contractor's personnel on proper installation of their respective products.
2. A letter of compliance indicating when meeting was held and who was in attendance shall be sent to Government.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver hardware packaged and marked for specific openings in accordance with approved schedule.

B. Include with package all screws, special wrenches, instructions, and installation templates for accurately locating, setting, adjusting, and attaching.

1.6 MAINTENANCE

A. Operating Tools: Furnish adjusting tools.

B. Keys:
1. Stamp keys for identification and deliver to Government.
2. Furnish two keys for each lock.
3. Use of final keys will not be permitted during construction.

C. Operation and Maintenance Data:
1. Manufacturer's operation and maintenance data for hardware.
2. A final typed finish hardware schedule that includes any corrections and changes to submittal schedule.

1.7 WARRANTY

A. Mechanical failure on door closers for five years.

B. Blanket coverage on locksets for five years.

C. Failure on parts of all hardware except door closers for two years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Butts, Hinges: Hager Hinge Co.; McKinney Products Co.; Stanley Hardware Division, Stanley Works.

B. Lock Sets: Sargent; Schlage.

C. Cylinders:
1. ASSA; Sargent; Schlage.
2. Furnished by Government, installed by Contractor.

D. Closers: LCN; Sargent.

E. Exit Devices: Sargent; Von Duprin, Inc.

F. Door Trim, Stops, and Holders: Glynn-Johnson Corp.; Hager; Hewi.

H. Door Stripping and Seals: Master Manufacturers, Inc.; National Guard Products, Inc.; Pemko Manufacturing Co., Inc.

I. Electric Strikes: Von Duprin, Inc., ABBA.

J. Cypher locks: KARA Simplex; Sargent.

2.2 MATERIALS

A. Butts, Hinges:
1. Five knuckle, button tip, full mortise template type.
2. Hinge Pins:
   a. Out-Swing Corridor doors with Locks: Non-removable pins.
   b. Interior Doors: Non-rising pins.
   c. Tips: Flat button and matching plug, finished to match leaves.
3. Interior Doors: Ball bearing type, wrought steel construction, with 0.134 or 0.145 gauge hinges
   a. Doors to 36 Inches Width: 4.5 inches by 4.5 inches hinges.
4. Number of Hinges:
   a. Minimum three hinges per door leaf for doors 90 inches or less in height.

B. Lock Sets:
1. Heavy-duty mortise type, non-handed case.
2. Ability to reverse locking hub without opening case cover.
3. Independent spindles.
5. Lock Throw: 3/4 inch minimum throw of latch and 1 inch minimum throw of deadbolt.
6. Trim: Cast lever and cast escutcheon.

C. Cylinders:
1. Contractor shall supply all locks with construction cylinders to secure building.
2. Contractor shall furnish final cylinders and replace construction cylinders at job completion.
3. Keys: Construction keys and permanent keys furnished by Contractor.
4. Keying:
   a. Match existing key system.
   b. Cores shall be replaceable and interchangeable with the BEST locking system currently used by GSA.

D. Closers:
1. Provide Extra-Duty Arm on parallel arm applications.
2. Through-bolted on all doors.
3. Surface Mounted Closers: Product of a single manufacturer.
4. Interior Doors: Delayed action and conform to ABAAS requirements.

5. Size of Units: Adjust closers to comply with manufacturer's recommendations for size of door control unit, depending upon size of door, exposure to weather, wind conditions, and anticipated frequency of use.

E. Exit Devices:
1. Exit Device Dogging: Except on fire-rated doors, wherever closers are provided on doors equipped with exit devices, equip units with Allen-key dogging device to hold push bar down and latch bolt in open position.
2. Fire-Rated Exit Devices: Provide with U.L. Label.
3. Through-bolt on all doors including center cases, end cases and latches.

F. Door Trim and Stops:
1. Kick Plates:
   a. Manufacturer's standard exposed fasteners.
   b. Through-bolted push/pull units for matched pairs, but not for single units.
   c. Trim Plates: 0.050 inch thickness.
   d. Protection Plates (Kick Type): Minimum 2 inches less than door width on stop side.
2. Stops: Locate in position to permit maximum door swing but not to present a hazard or obstruction.

G. Door Seals:
1. Smoke Seal Applications:
   a. Provide on interior doors as required to meet all applicable codes.
   b. Provide only those units where resilient or flexible seal strip is easily replaceable and readily available from stocks maintained by manufacturer.
2. Fasteners:
   c. Manufacturer's standard exposed fasteners for door trim units.
   d. Non-corrosive fasteners as recommended by manufacturer for application indicated.

2.3 FINISHES

A. Match finish of lock sets: US10, Satin Bronze.

B. Closers: Paint to match locksets.

C. Smoke Seal Housing: Bronze material with US10 finish or Dark Bronze (DKB).

D. Coordinate all various manufactured items furnished on this Work to ensure an acceptable uniform finish.

2.4 KEYING

A. Final cylinder keying shall be approved by Government and installed by Contractor.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine installed door frames before hanging doors to verify they comply with indicated requirements for type, size, location, and swing characteristics, and have been installed with plumb jambs and level heads.

B. Proceed with hardware installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Hollow Metal Frames:
1. Mortise, reinforce, drill, and tap as required for all mortised hardware in accordance with final

approved hardware schedule and templates provided by hardware supplier
2. Drilling and tapping for surface door closers, door closer brackets, and adjusters shall be done in field by Installer.

B. Wood Doors:
1. Mortise and prepare doors as required for all hardware in accordance with a final approved hardware schedule, with templates provided by hardware supplier and/or security supplier in accordance with NFPA 80, “Standard for Fire Doors and Fire Widows,” and Underwriters Laboratories (UL) 10C, “Standard for positive Pressure Fire Tests of Door Assemblies” (including minimum raceways for electrical hardware, electric hinges, and/or power transfers, door position switches and other electrified hardware).
2. Drilling and tapping for surface door closers, door closer brackets, and adjusters shall be done in field by Installer.

3.3 INSTALLATION

A. General:
1. Install hardware at location shown.
2. Install items uniformly with like items in same relative positions.
3. Follow manufacturer’s instructions.
4. Use accurately sized boring jigs, strike gauges, routers, and templates.
5. Install locksets using a system of jigs and dado equipment capable of accurately cutting openings.
6. Avoid marring or damaging hardware or adjacent work.
7. Defaced screw heads and marred or imperfect hardware are not acceptable.
8. Set metal thresholds in sealant.
9. Clean and lubricate hardware and adjust for correct operation.

B. Mount hardware units at heights indicated in following applicable publications, except as specifically indicated or required to comply with governing regulations.
1. "Recommended Locations for Builders Hardware for Custom Steel Doors and Frames" by the Door and Hardware Institute.
2. NWWDA Industry Standard I.S.1.7, "Hardware Locations for Wood Flush Doors."

C. Where cutting and fitting is required to install hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation with finishing work specified in Section 09 90 00, “Painting and Coating.”

D. Do not install surface-mounted items until finishes have been completed on substrates involved.

E. Set units level, plumb, and true to line and location.

F. Adjust and reinforce attachment substrate as necessary for proper installation and operation.

G. Drill and countersink units that are not factory prepared for anchorage fasteners.

H. Space fasteners and anchors in accordance with industry standards.

I. Seals: Comply with manufacturer’s instructions and recommendations to extent installation requirements are not otherwise indicated.

3.4 FIELD QUALITY CONTROL

A. After installation has been completed, a certified AHC from hardware supplier shall check project to determine proper application of finish hardware according to approved hardware schedule.

3.5 ADJUSTING/CLEANING

A. Adjust and check each operating item of hardware and each door to ensure proper operation or

B. Replace units that cannot be adjusted to operate freely and smoothly or as intended for application made.

C. Where door hardware is installed more than one month prior to acceptance or occupancy of a space or area, make final check and adjustment of all hardware items in such space or area during week prior to acceptance or occupancy.

D. Clean operating items as necessary to restore proper function and finish of hardware and doors.

E. Adjust door control devices to compensate for final operation of heating and ventilating equipment and compliance with ABAAS.

F. Clean adjacent surfaces soiled by hardware installation.

G. Instruct Government's personnel in proper adjustment and maintenance of door hardware and hardware finishes.

H. Installer, accompanied by representatives of manufacturers of lock sets, door control devices, and of other major hardware suppliers, shall return to Project approximately eleven months after date of Substantial Completion, to perform following work:
1. Examine and re-adjust each item of door hardware as necessary to restore function of doors and hardware to comply with specified requirements.
2. Consult with and instruct Government's personnel in recommended additions to maintenance procedures.
3. Replace Contractor-furnished hardware items that have deteriorated or failed due to faulty design, materials, or installation of hardware units.
4. Prepare a written report of current and predictable problems (of substantial nature) in performance of hardware.

3.6 SCHEDULE

A. Legend:

Manufacturer		Approved Substitute
(AS)	Assa Abloy Mortise Cylinders	no substitute
(GL)	Glynn-Johnson	H.B. Ives, Stanley, Hager
(HA)	Hager Trim	Trimco, Ives
(HE)	Hewi	no substitute
(MC)	McKinney Hinges	Stanley, Hager
(NA)	National Guard	Pemko, Zero
(SA)	Sargent Lock Sets, Closers, Exit Devices	Von Duprin
(IVE)	H.B. Ives	
(VD)	Von Duprin	
(SM)	Simplex	

B. Hardware Groups:

GROUP #1: Fire-rated Doors. Doors 2403B, 2405, 2406
Each Opening to have:

3	HINGES	TA 2714 4-1/2 X 4-1/2	652	MC
1	LOCKSET	8205 MORTISE LNL	626	SA
1	CYLINDER RIM	Furnished & installed by Government		
1	MORTISE CYLINDER	Furnished & installed by Government		
1	CLOSER	351	626	SA
1	KICKPLATE	190S 2 inches L.D.W.	652	HA
1	WALL STOP	610 W/ANCHOR	GRAY	HE
1	SMOKE SEAL	2525B AT HEAD AND JAMBS	DKB	NA

GROUP #2: Phone Booth Rooms. Doors 2414, 2416, 2425, 2427
Each Opening to have:

3	HINGES	TA 2714 4-1/2 X 4-1/2	652	MC
1	LATCHSET	8215 MORTISE LNL	626	SA
1	CLOSER	351	626	SA
1	WALL STOP	610 W/ANCHOR	GRAY	HE
3	SILENCERS	307D	DKB	HA

GROUP #3: Storage Rooms. Doors 2408, 2409
Each Opening to have:

3	HINGES	TA 2714 4-1/2 X 4-1/2	652	MC
1	STOREROOM LOCKSET	8227 MORTISE LNL	626	SA
1	CYLINDER RIM	Furnished & installed by Government		
1	MORTISE CYLINDER	Furnished & installed by Government		
1	KICKPLATE	190S 2 inches L.D.W.	652	HA
1	WALL STOP	610 W/ANCHOR	GRAY	HE
3	SILENCERS	307D	DKB	HA

GROUP #4: Offices & Meeting Room. Doors 2403A, 2411, 2413, 2415, 2418, 2419, 2424, 2426
Each Opening to have:

3	HINGES	TA 2714 4-1/2 X 4-1/2	652	MC
1	OFFICE LOCKSET	8205 MORTISE LNL	626	SA
1	CYLINDER RIM	Furnished & installed by Government		
1	MORTISE CYLINDER	Furnished & installed by Government		
1	KICKPLATE	190S 2 inches L.D.W.	652	HA
1	WALL STOP	610 W/ANCHOR	GRAY	HE
3	SILENCERS	307D	DKB	HA

END OF SECTION 08 71 00

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SECTION 08 8000

GLAZING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Glazing units.

B. Glazing compounds and accessories.

1.02 RELATED REQUIREMENTS

A. Section 07 9200 - Joint Sealants: Sealants for other than glazing purposes.

B. Section 08 1113 - Hollow Metal Doors and FrameS.

1.03 REFERENCE STANDARDS

A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; current edition.

B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test; 2015.

C. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.

D. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers; 2005 (Reapproved 2015).

E. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.

F. ASTM C1036 - Standard Specification for Flat Glass; 2016.

G. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2012.

H. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016.

I. ASTM C1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass; 2015.

J. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings; 2016.

K. GANA (GM) - GANA Glazing Manual; 2008.

L. GANA (SM) - GANA Sealant Manual; 2008.

M. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by each of the affected installers.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data on Glazing Types: Provide structural, physical and environmental characteristics, size limitations, special handling and installation requirements.

C. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.

D. Samples: Submit two samples 12 by 12 inch in size of glass units, showing coloration and design.

E. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

A. Perform Work in accordance with GANA (GM), GANA (SM), GANA (LGRM), and IGMA TM-3000 for glazing installation methods. Maintain one copy on site.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years of documented experience.

C. Installer Qualifications: Company specializing in performing work of the type specified and with at least five years documented experience and approved by manufacturer.

1.07 FIELD CONDITIONS

A. Do not install glazing when ambient temperature is less than 40 degrees F (4 degrees C).

B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.08 WARRANTY

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

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Float Glass Manufacturers:
   1. AGC Glass North America, Inc; www.agcglass.com/#sle.
   2. Cardinal Glass Industries; www.cardinalcorp.com/#sle.
   3. Guardian Glass, LLC; www.guardianglass.com/#sle.
   4. Pilkington North America Inc; www.pilkington.com/na/#sle.
   5. Vitro Architectural Glass (formerly PPG Glass); www.vitroglazings.com/#sle.
   6. Substitutions: Refer to Section 01 6000 - Product Requirements.

2.02 GLASS MATERIALS

A. Float Glass: Provide float glass based glazing unless otherwise indicated.
   1. Annealed Type: ASTM C1036, Type I - Transparent Flat, Class 1 - Clear, Quality - Q3.
   2. Kind HS - Heat-Strengthened Type: Complies with ASTM C1048.
   3. Kind FT - Fully Tempered Type: Complies with ASTM C1048.
   4. Fully Tempered Safety Glass: Complies with ANSI Z97.1 or 16 CFR 1201 criteria for safety glazing used in hazardous locations.
   5. Thicknesses: ¼”

2.03 GLAZING UNITS

A. Type G-2 - Monolithic Interior Vision Glazing:
   1. Applications: Interior glazing unless otherwise indicated.
   2. Glass Type: Fully Tempered Safety Glass, located adjacent to doors.
   3. Tint: Clear.
   4. Thickness: 1/4 inch (6.4 mm), nominal.

2.04 GLAZING COMPOUNDS

A. Type GC-2 - Butyl Sealant: Single component; ASTM C920, Grade NS, Class 12-1/2, Uses M and A, Shore A hardness of 10 to 20; color to match frame.

B. Manufacturers:
   1. BASF Corporation; www.basf.com/us/en.html/#sle.
   2. Bostik Inc; www.bostik-us.com/#sle.
   3. Dow Corning Corporation; www.dowcorning.com/construction/#sle.
   4. Momentive Performance Materials, Inc; www.momentive.com/#sle.
   5. Substitutions: Refer to Section 01 6000 - Product Requirements.

2.05 ACCESSORIES

A. Setting Blocks: Neoprene, with 80 to 90 Shore A durometer hardness; ASTM C864 Option II. Length of 0.1 inch for each square foot (25 mm for each square meter) of glazing or minimum 4

inch (100 mm) by width of glazing rabbet space minus 1/16 inch (1.5 mm) by height to suit glazing method and pane weight and area.

B. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness; ASTM C864 Option II. Minimum 3 inch (75 mm) long by one half the height of the glazing stop by thickness to suit application, self adhesive on one face.

C. Glazing Tape, Back Bedding Mastic Type: Preformed, butyl-based, 100 percent solids compound with integral resilient spacer rod applicable to application indicated; 5 to 30 cured Shore A durometer hardness; coiled on release paper; color to match frame.

D. Glazing Splines: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C864 Option II; color to match frame.

E. Glazing Clips: Manufacturer's standard type.

PART 3 EXECUTION

3.01 VERIFICATION OF CONDITIONS

A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.

B. Verify that the minimum required face and edge clearances are being provided.

C. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.

D. Verify that sealing between joints of glass framing members has been completed effectively.

E. Proceed with glazing system installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Clean contact surfaces with appropriate solvent and wipe dry within maximum of 24 hours before glazing. Remove coatings that are not tightly bonded to substrates.

B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.

C. Prime surfaces scheduled to receive sealant where required for proper sealant adhesion.

3.03 INSTALLATION, GENERAL

A. Install glazing in compliance with written instructions of glass, gaskets, and other glazing material manufacturers, unless more stringent requirements are indicated, including those in glazing referenced standards.

B. Install glazing sealants in accordance with ASTM C1193, GANA (SM), and manufacturer's instructions.

C. Do not exceed edge pressures around perimeter of glass lites as stipulated by glass manufacturer.

D. Set glass lites of system with uniform pattern, draw, bow, and similar characteristics.

E. Set glass lites in proper orientation so that coatings face exterior or interior as indicated.

F. Prevent glass from contact with any contaminating substances that may be the result of construction operations such as, and not limited to the following; weld splatter, fire-safing, plastering, mortar droppings, etc.

3.04 INSTALLATION - DRY GLAZING METHOD (GASKET GLAZING)

A. Application - Exterior and/or Interior Glazed: Set glazing infills from either the exterior or the interior of the building.

B. Place setting blocks at 1/4 points with edge block no more than 6 inch (152 mm) from corners.

C. Rest glazing on setting blocks and push against fixed stop with sufficient pressure on gasket to attain full contact.

D. Install removable stops without displacing glazing gasket; exert pressure for full continuous contact.

3.05 CLEANING

A. See Section 01 7419 - Construction Waste Management and Disposal, for additional requirements.

B. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners recommended by manufacturers.

C. Remove non-permanent labels immediately after glazing installation is complete.

D. Clean glass and adjacent surfaces after sealants are fully cured.

E. Clean glass on both exposed surfaces not more than 4 days prior to Date of Substantial Completion in accordance with glass manufacturer's written recommendations.

3.06 PROTECTION

A. After installation, mark pane with an 'X' by using removable plastic tape or paste; do not mark heat absorbing or reflective glass units.

B. Remove and replace glass that is damaged during construction period prior to Date of Substantial Completion.

END OF SECTION

SECTION 09 21 16

GYPSUM BOARD ASSEMBLIES

PART 1 - GENERAL

1.1 SECTION INCLUDES
- A. Performance criteria for gypsum board assemblies.
- B. Metal stud wall framing.
- C. Metal channel ceiling framing.
- D. Acoustic insulation.
- E. Gypsum wallboard.

1.2 RELATED REQUIREMENTS
- A. Section 06 1000 - Rough Carpentry: Wood blocking product and execution requirements.
- B. Section 07 9200 - Joint Sealants: Sealing acoustical gaps in construction other than gypsum board.

1.3 REFERENCE STANDARDS
- A. AISI S100-12 - North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 2012.
- B. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units; 2010 (Reaffirmed 2016).
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2017.
- D. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2015.
- E. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2014, with Editorial Revision (2015).
- F. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2017.
- G. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2017.
- H. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2017a.
- I. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness; 2015.
- J. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2016.
- K. ASTM C1047 - Standard Specification for Accessories For Gypsum Wallboard and Gypsum Veneer Base; 2014a.
- L. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2017.
- M. GA-216 - Application and Finishing of Gypsum Panel Products; 2016.

1.4 SUBMITTALS
- A. See Section 01 3300 – Submittal Procedures.
- B. Product Data: Provide data on metal framing, gypsum board, accessories, and joint finishing system.
- C. Product Data: Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.
- D. Provide 4’ wide by full wall height mock-up of finished drywall to match existing texture. Locate mock-up directly adjacent to existing finish to remain.

1.5 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics:
  1. Where fire-rated gypsum board assemblies are indicated, provide materials and construction identical to those of assemblies tested for fire resistance per ASTM E 119 by an independent testing and inspecting agency.
  2. Fire Resistance Ratings: As indicated by reference to GA File Numbers in GA-600 "Fire

Resistance Design Manual" or to design designations in UL "Fire Resistance Directory" or in listing of another testing and inspecting agency acceptable to authorities having jurisdiction.

B. Single-Source Responsibility: Obtain gypsum board products, joint treatment products, and textured coatings from a single manufacturer (no exceptions).

C. Contractor shall become familiar with various wall and ceiling assemblies referenced on drawings including, but not limited to, 2006 IBC, and most recent Gypsum Association Fire Resistance Design Manual.

D. For conditions not covered by this Section, follow recommendations in manufacturer's technical literature.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packaging and Shipping: Have materials shipped in manufacturer's original packages show manufacturer's name and product brand name.

B. Storage and Protection:
1. Store gypsum board flat, taking care not to exceed load limits of floor.
2. Leave in original wrappings or containers until ready for installation.
3. Protect against sagging or damage to edges, ends, and surfaces.
4. Protect gypsum board from moisture and direct sunlight.
5. Protect steel studs and accessories from bending.

1.7 PROJECT CONDITIONS

A. Environmental Requirements: Establish and maintain application and finishing environment in accordance with ASTM C 840.

B. Room Temperatures:
1. For non-adhesive attachment of gypsum board to framing, maintain not less than 40 degrees F.
2. For adhesive attachment and finishing of gypsum board, maintain not less than 50 degrees F. for forty-eight hours prior to application and continuously after until dry.

C. Ventilation:
1. Ventilate building spaces, as required, for drying joint treatment materials.
2. Avoid drafts during hot dry weather to prevent finishing materials from drying too rapidly.

PART 2 - PRODUCTS

2.1 GYPSUM BOARD ASSEMBLIES

A. Provide completed assemblies complying with ASTM C840 and GA-216.
1. See PART 3 for finishing requirements.

2.2 METAL FRAMING MATERIALS

A. Manufacturers - Metal Framing, Connectors, and Accessories:
1. Clarkwestern Dietrich Building Systems LLC: www.clarkdietrich.com.
2. Phillips Manufacturing Co: www.phillipsmfg.com/#sle.
3. Substitutions: See Section 01 6000 - Product Requirements.

B. Non-Loadbearing Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/120 at 5 psf (L/120 at 240 Pa).
1. Studs: "C" shaped with flat or formed webs with knurled faces.
2. Runners: U shaped, sized to match studs.
3. Ceiling Channels: C-shaped.
4. Furring: Hat-shaped sections, minimum depth of 7/8 inch (22 mm).

5. Resilient Furring Channels: 1 5/8 inch depth, for attachment to substrate through both legs; both legs expanded metal mesh.
    a. Products:
        1) Phillips Manufacturing Co; RC-2 Resilient Sound Channel: www.phillipsmfg.com/#sle.
        2) Substitutions: See Section 01 6000 - Product Requirements.

C. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.

D. Partition Head to Structure Connections: Provide mechanical anchorage devices that accommodate deflection using slotted holes, screws and anti-friction bushings, preventing rotation of studs while maintaining structural performance of partition.
1. Structural Performance: Maintain lateral load resistance and vertical movement capacity required by applicable code, when evaluated in accordance with AISI S100-12.
2. Material: ASTM A653/A653M steel sheet, SS Grade 50/340, with G60/Z180 hot dipped galvanized coating.

2.3 BOARD MATERIALS

A. Manufacturers - Gypsum-Based Board:
1. American Gypsum Company: www.americangypsum.com.
2. CertainTeed Corporation: www.certainteed.com.
3. Georgia-Pacific Gypsum: www.gpgypsum.com.
4. USG Corporation: www.usg.com.
5. Substitutions: See Section 01 6000 - Product Requirements.

B. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
2. Class A Flame Spread Index per ASTM E84.
3. Thickness:
    a. Vertical Surfaces: 5/8 inch (16 mm).
    b. Ceilings: 1/2 inch (13 mm).

2.4 ACCESSORIES

A. Acoustic Insulation: ASTM C665; preformed mineral wool, friction fit type, unfaced. Thickness: 4 inch.

B. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.

C. Finishing Accessories: ASTM C1047, galvanized steel or rolled zinc, unless noted otherwise.
1. Types: As detailed or required for finished appearance.
2. Special Shapes: In addition to conventional corner bead and control joints, provide U-bead at exposed panel edges.
3. Products:
    a. Same manufacturer as framing materials.
    b. Substitutions: See Section 01 6000 - Product Requirements.

D. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.

E. High Build Drywall Surfacer: Vinyl acrylic latex-based coating for spray application, designed to take the place of skim coating and separate paint primer in achieving Level 5 finish.

F. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inch (0.84 mm) in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion resistant.

G. Screws for Fastening of Gypsum Panel Products to Steel Members from 0.033 to 0.112 inch (0.84 to 2.84 mm) in Thickness: ASTM C954; steel drill screws, corrosion resistant.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 FRAMING INSTALLATION

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

B. Suspended Ceilings and Soffits: Space framing and furring members as indicated.
   1. Level ceiling system to a tolerance of 1/600.

C. Studs: Space studs at 16 inches on center (at 406 mm on center).
   1. Extend partition framing to structure in all locations.
   2. Partitions Terminating at Structure: Attach extended leg top runner to structure, maintain clearance between top of studs and structure, and brace both flanges of studs with continuous bridging.

D. Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jambs.

E. Acoustic Furring: Install resilient channels at maximum 24 inches (600 mm) on center. Locate joints over framing members.

F. Blocking: Install wood blocking for support of:
   1. Framed openings.
   2. Wall mounted cabinets.
   3. Plumbing fixtures.
   4. Wall mounted door hardware.
   5. Countertops and Casework
   6. Lockers
   7. Signage.

3.3 ACOUSTIC ACCESSORIES INSTALLATION

A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.

B. Acoustic Sealant: Install in accordance with manufacturer's instructions.
   1. Seal around all penetrations by conduit, pipe, ducts, and rough-in boxes, except where firestopping is provided.

3.4 BOARD INSTALLATION

A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.

B. Single-Layer Non-Rated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.
   1. Exception: Tapered edges to receive joint treatment at right angles to framing.

C. Cementitious Backing Board: Install over steel framing members and plywood substrate where indicated, in accordance with ANSI A108.11 and manufacturer's instructions.

D. Installation on Metal Framing: Use screws for attachment of gypsum board.

E. Match level of finish of existing adjacent gypsum wall board.

3.5 INSTALLATION OF TRIM AND ACCESSORIES

A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.
   1. Not more than 30 feet (10 meters) apart on walls and ceilings over 50 feet (16 meters) long.

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

C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.

3.6 JOINT TREATMENT

A. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
   1. Level 5: Walls and ceilings to receive semi-gloss or gloss paint finish and other areas specifically indicated.

2. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
3. Level 2: In utility areas, behind cabinetry, and on backing board to receive tile finish.
4. Level 1: Fire rated wall areas above finished ceilings, whether or not accessible in the completed construction.

B. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
1. Feather coats of joint compound so that camber is maximum 1/32 inch (0.8 mm).

C. Where Level 5 finish is indicated, spray apply high build drywall surfacer over entire surface after joints have been properly treated; achieve a flat and tool mark-free finish.

3.7 TOLERANCES

A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet (3 mm in 3 m) in any direction.

3.8 CLEANING AND PROTECTION

A. Promptly remove any residual joint compound from adjacent surfaces.

B. Protect gypsum board installations from damage and deterioration until date of Substantial Completion.

END OF SECTION 09 21 16

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SECTION 09 51 00

ACOUSTICAL CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Acoustical panel ceilings.

B. Related Sections:
   1. Section 09 21 16: "Gypsum Board Systems."
   2. Federal Acquisition Regulation (FAR).

C. Abbreviations:
   1. American Society for Testing Materials (ASTM)
   2. American National Standards Institute (ANSI)
   3. Underwriters Laboratory (UL)
   4. Ceilings and Interior Systems Contractors' Association (CISCA)

1.2 SUBMITTALS

A. Product Data: Manufacturer's technical product data and installation instructions for system.

B. Samples: Submit three 12-inch square samples of each type of acoustical material to illustrate color and range of appearance to be expected in completed work.

C. Certificates:
   1. Certify that products furnished for this project are asbestos free.
   2. Certify that products meet or exceed specification requirements.

D. Maintenance:
   1. Submit instructions for proper maintenance and cleaning.
   2. Provide instructions for refinishing.
   3. Provide recommendations on precautions against materials and methods which may be detrimental to finishes and acoustical performance.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacture of acoustical ceiling tile and panels with three years minimum experience.

B. Installer Qualifications: Company with three years minimum experience and approved by manufacturer of acoustical units.

C. Terminology and Performance: Applicable publications by Ceilings and Interior Systems Contractors' Association (CISCA), including former Acoustical Materials Association Standards issued by CISCA.

D. Acoustical Materials: ASTM E1264 and CISCA publications.

E. Fire Hazard Classification: UL tested, listed and labeled as "Class 0-25," smoke developed of 50 or less per ASTM E84.

F. Fire Resistance Rating: UL tested, listed and labeled for UL design and hours of resistance as indicated, with each panel bearing UL label.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver material in original, unopened, protective packaging, with manufacturer's labels intact and legible, showing brand name, pattern, size, thickness, and fire rating.

B. Follow manufacturer's recommendations for storage.

1.5 PROJECT CONDITIONS

A. General Contractor, Government, and Subcontractors shall conduct a pre-installation coordination meeting.

B. Maintain minimum temperature of 60 degrees F. and maximum humidity of 40 percent during installation of acoustical units and until final acceptance.

1.6 MAINTENANCE

A. At time of completing installation, deliver stock of maintenance materials to Government.

B. Furnish full size units matching units installed, packaged with protective covering for storage, and identified with appropriate labels.

C. Acoustical Units:
1. Furnish an amount equal to 2 percent of amount installed of each type, pattern, color, but not less than ten units.
2. Do not use for replacement of damaged units prior to building occupancy or substantial completion whichever occurs later.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acoustical Tile Ceiling:
1. Armstrong World Industries, Inc.
2. CertainTeed Ceiling.
3. USG Interiors, Inc.

B. Metal Suspension Systems:
1. Chicago Metallic Corp.
2. Armstrong World Industries, Inc.
3. USG Interiors, Inc.
4. Donn.

2.2 CEILING UNITS

A. Glass and Mineral Fiber Lay-In Acoustical Panels:
1. Type ACT-1: 24" x 48" x 0.75", mineral fiber lay-in boards with beveled tegular edges, Second Look, Ultima Fine Texture No. 1912 by Armstrong or equal by listed manufacturer, white color.
   a. NRC: Not less than 0. 70.
   b. CAC: Not less than 35.
   c. Reflectance: Not less than 90%.
   d. Minimum Recycled Content: 66% by weight.

2.3 CEILING SUSPENSION MATERIALS

A. General

1. Comply with ASTM C635, as applicable to the type of suspension system required for the type of ceiling units indicated. Coordinate with other work supported by or penetrating through the ceilings.

a. Structural Class: Heavy Duty System.
b. Minimum Recycled Content: 60% of steel by weight.

B. Finishes

1. Provide manufacturer's standard finish for type of system indicated, unless otherwise required. For exposed suspension members and accessories with painted finish, provide white standard color.

C. Attachment Devices

1. Hanger Wires: Galvanized carbon steel, ASTM A641, soft temper, prestretched, yield-stress load of at least 3 times design load, but not less than 12 gage (0.106").

D. Exposed Suspension System

1. Armstrong Prelude XL 15/16" Wide Suspension System with #7301 mains, #XL7327 (24") and #XL7348 (48") cross-tees and No. 7800 0.875" hemmed edge angle molding or approved equal by listed manufacturer.
a. Edge Moldings: Use for edges and penetrations of ceiling.
b. Perimeter Molding: 15/16” shadow molding.

2.4 MISCELLANEOUS MATERIALS

A. Decorative Trim

1. Recessed Pocket Trim Between Acoustical Ceiling and Adjacent Construction: Provide Softforms by Pittcon Industries or approved equal by Fry Reglet, Gordon or MM Systems, finished to match adjacent suspension system members, in custom shapes as detailed on the drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage.

B. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Coordination: Furnish layouts for cast-in-place anchors, clips, and other ceiling anchors whose installation is specified in other Sections.

3.3 INSTALLATION

A. Install acoustical panel ceilings to comply with publications referenced below per manufacturer's instructions and CISCA "Ceiling Systems Handbook."

B. Suspension System:
1. Install system as recommended by manufacturer, complying with ASTM C636.
2. Lay out system to a balanced grid design with edge units no less than 50 percent of acoustical unit size.
3. Install hangers supported only from building structural members, plumb and free from contact with insulation and other objects.
4. Support main runners directly from hangers, not bearing on walls or partitions.
5. Support fixtures independently from suspension system, or provide additional hangers for fixtures as required to prevent exceeding deflection capability.

6. Interlock cross runners with main runners or other cross runners.
7. Provide moldings where ceilings meet walls, partitions, and other vertical elements.
8. Install angle type moldings with exposed leg in same plan as bottom flange of runners.
9. Form expansion joints as shown to accommodate plus-or-minus 1 inch movement.

C. Acoustical Units:
1. Lay units flush and level, without damaged edges or corners.
2. Scribe and accurately fit units at borders and around pipes, ducts, and other connecting work, centering lighting fixtures on units where possible.
3. Paint cut panel edges remaining exposed after installation; match color of exposed panel surfaces using coating recommended for this purpose by acoustical panel manufacturer.

3.4 CLEANING

A. Clean soiled or discolored panel surfaces as recommended by manufacturer.

B. Remove and replace damaged or improperly installed units.

END OF SECTION 09 51 00

SECTION 09 65 00

RESILIENT FLOORING

PART I - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Resilient base and accessories.
2. Resilient flooring.

B. Related Sections:
1. Federal Acquisition Regulation (FAR).

C. Abbreviations:
1. American Society for Testing Materials (ASTM)
2. Federal Specifications (FS)

1.2 SUBMITTALS

A. Product Data: Maintenance instructions for proper maintenance and cleaning.

B. Samples:
1. Submit three samples of each type and color or pattern of resilient flooring and base material.
2. Tiles: 6' x 6'
3. Base: 6-inch minimum lengths.

C. Certificates: Certify that products furnished for this project are asbestos-free and that products meet or exceed specification requirements.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: Minimum three years experience installing resilient flooring material.

B. Codes/Standards: Conform to following fire test data:
1. Flame Spread: 75 or less per ASTM E84.
2. Smoke Density: 450 or less per ASTM E662.
3. Critical Radiant Flux: Not less than 0.45 watts per square centimeter per ASTM E648.

C. Provide each type of resilient flooring, installation compounds, and accessories produced by a single manufacturer.

1.4 PROJECT CONDITIONS

A. Maintain a minimum temperature of 70 degrees F. in space to receive flooring for twenty-four hours before and forty-eight hours after installation.

B. Moisture content of concrete slabs and relative humidity shall be within limits recommended by flooring manufacturer.

1.5 MAINTENANCE

A. Extra Materials:
1. Furnish materials at rate of 1 percent of total square footage installed, but not less than 40 square feet for each color and pattern of flooring.
2. Furnish materials at rate of 120 LF (one carton) for each color and type of base installed.
3. Maintenance materials must be from same manufactured lot as materials installed.

B. Maintenance Instructions: Submit manufacturer's written instructions for recommended maintenance practices for each type of resilient flooring and accessory.

PART 2 - PRODUCTS

1.1 MANUFACTURERS

A. Manufacturers offering products which may be incorporated in work, but are not limited to following:

1. Sheet Linoleum:
   a. Basis of Design: Forbo Marmoleum Real. 3146, Serene Gray.
   b. Substitutions: See Section 01 25 00 Substitution Procedures.

2. Rubber Wall Base:
   a. Basis of Design: Roppe 4” Pinnacle Rubber Wall Base. 100 Black. Standard toe.
   b. Substitutions: See Section 01 25 00 Substitution Procedures.

2.2 MATERIALS

A. Sheet Flooring:
1. Linoleum.
2. Maximum Static Load Capacity: 50 PSI.

B. Wall Base (RB-01):
1. Type TS (rubber, vulcanized thermoset).
2. Group/type I (solid).
3. 1/8 inch by 4 inches high.
4. Complying with FS SS-W-40A.
5. Complying with ASTM F1861.
6. Provide topset style with coved base for all locations.
7. Provide preformed external corner units and matching end stops.
8. Through-color smooth surface.
9. Maximum Static Load Capacity: 50 PSI.

C. Accessories:
1. Adhesives:
   a. Waterproof, stabilized type, as recommended by flooring manufacturer.
   b. Use asbestos-free asphaltic type for concrete substrate.
2. Concrete Slab Primer: Non-staining, as recommended by flooring manufacturer.
3. Leveling Compound: Latex type which can be feather edged, as recommended by flooring manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Determine that surfaces to which flooring is to be applied are even, smooth, sound, thoroughly clean and dry, and free from defects that might affect proper installation.

B. Report unsatisfactory surfaces to Government, or correct defective surfaces.

3.2 PREPARATION

A. Adjacent Surfaces Protection: Protect adjacent work areas and finish surfaces from damage during product installation.

B. Prepare floor substrate to be smooth, rigid, flat, level, permanently dry, clean and free of foreign materials such as dust, paint, grease, oils, solvent, curing and hardening compounds, sealers, asphalt and old adhesive residue.

C. Do not use of install flooring over gypsum-based leveling or patching materials.

D. Apply concrete slab primer prior to application of adhesive, following instructions and recommendations of flooring manufacturer.

3.3 INSTALLATION

A. General:
1. Install flooring after finishing operations, including painting, have been completed and heating system is operating.
1. Place flooring with adhesive cement complying with manufacturer's recommendations.
2. Butt tightly to vertical surfaces, thresholds, nosing and edgings.
3. Scribe around obstructions and to produce neat joints, laid with joints tight, even and straight.
4. Extend flooring into toe spaces, door reveals, closets, and similar openings.
5. Tightly cement flooring to sub-base without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, or other surface imperfections.

B. Sheet Flooring:
1. Grind concrete floor slabs for a level finish of 1/8 inch in 10 feet tolerance.
2. Lay flooring with as few seams as possible, matching edges for color shading and pattern.
3. Net fit seams to provide smooth installation.
4. Adhere sheet flooring to substrates using method approved by flooring manufacturer for type of sheet flooring and substrate condition indicated.

C. Accessories:
1. Resilient Base:
a. Apply to walls, columns, pilasters, and other permanent fixtures as required.
b. Install base in as long lengths as practical, with mitered or coped intersections.
c. Install preformed corner units at external corners.
d. Tightly bond to backing with continuous contact at all surfaces.
e. On irregular surfaces, fill voids along to edge of resilient wall base with manufacturer’s recommended adhesive filler material.

3.5 CLEANING

A. Remove excessive adhesive using neutral type cleaners as recommended by flooring manufacturer.

B. Finishing: After completion of project and just prior to final inspection of work, thoroughly clean floors and accessories, buff with power buffers.

3.6 INDOOR AIR QUALITY MANAGEMENT (Credit EQ3)

A. Manage indoor air quality in accordance with provisions in Section 01 33 29.

3.7 CONSTRUCTION WASTE MANAGEMENT: (Credit MR2)

A. Manage construction waste in accordance with provisions of Section 01 74 19. Submit documentation to satisfy the requirements of that section.

3.8 PROTECTION

A. Protect flooring against damage during construction period to comply with flooring manufacturer's recommendations.

END OF SECTION 09 65 00

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SECTION 09 68 00

CARPETING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Tile carpeting.

B. Related Sections:
   1. Section 09 65 00: “Resilient Flooring.”
   2. Federal Acquisition Regulation (FAR).

C. Abbreviations:
   1. American Society for Testing Materials (ASTM)
   2. Carpet and Rug Institute (CRI)
   3. American National Standards Institute (ANSI)
   4. International Code Council (ICC)

1.2 REFERENCES

A. American National Standards for Making Buildings and Facilities Accessible to and Usable by Physically Handicapped People ICC/ANSI A117.1.

B. Uniform Federal Accessibility Standards (UFAS).

C. The Carpet and Rug Institute “Standard for Installation of Commercial Textile Floor-covering Materials” (CRI 104).

1.3 SYSTEM DESCRIPTION

A. Design Requirements: Direct glue-down application.

1.4 SUBMITTALS

A. Samples:
   1. Two samples of carpet tile in colors specified.
   2. Minimum Size: 18" x 18"

C. Maintenance: Submit instructions for proper maintenance and cleaning.

1.5 QUALITY ASSURANCE

A. Qualifications:
   1. Installer: Firm with not less than five years of carpeting experience on projects of similar size and type to work of this section and certified in writing by carpet manufacturer to install specified carpeting.
   2. Manufacturer: Firm (carpet mill) with not less than five years of production experience with carpet manufacturing, and who’s published product literature clearly indicates general compliance of products with requirements of this Section.

B. Carpeting systems shall meet or exceed requirements of Carpet and Rug Institute Green Label Indoor Air Quality Test Program.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Comply with Carpet and Rug Institute's CRI 104, Section 5.

B. Deliver to site in original factory wrapping labeled with identification of manufacturer, brand name, and lot number.

1.7 PROJECT CONDITIONS

A. Maintain temperatures between 65 and 95 degrees F. and a maximum relative humidity of 65 percent and a minimum of 10 percent for at least forty-eight hours before installation, during installation, and for seventy-two hours after installation.

B. Complete work of all other trades before installation.

1.8 WARRANTY

A. Provide special warranty, signed by Contractor, Installer, and Manufacturer (carpet mill), agreeing to repair or replace defective materials and workmanship of carpeting work during two-year warranty period following date of Notice of Acceptance.

B. Attach copies of product warranties.

C. Furnish manufacturer's written warranty agreeing to supply replacement carpet if face weight loss in area exceeds 10 percent in ten years.

1.9 MAINTENANCE

A. Extra Materials:
1. Deliver properly packaged and identified roll ends of less than 9 feet in length and carpet pieces of more than 10 SF area to Government's designated storage space.
2. Minimum Materials: 2 Percent of each type, color, texture, and pattern.
3. Balance shall be removed from job site.

PART 2 - PRODUCTS

2.1 CARPET TILE

A. Basis of Design: Interface Raku, Global Change
a. Style # 1426802500
b. Color: 105515 Eclipse
c. Backing: GlasBacRE
d. Size 50cm x 50cm

B. Accessories:
1. Carpet Edge Guard:
a. Manufacturer's standard bend-down type formed or extruded vinyl stripping.
b. Units formed with concealed teeth to grip carpeting from below; holes for nailing to substrate; tapered smooth safety top bar to bend down on carpeting to secure it to stripping.
2. Sub-Floor Filler: Type recommended by carpet manufacturer.
3. Adhesive:
a. Solvent free, as recommended by carpet manufacturer.
b. Cushion to Floor: Pressure sensitive, solvent-free, as recommended by carpet manufacturer.
4. Seal Sealer: As recommended by carpet manufacturer.

5. Cushion:
   a. Produced for double-glue down installation as recommended by carpet manufacturer.
7. Tackless Strip: Minimum 1 inch wide and 1/4 inch thick, with two rows of pins, commercial or architectural grade, with three rows of pins when dimensions exceed 30 feet.
8. Floor Primer or Sealer: As recommended by cushion manufacturer.

PART 3 - EXECUTION

3.2 EXAMINATION

A Carpeting installer shall inform General Contractor of any conditions that do not meet installation requirements.

B. Start of work constitutes acceptance by Carpeting Installer of floor and responsibility for finished result.

3.3 PREPARATION

A. Remove debris, cementitious deposits, and similar obstructions on substrates to receive carpet.

B. Fill cracks and voids including honeycombed concrete, but do not obstruct expansion joints.

C. Verify that substrate surfaces are smooth and flat with maximum variation of 1/8-inch in ten feet.

D. Ensure that all surfaces on which carpet is to be laid are vacuum clean, dry and smooth.

E. Correct any defect that may affect carpet installation.

F. Carpeting Installer shall be responsible for complete preparation of new and/or existing substrates to receive carpeting without additional cost to Government.

3.4 INSTALLATION

A. General:
   1. Comply with CRI 104.
   2. Comply with manufacturer's written instructions and recommendations for installation, including seam locations and direction of carpet as shown.
   3. Maintain uniformity of carpet direction and lay of pile.
   4. At doorways, center seams under door in closed position.
   5. Cut and fit carpet to butt vertical surfaces, including pipes, outlets, edgings, thresholds, and nosing.
   6. Do not bridge building expansion joints with continuous carpet.
   7. Bind or seal all exposed cut edges.

B. Tile Carpeting Installation:
   1. Pattern: Brick.
   2. Carpet Tiles:
      a. Follow carpet manufacturer’s written recommendations precisely.
      b. Install tiles with no visible gaps, peaks, or overlaps.
      c. Do not trap yarn between tiles.
   3. Full Spread Adhesive Application:
      a. Install a control grid at regular 15-foot intervals.
      b. Place adhesive around perimeter of area.
   4. TacFast Adhesive Application: Comply with recommendations of tape and carpet manufacturers.
   5. Seaming: Seal all seams and exposed edges.

3.5 ACCESSORIES

A. Edge Molding: Install at all exposed edges.

B. Transitions: Install where materials change.

3.6 FIELD QUALITY CONTROL

A. Carpeting materials in any contiguous area shall be from a single dye lot.

B. Visible differences in color or texture shall be grounds for rejection.

C. Inspect and verify materials upon delivery for quantity, packaging, labeling, condition,, and compliance with specification.

D. Government reserves right to take and retain possession of random samples of carpeting for testing by an independent laboratory.

3.7 ADJUSTING/CLEANING

A. Vacuum carpet using commercial machine with face-beater element.

B. Remove spots and replace carpet where spots cannot be removed.

C. Remove any protruding face yarn using sharp scissors.

D. Restrict traffic for a minimum of twenty-four hours for direct glue-down installation, forty-eight hours for double-stick installation, or as recommended by carpet manufacturer.

E. Clean and vacuum carpeting surfaces.

3.8 PROTECTION

A. Cover carpeted areas with non-staining building paper until final acceptance.

B. Do not use plastic sheeting.

C. Use sheets of hardboard or plywood in areas affected by rolling traffic.

END OF SECTION 09 68 00

SECTION 09 8414

ACOUSTIC STRETCHED-FABRIC WALL SYSTEMS

ALTERNATE #1

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Acoustic stretched-fabric wall system.

B. Accessories as required for complete installation.

1.02 RELATED REQUIREMENTS

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

1.03 REFERENCE STANDARDS

A. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method; 2009a.

B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2018.

C. ASTM E795 - Standard Practices for Mounting Test Specimens During Sound Absorption Tests; 2016.

D. ASTM E2573 - Standard Practice for Specimen Preparation and Mounting of Site-Fabricated Stretch Systems to Assess Surface Burning Characteristics; 2017.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.
   4. Specimen warranty.

C. Shop Drawings: Details indicating typical transitions to other finish surfaces.

D. Selection Samples: Fabric swatches representing manufacturer's full range of available colors, textures, and patterns.

E. Verification Samples:
   1. For each fabric specified, minimum size 12 inch (305 mm) square, representing actual product in color, texture, and pattern.

F. Test Reports: Certified test data from an independent test agency verifying that wall and ceiling systems meet specified requirements for acoustical and fire performance.

G. Maintenance Contract.

H. Warranty Documentation: Submit manufacturer's warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Supply an additional 10 (ten) percent of accessories installed for Owner's use in maintenance of project.
   2. Supply an additional 5 (five) percent of fabric installed for Owner's use in maintenance of project.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with at least three years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience and approved by manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect fabric, acoustical backing, and track from excessive moisture in shipment, storage, and handling.

B. Do not deliver materials to project until wet work such as concrete and plaster has been completed.

C. Store products in manufacturer's unopened packaging until ready for installation.

D. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.07 FIELD CONDITIONS

A. Do not begin installation until interior conditions have reached temperature and humidity that will be maintained during occupancy.

B. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.08 WARRANTY

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

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Acoustic Stretched-Fabric Wall Systems:
   1. Fabric Wall: www.fabric-wall.com/#sle.
   2. Fabricmate Systems: www.fabricmate.com/#sle.
   3. Snaptex; www.snaptex.com
   4. Substitutions: See Section 01 6000 - Product Requirements.

2.02 ACOUSTIC STRETCHED-FABRIC SYSTEM

A. Acoustic Stretched-Fabric System: Field installed, fabric is stretched and set into framework and laid over acoustic material anchored to substrate. Framework consists of continuous perimeter and intermediate mounting frames anchored to substrate, and designed to permit removal and replacement of fabric within framed areas without affecting adjacent areas.
   1. Surface Burning Characteristics: Flame Spread Index of 25, maximum; Smoke Developed Index of 450, maximum; when whole system is tested in accordance with ASTM E84 using mounting specified in ASTM E2573 for stretched systems.
   2. Noise Reduction Coefficient (NRC): 0.80, minimum, when tested in accordance with ASTM C423, Type A mounting per ASTM E795.
   3. Seams in fabric are not permitted; base the frame layout dimensions on fabric at least 72 inch (1.83 m) wide.

B. Provide materials and systems made of recycled content, at least 90 percent post-consumer or pre-consumer (post-industrial).

C. Verify that adhesives and sealants used in installation of acoustic stretched-fabric system have acceptable low VOC emission ratings.

2.03 MATERIALS

A. Frame: Extruded polymer framing system with serrated jaws of sufficient strength to hold fabric in place after repeated applications.
   1. Frame Color: As selected from manufacturer's standard colors.

B. Acoustic Material:
   1. 6-7 pcf fiberglass, Minimum 5/8" thick perforated mineral fiberboard.
   2. Provide type of acoustic material in thickness required to achieve Noise Reduction Coefficient (NRC) indicated.

C. Fabric: Heavy-duty fire-retardant commercial fabric, as provided by manufacturer of acoustic stretched-fabric system; color, pattern, and texture as selected from system manufacturer's fabric supplier's standard line of fabric.

D. Fasteners: As recommended by manufacturer of acoustic stretched-fabric system in accordance with project requirements.

E. Adhesives: Low VOC or water-based, approved by acoustic stretched-fabric system manufacturer, and complying with requirements of Section 01 6100.

PART 3 EXECUTION

3.01 EXAMINATION

A. Begin installation only after substrates have been properly prepared.

B. Verify that casework, markerboards, door and window jambs, finished ceiling, and other finished items adjacent or abutting the acoustic stretched-fabric system have been properly installed.

C. When preparation of substrate is the responsibility of another installer, notify Architect of unsatisfactory preparation prior to proceeding with this work.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation of this work.

B. Prepare substrate surfaces using methods as recommended by the manufacturer for achieving acceptable result as required for this work.

C. Remove wall plates and other obstacles, and properly prepare substrates to receive frames and acoustic material in accordance with manufacturer's instructions.

3.03 INSTALLATION

A. Install acoustic stretched-fabric system at locations indicated in accordance with approved shop drawings and manufacturer's instructions.

B. Frames: Install perimeter and intermediate frames using appropriate fasteners for prepared substrate, firmly secured to ensure frames do not separate from substrate.
   1. For tile or masonry substrates, apply continuous bead of adhesive along base of framing in addition to spacing of conical anchors and/or fasteners at 6 to 8 inches (152 to 203 mm) on center.
   2. Follow contours of wall and scribe to adjoining work at borders, penetrations, and imperfections.
   3. Install framing around openings and penetrations.
   4. Allow for spacing of framework to accommodate insertion of installation tool.

C. Acoustic Material: Cut and trim acoustic material to fit snugly within perimeter and intermediate framework.
   1. Apply adhesive and press acoustic material into place, maintaining constant plane.

D. Fabric: Stretch fabric over acoustic material, locking edges of fabric into frame's serrated jaws using manufacturer's recommended tool. Maintain fabric weave plumb, level and true, in proper relation to building lines, without ripples, waviness, hourglass, or other deleterious effects.
   1. Upon fabric installation, do not employ adhesives or mechanical fasteners of any type, and ensure fabric is free-floating and in contact with acoustic material as necessary.
   2. Stapling or gluing of fabric to cores or channel framework is not permitted.
   3. Provide tension in fabric sufficient to prevent sagging under anticipated changes in temperature and humidity.

3.04 CLEANING

A. Clean exposed surfaces of acoustic stretched-fabric system in compliance with manufacturers instructions for cleaning and repair of minor damage to exposed surfaces.

B. Remove and replace work that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage to system.

3.05 PROTECTION

A. Protect installed materials upon completion of this work, using methods that will ensure that the finished work is without damage or deterioration upon Date of Substantial Completion.

3.06 MAINTENANCE

A. See Section 01 7800 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.

B. Provide a separate maintenance contract for specified maintenance service.

END OF SECTION

SECTION 09 90 00

PAINTING AND COATING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Interior paint and coatings systems including paint, transparent coatings, and opaque finishes.

B. Field Painting: Includes exposed metal, hangers, exposed steel and iron work.

C. Painting is not required on pre-finished items including following factory-finished components:
   1. Acoustic materials.
   2. Finished mechanical and electrical equipment.
   3. Light fixtures.
   4. Concealed surfaces.
   5. Labels: Do not paint over Underwriters Laboratories, Factory Mutual or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.
   6. Concealed surfaces including wall or ceiling surfaces in generally inaccessible areas.

D. Related Sections:
   1. Section 07 92 00: “Joint Sealants.”
   2. Section 09 21 16: “Gypsum Board Assemblies.”
   3. Federal Acquisition Regulation (FAR).

E. Abbreviations:
   1. American Society for Testing Materials (ASTM)
   2. Underwriters Laboratories (UL)
   3. American National Standards Institute (ANSI)
   4. Factory Mutual (FM)
   5. Steel Structure Painting Council (SSPC)
   6. Environmental Protection Agency (EPA)
   7. Ozone Treatment Commission (OTC)
   8. Volatile Organic Compound (VOC)
   9. Indoor Environmental Quality (IEQ)
   10. National Institute for Occupational Safety and Health (NIOSH)
   11. National Association of Corrosion Engineers (NACE)
   12. Green Seal (GS)

1.2 REFERENCES

A. SSPC-SP 1 – Solvent Cleaning.

B. SSPC-SP 2 – Hand Tool Cleaning.

C. SSPC-SP 3 – Power Tool Cleaning.

D. SSPC-SP 13 – NACE No. 6 Surface Preparation for Concrete.

E. EPA-Method 24.

F. OTC-Regulation No. 41.

1.3 SUBMITTALS

A. Product Data:

1. Submit manufacturer's data sheets on each painting and coating product shall include:
    a. Manufacturer’s catalog number and general classification.
    b. Product characteristics.
    c. Surface preparation instructions and recommendations.
    d. Primer requirements.
    e. Finish specifications.
    f. Storage and handling requirements and recommendations.
    g. Application methods.
    h. Cautions.
2. List each material and cross-reference specific painting, coating, and finish system.

B. Samples:
1. Selection Samples: Submit a complete set of color chips that represent full range of manufacturer’s color samples available.
2. Verification Samples: For each finish product specified, submit samples that represents actual product, color, and sheen.

1.4 QUALITY ASSURANCE

A. Engage an experienced applicator who has completed painting and coating system applications similar in material and extent to those indicated for Project that have resulted in a construction record of successful in-service performance.

B. Provide primers and undercoat painting produced by same manufacturer as finish coats.

C. VOC emissions from painting shall not exceed VOC and chemical component limits of Green Seal requirements.

D. Mock-Ups:
1. Finish surfaces for verification of products, colors, and sheens shall be 12”x12,” minimum.
2. Finish area shall be a minimum of 4 SF and as designated by Government.
3. Provide samples that designate prime and finish coats.
4. Do no proceed with remaining work until Government approves mock-up samples.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Delivery:
1. Deliver manufacturer's unopened containers to project site.
2. Packaging shall bear manufacturer's name, label, and following information:
    a. Product name, type (description).
    b. Application and use instructions.
    c. Surface preparation.
    d. V.O.C. content.
    e. Environmental issues.
    f. Batch date.
    g. Color number and name.

B. Storage:
1. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.
2. Store materials in an area that is within acceptable temperature range, per manufacturer’s instruction.
3. Protect from freezing.

C. Handling:
1. Maintain a clean, dry storage area, to prevent contamination or damage to painting and coating materials.
2. Take necessary measures to ensure that workers and work areas are protected from fire and

health hazards resulting from handling, mixing, and application.

1.6 PROJECT/SITE CONDITIONS

A. Finish Material Application:
1. Apply finish material when temperature is 50 degrees F. or above.
2. Do not apply exterior materials in damp, rainy weather.
3. Do not apply paint on surfaces in direct sunlight.
4. Apply finishes only when air is free of dust that would speck finish.
5. Do not apply finishes unless moisture content of surfaces, as measured using an electronic moisture meter, are below following maximums:
   a. Gypsum Wallboard: 12 Percent.
   b. Interior Wood: 15 Percent.

B. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results.

C. Do not apply painting and coating under environmental conditions outside manufacturer's absolute limits.

D. Keep fire hazard to a minimum; remove all oily rags, waste, and other combustibles not in covered metal containers daily from area.

1.7 WARRANTY

A. Guarantee painting and coating for one year against becoming unserviceable or objectionable in appearance as a result of being defective or non-conforming.

B. Without limiting guarantee scope, work shall be guaranteed not to:
1. Noticeably discolor, flash yellow, streak, bloom, bleach or darken;
2. Change sheen with excessive speed or irregularity;
3. Peel, crack, blister or alligator;
4. Release from the substrate or intermediate coats;
5. Chalk or dust excessively;
6. Stay tacky or become tacky;
7. Mildew.

1.8 MAINTENANCE

A. Furnish one quart of each type and color of paint used.

B. Maintenance Data:
1. Manufacturer's cleaning instructions for painted surfaces.
2. Final paint schedule, listing manufacturer, product name and /or number, color name and /or number, and locations for each type of paint material.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:
1. The Sherwin-Williams Company
2. Benjamin Moore Paints
3. ICI Dulux Paints
4. Kwal Howells, Inc.
5. PPG Industries
6. Diamond Vogel

B. Basis of Design:

1. Sherwin Williams (SW)
2. Other manufacturer colors and products to match.

C. Substitutions:
1. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00, “Product Requirements.”
2. When submitting request for substitution, provide complete product data specified above under Submittals, for each substitute product.

2.2 MATERIALS

A. Filling Compounds: Use only high quality, non-shrink materials which have been approved.

B. Colors:
1. Shall be selected from paint manufacturer’s standard colors & as selected by Contracting Officer.

C. Paints and Primers:
1. Recycled Content: Minimum 20 percent post-consumer recycled content for light colors; minimum 50 percent post-consumer recycled content for dark colors.
2. Toxicity/IEQ:
   a. Comply with applicable regulations regarding toxic hazardous materials, and as specified.
   b. Paints and coatings shall meet or exceed VOC and chemical component limits of Green Seal requirements.
      1) Interior Paint: Comply with GS-11.

D. Painting and Coating:
1. Unless otherwise indicated, provide factory-mixed paints and coatings.
2. When required, mix paints and coatings to correct consistency in accordance with manufacturer’s instructions before application.
3. Do not reduce, thin, or dilute paints and coatings or add materials to paints and coatings unless such procedure is specifically described in manufacturer’s product instructions.
4. For opaque finishes, tint each coat including primer coat and intermediate coats, one-half shade lighter than succeeding coat, with final finish coat as base color.

E. Primers: Where manufacturer offers options on primers for a particular substrate, use primer categorized as “best” by manufacturer.

F. VOC Content and Environmental Requirements:
1. Limit VOC content of solvent borne and waterborne paint materials and coatings to the following limits as determined in accordance with Green Seal standard listed below or as determined in accordance with SCAQMD Rule #1113 for items not intended to comply with Green Seal standards:
   a. Flat Finish: Not more than 50 grams per liter (comply with GS-11).
   b. Non-Flat Finishes: Not more than 150 grams per liter (comply with GS-11).
   c. Concrete Sealer: Not more than 250 grams per liter (not intended to comply with GC-03 or GS-11).
   d. Wood Stain: Not more than 250 grams per liter (not intended to comply with GC-03 or GS-11).
   e. Clear Wood Varnished (Polyurethane): Not more than 350 grams per liter (not intended to comply with GC-03 or GS-11).
   f. "Anti-Corrosive" Coating for Interior and Exterior Metals: Not more than 250 grams per liter (not intended to comply with GS-11; comply with GC-03).
      1) This includes the clear urethane applied to aluminum components of the monumental stair and the metallic coating applied to elevator lobby doors, frames and transoms.
   g. Primers with Flat Sheen: Not more than 50 grams per liter (comply with GS-11).
   h. Primers with Non-Flat Sheen: Not more than 150 grams per liter (comply with GS-11).
2. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).

3. Restricted Components: Paints and coatings shall not contain any of the following:
   Acrolein.
   Acrylonitrile.
   Antimony.
   Benzene.
   Butyl benzyl phthalate.
   Cadmium.
   Di (2-ethylhexyl) phthalate.
   Di-n-butyl phthalate.
   Di-n-octyl phthalate.
   1 ,2-dichlorobenzene.
   Diethyl phthalate.
   Dimethyl phthalate.
   Ethylbenzene.
   Formaldehyde.
   Hexavalent chromium.
   Isophorone.
   Lead.
   Mercury.
   Methyl ethyl ketone.
   Methyl isobutyl ketone.
   Methylene chloride.
   Naphthalene.
   Toluene (methylbenzene).
   1,1, 1-trichloroethane.
   Vinyl chloride.

2.3 ACCESSORIES

A. Painting and Coating Application Accessories: Provide all primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials required per manufacturer's specifications.

2.4 SURFACES TO BE COATED

A. Interior Surfaces to be Painted and Coated:
   1. Metal: Galvanized metal, hollow metal door frames.
   2. Drywall: Walls and ceilings.
      a. Reflectance:
         1. Walls: 65%.
         2. Ceiling: 80%.

B. Interior Surfaces to be Stained:
   1. Interior Wood Doors: Transparent.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Do not begin painting and coating application until substrates have been properly prepared.

B. Notify Government of unsatisfactory conditions before proceeding.

C. Proceed with work only after conditions have been corrected, and approved by all parties, otherwise application of painting and coating materials will be considered as an acceptance of surface conditions.

3.3 PREPARATION

A. Surface shall be dry and in sound condition.

B. Remove oil, dust, dirt, loose rust, peeling paint, or other contamination to ensure good adhesion.

C. Mildew:
1. Remove mildew before painting by washing with a solution of one part liquid household bleach and three parts of warm water.
2. Apply solution and scrub mildewed area.
3. Allow solution to remain on surface for ten minutes.
4. Rinse thoroughly with clean water and allow surface to dry forty-eight hours before painting.
5. Wear protective glasses or goggles, waterproof gloves, and protective clothing.
6. Quickly wash off any of mixture that comes in contact with your skin.
7. Do not add detergents or ammonia to bleach/water solution.

D. Drywall Preparation Methods:
1. Shall be clean and dry.
2. All nail heads shall be set and spackled.
3. Joints shall be taped and covered with a joint compound.
4. Spackled nail heads and tape joints shall be sanded smooth and all dust removed prior to painting.

E Existing Surface Preparation Methods for Repainting:
1. Where existing work is cut, patched, or added to, paint or touch up all surfaces to match adjacent present work as closely as possible.
2. Prepare existing surfaces to provide good adhesion for paint.
3. Thoroughly clean and degloss by sanding or other means prior to painting.
4. Spot prime patched and bare area with same primer as specified for new work.

F. No painting should take place when interior temperature is below 50 degrees F. unless specified product is designed for marginal conditions.

G. WARNING:
1. Removal of old paint by sanding, scraping or other means may generate dust or fumes that contain lead.
2. Exposure to lead dust or fumes may cause brain damage or other adverse health effects, especially in children or pregnant women.
3. Controlling exposure to lead or other hazardous substances requires use of proper protective equipment, such as a properly fitted respirator (NIOSH approved) and proper containment and cleanup.
4. For more information, call National Lead Information Center at 1-800-424-LEAD (in US) or contact your local health authority.

3.4 APPLICATION

A. Items and Surfaces Not to be Painted:
1. Cover and protect finished work and surfaces not to be painted.
2. Use drop cloths of adequate size to protect adjacent areas.
3. Remove hardware, hardware accessories, machines surfaces, plates, lighting fixtures, and similar items in place and not to be painted, or provide surface applied protection.
4. Reinstall removed items when final coat is thoroughly dry.

B. Painting and Coating:
1. Apply all coatings and materials in accordance with manufacturer’s specifications.
2. Mix and thin coatings according to manufacturer’s recommendation.
3. Do not apply to wet or dry surfaces.
4. Apply coatings using methods recommended by manufacturer.
5. Uniformly apply coatings without runs, drips, or sags, without brush marks, and with

consistent sheen.
6. Apply coatings at spreading rate required to achieve manufacturer's recommended dry film thickness.
7. Regardless of number of coats specified, apply as many coats as necessary for complete hide and uniform appearance.
8. Inspection: Coated surface shall be inspected and approved by Government just prior to each coat.
9. Do not paint over dirt, rust, scale, grease, moisture, voids and blemishes, or other conditions detrimental to formation of a durable paint film.
10. Apply paint in accordance with manufacturer's directions.
11. Use techniques best suited for substrate and type of material being applied.
12. Secure approval of each coat before proceeding with next.
13. Apply materials evenly without runs, sags, or other defects.
14. Leave moldings, trim, ornaments, edges, and millwork clean and true to details without excess paint in corners or depressions.
15. Make edges of paint adjoining other materials or colors sharp and clean, without overlaps.
16. Paint interior surfaces of ducts visible through registers or grilles with a flat black paint.
17. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
18, Finish access panels, grilles, registers, and similar items in same color as their surroundings.
19. Apply materials at not less than manufacturer's recommended spreading rate, to establish a total dry film thickness as recommended by manufacturer.

C. Drying Time:
1. Minimum time recommended by manufacturer.
2. Do not apply succeeding coats until undercoat is thoroughly dry.

D. Sanding:
1. Lightly sand between coats to ensure that surface finish is smooth to touch.

E. Additional Coats:
1. Apply additional coats when undercoats, stains, or other conditions show through final coat or paint.
2. Final finish shall have uniform color and appearance.

F. Existing Surface Preparation for Repainting:
1. Where existing work is cut, patched, or added to, paint or touch up all surfaces to match adjacent present work as closely as possible.
2. Prepare existing surfaces to provide good adhesion for paint.
3. Thoroughly clean and degloss by sanding or other means prior to painting.
4. Spot prime patched and bare area with same primer as specified for new work.

3.5 CLEANING

A. At end of each work day, remove empty cans, rags, rubbish, and other discarded painting and coating materials from site.

B. Paint Spatters:
1. After completing painting, clean glass and paint-spattered surfaces.
2. Remove spattered paint by washing and scraping.
3. Use care to not scratch or damage adjacent finished surfaces.

3.6 PROTECTION

A. Protect finished coating from damage until completion of project.

B. Touch-up damaged painting and coating after substantial completion, following manufacturer's recommendation for touch-up or repair of damaged coatings.

C. Repair any defects that will hinder performance of coatings.

D. Provide “Wet Paint” signs to protect newly painted finishes.

E. Remove temporary protective wrappings provided by others to protect their work after completing painting operations.

3.7 SCHEDULES

A. Paint colors to be selected by Government. Assume 1 base color and 2 accent colors (20% of walls).

B. Existing Surfaces:
   1. Clean, fill, patch, sand as required. Roughen glossy surfaces and prepare for finish painting as recommended by manufacturer for surface and finish to be applied. Provide texture on patched surface to match adjacent surfaces. Prime or seal patched areas and apply one or two finish coats as scheduled for same or similar surfaces.

END OF SECTION 09 90 00

SECTION 10 14 00

SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Panel signage.
   2. Entry door – agency identification decal.

B. Related Sections:
   1. Section 09 21 16: “Gypsum Board Assemblies.”
   2. Federal Acquisition Regulation (FAR).

C. Abbreviations:
   1. Architectural Barriers Act Accessibility Standards (ABAAS)
   2. International Code Council (ICC)
   3. American National Standards Institute (ANSI)

1.2 REFERENCES

A. American National Standards Institute, Inc. (ANSI).

B. American National Standards for Making Buildings and facilities Accessible to and Usable by Physically Handicapped People, ICC/ANSI A117.1, and Uniform Federal Accessibility Standards (UFAS).

C. International Building Code (IBC) 2006.

1.3 SUBMITTALS

A. Product Data:
   1. Letter:
      a. Identifying manufacturer of materials.
      b. Stating that materials are in conformance with specifications.

B. Shop Drawings:
   1. Typical sign layout.
   2. Lettering style and size.
   3. Required symbols.
   4. Method of attachment to substrate.
   5. Schedule: Show location and mounting height of each sign.

C. Samples: Manufacturer’s standard colors.

D. Certificate: Stating that materials are in conformance with specifications.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store all materials in a manner to provide protection from damage and exposure to elements.

B. Remove damage or deteriorated materials from premises.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Interior Signs:
   1. ANDCO.
   2. A.R.K. Ramos

3. Arapahoe Signs
4. Gardner Signs
5. Gemini
6. Lynn Sign Co.
7. Matthews International Corp.
8. Metal Arts, Div. of L&H Manufacturing Co.
9. Metallic Arts
10. Mills Manufacturing Co.
11. Seaboard Graphics Inc.
12. The Southwell Co.
13. Spanjer Brothers, Inc.
14. The Supersine Co.

2.2 MATERIALS

A. Cast Acrylic Sheet:
1. Provide cast (not extruded or continuous cast) methacrylate plastic sheet with a minimum flexural strength of 16,000 psi, ASTM 0790, minimum allowable continuous service temperature of 180° F. , in sizes and thicknesses indicated, and in the following general types:
    a. Transparent Sheet: Where indicated as "clear" provide colorless sheet with light transmittance of 93%, ASTM 01 003, in matte finish.
    b. Opaque Sheet: Where indicated as "opaque" provide colored opaque acrylic sheet in colors and finishes indicated, or if not indicated, as selected from manufacturer's standards.

B. Photopolymer Sheet:
1. Provide 0.125" sheet thickness prior to etching. Provide sheet that retains photographic image of sign copy on the sheet to allow etching of remainder of sheet to achieve raised lettering as specified.

C. Decorative Resin Panels:
1. Provide decorative resin panels complying with the applicable requirements of Section 06 60 00.
2. Provide 3form - Varia EcoResin by Simtec Surfaces as follows:
    a. Thickness: 0.25".
    b. Finish: Supermatte on each face.
    c. Edge Seal: Required.
    d. Colors and Patterns: As indicated in the Room Finish Schedule of Materials on the drawings.

D. Vinyl Film:
1. Combination of clear and opaque non-reflective vinyl film, 0.0035” minimum thickness, with pressure sensitive adhesive application.
2. Assume 30” x 30” minimum image for agency logo.
3. Location: Glass Entry.

2.3 FABRICATION OF PANEL SIGNS

A. General:
1. Fabricate panel signs to comply with requirements indicated for materials, thicknesses, finishes, designs, shapes, sizes and details of construction in colors as selected by Architect.
2. Produce smooth, even, level sign panel surfaces, constructed to remain flat under installed conditions within a tolerance of ±1/16" measured diagonally from corner to corner.

B. Locations:
1. Provide one panel sign at each interior door location (either single door or paired door location; either new or existing), except at the following locations:
    a. Cross-corridor doors.

b. Vestibule doors.
2. Provide life safety signage.
3. Coordinate final locations and text with Government.

C. Unframed Panel Signs:
1. Fabricate unframed panel signs with edges mechanically and smoothly finished with square cut edges and square corners.
a. Provide NocAcryl - ECR Series by Nova Polymers or approved equal. Include changeable insert where indicated.

D. Laminated Sign Panels:

E. Permanently laminate 0.125" (maximum) clear photopolymer face panels to 0.25" decorative resin panel backing sheets using manufacturer's standard process.
1. Include solid color acrylic sheet for spacer at back of signs as indicated.

F. Graphic Image Process:
1. Provide sign copy to comply with requirements indicated for sizes, styles, spacings, content, positions, materials, finishes and colors of letters, numbers, symbols and other graphic devices.
a. Typestyle: Futura unless otherwise required to comply with accessibility requirements.

G. Raised Copy:
1. Photograph required copy including pictograms and Grade 2 braille lettering (where required), onto photopolymer sheet. Etch photopolymer sheet to produce raised copy. Apply colored coating to face of raised copy only (do not apply to sides of raised copy). Provide raised copy thickness not less than 0.03125" thick.
2. Provide International symbol for handicapped access on signage designated for those areas accessible for the handicapped as required by ADA
3. Pictograms, if used, shall be accompanied with the equivalent written description placed below the pictogram.

PART 3 - EXECUTION

3.1 ERECTION/INSTALLATION/APPLICATION

A. Attach as shown, using non-staining cement adhesive or screw attachment supplied by manufacturer.

B. Following elements and spaces of accessible facilities shall be identified by international symbol of accessibility:
1. Accessible toilet rooms.

C. Following elements and spaces shall be provided with directional signage indicating route to nearest similar accessible element:
1. Inaccessible building entrances.

D. Provide a tactile sign including raised letters and Braille stating EXIT that complies with ICC/ANSI A117.1.

E. Provide signs indicating location of accessible means of egress at exits serving a required accessible space, but not providing an approved accessible means of egress.

F. Install signs in strict accordance with manufacturer's recommendations.

G. Rigidly install signs straight, level, and in perfect alignment.

H. Mounting Height, Interior space: 54 inches to centerline of sign above finished floor.

3.2 ADJUSTING

A. Carefully adjust all signs to be plumb and level.

3.3 INDOOR AIR QUALITY MANAGEMENT:

A. Manage indoor air quality in accordance with provisions of Section 01 33 29.

3.4 CONSTRUCTION WASTE MANAGEMENT:

B. Manage construction waste in accordance with provisions of Section 01 74 19. Submit documentation to satisfy the requirements of that section.

3.3 CLEANING

A. Clean finish surfaces.

B. Leave free from imperfections.

END OF SECTION 10 14 00

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SECTION 10 26 00

STAINLESS STEEL CORNER GUARDS

PART 1 – GENERAL

1.1 SUMMARY

A. Corner guard system for wall corner protection.

B. Related Sections:
1. Section 09 21 16: “Gypsum Board Assemblies.”
2. Federal Acquisition Regulation (FAR).

C. Abbreviations:
1. National Sanitation Foundation (NSF).

1.2 SECTION INCLUDES

A. Stainless Steel Corner Guard Systems

1.3 SUBMITTALS

A. Product data for each type of corner guard specified.

B. Detail drawings indicating mounting details with the appropriate fasteners for specific project substrates.

C. Samples for verification purposes of corner guard, 6" (152mm) long, in full size profiles of each type and color indicated.

D. Cleaning and maintenance instructions for door and wall protection systems.

1.4 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in unopened factory packaging to the jobsite and store in original packaging in a climate controlled location away from direct sunlight.

1.5 PROJECT CONDITIONS

A. Products must be installed in an interior climate controlled environment.

1.6 WARRANTY

A. Standard Manufacturer Limited Lifetime Warranty against material and manufacturing defects.

PART 2 – PRODUCTS

2.1 MANUFACTURER

A. Acceptable Manufacturer’s:
1. IPC Door and Wall Protection Systems, Muskego, WI 53150, 800-222-5556
2. Equivalent product of an approved manufacturer.

B. Provide all corner guards and wall protection from a single source.

2.2 MANUFACTURED UNITS

A. Corner Guards

1. Stainless Steel Corner Guards (basis of design)
2. Model: 181124C-430, 1-1/2" (38mm) x 1-1/2" (38mm) 1/8" radius, Cement-on, Height: 4' (1.22m).

2.3 MATERIALS

A. Stainless Steel: Corner Guards shall be manufactured from Type 430, 16 gauge Stainless Steel.

2.4 COMPONENTS

A. Attachment
   1. Adhesive: Field applied heavy duty adhesive as recommended by manufacturer.

2.5 FINISHES

A. Stainless steel: No. 4 satin finish.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions in which the corner guard systems will be installed.
   1. Complete all finishing operations, including painting, before beginning installation of corner guards.

B. Wall surface shall be dry and free from dirt, grease and loose paint.

3.2 PREPARATION

A. General: Prior to installation, clean substrate to remove dust, debris and loose particles.

3.3 INSTALLATION

A. General: Locate the corner guard in compliance with the Manufacturer's installation instructions. Install corner guard level and plumb from subfloor to 4' above finished floor. Install at all outside corners throughout the Area of Work.

B. Installation of Stainless Steel Corner Guards:
   1. Surface must be dry, clean and properly sealed.
   2. Cement on: Apply a bead of Premium Heavy Duty Adhesive in a zigzag pattern over the back of each wing of the corner guard. Position corner guard on the wall and apply pressure until a tight fit is achieved.
   3. Remove the protective plastic covering from the exposed surface of the corner guard.

3.4 CLEANING

A. At completion of the installation, clean surfaces in accordance with the Manufacturer's clean up and maintenance instructions.

END OF SECTION

SECTION 12 30 00

CASEWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Manufactured wood casework.
2. Countertops.

B. Related Sections:
1. Section 06 10 00, "Rough Carpentry."
2. Division 22, “Plumbing.”
3 Division 23, "Mechanical."
4. Division 26, "Electrical."

1.2 SUBMITTALS

A. Product Data: Manufacturer's data and installation instructions for each type of manufactured casework.

B. Shop Drawings: Shall include plans, elevations, ends, details and location of anchorages and fitting to floors, walls and base, layout of units with respect to surrounding walls, doors, windows, existing casework and other building components.

C. Samples:
1. Plastic laminate color, size: 12”x12” minimum.

1.3 QUALITY ASSURANCE

A. Provide casework and counter tops manufactured or furnished by same equipment company for single responsibility.

B. Catalog Standards:
1. Manufacturer's catalog numbers are shown in these Specifications for convenience in identifying certain cabinet work and are based upon L.S.I. Corporation of America Inc.
2. Catalog description for indicated number constitutes requirements for each such cabinet.
3. Use of catalog numbers, and specific requirements set forth in Drawings and Specifications, are not intended to preclude use of any other acceptable manufacturer's product of procedures which may be equivalent, but are given for purpose of establishing a standard of design and quality for materials, construction, and workmanship.
4. Modifications to standard products shall be by notation of Drawings or otherwise specified.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver casework only after wet operations in building are completed.

B. Store completed casework in a ventilated place, protected from weather; keep covered with polyethylene film or other protective covering.

1.5 PROJECT/SITE CONDITIONS

A. Advise Contractor of requirements for maintaining heating, cooling, and ventilation in installation areas as required to reach relative humidity necessary to maintain optimum moisture content.

B. Provide a relative humidity of 50 percent or less at 70 degrees F. in spaces where casework is to be installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufactured Wood Casework:
   1. Case Systems.
   2. LSI Corporation of America
   3. R & R Millwork.
   4. T.M.I. Systems Design Corp.
   5. Westmark.
   6. Sidney Millwork Company.

2.2 MATERIALS

A. Particle (composition) Board: High grade industrial monolithic, water-proof type at countertops, 45 PCF, minimum density, 1-1/4 inches for shelves spanning 36 inches to 48 inches. 1 inch for shelves spanning up to 36 inches., 3/4 inch for main body, 5/8 inch elsewhere, 1/2 inch permitted when laminated to other structural materials, exposed unfinished edges prohibited.

B. Hardboard: Oil impregnated wood fiber, uniform density, 90 PSI internal bond, 3,000 PSI modulus of rupture, three-hundred-twenty-five pounds screw holding power, smooth finish both sides.

C. High Pressure Plastic Laminate:
   1. Vertical surface: NEMA Standards, suede surface finish.
      a. Color: North Sea D90-60. Matte Finish
   2. Counter top: 0.05 inch, minimum thickness, satin finish, heavy gauge balancing sheet with textured finish.
      a. Color: Calcutta Marble 4925k-07. Textured Gloss Finish with AEON.

2.3 MANUFACTURED PLASTIC-LAMINATE-CLAD CASEWORK

A. Joinery:
   1. 8 mm. Fluted dowels plus glueScrew: For accessory attachment only.
   2. Staples or nails not permitted.

B. Cabinets:
   1. Sub-base: Continuous, unfinished fir plywood, 3/4 inch thickness; particle board prohibited within 3 vertical inches of finished floor.
   2. Base Cabinet Top and Bottom: Particle board, 3/4 inch thickness.
   3. Wall Cabinet Top and Bottom: Particle board, 1 inch thickness; use concealed screws and fastening devices on bottom side.
   4. End: Particle board, 3/4 inch thickness, provide adjustable 2 inches on center standard shelving holes.
   5. Back: Particle board 3/4 inch thickness, exposed exterior back; provide removable back panels and closure panels for plumbing access where required for plumbing, etc.
   6. Vertical and Horizontal Divider: Particle board, 3/4 inch thickness, smooth finish both sides; secure to cabinet with molded plastic clips.

C. Door and Drawer Front: Particle board, 3/4 inch thickness.

D. Shelves: Particle board, 36 inches maximum unsupported free span for adjustable shelves, 48 inches maximum unsupported free span for fixed shelves, 1 inch, minimum thickness for spans up to 36 inches, 1-1/4 inches minimum thickness for spans 36 to 48inches.

E. Drawers:
   1. Rabbet or tongue and groove construction, butt joints prohibited.
   2. Subfronts: Particle board, 5/8 inch thickness, putty color polyester laminate interior face finish.
   3. Side and Back: Particle board, 1/2 inch thickness, putty color polyester laminate.
   4. Exposed top edge: P.V.C., putty color.

5. Bottom: Hardboard, 1/4 inch thickness, putty color polyester laminate exposed face finish; reinforce as required with intermediate spreaders.

F. Edge: Flat Edge Plastic Laminate to match countertop.

G. Finish:
1. Exterior: High pressure decorative plastic laminate, 0.03 inch, minimum, low glare, fine textured.
2. Interior: White Melamine.
3. Concealed Surfaces: Sealer.
4. Laminate adhesive: Liquid polyvinyl acetate, bond at 15 PSI., minimum; contact adhesives prohibited.
5. Shelving: High pressure plastic laminate at top and front edge; polyester laminate at bottom.

H. Hardware:
1. Manufacturer's standard types, styles and finishes, and as indicated below.
2. Comply with BHMA A156.9 requirements.
    a. Acceptable base materials for plated finishes include brass, bronze, and steel.
3. Locks: Provide locks on casework drawers and doors where indicated. Coordinate keying with Government.
    a. Hinged Doors: Cam type lock, satin chromium plated over nickel on base material.
    b. Tall Hinged Doors: Three-point latching system.
    c. Master Key System: All locks operable by master key.
4. Shelves in Cabinets:
    a. Shelf Standards and Rests: Vertical standards with rubber button fitted rests, satin chromium plated over nickel on base material.
5. Swinging Doors: Hinges, pulls, and catches.
    a. Hinges: Concealed, number as required by referenced standards for width, height, and weight of door.
        1. Concealed Hinges: Installed in cabinet edge, and on door back, satin chromium plated over nickel on base material.
    b. Pulls: Chrome wire pulls, 4 inches (102 mm) wide.
    c. Catches: Magnetic.
6. Drawers: Pulls and slides.
    a. Pulls: Chrome wire pulls, 4 inches (102 mm) wide.
    b. Slides: Steel, full extension arms, ball bearings; self-closing; capacity as recommended by manufacturer for drawer height and width.

2.4 COUNTERTOPS

A. Particle board, 3/4 inch thick, 4 inches minimum height backsplash and sidesplash, required at all terminations to vertical building surfaces and cabinet surfaces.

B. High pressure plastic laminate finish at surface and edge, color as noted above.

C. Laminate adhesive: Liquid polyvinyl acetate bonded at 15 PSI., minimum; contact adhesives prohibited.

2.5 HIDDEN COUNTERTOP BRACKETS

A. Basis of Design: Hidden Cali-Brackets.
1. Located at each stud.
2. Finish: Black painted steel

2.6 SOURCE QUALITY CONTROL

A. Above specifications are standard manufacturing procedures, not custom order.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Installer shall examine substrate and conditions under which work is to be performed, notify Contractor, in writing, of unsatisfactory conditions.

B. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to installer.

3.2 ERECTION/INSTALLATION/APPLICATION

A. Verify dimensions of cabinet locations in building prior to fabrication.

B. Install plumb, level, true and straight with no distortions, shim as required, using concealed shims.

C. Scribe and cut for accurate fit; before making cutouts, drill pilot holes at corners where cabinets abut other finished work.

D. Trim and Moldings: Install in single, unjointed lengths for openings and for runs less than maximum length of lumber available; for longer runs, use only one piece less than maximum length available in any straight run; stagger joints in adjacent members.

E. Countertops:
   1. Fabricate counter tops for scribe fit.
   2. Provide continuous tops for counter type cabinets fixed in a line.
   3. Apply plastic laminate to edges so that top laminate will cover edges.
   4. External corners: Beveled or radiused profile.

3.3 ADJUSTING

A. Repair and replace defective work upon completion of installation.

B. Adjust casework and hardware so that doors and drawers operate smoothly without warp or bind.

3.4 CLEANING

A. Remove all cartons, debris, sawdust, scraps, etc.; leave spaces clean; and clean shop-finished woodwork and leave all casework ready for Owner’s use.

B Touch-up as required or remove and refinish damaged or soiled areas.

3.5 PROTECTION

A. Cover casework with 4 mil polyethylene film, for protection against soiling and deterioration during remainder of construction period.

END OF SECTION 12 30 00

SECTION 211313

WET-PIPE SPRINKLER 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.

B. SUMMARY

C. Section Includes:

1. Pipes, fittings, and specialties.
2. Fire-protection valves.
3. Sprinklers.
4. Alarm devices.
5. Pressure gages.
6. Other fire sprinkler related appurtenances

D. Related Sections:

1. Division 1 Section “Submittal Procedures”
2. Division 7 Section “Firestopping”
3. Division 9, Section “Painting”
4. Division 28, Section “Digital Addressable Fire Alarm Systems” GSA Addressable/Analog Fire Alarm Specification

1.2 DESCRIPTION OF WORK

A. Scope: Provide a complete wet-pipe automatic sprinkler system, and associated equipment, ready for operation as shown on the Construction Documents and specified herein.

B. Description of Work: The work includes replacing the existing sprinkler heads in Area 3 with new quick response heads. The head locations will not change, but heads will be installed in the new ceiling.

C. Compliance: The entire wet-pipe automatic sprinkler system shall be designed in accordance with the specification. Any reference to "authority having jurisdiction" shall be interpreted to mean the GSA Regional Fire Protection Engineer. All material and equipment used shall be listed or approved by UL, FM or another nationally recognized testing agency approved by the GSA Regional Fire Protection Engineer, for their intended use and service.

1.3 PERFORMANCE REQUIREMENTS

A. General: Sprinkler system modifications shall follow the design shown on the Construction Documents. Any revised design shall be in accordance with all required and advisory provisions of NFPA 13, including all the Annexes, except where modified herein.

B. Sprinkler System Layout: Approved by GSA Regional Fire Protection Engineer.

1.4 SUBMITTALS

A. Submittals to be in accordance with Division 1, Submittal Procedures unless otherwise indicated by this section.

B. Product Data: Submit six (6) bound sets of submittals to the GSA Project Manager for each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories. Partial submittals will not be acceptable and will be returned without review. Before any work is commenced, the submittal must be approved by the GSA Regional Fire Protection Engineer. Manufacturer's data shall be provided for all products listed in Part 2 of this specification and annotated to show the specific model, type and size of each item:

C. Shop Drawings: For wet-pipe sprinkler systems, submit six (6) set of drawings to the GSA Project Manager that include all information as required by NFPA 13. The drawings shall be prepared on uniform sized sheets not less than 30 in by 42 in (760 by 1070 mm) unless GSA Fire Protection Engineer approves a smaller size. Partial submittals will not be acceptable and will be returned without review. Before any work is commenced, the submittal must be approved by the GSA Regional Fire Protection Engineer. Include plans, elevations, sections, details, isometric diagram of sprinkler system riser piping showing all control valve locations, and attachments to other work.

1. Layout indicating details, plan view, elevations and sections of the system piping. Indicate the location of sprinklers and piping in relation to the ceiling layout, showing pipe lengths and sizes.

2. Detailed riser diagram including isometric diagrams showing schematic of systems supply, supply connection, devices, valves, pipe and fittings.

3. Provide three (3) sets of CAD based electronic shop drawings to the GSA Project Manager; each set shall include DWG and DWF file formats, including all associated externally referenced electronic files (Xref's). These files shall contain externally referenced files that have been inserted (do not bind the Xref's). Provide both DWG and DWF file formats on three (3) separate recordable CD-R's (do not use CD-RW's or DVD-R/RW's). In addition, provide in each set a read only PDF copy of each As-Built drawing for archiving purposes. PDF files shall be created using the PDF Creator utility. These three (3) CD-R's shall be formatted, written to, and the recording session closed in such a manner as to prevent additional electronic file transfers to the recordable CD-R's.

D. Verification of Qualification. Prior to installation, submit documentation, to the GSA Project Manager, showing that the Contractor has successfully installed automatic fire suppression sprinkler systems of comparable size, type and design as specified herein or that the Contractor has a firm contractual agreement with a Subcontractor having such experience.

1. The data shall include the names and locations of at least three installations where the Contractor, or Subcontractor, installed such systems.

2. he Contractor, or Subcontractor, shall certify that each system has performed satisfactorily for a period of not less than one year.

3. The Contractor of Subcontract shall submit the NICET/PE certification/license number and expiration date.

E. As Built Drawings:

1. General: Prepare and submit to the GSA Project Manager six (6) sets of detailed "As-Built Drawings". The drawings shall show the system as installed, including all deviations from both the project drawings and the approved shop drawings. The drawings shall also include all information as required by NFPA 13. The drawings shall be prepared on uniform sized sheets not less than 30 in by 42 in (760 by 1070 mm). Submit these drawings within two weeks after the final acceptance test of the system.

2. Provide three (3) sets of CAD based electronic as-built drawings to the GSA Project Manager; each set shall include DWG and DWF file formats, including all associated externally referenced electronic files (Xref's). These files shall contain externally referenced files that have been inserted (do not bind the Xref's). Provide both DWG and DWF file formats on three (3) separate recordable CD-R's (do not use CD-RW's or DVD-R/RW's). In addition, provide in each set a read only PDF copy of each As-Built drawing for archiving purposes. PDF files shall be created using the PDF Creator utility. These three (3) CD-R's shall be formatted, written to, and the recording session closed in such a manner as to prevent additional electronic file transfers to the recordable CD-R's.

F. Field Test Reports and Certificates: Submit test certification, to the GSA Project Manager, for all pipe and fittings. 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."

G. Operation and Maintenance Data: Not less than calendar days prior to the final acceptance testing of the entire system, and for use during the instruction period hereinafter specified, provide six (6) bound copies of an Operation and Maintenance Manual to the GSA project Manager. The manual shall include an index, copies of all approved shop drawings and submittal materials (updated to as-built), and a complete parts list of all components. The manual shall also include, for each item, the manufacturer's name, the serial number of the part, an ordering number, if appropriate, and a physical description of the part. The manual shall include all data relative to alarm valves, waterflow switches and tamper switches.

1.5 QUALITY ASSURANCE

A. Qualifications:

1. Layout and hydraulic calculation shall be performed by a NICET Level III or IV Technician certified in Automatic Sprinkler Systems Layout or a Registered Fire Protection Engineer.

2. Installation shall be performed by a licensed sprinkler contractor who is experienced in the layout and installation of automatic sprinkler systems (minimum 3 years) of comparable size and type.

3. Installer's responsibilities include layout, fabrication, and installation of sprinkler systems.

4. Drawings shall be sealed by a licensed Professional Fire Protection Engineer.

B. Applicable References: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the latest editions of the following codes and standards:

1. National Fire Protection Association (NFPA), including all amendments and annexes

a. NFPA 13, "Installation of Sprinkler Systems."

2. Underwriter's Laboratories (UL)

    a. "Fire Protection Equipment Directory"

3. Factory Mutual Global (FM)

    a. Approval Guide

4. American Standard for Testing Materials (ASTM)

    a. ASTM A53/A53M, "Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless"

    b. ASTM A47/A47M, "Standard Specification for Ferritic Malleable Iron Castings"

    c. ASTM A153, "Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware"

    d. ASTM A234/A234M, "Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service"

    e. ASTM A536, "Standard Specification for Ductile Iron Castings"

    f. ASTM A733, "Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless-Steel Pipe Nipples"

    g. ASTM A795, "Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use"

    h. ASTM A865, "Standard Specification for Threaded Couplings, Steel, Black or Zinc-Coated (Galvanized) Welded or Seamless, for Use in Steel Pipe Joints"

    i. ASTM B75/B75M, "Standard Specification for Seamless Copper Tube"

    j. ASTM B88, "Standard Specification for Seamless Copper Water Tube"

    k. ASTM B584, "Standard Specification for Copper Alloy Sand Castings for General Applications"

    l. ASTM B633, "Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel"

    m. ASTM F2014, "Standard Specification for Non-Reinforced Extruded Tee Connections for Piping Applications"

5. American Society of Mechanical Engineers (ASME)

    a. ASME B1.20.1, "Pipe Threads, General Purpose"

    b. ASME B16.1, "Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250"

    c. ASME B16.3, "Malleable Iron Threaded Fittings"

    d. ASME B16.4, "Gray Iron Threaded Fittings"

    e. ASME B16.5, "Pipe Flanges and Flanged Fittings: NPS 1/2 through 24"

    f. ASME B16.9, "Factory-Made Wrought Buttwelding Fittings"

g. ASME B16.21, “Nonmetallic Flat Gaskets for Pipe Flanges”

h. ASME B16.22, “Wrought Copper and Copper Alloy Solder Joint Pressure Fittings”

i. ASME B16.24, “Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes 150, 300, 600, 900, 1500 and 2500”

j. ASME B18.2.1, “Square and Hex Bolts and Screws, Inch Series”

6. American Welding Society (AWS)

a. A5.8, “Specification for Filler Metals for Brazing and Braze Welding”

b. D10.12/D10.12M, “Guide for Welding Mild Steel Pipe”

7. Manufacturer’s Standardization Society (MSS)

a. SP-123, “Non-Ferrous Threaded and Solder-Joint Unions for Use with Copper Water Tube”

8. Federal Specifications

a. TT-P-636

9. International Code Council (ICC)

a. International Building Code (IBC)]

C. Guarantee. The Contractor shall guarantee labor, materials, and equipment provided under this contract against defects for a period of one year after the date of final acceptance of this work by the Government. Final Acceptance includes, but is not limited to, the receipt of as-built drawings and operation and maintenance manuals. Contractor shall be able to provide qualified personnel to site within a two (2) hour time frame and be available 24 hours a day, 7 days a week.

D. Conflicts. The system shall be installed in accordance with the drawings, specifications and referenced publications. Any conflicts between these documents shall be brought to the attention of the GSA Project Manager and the GSA Regional Fire Protection Engineer.

1.6 PROJECT CONDITIONS

A. Interruption of Existing Sprinkler Service: Do not interrupt sprinkler service to facilities without prior approval of the GSA Regional Fire Protection Engineer and the facility’s Senior Property Manager:

1. Existing Sprinkler Equipment: Existing sprinkler equipment shall be re-piped as required.

2. When sprinkler interruption is necessary, a written plan for putting the system back into service shall be submitted to the GSA Regional Fire Protection Engineer and the facility’s Senior Property Manager.

3. Equipment Removal: After acceptance of the new system by the Government, all existing equipment so indicated shall be removed and all damaged surfaces shall be restored as herein specified.

1.7 COORDINATION

A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

PART 2 - PRODUCTS

2.1 All products shall be UL listed or FM approved for Fire Protection Service unless specifically allowed otherwise by this specification.

2.2 PIPING MATERIALS

A. Materials shall be steel or ductile iron.

2.3 STEEL PIPE AND FITTINGS

A. Schedule 40, Black-Steel Pipe: ASTM A795, in NPS 2 in (DN 50) and smaller. Pipe ends may be factory or field formed to match joining method.

B. Schedule 10, Black-Steel Pipe: ASTM A795, Schedule 10 in pipe greater than NPS 2 in (DN 50). Pipe ends may be factory or field formed to match joining method.

C. Black-Steel Pipe Nipples: ASTM A733, made of ASTM A795, Schedule 40 steel pipe with threaded ends.

D. Steel Couplings: ASTM A865, threaded.

E. Malleable- or Ductile-Iron Unions: UL listed.

F. Cast-Iron Flanges: ASME 16.1, Class 125.

G. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.

H. Steel Welding Fittings: ASTM A234/A234M and ASME B16.9.

I. Malleable Iron Fittings: ASMT B16.3, Class 150

J. Grooved-Joint, Steel-Pipe Appurtenances:

1. Pressure Rating: 175 psig minimum.

2. 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 rigid pattern, unless otherwise indicated by this specification, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.4 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials: [AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick] [ASME B16.21, nonmetallic and asbestos free].

1. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.

2. Class 250, Cast-Iron Flanges and Class 300, Steel Raised-Face Flanges: Ring-type gaskets.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated by this specification.

C. 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.

1. Valve Operation: Integral supervisory switch with visual indicating device.

2.5 SPRINKLERS

A. General Requirements:

1. Pressure Rating for Automatic Sprinklers: 175 psig minimum.

2. Sprinklers with O-rings are not permitted.

B. Automatic Sprinklers with Heat-Responsive Element:

1. Characteristics: Nominal ½-inch (12.7-mm) orifice with Discharge Coefficient K of 5.6, Quick Response type.

C. Sprinkler Finishes:

1. Chrome plated or White to match existing sprinkler finish

D. 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: Chrome-plated or White steel, two piece, with 1-inch (25-mm) vertical adjustment.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.

1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with GSA Regional Fire Protection Engineer before deviating from approved working plans.

B. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes. Reductions in pipe sizes shall be made with tapered fittings, bushings shall not be permitted.

3.2 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, 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 by this specification.

B. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 (DN 65) and larger end connections.

C. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

D. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

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 the requirements and recommendations of NFPA 13.

1. Shop weld pipe joints where welded piping is indicated. Do not weld to galvanized-steel pipe.

2. Affix cutout disks, which are created by cutting holes in the walls of pipe for flow switches and non-threaded pipe connections to the respective waterflow switch or pipe connection near to the pipe from where they were cut.

G. 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.

H. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.3 SPRINKLER INSTALLATION

A. Temperature Rating: Install ordinary temperature sprinklers, unless modified herein the specification. Sprinklers installed in higher ambient temperature areas shall be installed in accordance with NFPA 13.

1. For sprinklers installed directly underneath skylights, install intermediate temperature sprinklers.

B. Flexible sprinkler fittings shall not be used.

3.4 FIELD QUALITY CONTROL

A. Final Inspection and Testing: Advise the GSA Regional Fire Protection Engineer when hydrostatic and alarm tests have been completed and all necessary corrections made, so as to permit final inspection and testing. Submit request for testing at least 15 calendar days prior to test date. A final acceptance test WILL NOT BE SCHEDULED until operation and maintenance manuals have been received by the Contracting Officer or designated representative.

1. At the final test, a material and test certificate must be provided in accordance with NFPA 13.

2. Submit up-to-date red-lined shop drawings to the GSA Regional Fire Protection Engineer or designated representative at the final test. These drawings shall be undamaged sets of prints of the shop drawings, with changes from the original drawings marked in red. Up-to-date drawings shall be maintained on site throughout construction.

3. The final test shall be witnessed by GSA Regional Fire Protection Engineer. The Contractor and an authorized representative from each supplier of equipment shall be in attendance at the final test.

4. Final testing shall include, but is not limited to, full flow testing through both the main drain and the inspector's test connection as well as testing of all waterflow and tamper switches.

5. Provide all equipment, services and labor to properly perform all required tests. The Regional GSA Regional Fire Protection Engineer shall supervise all testing.

B. Coordination of Installation:

1. The Contractor shall coordinate this sprinkler system work with other trades to avoid conflicts, assure system completion and testing within the project schedule and to assure a quality, workmanlike finished product. In occupied buildings the Contractor shall coordinate all work with the GSA Property Manager to limit the disruptions to government business and activities. This may mean altered scheduling, after hours work, and/or sequencing construction activities to avoid disruptions to occupants of the building.

2. Disruptions to existing automatic sprinkler systems shall be kept to a minimum or avoided. Sprinkler systems outside of the construction project shall be kept in service at all times in a method approved by the GSA Regional Fire Protection Engineer.

3. Delineate phasing of construction to ensure that installations of new systems are expedited, and existing systems are kept in service until the replacement system is operational.

3.5 CLEANING AND PAINTING

A. Clean dirt and debris from sprinklers.

B. Remove and replace sprinklers with paint other than factory finish.

C. Paint sprinkler pipe as required by Division 9, Painting.

END OF SECTION

SECTION 22 05 00

COMMON WORK RESULTS FOR PLUMBING

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:

1. Piping materials and installation instructions common to most piping systems.
2. Equipment nameplate data requirements.
3. Nonshrink grout for equipment installations.
4. Field-fabricated metal equipment supports.
5. Installation requirements common to equipment specification sections.
6. Mechanical demolition.
7. Cutting and patching.
8. Touch-up painting and finishing.

B. The plans and specifications are complimentary and shall be used together in order to fully describe the Work. In the case of a conflict between the plans and specifications, the plans take precedence.

C. The OWNER Technical Representative has based the drawings and design on non-certified information furnished by various equipment manufacturers. It is incumbent on the part of the CONTRACTOR to include in the bid all material and labor needed to install the actual equipment furnished.

D. Related Sections:

1. The following is work of Division 26 sections of the Specifications:

a. Power supply wiring from power source to power connection on equipment. Include starters, disconnects, and required electrical devices, except where specified as furnished, or factory-installed, by manufacturer.
b. Interlock wiring between field-installed equipment, except where specified as factory installed. Interlock wiring, as used in this specification, is defined as that wiring between electrically-interlocked equipment for the purpose of controlling one piece or pieces of equipment by the operation (on, off, etc.) of another piece or pieces of associated equipment.

2. Pipe and pipe fitting materials as specified in piping system sections.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:

1. ABS: Acrylonitrile-butadiene-styrene plastic.
2. CPVC: Chlorinated polyvinyl chloride plastic.
3. PE: Polyethylene plastic.
4. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.4 REFERENCES

A. Applicable Standards:

1. American Society for Testing and Materials (ASTM):

a. A47 - Ferritic Malleable Iron Castings.
b. A53 - Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
c. A126 - Gray Iron castings for Valves, Flanges, and Pipe Fittings.
d. A536 - Ductile Iron Castings.
e. B32 - Solder Metal.
f. C1107 - Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
g. D709 - Laminated Thermosetting Materials.

2. American Society of Mechanical Engineers (ASME):

a. Boiler and Pressure Vessel Code.
b. A13.1 - Scheme for the Identification of Piping Systems.
c. B1.20.1 - Pipe Threads, General Purpose (Inch).
d. B16.20 - Ring-Joint Gaskets and Grooves for Steel Pipe Flanges.
e. B16.21 - Nonmetallic Flat Gaskets for Pipe Flanges.
f. B18.2.1 - Square and Hex Bolts and Screws-Inch Series.
g. B31 Series - Code for Pressure Piping.

3. American Welding Society (AWS):

a. Soldering Manual, latest.
b. Brazing Manual, latest.
c. A5.8 - Filler Metals for Brazing.
d. D1.1 - Structural Welding Code for Steel.
e. D10.12 - Recommended Practices and Procedures for Welding Low Carbon Steel Pipe.

1.5 SUBMITTALS

A. Submit manufacturer’s data sheets on all system components, including the following:

1. Transition fittings
2. Dielectric fittings
3. Mechanical sleeve seals
4. Escutcheons

B. General, all Division 22 sections of the Specifications: Follow the procedures specified in Division 01. Prepare maintenance manuals in accordance with Division 01.
C. Welder certificates signed by Contractor certifying that welders comply with requirements specified under the “Quality Assurance” article of this section.

1.6 QUALITY ASSURANCE

A. Qualify welding processes and operators for structural steel according to AWS D1.1.
B. All welding on pressure piping shall conform with the requirements of the American National Standard Code for Pressure Piping, ANSI B31.3, "Chemical Plant and Petroleum Refinery Piping." All welds on piping having working pressures of 300 psig or greater shall be subjected to a full X-ray examination and will not be accepted until all welds meet the requirements of ANSI B31.1, "Power Piping." Faulty welds shall be removed at no additional cost to OWNER. X-ray testing shall be performed by others at no additional cost to the Contractor.

    1. Certify that each welder has passed AWS qualification tests for the welding processes involved and that certification is current.

C. Pressure Vessels: Prior to installation and acceptance, any power boiler, low-pressure heating boiler, or unfire pressure vessel operated at pressures of 15 pounds per square inch or greater, furnished under this contract will be stamped with ASME Boiler and Pressure Vessel Code Symbol and a National Board of Boiler and Pressure Vessel Inspector's number, thus certifying that the vessel has been fabricated and tested per the provisions of the ASME Boiler and Pressure Vessel Code. Manufacturers' data reports (unless exempted by the ASME Code) will be filed with the National Board in Columbus, Ohio. Two copies of these data reports shall be submitted to OWNER. Testing, certification, and registration will be at the expense of the Contractor.
D. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.7 DELIVERY, STORAGE, AND PROTECTION

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and prevent entrance of dirt, debris, and moisture.
B. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. When stored inside, do not exceed structural capacity of the floor.
C. Protect flanges, fittings, and piping specialties from moisture and dirt.
D. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.
E. Materials and equipment furnished by others.

    1. When equipment or materials are indicated to be furnished by others (F.B.O.) or by government furnished equipment (GFE) to the CONTRACTOR for installation and connection, the CONTRACTOR shall make a complete check of all materials and furnish a receipt to the OWNER detailing the products received and the condition of the products delivered to him. After executing the receipt and acceptance by the CONTRACTOR, the CONTRACTOR shall assume full responsibility for the safe keeping, handling, and installation of the materials and equipment furnished by others or furnished by government, until completed installation and final approval by the OWNER Technical Representative.
    2. If the CONTRACTOR fails to issue said receipt it shall be assumed that all equipment and materials were then delivered to the CONTRACTOR in the proper quantities and in perfect condition.

1.8 PROJECT SITE CONDITIONS

A. Altitude Ratings: Unless otherwise noted, all specified equipment capacities, air quantities, etc., are for an altitude of 5,300 feet above sea level. Adjustments to manufacturers' ratings must be made accordingly.

1.9 SEQUENCING AND SCHEDULING

A. Coordinate plumbing equipment installation with other building components.
B. Arrange for chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.
C. Coordinate the installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components, as they are constructed.
D. Sequence, coordinate, and integrate installations of plumbing materials and equipment for efficient flow of the work. Coordinate installation of large equipment requiring positioning prior to closing in the building.
E. Interruption of Plumbing Utilities:

1. The Contractor shall not interrupt any main interior or exterior plumbing utility without written request for an outage and a subsequent approval of OWNER Construction Manager nor shall he interrupt any branch line to an outlet or item of equipment without approval from the OWNER Construction Manager.
2. Written request for outages shall be submitted seven calendar days in advance of the outage date. This request will delineate the particular utility or service in question, the time the service will be interrupted and the approximate hours the utility shall be off.
3. Unless otherwise noted on the drawings, or directed, any tie-ins or connections to existing utilities or equipment that necessitate interruptions of service shall be performed on a during non standard hours
4. The work to be performed during the interruption, will be preceded by all possible preparation, and will be carefully coordinated to minimize the duration of the interruption and work will proceed continuously until the system is restored to normal.
5. Unless otherwise directed, the manipulation of existing main valves to isolate piping, the shutdown of equipment will be done by OWNER maintenance personnel.

F. Coordinate installation of identifying devices after completion of covering and painting, where devices are applied to surfaces. Install identifying devices prior to installation of acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Pipe and Pipe Fittings:

1. Refer to individual piping system specification sections for pipe and fitting materials and joining methods.
2. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

B. Joining Materials:

1. Refer to individual piping system specification sections in Division 22 for special joining materials not listed below.
2. Pipe Flange Gasket Materials: Suitable for the chemical and thermal conditions of the piping system contents.

a. ASME B16.21 - Nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness, except where thickness or specific material is indicated.

1) Full-Face Type: For flat-face, Class 125 cast-iron and cast-bronze flanges.
2) Narrow-Face Type: For raised-face, class 250 cast-iron and steel flanges.

b. ASME B16.20 - For grooved, ring-joint, steel flanges.
c. AWWA C110 - Rubber, flat face, 1/8-inch thick, except where other thickness is indicated; and full-face or ring type, except where type is indicated.

3. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, except where other material is indicated.
4. Solder Filler Metal: ASTM B32.

a. Alloy Sn95 or Alloy Sn94: Tin (approximately 95%) and silver (approximately 5%), having 0.10% lead content.
b. Alloy E: Tin (approximately 95%) and copper (approximately 5%), having 0.10% maximum lead content.
c. Alloy HA: Tin-antimony-silver-copper-zinc, having 0.10% maximum lead content.
d. Alloy HB: Tin-antimony-silver-copper-nickel, having 0.10% maximum lead content.
e. Alloy Sb5: Tin (95%) and antimony (5%), having 0.20% maximum lead content.

5. Brazing Filler Metals: AWS A5.8.

a. BCuP Series: Copper-phosphorous alloys.
b. BAgl: Silver alloy.

6. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
7. Flanged, Ductile-Iron Pipe Gasket, Bolts, and Nuts: AWWA C110, rubber gasket, carbon steel bolts and nuts.
8. Couplings: Iron body sleeve assembly, fabricated to match outside diameters of plain-end, pressure pipes.

a. Sleeve: ASTM A126, Class B, gray iron.
b. Followers: ASTM A47, Grade 32510 or ASTM A536 ductile iron.
c. Gaskets: Rubber.
d. Bolts and Nuts: AWWA C111.
e. Finish: Enamel paint.

C. Piping Specialties:

1. Dielectric Fittings: Assembly or fitting having insulating material isolating joined dissimilar metals, to prevent galvanic action and stop corrosion.

a. Description: Combination of copper alloy and ferrous; threaded, solder, plain, and weld neck end types and matching piping system materials.
b. Insulating Material: Suitable for system fluid, pressure, and temperature.
c. Dielectric Unions: Factory-fabricated, union assembly, for 250 psig minimum working pressure at 180°F temperature.
d. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150 or 300 psig minimum pressure to suit system pressures.
e. Dielectric-Flange Insulation Kits: Field-assembled, companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

1) Provide separate companion flanges and steel bolts and nuts for 150- or 300-psig minimum working pressure to suit system pressures.
2) Dielectric Couplings: Galvanized steel coupling, having inert and noncorrosive, thermoplastic lining, with threaded ends and 300-psig minimum working pressure at 225°F temperature.
3) Dielectric Nipples: Electroplated steel nipple, having inert and noncorrosive, thermoplastic lining, with combination of plain, threaded, or grooved end types and 300-psig working pressure at 225ºF temperature.

2. Mechanical Sleeve Seals: Modular, watertight, mechanical type. Components include interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve. Connecting bolts and pressure plates cause rubber sealing elements to expand when tightened.
3. Sleeves: The following materials are for wall, floor, slab, and roof penetrations:

    a. Steel Pipe: ASTM A53, Type E, Grade A, Schedule 40, galvanized, plain ends.
    b. Wall Penetration Systems: Wall sleeve assembly, consisting of housing, gaskets, and pipe sleeve, with one mechanical joint end conforming to AWWA C110 and one plain pipe sleeve end.

        1) Penetrating Pipe Deflection: 5% without leakage.
        2) Housing: Ductile-iron casting having water stop and anchor ring, with ductile-iron gland, steel studs and nuts, and rubber gasket conforming to AWWA C111, of housing and gasket size as required to fit penetrating pipe.
        3) Pipe Sleeve: AWWA C151, ductile-iron pipe.
        4) Housing-to-Sleeve Gasket: Rubber or neoprene, push-on type, of manufacturer's design.

    c. Cast-Iron Sleeve Fittings: Commercially made sleeve having integral clamping flange, with clamping ring, bolts, and nuts for membrane flashing.

D. Escutcheons

1. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

    a. One Piece, Deep-Pattern Type: Deep-drawn, box shaped brass with polished chrome plated finish.
    b. One-Piece, Cast-Brass Type: With set screw or Split-Casting, Cast-Brass-Type: With concealed hinge and set screw. Finish: Polished chrome plated.
    c. Split-Casting, Cast-Brass Type: With concealed hinge and set screw. Finish: Polished chrome plated.
    d. One-Piece, Floor-Plate Type: Cast-iron floor plate.
    e. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

E. Grout: Nonshrink, Nonmetallic Grout: ASTM C1107, Grade B.

1. Characteristics: Post-hardening, volume-adjusting, dry, hydraulic-cement grout, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.

F. Design Mix: 5000 psi, 28-day compressive strength.

2.2 IDENTIFICATION

A. Equipment Labels:

1. Metal Labels for Equipment:

    a. Material and Thickness: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
    b. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
    c. Minimum Letter Size: 1/4 inch for name of units. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
    d. Fasteners: Stainless-steel rivets or self-tapping screws.

e. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

2. Plastic Labels for Equipment:

a. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
b. Letter Color: White
c. Background Color: Black or blue.
d. Maximum Temperature: Able to withstand temperatures up to 160 ºF.
e. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
f. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
g. Fasteners: Stainless-steel rivets or self-tapping screws.
h. Adhesive: Contract-type permanent adhesive, compatible with label and with substrate.

3. Label Content: Include equipment's unique equipment number, Drawings numbers where equipment is indicated (plan, details, and schedules).
4. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the specification section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

B. Pipe Labels:

1. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
2. Pre-tensioned Pipe Labels: Pre-coiled, semi-rigid plastic formed to cover full circumference of pipe and t attach to pipe without fasteners or adhesive.
3. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
4. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

a. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
b. Lettering Size: At least 1-1/2 inches high.

C. Stencils:

1. Stencils: Prepare with letter sizes according to ASME A 13.1 for piping; minimum letter height of 2 inches for equipment labels, and similar operational instructions.
2. Stencil Material: Fiberboard or metal.
3. Stencil Paint: Exterior, gloss enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
4. Identification Paint: Exterior enamel in colors according to ASME A13.1 unless otherwise indicated.

D. Valve Tags:

1. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

a. Tag Materials: Brass, 0.032-inch minimum thickness, and having pre-drilled or stamped holes for attachment hardware.

2. Valve Schedules: For each piping system, on 8-/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open or closed), and variations for identification. Mark valves for emergency shutoff and similar special uses.
3. Valve tag schedule shall be included in operation and maintenance data.

PART 3 - EXECUTION

3.1 ERECTION INSTALLATION APPLICATION

A. Piping Systems - Common Requirements:

1. General: Install piping as described below, except where system sections specify otherwise. Individual piping system specification sections in Division 22 specify piping installation requirements unique to the piping system.
2. General Locations and Arrangements: Drawings (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, except where deviations to layout are approved on coordination drawings.
3. Install piping at indicated slope.
4. Install components having pressure rating equal to or greater than system operating pressure.
5. Install piping in concealed interior and exterior locations, except in equipment rooms and service areas.
6. Install piping free of sags and bends.
7. Install exposed interior and exterior piping at right angles or parallel to building walls. Diagonal runs are prohibited, except where indicated.
8. Install piping tight to slabs, beams, joists, columns, walls, and other building elements. Allow sufficient space above removable ceiling panels to allow for ceiling panel removal.
9. Install piping to allow application of insulation plus 1-inch clearance around insulation.
10. Locate groups of pipes parallel to each other, spaced to permit valve servicing.
11. Install fittings for changes in direction and branch connections.
12. Escutcheons: Where uncovered exposed pipes pass through floors, finished walls, or finished ceilings, they shall be fitted with chromium-plated cast-brass plates on chromium-plated pipe, or with cast-iron or steel plates on ferrous pipe. Plates shall be large enough to completely close the holes around the pipes and shall be square, octangular, or round, with the least dimension not less than 1-1/2 inches or more than 2-1/2 inches larger than the diameter of the pipe. Plates shall be secured in an approved manner.
13. Install sleeves for pipes passing through concrete and masonry walls, concrete floor and roof slabs, and where indicated.
14. Above Grade, Exterior Wall, and Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeve for 1-inch annular clear space between pipe and sleeve for installation of mechanical seals.

    a. Install steel pipe for sleeves smaller than 6 inches.
    b. Install cast-iron wall pipes for sleeves 6 inches and larger.
    c. Assemble and install mechanical seals according to manufacturer's printed instructions.

15. Below Grade, Exterior Wall, and Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Size sleeve for 1-inch annular clear space between pipe and sleeve for installation of mechanical seals.

16. Below Grade, Exterior Wall, and Pipe Penetrations: Install ductile-iron wall penetration system sleeves according to manufacturer's printed installation instructions.
17. Verify final equipment locations for roughing in.
18. Refer to equipment specifications in other sections of these specifications for roughing-in requirements.
19. Piping Joint Construction: Join pipe and fittings as follows and as specifically required in individual piping system specification sections.

    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. Soldered Joints: Construct joints according to AWS "Soldering Manual."
    d. Brazed Joints: Construct joints according to AWS "Brazing Manual."
    e. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1.
    f. Flanged Joints: Align flange surfaces parallel. Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench.

20. Piping Connections: Except as otherwise indicated, make piping connections as specified below.

    a. Install unions, in piping 2 inches and smaller, adjacent to each valve and at final connection to each piece of equipment having 2-inches or smaller threaded pipe connection.
    b. Install flanges, in piping 2-1/2 inches and larger, adjacent to flanged valves and at final connection to each piece of equipment having flanged pipe connection.
    c. Dry Piping Systems (Gas, Compressed Air, and Vacuum): Install dielectric unions and flanges to connect piping materials of dissimilar metals.
    d. Wet Piping Systems (Water and Steam): Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

B. Equipment Installation - Common Requirements:

1. Install equipment to provide the maximum possible head room, where mounting heights are not indicated.
2. Install equipment according to approved submittal data. Portions of the Work are shown only in diagrammatic form. Refer conflicts to the OWNER.
3. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, except where otherwise indicated.
4. Install plumbing equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. Connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.
5. Install equipment giving right-of-way to piping systems installed at a required slope.
6. Shaft Alignment: All motors and pumps (or drives) connected by a shaft coupling, whether factory or field assembled, shall be aligned during installation using a dial indicator applied to both ends of both shafts for a full 360 degrees prior to operation. Alignment of the shafts shall be less than the maximum allowable tolerances as recommended by the coupling or equipment manufacturer. Alignment of shafts shall be rechecked after several hours of operation and equipment has reached operating temperature.

C. Painting and Finishing:

1. Field painting requirements are specified in Division 09.
2. Damage and Touch-Up: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

D. Identification Tags and Labels:

1. Materials:

a. Pipe Labels: Pipe labels shall be self-adhesive labels, all temperature Perma-Code pipe markers No. B-500, manufactured by the W. H. Brady Company. The background color code for all markers shall conform to the American National Standard ANSI A-13.1 "Scheme for the Identification of Piping Systems." This standard establishes four basic backgrounds as follows: Yellow for dangerous materials, bright blue for protective materials, red for fire protection equipment, and green for safe materials.

b. Tags: Tags shall be aluminum, brass or laminated plastic 2" x 1" minimum with edges ground smooth or rolled. Each tag shall be punched to receive tie wires or chain. Letters and Numbers shall be evenly spaced and stamped or engraved into the surface.

2. Installation:

a. Identification of Piping:

1) Identify all piping according to the following procedures:

a) Bare pipes to be marked shall first be wiped clean of dirt, dust, grease, and moisture. Markers to be installed on painted piping shall be applied only after completion of final coat of paint. Insulated pipes shall first be painted to a smooth, hard surface in the area the label is to be applied. Labels shall be applied, using pressure, so that it lies smooth and flat. After application on insulated pipes, the label shall be stapled securely to the insulation. The labels shall be applied to the pipe so that the lettering is in the most legible position. For overhead piping apply markers on the lower half of the pipe where view is unobstructed, so that markers can be read at a glance from floor level. The wording on the labels shall correspond directly to the wording in the mechanical symbol lists, regardless of whether or not it is standard wording for the designated manufacturer.

b) Use an arrow marker with each pipe content marker. The arrow shall always point away from the pipe marker and in the direction of flow, with background color and height the same as content marker. If flow can be in both directions, use two arrow markers.

c) Apply pipe marker and arrow marker at each valve, at every point of pipe entry or exit through wall or ceiling, on each riser and branch of tee, and every 20 feet on long continuous lines or at every bay or aisle to show proper identification of pipe content and direction of flow.

b. Valves: All main service valves, including fire protection, located inside the building shall be tagged and identified as to the type of service. All valves controlling branch mains or risers to various portions of the building shall be tagged and identified as to the areas served.

c. Controls: All automatic controls, control panels, zone valves, pressure electric, electric pressure switches, relays and starters shall be clearly tagged and identified. Wording shall be identical to that on the control diagram in the contract drawings.

d. Pumps: All pumps shall be identified as to service with aluminum or brass tags secured by tie wires.

E. Erection of Metal Supports and Anchorage:

1. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
2. Field Welding: Comply with AWS D1.1 "Structural Welding Code - Steel."

F. Cutting and Patching:

1. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for plumbing installations. Perform cutting by skilled mechanics of the trades involved.
2. Repair cut surfaces to match adjacent surfaces.

G. Grouting:

1. Install nonmetallic, nonshrink grout for plumbing equipment base bearing surfaces, pump and other equipment base plates and anchors. Mix grout according to manufacturer's printed instructions.
2. Clean surfaces that will come into contact with grout.
3. Provide forms for placement of grout, as required.
4. Avoid air entrapment when placing grout.
5. Place grout, completely filling equipment bases.
6. Place grout on concrete bases to provide a smooth bearing surface for equipment.
7. Place grout around anchors.
8. Cure placed grout according to manufacturer's printed instructions.

END OF SECTION 22 05 00

SECTION 22 05 23.12

BALL VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Bronze ball valves.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1. Certification that products comply with NSF 61 Annex G and NSF 372.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
B. ASME Compliance:

1. ASME B1.20.1 for threads for threaded end valves.
2. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
3. ASME B16.18 for solder-joint connections.
4. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61 Annex G and NSF 372 for valve materials for potable-water service.
D. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.
E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
F. Valve Sizes: Same as upstream piping unless otherwise indicated.
G. Valve Actuator Types:

1. Gear Actuator: For quarter-turn valves NPS 4 and larger.
2. Handlever: For quarter-turn valves smaller than NPS 4.

H. Valves in Insulated Piping:

1. Include 2-inch stem extensions.
2. Extended operating handles of nonthermal-conductive material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
3. Memory stops that are fully adjustable after insulation is applied.

2.2 BRONZE BALL VALVES

A. Bronze Ball Valves, Two-Piece with Full Port, and Bronze:

1. Description:

a. Standard: MSS SP-110.
b. CWP Rating: 600 psig.

c. Body Design: Two piece.
d. Body Material: Bronze.
e. Ends: Threaded and soldered.
f. Seats: PTFE.
g. Stem: Bronze or brass.
h. Ball: Chrome-plated brass.
i. Port: Full.

PART 3 - EXECUTION

3.1 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
B. Locate valves for easy access and provide separate support where necessary.
C. Install valves in horizontal piping with stem at or above center of pipe.
D. Install valves in position to allow full stem movement.

3.2 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.
B. Select valves with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
2. For Steel Piping, NPS 2 and Smaller: Threaded ends.

3.3 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Bronze ball valves, two-piece with full port and bronze trim.

END OF SECTION 22 05 23.12

SECTION 22 05 23.14

CHECK VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Bronze swing check valves.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1. Certification that products comply with NSF 61 Annex G and NSF 372.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B1.20.1 for threads for threaded end valves.
2. ASME B16.1 for flanges on iron valves.
3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
4. ASME B16.18 for solder joint.
5. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61 Annex G and NSF 372 for valve materials for potable-water service.

D. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

F. Valve Sizes: Same as upstream piping unless otherwise indicated.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE SWING CHECK VALVES

A. Bronze Swing Check Valves with Bronze Disc, Class 125:

1. Description:

a. Standard: MSS SP-80, Type 3.
b. CWP Rating: 200 psig.
c. Body Design: Horizontal flow.
d. Body Material: ASTM B 62, bronze.
e. Ends: Threaded or soldered. See valve schedule articles.
f. Disc: Bronze.

PART 3 - EXECUTION

3.1 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
B. Locate valves for easy access and provide separate support where necessary.
C. Install valves in horizontal piping with stem at or above center of pipe.
D. Install valves in position to allow full stem movement.
E. Install swing check valves for proper direction of flow in horizontal position with hinge pin level.

3.2 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.3 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller: Bronze swing check valves bronze disc, Class 125, with soldered or threaded end connections.

END OF SECTION 22 05 23.14

SECTION 22 05 29

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Thermal-hanger shield inserts.
4. Fastener systems.
5. Pipe positioning systems.
6. Equipment supports.

1.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.3 ACTION SUBMITTALS

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

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:

1. Trapeze pipe hangers.
2. Equipment supports.

C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.5 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

B. Stainless-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

C. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 THERMAL-HANGER SHIELD INSERTS

A. Insulation-Insert Material for Cold and Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig. minimum compressive strength.
B. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
C. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
D. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.4 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated or stainless- steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.5 PIPE POSITIONING SYSTEMS

A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.6 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.7 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
D. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

E. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.
F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
I. Install lateral bracing with pipe hangers and supports to prevent swaying.
J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
K. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

M. Insulated Piping:

1. Attach clamps and spacers to piping.

   a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
   b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
   c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

   a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

   a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

   a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
   b. NPS 4: 12 inches long and 0.06 inch thick.
   c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
   d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
   e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.

5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and or equipment supports.
B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.

4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
B. Trim excess length of continuous-thread hanger and support rods.

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
E. Use carbon-steel pipe hangers and supports and or metal trapeze pipe hangers and attachments for general service applications.
F. Use stainless-steel pipe hangers and stainless-steel or corrosion-resistant attachments for hostile environment applications.
G. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.
H. Use padded hangers for piping that is subject to scratching.
I. Use thermal-hanger shield inserts for insulated piping and tubing.
J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes.
2. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes.
3. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 and larger, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
4. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 and larger, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
5. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 and larger, from two rods if longitudinal movement caused by expansion and contraction might occur.
6. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 and larger if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.

K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS ¾ and larger.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS ¾ and larger if longer ends are required for riser clamps.

L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.

M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.

8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.

N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
3. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.

P. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

Q. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

R. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 22 05 29

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SECTION 22 05 53

IDENTIFICATION FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe labels.

1.2 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include pipe size and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping-system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.

2. Lettering Size: At least 1/2 inch.

PART 3 - EXECUTION

3.1 PIPE LABEL INSTALLATION

A. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

B. Pipe Label Color Schedule:

1. Domestic Water Piping

a. Background: Green.
b. Letter Colors: White.

2. Sanitary Waste:

a. Background Color: Yellow
b. Letter Color: Black.

END OF SECTION 22 05 53

SECTION 22 07 19

PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes insulating the following plumbing piping services:

1. Domestic hot-water piping.
2. Domestic cold-water piping.

B. Related Sections:

1. Section 220716 "Plumbing Equipment Insulation."

1.2 ACTION SUBMITTALS

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

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. 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.

B. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Supply and Drain Protective Shielding Guards: ICC A117.1.

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. Mineral-Fiber, Preformed Pipe Insulation:

1. Type I, 850 Deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 INSULATING CEMENTS

A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

2.3 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.
C. ASJ Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
B. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.

1. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
2. Service Temperature Range: Minus 20 to plus 180 deg F.
3. Solids Content: 60 percent by volume and 66 percent by weight.
4. Color: White.

2.5 SEALANTS

A. ASJ Flashing Sealants Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: White.

2.6 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

2.7 TAPES

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

1. Width: 3 inches.
2. Thickness: 11.5 mils.
3. Adhesion: 90 ounces force/inch in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

2.8 SECUREMENTS

A. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.
B. Wire: 0.080-inch nickel-copper alloy or 0.062-inch soft-annealed, stainless steel or 0.062-inch soft-annealed, galvanized steel.

PART 3 - EXECUTION

3.1 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
C. 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- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
    3. Overlap jacket longitudinal seams at least 1-1/2 inches. 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 or 4 inches o.c.

a. For below-ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to 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 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. Cleanouts.

3.3 PENETRATIONS

A. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
B. 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 Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

3.4 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
B. 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. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

C. 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.

D. 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 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.

3.5 INSTALLATION OF MINERAL-FIBER PREFORMED PIPE INSULATION

A. 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 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.

B. 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, and seal joints with flashing sealant.

C. 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.

D. 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.

3.6 FINISHES

A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

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.
C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
D. Do not field paint aluminum or stainless-steel jackets.

3.7 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, three locations of welded fittings, two locations of threaded strainers, 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.

3.8 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.

3.9 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Hot Water: Insulation shall be the following:

1. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

B. Domestic Cold Water: Insulation shall be the following:

1. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

END OF SECTION 22 07 19

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SECTION 22 11 16

DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copper tube and fittings.
2. Piping joining materials.
3. Transition fittings.
4. Dielectric fittings.

1.2 ACTION SUBMITTALS

A. Product Data: For transition fittings and dielectric fittings.

1.3 INFORMATIONAL SUBMITTALS

A. System purging and disinfecting activities report.
B. Field quality-control reports.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.
B. Potable-water piping and components shall comply with NSF 14 and NSF 61 Annex G. Plastic piping components shall be marked with "NSF-pw."
C. Comply with NSF 372 for low lead.

2.2 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.
B. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

2.3 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials:

1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
2. Full-face or ring type unless otherwise indicated.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
C. Solder Filler Metals: ASTM B 32, lead-free alloys.
D. Flux: ASTM B 813, water flushable.
E. Brazing Filler Metals: AWS A5.8M/A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.4 TRANSITION FITTINGS

A. General Requirements:

1. Same size as pipes to be joined.
2. Pressure rating at least equal to pipes to be joined.
3. End connections compatible with pipes to be joined.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

C. Plastic-to-Metal Transition Fittings:

1. Description:

a. CPVC or PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions.
b. One end with threaded brass insert and one solvent-cement-socket or threaded end.

D. Plastic-to-Metal Transition Unions:

1. Description:

a. CPVC or PVC four-part union.
b. Brass or stainless-steel threaded end.
c. Solvent-cement-joint or threaded plastic end.
d. Rubber O-ring.
e. Union nut.

2.5 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

1. Standard: ASSE 1079.
2. Pressure Rating: 125 psig minimum at 180 deg F or 150 psig or 250 psig.
3. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

1. Standard: ASSE 1079.
2. Factory-fabricated, bolted, companion-flange assembly.
3. Pressure Rating: 125 psig minimum at 180 deg F or 150 psig or 175 psig or 300 psig.
4. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:

1. Nonconducting materials for field assembly of companion flanges.
2. Pressure Rating: 150 psig.
3. Gasket: Neoprene or phenolic.
4. Bolt Sleeves: Phenolic or polyethylene.
5. Washers: Phenolic with steel backing washers.

E. Dielectric Nipples:

1. Standard: IAPMO PS 66.
2. Electroplated steel nipple complying with ASTM F 1545.
3. Pressure Rating and Temperature: 300 psig at 225 deg F.
4. End Connections: Male threaded or grooved.
5. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
C. Install shutoff valve immediately upstream of each dielectric fitting.
D. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Section 221119 "Domestic Water Piping Specialties."
E. Install domestic water piping level without pitch and plumb.
F. Rough-in domestic water piping for water-meter installation according to utility company's requirements.
G. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
H. 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.
I. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
J. Install piping to permit valve servicing.
K. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.
L. Install piping free of sags and bends.
M. Install fittings for changes in direction and branch connections.
N. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
O. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements for thermometers in Section 220519 "Meters and Gages for Plumbing Piping."
P. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
Q. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
R. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.2 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 pipes, tubes, and fittings before assembly.
C. 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.

D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Brazed Joints" chapter.
E. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

F. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.

G. Joint Construction for Solvent-Cemented Plastic Piping: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
3. PVC Piping: Join according to ASTM D 2855.

H. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.3 TRANSITION FITTING INSTALLATION

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Underground Domestic Water Piping:

1. Fittings for NPS 1-1/2 and Smaller: Fitting-type coupling.
2. Fittings for NPS 2 and Larger: Sleeve-type coupling.

C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings or unions.

3.4 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings or couplings or nipples or nipples or unions.

C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges or flange kits or nipples.

D. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for pipe hanger, support products, and installation in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1. Vertical Piping: MSS Type 8 or 42, clamps.
2. Individual, Straight, Horizontal Piping Runs:

    a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.

E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.

3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
4. NPS 2-1/2: 108 inches with 1/2-inch rod.
5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
6. NPS 6: 10 feet with 5/8-inch rod.
7. NPS 8: 10 feet with 3/4-inch rod.

F. Install supports for vertical copper tubing every 10 feet.
G. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4 and Smaller: 84 inches with 3/8-inch rod.
2. NPS 1-1/2: 108 inches with 3/8-inch rod.
3. NPS 2: 10 feet with 3/8-inch rod.
4. NPS 2-1/2: 11 feet with 1/2-inch rod.
5. NPS 3 and NPS 3-1/2: 12 feet with 1/2-inch rod.
6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
7. NPS 6: 12 feet with 3/4-inch rod.
8. NPS 8 to NPS 12: 12 feet with 7/8-inch rod.

H. Install supports for vertical steel piping every 15 feet.
I. Install vinyl-coated hangers for CPVC piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1 and Smaller: 36 inches with 3/8-inch rod.
2. NPS 1-1/4 to NPS 2: 48 inches with 3/8-inch rod.
3. NPS 2-1/2 to NPS 3-1/2: 48 inches with 1/2-inch rod.
4. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
5. NPS 6: 48 inches with 3/4-inch rod.
6. NPS 8: 48 inches with 7/8-inch rod.

J. Install supports for vertical CPVC piping every 60 inches for NPS 1 and smaller, and every 72 inches for NPS 1-1/4 and larger.
K. Install vinyl-coated hangers for PEX tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1 and Smaller: 32 inches with 3/8-inch rod.

L. Install hangers for vertical PEX tubing every 48 inches.
M. Install vinyl-coated hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 2 and Smaller: 48 inches with 3/8-inch rod.
2. NPS 2-1/2 to NPS 3-1/2: 48 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
4. NPS 6: 48 inches with 3/4-inch rod.
5. NPS 8: 48 inches with 7/8-inch rod.

N. Install supports for vertical PVC piping every 48 inches.
O. Support piping and tubing not listed in this article according to MSS SP-58 and manufacturer's written instructions.

3.6 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.
B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.
C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:

1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
3. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
4. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.7 IDENTIFICATION

A. Identify system components. Comply with requirements for identification materials and installation in Section 220500 "Common Work Results for Plumbing."
B. Label pressure piping with system operating pressure.

3.8 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Piping Inspections:

a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:

1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.

c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

2. Piping Tests:

a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
f. Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.
C. Prepare test and inspection reports.

3.9 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.

    a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
    b. Adjust calibrated balancing valves to flows indicated.

5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.10 CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:

    a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    b. Fill and isolate system according to either of the following:

        1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
        2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.

    c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
    d. Repeat procedures if biological examination shows contamination.
    e. Submit water samples in sterile bottles to authorities having jurisdiction.

B. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.
C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.11 PIPING SCHEDULE

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.

D. Aboveground domestic water piping, NPS 2 and smaller, shall be one of the following:

1. Hard copper tube, ASTM B 88, Type L; wrought-copper, solder-joint fittings; and brazed or soldered joints.

END OF SECTION 22 11 16

SECTION 22 13 16

SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cast-iron soil pipe and fittings.
2. Copper tube and fittings.
3. Specialty Pipe Fittings

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 10-foot head of water.

B. Seismic Performance: Soil, waste, and vent piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

2.2 PIPING MATERIALS

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
B. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.3 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.
B. CISPI, Hubless-Piping Couplings:

1. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.4 COPPER TUBE AND FITTINGS

A. Copper Type DWV Tube: ASTM B 306, drainage tube, drawn temper.
B. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.
C. Copper Pressure Fittings:

1. Copper Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
2. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

D. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.

1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

E. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

2.5 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
2. Unshielded, Nonpressure Transition Couplings:

a. Standard: ASTM C 1173.
b. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
c. End Connections: Same size as and compatible with pipes to be joined.
d. Sleeve Materials:

1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
2) For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
3) For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

3. Shielded, Nonpressure Transition Couplings:

a. Standard: ASTM C 1460.
b. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
c. End Connections: Same size as and compatible with pipes to be joined.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.

1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
2. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
C. 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.
D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
E. Install piping to permit valve servicing.
F. Install piping at indicated slopes.
G. Install piping free of sags and bends.
H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.
J. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.

1. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical.
2. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe.

a. Straight tees, elbows, and crosses may be used on vent lines.

3. Do not change direction of flow more than 90 degrees.
4. Use proper size of standard increasers and reducers if pipes of different sizes are connected.

a. Reducing size of waste piping in direction of flow is prohibited.

K. Install soil and waste and vent piping at the following minimum slopes unless otherwise indicated:

1. Building Sanitary Waste: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 2 percent downward in direction of flow for piping NPS 4 and larger.
2. Horizontal Sanitary Waste Piping: 2 percent downward in direction of flow.
3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

L. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
M. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."
N. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
O. Install sleeves for piping penetrations of walls, ceilings, and floors.
P. Install sleeve seals for piping penetrations of concrete walls and slabs.
Q. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.2 JOINT CONSTRUCTION

A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
B. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.
C. Grooved Joints: Cut groove ends of pipe according to AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections, over gasket, with keys seated in piping grooves. Install and tighten housing bolts.

3.3 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in ODs.
2. In Waste Drainage Piping: Unshielded Shielded, nonpressure transition couplings.

3.4 VALVE INSTALLATION

A. Comply with requirements in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.14 "Check Valves for Plumbing Piping," for general-duty valve installation requirements.
B. Shutoff Valves:

1. Install full-port ball valve for piping NPS 2 and smaller.

C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment." Section 220548.13.

1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
2. Install stainless-steel fiberglass pipe hangers for horizontal piping in corrosive environments.
3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
5. Vertical Piping: MSS Type 8 or Type 42, clamps.
6. Install individual, straight, horizontal piping runs:

    a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.

7. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
8. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.

D. Support vertical piping and tubing at base and at each floor.

E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.

F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
2. NPS 3: 60 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.

G. Install supports for vertical cast-iron soil piping every 15 feet.

H. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4: 84 inches with 3/8-inch rod.
2. NPS 1-1/2: 108 inches with 3/8-inch rod.
3. NPS 2: 10 feet with 3/8-inch rod.
4. NPS 2-1/2: 11 feet with 1/2-inch rod.
5. NPS 3: 12 feet with 1/2-inch rod.
6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.

I. Install supports for vertical steel piping every 15 feet.

J. Install hangers for stainless-steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 2: 84 inches with 3/8-inch rod.
2. NPS 3: 96 inches with 1/2-inch rod.
3. NPS 4: 108 inches with 1/2-inch rod.

K. Install supports for vertical stainless-steel piping every 10 feet.
L. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4: 72 inches with 3/8-inch rod.
2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
3. NPS 2-1/2: 108 inches with 1/2-inch rod.
4. NPS 3 and NPS 5: 10 feet with 1/2-inch rod.

M. Install supports for vertical copper tubing every 10 feet.
N. Support piping and tubing not listed above according to MSS SP-58 and manufacturer's written instructions.

3.6 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.
B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
C. Connect waste and vent piping to the following:

1. Plumbing Fixtures: Connect waste piping in sizes indicated, but not smaller than required by plumbing code.
2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
3. Plumbing Specialties: Connect waste and vent piping in sizes indicated, but not smaller than required by plumbing code.
4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
5. Comply with requirements for backwater valves cleanouts and drains specified in Section 221319 "Sanitary Waste Piping Specialties."
6. Equipment: Connect waste piping as indicated.

a. Provide shutoff valve if indicated and union for each connection.
b. Use flanges instead of unions for connections NPS 2-1/2 and larger.

D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
E. Make connections according to the following unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.7 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping.
B. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.8 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.

2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
D. Test sanitary waste and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.

a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.

2. Leave uncovered and unconcealed new, altered, extended, or replaced waste and vent piping until it has been tested and approved.

a. Expose work that was covered or concealed before it was tested.

3. Roughing-in Plumbing Test Procedure: Test waste and vent piping except outside leaders on completion of roughing-in.

a. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water.
b. From 15 minutes before inspection starts to completion of inspection, water level must not drop.
c. Inspect joints for leaks.

4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight.

a. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg.
b. Use U-tube or manometer inserted in trap of water closet to measure this pressure.
c. Air pressure must remain constant without introducing additional air throughout period of inspection.
d. Inspect plumbing fixture connections for gas and water leaks.

5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

3.9 CLEANING AND PROTECTION

A. Clean interior of piping. Remove dirt and debris as work progresses.
B. Protect sanitary waste and vent piping during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
C. Place plugs in ends of uncompleted piping at end of day and when work stops.
D. Repair damage to adjacent materials caused by waste and vent piping installation.

3.10 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
B. Aboveground, soil and waste piping NPS 4 and smaller shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.

2. Copper Type DWV tube, copper drainage fittings, and soldered joints.
3. Dissimilar Pipe-Material Couplings: Unshielded Shielded, nonpressure transition couplings.

C. Aboveground, vent piping NPS 4 and smaller shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Copper Type DWV tube, copper drainage fittings, and soldered joints.

    a. Option for Vent Piping, NPS 2-1/2 and NPS 3-1/2: Hard copper tube, Type M; copper pressure fittings; and soldered joints.

3. Dissimilar Pipe-Material Couplings: Unshielded Shielded, nonpressure transition couplings.

END OF SECTION 22 13 16

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SECTION 23 01 30.52

EXISTING HVAC AIR DISTRIBUTION SYSTEM CLEANING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes cleaning existing HVAC air-distribution equipment, ducts, plenums, and system components.

1.2 DEFINITIONS

A. ACAC: American Council for Accredited Certification.
B. AIHA-LAP: American Industrial Hygiene Association Lab Accreditation Program
C. ASCS: Air systems cleaning specialist.
D. CESB: Council of Engineering and Scientific Specialty Boards.
E. CMI: Certified Microbial Investigator.
F. CMC: Certified Microbial Consultant.
G. CMR: Certified Microbial Remediator.
H. CMRS: Certified Microbial Remediation Supervisor.
I. EMLAP: Environmental Microbiology Laboratory Accreditation Program.
J. IEP: Indoor Environmental Professional.
K. IICRC: Institute of Inspection, Cleaning, and Restoration Certification.
L. NADCA: National Air Duct Cleaners Association.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. ASCS Qualifications: A certified member of NADCA.

1. Certification: Employ an ASCS certified by NADCA on a full-time basis.
2. Supervisor Qualifications: Certified as an ASCS by NADCA.

B. IEP Qualifications: CMI who is certified by ACAC and accredited by CESB.
C. CMR Qualifications: Certified by ACAC and accredited by CESB.
D. CMRS Qualifications: Certified by ACAC and accredited by CESB.

PART 2 - PRODUCTS

2.1 HVAC CLEANING AGENTS

A. Description:

1. Formulated for each specific soiled coil condition that needs remedy.

2.2 ANTIMICROBIAL SURFACE TREATMENT

A. Description: Specific product selected shall be as recommended by the IEP based on the specific antimicrobial needs of the specific Project conditions.

1. Formulated to kill and inhibit growth of microorganisms.
2. EPA-registered for use in HVAC systems and for the specific application in which it will be used.
3. Have no residual action after drying, with zero VOC off-gassing.
4. OSHA compliant.
5. Treatment shall dry clear to allow continued visual observation of the treated surface.

PART 3 - EXECUTION

3.1 PREPARATION

A. Inspect HVAC air-distribution equipment, ducts, plenums, and system components to determine appropriate methods, tools, and equipment required for performance of the Work.
B. Cleaning Plan: Prepare a written plan for air-distribution system cleaning that includes strategies and step-by-step procedures.
C. Proceed with work only after conditions detrimental to performance of the Work have been corrected and cleaning plan has been approved.
D. Use the existing service openings, as required for proper cleaning, at various points of the HVAC system for physical and mechanical entry and for inspection.
E. Mark the position of manual volume dampers and air-directional mechanical devices inside the system prior to cleaning.

3.2 CLEANING

A. Comply with NADCA ACR.
B. Perform electrical lockout and tagout according to Park's standards or authorities having jurisdiction.
C. Remove non-adhered substances and deposits from within the HVAC system.
D. Systems and Components to Be Cleaned: All air-moving and -distribution equipment.
E. Collect debris removed during cleaning. Ensure that debris is not dispersed outside the HVAC system during the cleaning process.

1. Particulate Collection: For particulate collection equipment, include adequate filtration to contain debris removed. Locate equipment downwind and away from all air intakes and other points of entry into the building.
2. HEPA filtration with 99.97 percent collection efficiency for particles sized 0.3 micrometer or larger shall be used where the particulate collection equipment is exhausting inside the building,

F. Control odors and mist vapors during the cleaning and restoration process.
G. Mark the position of manual volume dampers and air-directional mechanical devices inside the system prior to cleaning. Restore them to their marked position on completion of cleaning.
H. System components shall be cleaned so that all HVAC system components are visibly clean. On completion, all components must be returned to those settings recorded just prior to cleaning operations.
I. Clean all air-distribution devices, registers, grilles, and diffusers.
J. Clean non-adhered substance deposits according to NADCA ACR and the following:

1. Clean airstream surfaces, components
2. Ensure that a suitable operative drainage system is in place prior to beginning wash-down procedures.

K. Air-Distribution Systems:

1. Create service openings in the HVAC system as necessary to accommodate cleaning.
2. Mechanically clean air-distribution systems specified to remove all visible contaminants, so that the systems are capable of passing the HVAC System Cleanliness Tests (see NADCA ACR).

L. Debris removed from the HVAC system shall be disposed of according to applicable Federal, state, and local requirements.

M. Mechanical Cleaning Methodology:

1. Source-Removal Cleaning Methods: The HVAC system shall be cleaned using source-removal mechanical cleaning methods designed to extract contaminants from within the HVAC system and to safely remove these contaminants from the facility. No cleaning method, or combination of methods, shall be used that could potentially damage components of the HVAC system or negatively alter the integrity of the system.

    a. Use continuously operating vacuum-collection devices to keep each section being cleaned under negative pressure.
    b. Cleaning methods that require mechanical agitation devices to dislodge debris that is adhered to interior surfaces of HVAC system components shall be equipped to safely remove these devices. Cleaning methods shall not damage the integrity of HVAC system components or damage porous surface materials, such as duct and plenum liners.

2. Cleaning Mineral-Fiber Insulation Components:

    a. Fibrous-glass thermal or acoustical insulation elements present in equipment or ductwork shall be thoroughly cleaned with HEPA vacuuming equipment while the HVAC system is under constant negative pressure and shall not be permitted to get wet according to NADCA ACR.
    b. Cleaning methods used shall not cause damage to fibrous-glass components and will render the system capable of passing the HVAC System Cleanliness Tests (see NADCA ACR).
    c. Fibrous materials that become wet shall be discarded and replaced.

N. Application of Antimicrobial Treatment:

1. Apply antimicrobial agents and coatings if active fungal growth is determined by the IEP to be at Condition 2 or Condition 3 status according to IICRC S520, as analyzed by a laboratory accredited by AIHA-LAP with an EMLAP certificate, and with results interpreted by an IEP. Apply antimicrobial agents and coatings according to manufacturer's written recommendations and EPA registration listing after the removal of surface deposits and debris.
2. Apply antimicrobial treatments and coatings after the system is rendered clean.
3. Apply antimicrobial agents and coatings directly onto surfaces of interior ductwork.
4. Microbial remediation shall be performed by a qualified CMR and CMRS

3.3 CLEANLINESS VERIFICATION

A. Verify cleanliness according to NADCA ACR, "Verification of HVAC System Cleanliness" Section.

B. Surface-Cleaning Verification: Perform visual inspection for cleanliness. If no contaminants are evident through visual inspection, the HVAC system shall be considered clean. If visible contaminants are evident through visual inspection, those portions of the system where contaminants are visible shall be re-cleaned and subjected to re-inspection for cleanliness.

C. Prepare a written cleanliness verification report.

3.4 RESTORATION

A. Restore and repair HVAC air-distribution ducts, plenums, and components according to NADCA ACR, "Restoration and Repair of Mechanical Systems" Section.
B. Restore service openings capable of future reopening. Comply with requirements in Section 233113 "Metal Ducts".
C. Replace fibrous-glass materials that cannot be restored by cleaning or resurfacing. Comply with requirements in Section 233113 "Metal Ducts"
D. Replace damaged insulation according to Section 230713 "Duct Insulation."
E. Ensure that closures do not hinder or alter airflow.
F. New closure materials, including insulation, shall match opened materials and shall have removable closure panels fitted with gaskets and fasteners.
G. Restore manual volume dampers and air-directional mechanical devices inside the system to their marked position on completion of cleaning.

END OF SECTION 23 01 30.52

SECTION 23 05 00

COMMON WORK RESULTS FOR HVAC

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:

1. Equipment nameplate data requirements.
2. Nonshrink grout for equipment installations.
3. Field-fabricated metal and wood equipment supports.
4. Installation requirements common to equipment specification sections.
5. Mechanical demolition.
6. Cutting and patching.
7. Touch-up painting and finishing.

B. The plans and specifications are complimentary and shall be used together in order to fully describe the Work. In the case of a conflict between the plans and specifications, the plans take precedence.

C. The engineer has based the drawings and design on non-certified information furnished by various equipment manufacturers. It is incumbent on the part of the Contractor to include in the bid all material and labor needed to install the actual equipment furnished.

D. Related Sections:

1. The following is work of Division 26 sections of the Specifications:

a. Power supply wiring from power source to power connection on equipment. Include starters, disconnects, and required electrical devices, except where specified as furnished, or factory-installed, by manufacturer.
b. Interlock wiring between field-installed equipment, except where specified as factory installed. Interlock wiring, as used in this specification, is defined as that wiring between electrically-interlocked equipment for the purpose of controlling one piece or pieces of equipment by the operation (on, off, etc.) of another piece or pieces of associated equipment.

E. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

1. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
3. Requirements for Contractor to provide quality-assurance and -control services required by Architect, Owner or authorities having jurisdiction are not limited by provisions of this Section.
4. Specific test and inspection requirements are not specified in this Section.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
F. The following are industry abbreviations for plastic materials:

1. ABS: Acrylonitrile-butadiene-styrene plastic.
2. CPVC: Chlorinated polyvinyl chloride plastic.
3. PE: Polyethylene plastic.
4. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.4 REFERENCES

A. Applicable Standards:

1. American Society for Testing and Materials (ASTM):

a. A47 - Ferritic Malleable Iron Castings.
b. A53 - Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
c. A126 - Gray Iron castings for Valves, Flanges, and Pipe Fittings.
d. A536 - Ductile Iron Castings.
e. B32 - Solder Metal.
f. C1107 - Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
g. D709 - Laminated Thermosetting Materials.

2. American Society of Mechanical Engineers (ASME):

a. A13.1 - Scheme for the Identification of Piping Systems.
b. B1.20.1 - Pipe Threads, General Purpose (Inch).
c. B16.20 - Ring-Joint Gaskets and Grooves for Steel Pipe Flanges.
d. B16.21 - Nonmetallic Flat Gaskets for Pipe Flanges.
e. B18.2.1 - Square and Hex Bolts and Screws-Inch Series.
f. B31 Series - Code for Pressure Piping.

3. American Welding Society (AWS):

a. Soldering Manual, latest.
b. Brazing Manual, latest.
c. A5.8 - Filler Metals for Brazing.
d. D1.1 - Structural Welding Code for Steel.
e. D10.12 - Recommended Practices and Procedures for Welding Low Carbon Steel Pipe.

1.5 SUBMITTALS

A. Submit manufacturer’s data sheets on all system components.
B. General, all Division 23 sections of the Specifications: Follow the procedures specified in Division 1. Prepare maintenance manuals in accordance with Division 1 sections of the Specifications.

1.6 QUALITY ASSURANCE

A. Electrical Characteristics for Mechanical Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.
B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, and telephone number of technical representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at Project site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement whether conditions, products, and installation will affect warranty.
7. Other required items indicated in individual Specification Sections.

C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, and telephone number of factory-authorized service representative making report.
2. Statement that equipment complies with requirements.
3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
4. Statement whether conditions, products, and installation will affect warranty.
5. Other required items indicated in individual Specification Sections.

D. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
E. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
F. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
G. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
H. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

1.7 DELIVERY, STORAGE, AND PROTECTION

A. Protect stored ducts and tubes from moisture and dirt. Elevate above grade. When stored inside, do not exceed structural capacity of the floor.
B. Protect flanges, fittings, and ducting specialties from moisture and dirt.
C. Materials and equipment furnished by others.

1. When equipment or materials are indicated to be furnished by others (F.B.O.) or by owner furnished equipment (OFE) to the CONTRACTOR for installation and connection, the CONTRACTOR shall make a complete check of all materials and furnish a receipt to the owner detailing the products received and the condition of the products delivered to him. After executing the receipt and acceptance by the CONTRACTOR, the CONTRACTOR shall assume full responsibility for the safe keeping, handling, and installation of the materials and equipment furnished by others or furnished by government, until completed installation and final approval by the engineer and owner.
2. If the CONTRACTOR fails to issue said receipt it shall be assumed that all equipment and materials were then delivered to the CONTRACTOR in the proper quantities and in perfect condition.

1.8 PROJECT SITE CONDITIONS

A. Altitude Ratings: Unless otherwise noted, all specified equipment capacities, air quantities, etc., are for an altitude of 5,280 feet above sea level. Adjustments to manufacturers' ratings must be made accordingly.

1.9 SEQUENCING AND SCHEDULING

A. Coordinate mechanical ducting, and equipment installation with other building components.
B. Arrange for chases, slots, and openings in building structure during progress of construction, to allow for mechanical installations.
C. Coordinate the installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components, as they are constructed.
D. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the work. Coordinate installation of large equipment requiring positioning prior to closing in the building.
E. Interruption of Mechanical Utilities:

1. The Contractor shall not interrupt any main interior or exterior mechanical utility without written request for an outage and a subsequent approval of owner nor shall he interrupt any branch line to an outlet or item of equipment without approval from the owner.
2. Written request for outages shall be submitted seven calendar days in advance of the outage date. This request will delineate the particular utility or service in question, the time the service will be interrupted and the approximate hours the utility shall be off.
3. Unless otherwise noted on the drawings, or directed, any tie-ins or connections to existing utilities or equipment that necessitate interruptions of service shall be performed on a during non standard hours
4. The work to be performed during the interruption, will be preceded by all possible preparation, and will be carefully coordinated to minimize the duration of the interruption and work will proceed continuously until the system is restored to normal.

F. Coordinate installation of identifying devices after completion of covering and painting, where devices are applied to surfaces. Install identifying devices prior to installation of acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Grout: Nonshrink, Nonmetallic Grout: ASTM C1107, Grade B.

1. Characteristics: Post-hardening, volume-adjusting, dry, hydraulic-cement grout, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000 psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HVAC DEMOLITION

A. Refer to Division 1 Section “Cutting and Patching” and Division 02 Section “Selective Structure Demolition” for general demolition requirements and procedures.
B. Disconnect, demolish, and remove HVAC systems, equipment, and components indicated to be removed.

1. Equipment to be removed: Disconnect and cap services and remove equipment.
2. Equipment to be removed and reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
3. Equipment to be removed and salvaged: Disconnect and cap services and remove equipment and deliver to owner.

C. If equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 ERECTION INSTALLATION APPLICATION

A. Mechanical Systems - Common Requirements:

1. General: Install ducting as described below, except where system sections specify otherwise.
2. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate general location and arrangement of mechanical systems. Install as indicated, except where deviations to layout are approved on coordination drawings.
3. Install components having pressure rating equal to or greater than system operating pressure.
4. Install ducting free of sags and bends.
5. Install exposed interior and exterior ducting at right angles or parallel to building walls. Diagonal runs are prohibited, except where indicated.
6. Install ducting tight to slabs, beams, joists, columns, walls, and other building elements. Allow sufficient space above removable ceiling panels to allow for ceiling panel removal.
7. Install ducting to allow application of insulation plus 1-inch clearance around insulation for all exterior insulated ducts.
8. Install fittings for changes in direction and branch connections.
9. Escutcheons: Where uncovered exposed ducts pass through floors, finished walls, or finished ceilings, they shall be fitted with chromium-plated cast-brass plates on chromium-plated pipe, or with cast-iron or steel plates on ferrous pipe. Plates shall be large enough to completely close the openings around the ducts and shall be square, octangular, or round, with the least dimension not less than 1-1/2 inches or more than 2-1/2 inches larger than the diameter of the duct. Plates shall be secured in an approved manner.
10. Verify final equipment locations for roughing in.
11. See equipment specifications in other sections of these specifications for roughing-in requirements.

B. Equipment Installation - Common Requirements:

1. Install equipment to provide the maximum possible head room, where mounting heights are not indicated.
2. Install equipment according to approved submittal data. Portions of the Work are shown only in diagrammatic form. Refer conflicts to the engineer.
3. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, except where otherwise indicated.
4. Install mechanical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. Connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.
5. Shaft Alignment: All motors and pumps (or drives) connected by a shaft coupling, whether factory or field assembled, shall be aligned during installation using a dial indicator applied to both ends of both shafts for a full 360 degrees prior to operation. Alignment of the shafts shall be less than the maximum allowable tolerances as recommended by the coupling or equipment manufacturer. Alignment of shafts shall be rechecked after several hours of operation and equipment has reached operating temperature.

C. Painting and Finishing:

1. Field painting requirements are specified in Division 9 sections of the Specifications.
2. Damage and Touch-Up: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

D. Erection of Metal Supports and Anchorage:

1. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
2. Field Welding: Comply with AWS D1.1 "Structural Welding Code - Steel."

E. Cutting and Patching:

1. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for mechanical installations. Perform cutting by skilled mechanics of the trades involved.
2. Repair cut surfaces to match adjacent surfaces.

F. Grouting:

1. Install nonmetallic, nonshrink grout for mechanical equipment base bearing surfaces, pump and other equipment base plates and anchors. Mix grout according to manufacturer's printed instructions.
2. Clean surfaces that will come into contact with grout.
3. Provide forms for placement of grout, as required.
4. Avoid air entrapment when placing grout.
5. Place grout, completely filling equipment bases.
6. Place grout on concrete bases to provide a smooth bearing surface for equipment.
7. Place grout around anchors.
8. Cure placed grout according to manufacturer's printed instructions.

END OF SECTION 23 05 00

SECTION 23 05 17

SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sleeves.
2. Sleeve-seal systems.
3. Grout.
4. Silicone sealants.

B. Related Requirements:

1. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop collar.
B. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, anti-corrosion coated or zinc coated, with plain ends and integral welded waterstop collar.
C. Galvanized-Steel Sheet Pipe Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

D. PVC Pipe Sleeves: ASTM D 1785, Schedule 40.

2.2 SLEEVE-SEAL SYSTEMS

A. Description:

1. Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
2. Designed to form a hydrostatic seal of 20-psig.

3. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size.

4. Pressure Plates: Carbon steel or Stainless steel.

5. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, ASTM B 633 or Stainless steel, of length required to secure pressure plates to sealing elements.

2.3 GROUT

A. Description: Nonshrink, recommended for interior and exterior sealing openings in nonfire-rated walls or floors.
B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
C. Design Mix: 5000-psi, 28-day compressive strength.
D. Packaging: Premixed and factory packaged.

2.4 SILICONE SEALANTS

A. Silicone, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant, ASTM C 920, Type S, Grade NS, Class 25, use NT.

1. Sealant shall have a VOC content of 250 g/L or less.
2. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Silicone, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade P, Class 25, Uses T and NT. Grade P Pourable (self-leveling) formulation is for opening in floors and other horizontal surfaces that are not fire rated.

1. Sealant shall have a VOC content of 250 g/L or less.
2. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.

2. Using grout or silicone sealant, seal space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.

2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use sealants appropriate for size, depth, and location of joint.

E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke-Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 078413 "Penetration Firestopping."

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal-system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.3 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.

B. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.

3.4 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Concrete Slabs Above Grade:

a. Piping Smaller Than NPS 6: Steel-pipe sleeves or PVC-pipe sleeves Sleeve-seal fittings.
b. .

2. Interior Partitions:

a. Piping Smaller Than NPS 6: Galvanized-steel pipe sleeves or PVC-pipe sleeves.

END OF SECTION 23 05 17

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SECTION 23 05 48.13

VIBRATION CONTROLS FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Spring hangers.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 SPRING HANGERS

A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression:

1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
8. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

PART 3 - EXECUTION

3.1 VIBRATION CONTROL DEVICE INSTALLATION

A. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.

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SECTION 23 05 53

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Duct labels.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032-inch or stainless steel, 0.025-inch or aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Letter Color: Black
3. Background Color: White.
4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
6. Fasteners: Stainless-steel rivets or self-tapping screws.
7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch or 1/8 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: Black.
3. Background Color: White.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number

and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 DUCT LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch or 1/8 inch thick, and having predrilled holes for attachment hardware.
B. Letter Color: Black.
C. Background Color: White.
D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
G. Fasteners: Stainless-steel rivets or self-tapping screws.
H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
I. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings; also include duct size and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions or as separate unit on each duct label to indicate flow direction.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.
B. Locate equipment labels where accessible and visible.

3.3 DUCT LABEL INSTALLATION

A. Install plastic-laminated or self-adhesive duct labels with permanent adhesive on air ducts.
B. Locate labels near points where ducts enter into and exit from concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

END OF SECTION 23 05 53

SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Balancing Air Systems:

a. Constant-volume air systems.
b. Variable-air-volume systems.

1.2 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 independent entity meeting qualifications to perform TAB work.
F. TDH: Total dynamic head.

1.3 ACTION SUBMITTALS

A. TAB Report: Documentation indicating that Work complies with ASHRAE/IES 90.1, Section 6.7.2.3 - "System Balancing."

1.4 INFORMATIONAL SUBMITTALS

A. Strategies and Procedures Plan: Within 30 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.
B. Certified TAB reports.

1.5 QUALITY ASSURANCE

A. TAB Specialists Qualifications: Certified by AABC.

1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC.
2. TAB Technician: Employee of the TAB specialist and certified by AABC as a TAB technician.

B. TAB Specialists Qualifications: Certified by NEBB or TABB.

1. TAB Field Supervisor: Employee of the TAB specialist and certified by NEBB or TABB.
2. TAB Technician: Employee of the TAB specialist and certified by NEBB or TABB as a TAB technician.

C. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."
D. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.7.2.3 - "System Balancing."

PART 2 - PRODUCTS (Not Applicable)
PART 3 - EXECUTION

3.1 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 installed systems for 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 applicable for intended purpose and 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 used for supply, return, or relief air to verify that they 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 verify that bearings are greased, belts are aligned and tight, filters are clean, 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 control valves for proper installation for their intended function of throttling, diverting, or mixing fluid flows.
L. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
M. Examine operating safety interlocks and controls on HVAC equipment.
N. 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.

3.2 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures for balancing the systems.
B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:

    1. Airside:

        a. Duct systems are complete with terminals installed.
        b. Volume, smoke, and fire dampers are open and functional.
        c. Clean filters are installed.
        d. Fans are operating, free of vibration, and rotating in correct direction.

e. Variable-frequency controllers' startup is complete and safeties are verified.
f. Automatic temperature-control systems are operational.
g. Ceilings are installed.
h. Windows and doors are installed.
i. Suitable access to balancing devices and equipment is provided.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance" or ASHRAE 111 or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" or SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.
B. Cut insulation, ducts, 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 Section 233300 "Air Duct Accessories."
3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 230713 "Duct Insulation," Section 230716 "HVAC Equipment Insulation," and Section 230719 "HVAC Piping Insulation."

C. 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.
D. 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. Cross-check 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 Section 233113 "Metal Ducts."

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.

a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
b. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.

c. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
d. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.

2. Measure fan static pressures as follows:

a. Measure static pressure directly at the fan outlet or through the flexible connection.
b. Measure static pressure directly at the fan inlet or through the flexible connection.
c. Measure static pressure across each component that makes up the air-handling system.
d. Report artificial loading of filters at the time static pressures are measured.

3. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
4. Obtain approval from Architect or Owner for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
5. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload occurs. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.

1. Measure airflow of submain and branch ducts.
2. Adjust submain and branch duct volume dampers for specified airflow.
3. Re-measure each submain and branch duct after all have been adjusted.

C. Adjust air inlets and outlets for each space to indicated airflows.

1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
2. Measure inlets and outlets airflow.
3. Adjust each inlet and outlet for specified airflow.
4. Re-measure each inlet and outlet after they have been adjusted.

3.6 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Adjust the variable-air-volume systems as follows:

1. Verify that the system static pressure sensor is located two-thirds of the distance down the duct from the fan discharge.
2. Verify that the system is under static pressure control.
3. Select the terminal unit that is most critical to the supply-fan airflow. Measure inlet static pressure, and adjust system static pressure control set point 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.
4. Calibrate and balance each terminal unit for maximum and minimum design airflow as follows:

a. Adjust controls so that terminal is calling for maximum airflow. Some controllers require starting with minimum airflow. Verify calibration procedure for specific project.

b. Measure airflow and adjust calibration factor as required for design maximum airflow. Record calibration factor.
c. When maximum airflow is correct, balance the air outlets downstream from terminal units.
d. Adjust controls so that terminal is calling for minimum airflow.
e. Measure airflow and adjust calibration factor as required for design minimum airflow. Record calibration factor. If no minimum calibration is available, note any deviation from design airflow.
f. When in full cooling or full heating, ensure that there is no mixing of hot-deck and cold-deck airstreams unless so designed.
g. On constant volume terminals, in critical areas where room pressure is to be maintained, verify that the airflow remains constant over the full range of full cooling to full heating. Note any deviation from design airflow or room pressure.

5. After terminals have been calibrated and balanced, test and adjust system for total airflow. Adjust fans to deliver total design airflows within the maximum allowable fan speed listed by fan manufacturer.

a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
b. Set terminals for maximum airflow. If system design includes diversity, adjust terminals for maximum and minimum airflow so that connected total matches fan selection and simulates actual load in the building.
c. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
d. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
e. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.

6. Measure fan static pressures as follows:

a. Measure static pressure directly at the fan outlet or through the flexible connection.
b. Measure static pressure directly at the fan inlet or through the flexible connection.
c. Measure static pressure across each component that makes up the air-handling system.
d. Report any artificial loading of filters at the time static pressures are measured.

7. Set final return and outside airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.

a. Balance the return-air ducts and inlets the same as described for constant-volume air systems.
b. Verify that terminal units are meeting design airflow under system maximum flow.

8. Re-measure the inlet static pressure at the most critical terminal unit and adjust the system static pressure set point to the most energy-efficient set point to maintain the optimum system static pressure. Record set point and give to controls contractor.
9. Verify final system conditions as follows:

a. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to match design if necessary.
b. Re-measure and confirm that total airflow is within design.
c. Re-measure final fan operating data, rpms, volts, amps, and static profile.
d. Mark final settings.
e. Test system in economizer mode. Verify proper operation and adjust if necessary. Measure and record all operating data.

f. Verify tracking between supply and return fans.

3.7 TOLERANCES

A. Set HVAC system's airflow 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.

B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.8 FINAL REPORT

A. 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.
3. Certify validity and accuracy of field data.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Fan curves.
2. Manufacturers' test data.
3. Field test reports prepared by system and equipment installers.
4. Other information relative to equipment performance; do not include Shop Drawings and Product Data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB specialist.
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.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outdoor, supply, return, and exhaust airflows.
2. Duct, outlet, and inlet sizes.
3. Pipe and valve sizes and locations.
4. Terminal units.
5. Balancing stations.
6. Position of balancing devices.

E. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:

1. Unit Data:

a. System identification.
b. Location.
c. Coil identification.
d. Capacity in Btu/h.
e. Number of stages.
f. Connected volts, phase, and hertz.
g. Rated amperage.
h. Airflow rate in cfm.
i. Face area in sq. ft..
j. Minimum face velocity in fpm.

2. Test Data (Indicated and Actual Values):

a. Heat output in Btu/h.
b. Airflow rate in cfm.
c. Air velocity in fpm.
d. Entering-air temperature in deg F.
e. Leaving-air temperature in deg F.
f. Voltage at each connection.
g. Amperage for each phase.

F. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:

a. System identification.
b. Location.
c. Make and type.
d. Model number and size.
e. Manufacturer's serial number.
f. Arrangement and class.
g. Sheave make, size in inches, and bore.
h. Center-to-center dimensions of sheave and amount of adjustments in inches.

2. Motor Data:

a. Motor make, and frame type and size.

b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
g. Number, make, and size of belts.

3. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Suction static pressure in inches wg.

G. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:

a. System and air-handling-unit number.
b. Location and zone.
c. Traverse air temperature in deg F.
d. Duct static pressure in inches wg.
e. Duct size in inches.
f. Duct area in sq. ft..
g. Indicated airflow rate in cfm.
h. Indicated velocity in fpm.
i. Actual airflow rate in cfm.
j. Actual average velocity in fpm.
k. Barometric pressure in psig.

H. Air-Terminal-Device Reports:

1. Unit Data:

a. System and air-handling unit identification.
b. Location and zone.
c. Apparatus used for test.
d. Area served.
e. Make.
f. Number from system diagram.
g. Type and model number.
h. Size.
i. Effective area in sq. ft..

2. Test Data (Indicated and Actual Values):

a. Airflow rate in cfm.
b. Air velocity in fpm.
c. Preliminary airflow rate as needed in cfm.
d. Preliminary velocity as needed in fpm.
e. Final airflow rate in cfm.
f. Final velocity in fpm.
g. Space temperature in deg F.

I. Instrument Calibration Reports:

1. Report Data:

    a. Instrument type and make.
    b. Serial number.
    c. Application.
    d. Dates of use.
    e. Dates of calibration.

3.9 VERIFICATION OF TAB REPORT

A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Architect or Owner or Construction Manager or commissioning authority.
B. Architect or Owner or Construction Manager or Commissioning authority shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
E. If TAB work fails, proceed as follows:

    1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
    2. If the second final inspection also fails, Owner may contract the services of another TAB specialist to complete TAB work according to the Contract Documents and deduct the cost of the services from the original TAB specialist's final payment.
    3. If the second verification also fails, Owner or design professional or Architect may contact AABC Headquarters regarding the AABC National Performance Guaranty.

F. Prepare test and inspection reports.

3.10 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 23 05 93

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SECTION 23 07 13

DUCT INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes insulating the following duct services:

1. Indoor, concealed supply
2. Indoor, concealed return.

1.2 ACTION SUBMITTALS

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

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. 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.

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. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
F. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
G. 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.

2.2 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.

1. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
2. Service Temperature Range: Minus 20 to plus 180 deg F.
3. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
4. Color: White.

2.3 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.4 TAPES

A. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Width: 3 inches.
2. Thickness: 6.5 mils.
3. Adhesion: 90 ounces force/inch in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

2.5 SECUREMENTS

A. Aluminum Bands: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch or 3/4 inch wide with wing seal or closed seal.

PART 3 - EXECUTION

3.1 PREPARATION

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

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 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. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches or 4 inches o.c.
4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.

J. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
K. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
L. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.3 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 and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches 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 from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch 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 at 18-foot 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.

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- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.3 INSTALLATION OF MINERAL-FIBER INSULATION

A. 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 and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches 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 from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch 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 at 18-foot 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.

5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches 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- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.4 FIELD-APPLIED JACKET INSTALLATION

A. 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 laps at longitudinal seams and 3-inch- wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

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. Ducts Requiring Insulation:

1. Indoor, concealed supply and return air.

B. Items Not Insulated:

1. Exposed ducts

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SECTION 23 31 13

METAL DUCTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Rectangular ducts and fittings.
2. Round ducts and fittings.
3. Sheet metal materials.
4. Sealants and gaskets.
5. Hangers and supports.

B. Related Sections:

1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Section 233116 "Nonmetal Ducts" for fibrous-glass ducts, thermoset fiber-reinforced plastic ducts, thermoplastic ducts, PVC ducts, and concrete ducts.

1.2 PERFORMANCE REQUIREMENTS

A. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and or ASCE/SEI 7.

B. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ANSI/ASHRAE 62.1.

1.3 ACTION SUBMITTALS

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

1.4 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports. or AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports. or AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

B. 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 D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

D. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 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 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.

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."

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."

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 or G90.
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.4 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: 3 inches or 4 inches or 6 inches.
3. Sealant: Modified styrene acrylic.
4. Water resistant.
5. Mold and mildew resistant.
6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 200 deg F.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
10. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
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, 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. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.
6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

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

F. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.

3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.5 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
H. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
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 ducts in maximum practical lengths.
D. Install ducts with fewest possible joints.
E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers.
L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

3.2 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 at a minimum to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":

1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
2. Outdoor, Supply-Air Ducts: Seal Class A.
3. Outdoor, Exhaust Ducts: Seal Class C.
4. Outdoor, Return-Air Ducts: Seal Class C.
5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
7. Unconditioned Space, Exhaust Ducts: Seal Class C.
8. Unconditioned Space, Return-Air Ducts: Seal Class B.
9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.
11. Conditioned Space, Exhaust Ducts: Seal Class B.
12. Conditioned Space, Return-Air Ducts: Seal Class C.

3.4 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 thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.
E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.5 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."
B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.6 DUCT CLEANING

A. Clean new and existing duct system(s) before testing, adjusting, and balancing.
B. Use service openings for entry and inspection.

1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 233300 "Air Duct Accessories" for access panels and doors.
2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
3. Remove and reinstall ceiling to gain access during the cleaning process.

C. Particulate Collection and Odor Control:

1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

D. Clean the following components by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).
2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
4. Coils and related components.
5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
6. Supply-air ducts, dampers, actuators, and turning vanes.
7. Dedicated exhaust and ventilation components and makeup air systems.

E. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.

3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.7 START UP

A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.8 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:
B. Supply Ducts:

1. Ducts connected upstream of terminal units:

a. Pressure Class: Positive 2-inch wg.
b. Minimum SMACNA Seal Class: B.
c. SMACNA Leakage Class for Rectangular: 12.
d. SMACNA Leakage Class for Round and: 6.

2. Ducts Connected downstream of terminal units:

a. Pressure Class: Positive 1-inch wg.
b. Minimum SMACNA Seal Class: .
c. SMACNA Leakage Class for Rectangular: 24.
d. SMACNA Leakage Class for Round: 12.

C. Transfer/Return Ducts:

1. Ducts Connected to Transfer/Return grilles:

a. Pressure Class: Positive 1-inch wg.
b. Minimum SMACNA Seal Class : C.
c. SMACNA Leakage Class for Rectangular: 24.
d. SMACNA Leakage Class for Round: 12.

D. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel or Carbon steel coated with zinc-chromate primer or Galvanized steel or carbon steel coated with zinc-chromate primer.
2. Stainless-Steel Ducts:

a. Exposed to Airstream: Match duct material.
b. Not Exposed to Airstream: Galvanized or Match duct material.

3. Aluminum Ducts: Aluminum or galvanized sheet steel coated with zinc chromate.

E. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."

    a. Velocity 1000 fpm or Lower:

        1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
        2) Mitered Type RE 4 without vanes.

    b. Velocity 1000 to 1500 fpm:

        1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
        2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
        3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

    c. Velocity 1500 fpm or Higher:

        1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
        2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
        3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."

    a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
    b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
    c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."

    a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.

        1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
        2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
        3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
        4) Radius-to Diameter Ratio: 1.5.

    b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
    c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam or Welded.

F. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."

    a. Rectangular Main to Rectangular Branch: 45-degree entry.

b. Rectangular Main to Round Branch: Spin in.

2. Round: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.

   a. Velocity 1000 fpm or Lower: 90-degree tap.
   b. Velocity 1000 to 1500 fpm: Conical tap.
   c. Velocity 1500 fpm or Higher: 45-degree lateral.

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SECTION 23 33 00

AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Manual volume dampers.
2. Turning vanes.
3. Flexible connectors.
4. Duct accessory hardware.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

2.2 MATERIALS

A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G60 or G90.
2. Exposed-Surface Finish: Mill phosphatized.

B. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts and finish for exposed ducts.
C. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
D. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.
E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.3 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:

1. Standard leakage rating, with linkage outside airstream.
2. Suitable for horizontal or vertical applications.

3. Frames:

    a. Frame: Hat-shaped, 0.094-inch- thick, galvanized sheet steel or 0.05-inch- thick stainless steel.
    b. Mitered and welded corners.
    c. Flanges for attaching to walls and flangeless frames for installing in ducts.

4. Blades:

    a. Multiple or single blade.
    b. Parallel- or opposed-blade design.
    c. Stiffen damper blades for stability.
    d. Galvanized or Stainless-steel, 0.064 inch thick.

5. Blade Axles: Galvanized steel or Stainless steel.
6. Bearings:

    a. Oil-impregnated bronze or Molded synthetic or Oil-impregnated stainless-steel sleeve or Stainless-steel sleeve.
    b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

7. Tie Bars and Brackets: Galvanized steel.

B. Jackshaft:

1. Size: 0.5-inch or 1-inch diameter.
2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

C. Damper Hardware:

1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
2. Include center hole to suit damper operating-rod size.
3. Include elevated platform for insulated duct mounting.

2.4 TURNING VANES

A. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

B. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."
D. Vane Construction: Single or Double wall.

2.5 FLEXIBLE CONNECTORS

A. Materials: Flame-retardant or noncombustible fabrics.
B. Coatings and Adhesives: Comply with UL 181, Class 1.

C. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches or 5-3/4 inches wide attached to two strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Provide metal compatible with connected ducts.
D. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 26 oz./sq. yd..
2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
3. Service Temperature: Minus 40 to plus 200 deg F.

2.6 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
C. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

1. Install steel volume dampers in steel ducts.
2. Install aluminum volume dampers in aluminum ducts.

D. Set dampers to fully open position before testing, adjusting, and balancing.
E. Install test holes at fan inlets and outlets and elsewhere as indicated.
F. Install flexible connectors to connect ducts to equipment.
G. Connect terminal units to supply ducts directly or with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.
H. Connect diffusers or light troffer boots to ducts directly or with maximum 60-inch lengths of flexible duct clamped or strapped in place.
I. Connect flexible ducts to metal ducts with adhesive or liquid adhesive plus tape or draw bands or adhesive plus sheet metal screws.
J. Install duct test holes where required for testing and balancing purposes.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Operate fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.

END OF SECTION 23 33 00

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SECTION 23 33 46

FLEXIBLE DUCTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Insulated flexible ducts.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
C. Comply with the Air Diffusion Council's "ADC Flexible Air Duct Test Code FD 72-R1."
D. Comply with ASTM E 96/E 96M, "Test Methods for Water Vapor Transmission of Materials."

2.2 INSULATED FLEXIBLE DUCTS

A. Insulated, Flexible Duct: UL 181, Class 1, two-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene or aluminized vapor-barrier film.

1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
2. Maximum Air Velocity: 4000 fpm.
3. Temperature Range: Minus 10 to plus 160 deg F.
4. Insulation R-Value: Comply with ASHRAE/IES 90.1 or R4.2 or R6 or R8 .

B. Insulated, Flexible Duct: UL 181, Class 1, multiple layers of aluminum laminate supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene or aluminized vapor-barrier film.

1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
2. Maximum Air Velocity: 4000 fpm.
3. Temperature Range: Minus 20 to plus 210 deg F.
4. Insulation R-Value: Comply with ASHRAE/IES 90.1 or R4.2 or R6 or R8 .

2.3 FLEXIBLE DUCT CONNECTORS

A. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action or Nylon strap in sizes 3 through 18 inches, to suit duct size.
B. Non-Clamp Connectors: Adhesive or Liquid adhesive plus tape or Adhesive plus sheet metal screws.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install flexible ducts according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
B. Install in indoor applications only. Flexible ductwork should not be exposed to UV lighting.
C. Connect terminal units to supply ducts directly or with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.
D. Connect diffusers to ducts directly or with maximum 60-inch lengths of flexible duct clamped or strapped in place.
E. Connect flexible ducts to metal ducts with adhesive or liquid adhesive plus tape or draw bands or adhesive plus sheet metal screws.
F. Install duct test holes where required for testing and balancing purposes.
G. Installation:

1. Install ducts fully extended.
2. Do not bend ducts across sharp corners.
3. Bends of flexible ducting shall not exceed a minimum of one duct diameter.
4. Avoid contact with metal fixtures, water lines, pipes, or conduits.
5. Install flexible ducts in a direct line, without sags, twists, or turns.

H. Supporting Flexible Ducts:

1. Suspend flexible ducts with bands 1-1/2 inches wide or wider and spaced a maximum of 48 inches apart. Maximum centerline sag between supports shall not exceed 1/2 inch per 12 inches.
2. Install extra supports at bends placed approximately one duct diameter from center line of the bend.
3. Ducts may rest on ceiling joists or truss supports. Spacing between supports shall not exceed the maximum spacing per manufacturer's written installation instructions.
4. Vertically installed ducts shall be stabilized by support straps at a maximum of 72 inches o.c.

END OF SECTION 23 33 46

SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Copper building wire rated 600 V or less.
2. Connectors, splices, and terminations rated 600 V and less.

B. Related Requirements:

1. Section 271513 "Communications Copper Horizontal Cabling" for twisted pair cabling used for data circuits.

1.3 DEFINITIONS

A. RoHS: Restriction of Hazardous Substances.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 PRODUCTS

2.1 COPPER BUILDING WIRE

A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

B. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. RoHS compliant.
3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

C. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.

D. Conductor Insulation:

1. Type THHN and Type THWN-2: Comply with UL 83.
2. Type XHHW-2: Comply with UL 44.

2.2 CONNECTORS AND SPLICES

A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

B. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.

C. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.

1. Material: Copper.
2. Type: One hole with standard barrels.
3. Termination: Compression.

PART 3 EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Feeders: Copper for feeders smaller than No. 4 AWG; copper or aluminum for feeders No. 4 AWG and larger. Conductors shall be solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

C. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

D. Branch Circuits: Copper. Solid for No. 12 AWG and smaller; stranded for No. 10 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.

B. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN/THWN-2, single conductors in raceway

C. Exposed Branch Circuits, Including in Crawlspaces: Type THHN/THWN-2, single conductors in raceway

D. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway.

E. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

G. Complete cable tray systems installation according to Section 260536 "Cable Trays for Electrical Systems" prior to installing conductors and cables.

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

B. Make splices, terminations, and taps that are compatible with conductor material.

1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) of slack.

3.5 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.7 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."

3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Perform each of the following visual and electrical tests:
    a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
    b. Test bolted connections for high resistance using one of the following:
        1) A low-resistance ohmmeter.
        2) Calibrated torque wrench.
        3) Thermographic survey.
    c. Inspect compression-applied connectors for correct cable match and indentation.
    d. Inspect for correct identification.
    e. Inspect cable jacket and condition.
    f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable for a one-minute duration.
    g. Continuity test on each conductor and cable.
    h. Uniform resistance of parallel conductors.
2. Initial Infrared Scanning: After Substantial Completion, but before Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.
    a. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
    b. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
3. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.

B. Prepare test and inspection reports to record the following:

1. Procedures used.
2. Results that comply with requirements.
3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

END OF SECTION

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SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes grounding and bonding systems and equipment.

1.3 ACTION SUBMITTALS

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

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with UL 467 for grounding and bonding materials and equipment.

2.2 CONDUCTORS

A. Insulated Conductors: **Copper** wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. 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 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

2.3 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.

C. Cable-to-Cable Connectors: Compression type, copper or copper alloy.

D. Conduit Hubs: Mechanical type, terminal with threaded hub.

E. Service Post Connectors: Mechanical type, bronze alloy terminal, in short- and long-stud lengths, capable of single and double conductor connections.

F. Straps: Solid copper, [**cast-bronze clamp**] [**copper lugs**]. Rated for 600 A.

PART 3 EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

B. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.

2. Connections to Structural Steel: Welded connectors.

3.2 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

3.3 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

C. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet (18 m) apart.

D. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.

1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
2. Make connections with clean, bare metal at points of contact.
3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
4. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.

C. Prepare test and inspection reports.

END OF SECTION

SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Steel slotted support systems.
2. Conduit and cable support devices.
3. Structural steel for fabricated supports and restraints.
4. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
5. Fabricated metal equipment support assemblies.

PART 2 PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch-(10-mm-) diameter holes at a maximum of 8 inches (200 mm) o.c. in at least one surface.

1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
2. Material for Channel, Fittings, and Accessories: Galvanized steel.
3. Channel Width: Selected for applicable load criteria.
4. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
5. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
6. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
7. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

C. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M steel plates, shapes, and bars; black and galvanized.

D. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Mechanical-Expansion Anchors: Insert-wedge-type, [zinc-coated] [stainless] steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
2. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
3. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
5. Toggle Bolts: All-steel springhead type.

6. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

PART 3 EXECUTION

3.1 APPLICATION

A. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

B. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."

C. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings, and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 for installation requirements except as specified in this article.

B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).

C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To New Concrete: Bolt to concrete inserts.
2. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
3. To Existing Concrete: Expansion anchor fasteners.
4. To Steel: Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69.
5. To Light Steel: Sheet metal screws.
6. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.

D. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Section 055000 "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

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SECTION 26 05 33

RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Metal conduits and fittings.
2. Metal wireways and auxiliary gutters.
3. Boxes, enclosures, and cabinets.

B. Related Requirements:

1. Section 078413 "Penetration Firestopping" for firestopping at conduit and box entrances.
2. Section 270528 "Pathways for Communications Systems" for conduits, wireways, surface pathways, innerduct, boxes, faceplate adapters, enclosures, cabinets, and handholes serving communications systems.

1.3 DEFINITIONS

A. GRC: Galvanized rigid steel conduit.

B. IMC: Intermediate metal conduit.

1.4 ACTION SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

PART 2 PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

A. Metal Conduit:

1. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. GRC: Comply with ANSI C80.1 and UL 6.
3. IMC: Comply with ANSI C80.6 and UL 1242.
4. EMT: Comply with ANSI C80.3 and UL 797.
5. FMC: Comply with UL 1; [zinc-coated steel] [or] [aluminum].
6. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

B. Metal Fittings:

1. Comply with NEMA FB 1 and UL 514B.
2. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. Fittings, General: Listed and labeled for type of conduit, location, and use.
4. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
5. Fittings for EMT:
   a. Material: Steel.
   b. Type: Setscrew.

6. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.

7. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.

C. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 METAL WIREWAYS AND AUXILIARY GUTTERS

A. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 unless otherwise indicated, and sized according to NFPA 70.

1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

C. Wireway Covers: Hinged type unless otherwise indicated.

D. Finish: Manufacturer's standard enamel finish.

2.3 BOXES, ENCLOSURES, AND CABINETS

A. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

B. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

C. Metal Floor Boxes – Poke Thru Devices:

1. Material: sheet metal.

2. Type: Fully adjustable.

3. Shape: Round poke thru.

4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb (23 kg). Outlet boxes designed for attachment of luminaires weighing more than 50 lb (23 kg) shall be listed and marked for the maximum allowable weight.

E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

F. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

G. Device Box Dimensions: 4 inches square by 2-1/8 inches deep (100 mm square by 60 mm deep).

H. Gangable boxes are prohibited.

I. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 with continuous-hinge cover with flush latch unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

PART 3 EXECUTION

3.1 RACEWAY APPLICATION

A. Indoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT

2. Exposed, Not Subject to Severe Physical Damage: EMT

3. Concealed in Ceilings and Interior Walls and Partitions: EMT
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
5. Damp or Wet Locations: GRC
6. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 in institutional and commercial kitchens and damp or wet locations.

B. Minimum Raceway Size: 3/4-inch (21-mm) trade size.

C. Raceway Fittings: Compatible with raceways and suitable for use and location.
1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. EMT: Use setscrew, steel fittings. Comply with NEMA FB 2.10.
3. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

D. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.

3.2 INSTALLATION

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.

B. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

C. Do not install raceways or electrical items on any "explosion-relief" walls or rotating equipment.

D. Do not fasten conduits onto the bottom side of a metal deck roof.

E. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

F. Complete raceway installation before starting conductor installation.

G. Arrange stub-ups so curved portions of bends are not visible above finished slab.

H. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches (300 mm) of changes in direction.

I. Make bends in raceway using large-radius preformed ells. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed for material and size involved.

J. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

K. Support conduit within 12 inches (300 mm) of enclosures to which attached.

L. Stub-Ups to Above Recessed Ceilings:
1. Use EMT, IMC, or RMC for raceways.
2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

M. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

N. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

O. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

P. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch (35mm) trade size and insulated throat metal bushings on 1-1/2-inch (41-mm) trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

Q. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

R. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

S. Cut conduit perpendicular to the length. For conduits 2-inch (53-mm) trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

T. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

U. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.

V. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service raceway enters a building or structure.
3. Conduit extending from interior to exterior of building.
4. Conduit extending into pressurized duct and equipment.
5. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
6. Where otherwise required by NFPA 70.

W. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

X. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches (1830 mm) of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.
2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

Y. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to [center] [top] [bottom] of box unless otherwise indicated.

Z. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

AA. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

BB. Locate boxes so that cover or plate will not span different building finishes.

CC. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

DD. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

EE. Set metal floor boxes level and flush with finished floor surface.

FF. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install 0sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.4 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

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SECTION 26 05 53

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Color and legend requirements for raceways, conductors, and warning labels and signs.
2. Labels.
3. Bands and tubes.
4. Tapes and stencils.
5. Tags.
6. Cable ties.
7. Fasteners for labels and signs.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with ASME A13.1

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Comply with NFPA 70E requirements for arc-flash warning labels.

F. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

2.2 COLOR AND LEGEND REQUIREMENTS

A. Raceways and Cables Carrying Circuits at 600 V or Less:

1. Black letters on an orange field.
2. Legend: Indicate voltage.

B. Color-Coding for Phase- and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded [service] [feeder] [and] [branch-circuit] conductors.

1. Color shall be factory applied or field applied for sizes larger than No. 8 AWG if authorities having jurisdiction permit.
2. Colors for 208/120-V Circuits:
    a. Phase A: Black.
    b. Phase B: Red.
    c. Phase C: Blue.
3. Colors for 480/277-V Circuits:
    a. Phase A: Brown.

b. Phase B: Orange.

c. Phase C: Yellow.

4. Color for Neutral: **White**.

5. Color for Equipment Grounds: **Green**.

C. Raceways and Cables Carrying Circuits at More Than 600 V:

1. Black letters on an orange field.

2. Legend: "DANGER - CONCEALED HIGH VOLTAGE WIRING."

D. Warning Label Colors:

1. Identify system voltage with black letters on an orange background.

E. Warning labels and signs shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."

2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM)."

F. Equipment Identification Labels:

1. Black letters on a white field.

2.3 LABELS

A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.

B. Snap-around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameters and that stay in place by gripping action.

C. Self-Adhesive Labels: Polyester, thermal, transfer-printed, 3-mil- (0.08-mm-) thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.

1. Minimum Nominal Size:

a. 1-1/2 by 6 inches (37 by 150 mm) for raceway and conductors.

b. 3-1/2 by 5 inches (76 by 127 mm) for equipment.

c. As required by authorities having jurisdiction.

2.4 BANDS AND TUBES

A. Snap-around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches (50 mm) long, with diameters sized to suit diameters and that stay in place by gripping action.

B. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameter and shrunk to fit firmly. Full shrink recovery occurs at a maximum of 200 deg F (93 deg C). Comply with UL 224.

2.5 TAPES AND STENCILS

A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide; compounded for outdoor use.

2.6 SIGNS

A. Baked-Enamel Signs:

1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.

2. 1/4-inch (6.4-mm) grommets in corners for mounting.
3. Nominal Size: 7 by 10 inches (180 by 250 mm).

B. Laminated Acrylic or Melamine Plastic Signs:
1. Engraved legend.
2. Thickness:
a. For signs up to 20 sq. in. (129 sq. cm), minimum 1/16 inch (1.6 mm) thick.
b. For signs larger than 20 sq. in. (129 sq. cm), 1/8 inch (3.2 mm) thick.
c. Engraved legend with black letters on white face.

2.7 CABLE TIES

A. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 Deg F (23 Deg C) according to ASTM D 638: 12,000 psi (82.7 MPa).
3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
4. Color: Black, except where used for color-coding.

B. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.
1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 Deg F (23 Deg C) according to ASTM D 638: 7000 psi (48.2 MPa).
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F (Minus 46 to plus 140 deg C).
5. Color: Black.

2.8 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 EXECUTION

3.1 PREPARATION

A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 INSTALLATION

A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.

B. Install identifying devices before installing acoustical ceilings and similar concealment.

C. Verify identity of each item before installing identification products.

D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.

E. Apply identification devices to surfaces that require finish after completing finish work.

F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.

G. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.

1. Secure tight to surface of conductor, cable, or raceway.

H. System Identification for Raceways and Cables over 600 V: Identification shall completely encircle cable or conduit. Place adjacent identification of two-color markings in contact, side by side.

1. Secure tight to surface of conductor, cable, or raceway.

I. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

J. Vinyl Wraparound Labels:

1. Secure tight to surface of raceway or cable at a location with high visibility and accessibility.

2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.

K. Snap-around Labels: Secure tight to surface at a location with high visibility and accessibility.

L. Self-Adhesive Wraparound Labels: Secure tight to surface at a location with high visibility and accessibility.

M. Self-Adhesive Labels:

1. On each item, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.

2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high.

N. Snap-around Color-Coding Bands: Secure tight to surface at a location with high visibility and accessibility.

O. Heat-Shrink, Preprinted Tubes: Secure tight to surface at a location with high visibility and accessibility.

P. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.

Q. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.

1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.

R. Nonmetallic Preprinted Tags:

1. Place in a location with high visibility and accessibility.

2. Secure using general-purpose cable ties.

S. Write-on Tags:

1. Place in a location with high visibility and accessibility.

2. Secure using general-purpose cable ties.

T. Baked-Enamel Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on minimum 1-1/2-inch- (38-mm-) high sign; where two lines of text are required, use signs minimum 2 inches (50 mm) high.

U. Metal-Backed Butyrate Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high sign; where two lines of text are required, use labels 2 inches (50 mm) high.

V. Laminated Acrylic or Melamine Plastic Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high sign; where two lines of text are required, use labels 2 inches (50 mm) high.

W. Cable Ties: General purpose, for attaching tags, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

3.3 IDENTIFICATION SCHEDULE

A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.

B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.

C. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.

D. Instructional Signs: Self-adhesive labels, including the color code for grounded and ungrounded conductors.

E. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive labels.

1. Apply to exterior of door, cover, or other access.

F. Arc Flash Warning Labeling: Self-adhesive labels.

G. Operating Instruction Signs: Self-adhesive labels.

H. Equipment Identification Labels:

1. Indoor Equipment: Self-adhesive label.
2. Equipment to Be Labeled:
    a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be in the form of a self-adhesive, engraved, laminated acrylic or melamine label.
    b. Enclosures and electrical cabinets.
    c. Access doors and panels for concealed electrical items.
    d. Remote-controlled switches, dimmer modules, and control devices.

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SECTION 26 09 23

LIGHTING CONTROL DEVICES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Indoor occupancy and vacancy sensors.
2. Switchbox-mounted occupancy sensors.

B. Related Requirements:

1. Section 262726 "Wiring Devices" for wall-box dimmers, non-networkable wall-switch occupancy sensors, and manual light switches.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of lighting control device to include in operation and maintenance manuals.

1.5 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace lighting control devices that fail(s) in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Faulty operation of lighting control software.
   b. Faulty operation of lighting control devices.

PART 2 PRODUCTS

2.1 INDOOR OCCUPANCYAND VACANCY SENSORS

A. General Requirements for Sensors:

1. Refer to Drawings for requirements.
2. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. Operation:
   a. Occupancy Sensor: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
   b. Vacancy Sensor: Unless otherwise indicated, lights are manually turned on and sensor turns lights off when the room is unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
   c. Combination Sensor: Unless otherwise indicated, sensor shall be programmed to turn lights on when coverage area is occupied and turn them off when unoccupied, or to turn off lights that have been manually turned on; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
4. Power Pack: Dry contacts rated for 20-A LED load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
5. Mounting:

a. Sensor: Suitable for mounting in any position on a standard outlet box.

b. Relay: Externally mounted through a 1/2-inch (13-mm) knockout in a standard electrical enclosure.

c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

6. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.

7. Bypass Switch: Override the "on" function in case of sensor failure.

2.2 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

A. General Requirements for Sensors: Automatic-wall-switch occupancy sensor with manual on-off switch, suitable for mounting in a single gang switchbox.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. Occupancy Sensor Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn lights off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.

3. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F (0 to 49 deg C).

4. Switch Rating: Not less than 800-VA LED load at 120 V, 1200-VA LED load at 277 V, and 800-W incandescent.

2.3 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine lighting control devices before installation. Reject lighting control devices that are wet, moisture damaged, or mold damaged.

B. Examine walls and ceilings for suitable conditions where lighting control devices will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SENSOR INSTALLATION

A. Comply with NECA 1.

B. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.

C. Install and aim sensors in locations to achieve not less than 90-percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.3 CONTACTOR INSTALLATION

A. Comply with NECA 1.

B. Mount electrically held lighting contactors with elastomeric isolator pads to eliminate structure-borne vibration unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.4 WIRING INSTALLATION

A. Comply with NECA 1.

B. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch (13 mm).

C. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

D. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.

E. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.5 IDENTIFICATION

A. Identify components and power and control wiring according to Section 260553 "Identification for Electrical Systems."

B. Label time switches and contactors with a unique designation.

3.6 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.

2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Lighting control devices will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.7 ADJUSTING

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

1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

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SECTION 26 24 16
PANELBOARDS

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. Lighting and appliance branch-circuit panelboards.

1.3 DEFINITIONS

A. ATS: Acceptance testing specification.

B. GFCI: Ground-fault circuit interrupter.

C. GFEP: Ground-fault equipment protection.

D. HID: High-intensity discharge.

E. MCCB: Molded-case circuit breaker.

F. SPD: Surge protective device.

G. VPR: Voltage protection rating.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of panelboard.

1. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
2. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details.
2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.
3. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
4. Detail bus configuration, current, and voltage ratings.
5. Short-circuit current rating of panelboards and overcurrent protective devices.
6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

1.5 INFORMATIONAL SUBMITTALS

A. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

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. Keys: **Two** spares for each type of panelboard cabinet lock.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: ISO 9001 or 9002 certified.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.

B. Handle and prepare panelboards for installation according to NECA 407

1.10 FIELD CONDITIONS

A. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.

2. Altitude not exceeding 6600 feet (2000 m).

B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Construction Manager no fewer than two days in advance of proposed interruption of electric service.

2. Do not proceed with interruption of electric service without Construction Manager's written permission.

3. Comply with NFPA 70E.

1.11 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.

1. Panelboard Warranty Period: **18** months from date of Substantial Completion.

PART 2 PRODUCTS

2.1 PANELBOARDS AND LOAD CENTERS COMMON REQUIREMENTS

A. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NEMA PB 1.

D. Comply with NFPA 70.

E. Enclosures: **Surface**-mounted, dead-front cabinets.

1. Rated for environmental conditions at installed location.

a. Indoor Dry and Clean Locations: NEMA 250, Type 1 .

2. Height: 84 inches (2.13 m) maximum.

3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.

4. Finishes:

a. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.

b. Back Boxes: Same finish as panels and trim.

F. Phase, Neutral, and Ground Buses:

1. Material: Hard-drawn copper, 98 percent conductivity.

a. Plating shall run entire length of bus.

b. Bus shall be fully rated the entire length.

2. Interiors shall be factory assembled into a unit. Replacing switching and protective devices shall not disturb adjacent units or require removing the main bus connectors.

3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.

G. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.

2. Terminations shall allow use of 75 deg C rated conductors without derating.

3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.

4. Main and Neutral Lugs: Mechanical type, with a lug on the neutral bar for each pole in the panelboard.

5. Ground Lugs and Bus-Configured Terminators: Mechanical type, with a lug on the bar for each pole in the panelboard.

H. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.

1. Panelboards and overcurrent protective devices rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.

2. Panelboards and overcurrent protective devices rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 14,000 A rms symmetrical.

2.2 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

B. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

C. Doors: Door-in-door construction with concealed hinges; secured with multipoint latch with tumbler lock; keyed alike. Outer door shall permit full access to the panel interior. Inner door shall permit access to breaker operating handles and labeling, but current carrying terminals and bus shall remain concealed.

2.3 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers:

a. Inverse time-current element for low-level overloads.

b. Instantaneous magnetic trip element for short circuits.

c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

2. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).

3. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).

4. MCCB Features and Accessories:
    a. Standard frame sizes, trip ratings, and number of poles.
    b. Breaker handle indicates tripped status.
    c. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
    d. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
    e. Multipole units enclosed in a single housing with a single handle.

2.4 IDENTIFICATION

A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.

B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.

C. Circuit Directory: Computer-generated circuit directory mounted inside panelboard door with transparent plastic protective cover.
    1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.

B. Receive, inspect, handle, and store panelboards according to NECA 407.

C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.

D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Comply with NECA 1.

C. Install panelboards and accessories according to NECA 407.

D. Equipment Mounting:
    1. Attach panelboard to the vertical finished or structural surface behind the panelboard.

E. Mount top of trim 90 inches (2286 mm) above finished floor unless otherwise indicated.

F. Mount panelboard cabinet plumb and rigid without distortion of box.

G. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

H. Install overcurrent protective devices and controllers not already factory installed.
    1. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written instructions.

I. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.

J. Install filler plates in unused spaces.

K. Stub four 1-inch (25 mm) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (25 mm) empty conduits into raised floor space or below slab not on grade.

L. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

D. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

2. Perform the following infrared scan tests and inspections and prepare reports:

a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.

b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.

c. Instruments and Equipment:

1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

C. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results, with comparisons of the two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly,and lubricate as recommended by manufacturer.

3.6 PROTECTION

A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature according to manufacturer's written instructions.

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SECTION 26 27 26

WIRING DEVICES

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. Standard-grade receptacles, 125 V, **20** A.
2. USB receptacles.
3. GFCI receptacles, 125 V, 20 A.
4. Twist-locking receptacles.
5. Cord and plug sets.
6. Toggle switches, 120/277 V, 20 A.
7. Wall plates.
8. Poke-through assemblies.

1.3 DEFINITIONS

A. AFCI: Arc-fault circuit interrupter.

B. BAS: Building automation system.

C. EMI: Electromagnetic interference.

D. GFCI: Ground-fault circuit interrupter.

E. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

F. RFI: Radio-frequency interference.

G. SPD: Surge protective device.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

C. Samples: One for each type of device and wall plate specified, in each color specified.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

PART 2 PRODUCTS

2.1 GENERAL WIRING-DEVICE REQUIREMENTS

A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

B. Comply with NFPA 70.

C. RoHS compliant.

D. Comply with NEMA WD 1.

E. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:

1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.

2. Devices shall comply with requirements in this Section.

F. Devices for Owner-Furnished Equipment:

1. Receptacles: Match plug configurations.
2. Cord and Plug Sets: Match equipment requirements.

G. Device Color:

1. Wiring Devices Connected to Normal Power System: As selected by Architect unless otherwise indicated or required by NFPA 70 or device listing.
2. Wiring Devices Connected to Essential Electrical System: Red.

H. Wall Plate Color: For plastic covers, match device color.

I. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 STANDARD-GRADE RECEPTACLES, 125 V, 20 A

A. Duplex Receptacles, 125 V, 20 A:

1. Description: Two pole, three wire, and self-grounding.
2. Configuration: NEMA WD 6, Configuration 5-20R.
3. Standards: Comply with UL 498 and FS W-C-596.

2.3 USB RECEPTACLES

A. USB Charging Receptacles:

1. Description: Single-piece, rivetless, nickel-plated, all-brass grounding system. Nickel-plated, brass mounting strap.
2. USB Receptacles: Dual, USB Type A, 5 V dc, and 2.1 A per receptacle (minimum).
3. Standards: Comply with UL 1310 and USB 3.0 devices.

2.4 GFCI RECEPTACLES, 125 V, 20 A

A. Duplex GFCI Receptacles, 125 V, 20 A

1. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding.
2. Configuration: NEMA WD 6, Configuration 5-20R.
3. Type: **Feed** through.
4. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.

2.5 TWIST-LOCKING RECEPTACLES

A. Twist-Lock, Single Receptacles, 120 V, 20 A:

1. Configuration: NEMA WD 6, Configuration L5-20R.
2. Standards: Comply with UL 498.

B. Twist-Lock, Single Receptacles, 250 V, 20 A:

1. Configuration: NEMA WD 6, Configuration L6-20R.
2. Standards: Comply with UL 498.

2.6 PENDANT CORD-CONNECTOR DEVICES

A. Description: Matching, locking-type plug and receptacle body connector, heavy-duty grade.

B. Configuration: NEMA WD 6, Configurations L5-20P and L5-20R.

C. Body: Nylon, with screw-open, cable-gripping jaws and provision for attaching external cable grip.

D. External Cable Grip: Woven wire-mesh type made of high-strength, galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

E. Standards: Comply with FS W-C-596.

2.7 CORD AND PLUG SETS

A. Match voltage and current ratings and number of conductors to requirements of equipment being connected.

B. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and ampacity of at least 130 percent of the equipment rating.

C. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.8 TOGGLE SWITCHES, 120/277 V, 20 A

A. Single-Pole Switches, 120/277 V, 20 A:

1. Standards: Comply with UL 20 and FS W-S-896.

2.9 WALL PLATES

A. Single Source: Obtain wall plates from same manufacturer of wiring devices.

B. Single and combination types shall match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: Smooth, high-impact thermoplastic.
3. Material for Unfinished Spaces: Galvanized steel.
4. Material for Damp Locations: Thermoplastic with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.

2.10 POKE-THROUGH ASSEMBLIES

A. Description: Factory-fabricated and -wired assembly of below-floor junction box with multichanneled, through-floor raceway/firestop unit and detachable matching floor service-outlet assembly.

B. Manufacturer and Product: Wiremold Evolution 6-inch Series

C. Standards: Comply with scrub water exclusion requirements in UL 514.

D. Service-Outlet Assembly: Recessed type with four simplex receptacles and space for four RJ-45 jacks, complying with requirements in Section 271513 "Communications Copper Horizontal Cabling."

E. Size: Selected to fit nominal 6-inch cored holes in floor and matched to floor thickness.

F. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.

G. Wiring Raceways and Compartments: For a minimum of four No. 12 AWG conductors and a minimum of four, four-pair cables that comply with requirements in Section 271513 "Communications Copper Horizontal Cabling."

PART 3 EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.

B. Coordination with Other Trades:

1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes, and do not cut holes for boxes with routers that are guided by riding against outside of boxes.

2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:
1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall comply with NFPA 70, Article 300, without pigtails.
4. Existing Conductors:
a. Cut back and pigtail, or replace all damaged conductors.
b. Straighten conductors that remain and remove corrosion and foreign matter.
c. Pigtailing existing conductors is permitted, provided the outlet box is large enough.

D. Device Installation:
1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:
1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

H. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 GFCI RECEPTACLES

A. Install non-feed-through GFCI receptacles where protection of downstream receptacles is not required.

3.3 IDENTIFICATION

A. Comply with Section 260553 "Identification for Electrical Systems."

B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

C. Essential Electrical System: Mark receptacles supplied from the essential electrical system to allow easy identification using a self-adhesive label.

3.4 FIELD QUALITY CONTROL

A. Tests for Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault-current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

B. Prepare test and inspection reports.

END OF SECTION

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SECTION 26 28 13

FUSES

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. Cartridge fuses rated 600 V ac and less for use in the following:

a. Enclosed switches.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:

1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.

a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.

b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.

2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.

3. Current-limitation curves for fuses with current-limiting characteristics.

1.4 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: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, current-limiting, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NEMA FU 1 for cartridge fuses.

D. Comply with NFPA 70.

E. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.

C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

3.3 IDENTIFICATION

A. Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information inside of door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION

SECTION 26 28 16
ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.
3. Enclosures.

1.3 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.
2. Current and voltage ratings.
3. Short-circuit current ratings (interrupting and withstand, as appropriate).
4. Include evidence of a nationally recognized testing laboratory (NRTL) listing for series rating of installed devices.
5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.

1.5 FIELD CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).
2. Altitude: Not exceeding 6600 feet (2010 m).

1.6 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within specified warranty period.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

D. Comply with NFPA 70.

2.2 FUSIBLE SWITCHES

A. Type HD, Heavy Duty:

1. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate **indicated** fuses.

2. Lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

B. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.

2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.

2.3 NONFUSIBLE SWITCHES

A. Type HD, Heavy Duty, Three Pole, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

B. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.

2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.

2.4 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

B. Enclosure Finish: The enclosure shall be gray baked enamel paint, electrodeposited on cleaned, phosphatized steel (NEMA 250 Type 1)

C. Conduit Entry: NEMA 250 Types 4, 4X, and 12 enclosures shall contain no knockouts. NEMA 250 Types 7 and 9 enclosures shall be provided with threaded conduit openings in both endwalls.

D. Operating Mechanism: The circuit-breaker operating handle shall be externally operable with the operating mechanism being an integral part of the box, not the cover. The cover interlock mechanism shall have an externally operated override. The override shall not permanently disable the interlock mechanism, which shall return to the locked position once the override is released. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

1. Commencement of work shall indicate Installer's acceptance of the areas and conditions as satisfactory.

3.2 PREPARATION

A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Construction Manager no fewer than [seven] <Insert number> days in advance of proposed interruption of electric service.
2. Indicate method of providing temporary electric service.
3. Comply with NFPA 70E.

3.3 INSTALLATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

C. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."

D. Install fuses in fusible devices.

E. Comply with NFPA 70 and NECA 1.

3.4 IDENTIFICATION

A. Comply with requirements in Section 260553 "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections for Switches:

1. Visual and Mechanical Inspection:
    a. Inspect physical and mechanical condition.
    b. Inspect anchorage, alignment, grounding, and clearances.
    c. Verify that the unit is clean.
    d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
    e. Verify that fuse sizes and types match the Specifications and Drawings.
    f. Verify that each fuse has adequate mechanical support and contact integrity.
    g. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.
2. Electrical Tests:
    a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
    b. Measure contact resistance across each switchblade fuseholder. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's

published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.

c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.

d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.

e. Perform ground fault test according to NETA ATS 7.14 "Ground Fault Protection Systems, Low-Voltage."

C. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

1. Test procedures used.

2. Include identification of each enclosed switch and circuit breaker tested and describe test results.

3. List deficiencies detected, remedial action taken, and observations after remedial action.

3.6 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

END OF SECTION

SECTION 26 51 19
INTERIOR LIGHTING

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 LED luminaires.

B. Related Requirements:

1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. LED: Light-emitting diode.

F. Lumen: Measured output of lamp and luminaire, or both.

G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Arrange in order of luminaire designation.
2. Include data on features, accessories, and finishes.
3. Include physical description and dimensions of luminaires.
4. Include emergency lighting units, including batteries and chargers.
5. Include life, output (lumens, CCT, and CRI), and energy-efficiency data.
6. Photometric data and adjustment factors based on laboratory tests, complying with IES "Lighting Measurements Testing and Calculation Guides" for each luminaire type. The adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this Project.
    a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.

1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.6 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.

B. Provide luminaires from a single manufacturer for each luminaire type.

C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.8 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

B. Warranty Period: Five year(s) from date of Substantial Completion.

PART 2 PRODUCTS

2.1 LUMINAIRE REQUIREMENTS

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. Recessed luminaires shall comply with NEMA LE 4.

2.2 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

B. Steel:

1. ASTM A 36/A 36M for carbon structural steel.
2. ASTM A 568/A 568M for sheet steel.

C. Galvanized Steel: ASTM A 653/A 653M.

D. Aluminum: ASTM B 209.

2.3 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.4 LUMINAIRE SUPPORT

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage (2.68 mm).

D. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.

E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Install lamps in each luminaire.

D. Supports:

1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning and relamping.
3. Provide support for luminaire without causing deflection of ceiling or wall.
4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.

E. Flush-Mounted Luminaires:

1. Secured to outlet box.
2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
3. Trim ring flush with finished surface.

F. Ceiling-Grid-Mounted Luminaires:

1. Secure to any required outlet box.
2. Secure luminaire to the luminaire opening using approved fasteners in a minimum of four locations, spaced near corners of luminaire.
3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.

G. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION

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SECTION 26 52 13
EMERGENCY AND EXIT LIGHTING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Emergency lighting units.
2. Exit signs.
3. Luminaire supports.

1.03 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Emergency Lighting Unit: A lighting unit with internal or external emergency battery powered supply and the means for controlling and charging the battery and unit operation.

D. Fixture: See "Luminaire" Paragraph.

E. Lumen: Measured output of lamp and luminaire, or both.

F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of emergency lighting unit, exit sign, and emergency lighting support.

1. Include data on features, accessories, and finishes.
2. Include physical description of the unit and dimensions.
3. Battery and charger for light units.
4. Include life, output of luminaire (lumens, CCT, and CRI), and energy-efficiency data.
5. Include photometric data and adjustment factors based on laboratory tests, complying with IES LM-45, for each luminaire type.
    a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in emergency, operation, and maintenance manuals.

1.06 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.08 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS FOR EMERGENCY LIGHTING

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. NRTL Compliance: Fabricate and label emergency lighting units, exit signs, and batteries to comply with UL 924.

C. Comply with NFPA 70 and NFPA 101.

D. Comply with NEMA LE 4 for recessed luminaires.

E. Internal Type Emergency Power Unit: Self-contained, modular, battery-inverter unit, factory mounted within luminaire body.

1. Emergency Connection: Operate **one** lamp(s) continuously at an output of **1100** lumens each upon loss of normal power. Connect unswitched circuit to battery-inverter unit and switched circuit to luminaire ballast.

2. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.

3. Test Push-Button and Indicator Light: Visible and accessible without opening luminaire or entering ceiling space.

a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.

b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

4. Battery: Sealed, maintenance-free, **nickel-cadmium** type.

5. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.

6. Remote Test: Switch in handheld remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.

7. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

2.02 EMERGENCY LIGHTING

A. General Requirements for Emergency Lighting Units: Self-contained units.

B. Emergency Luminaires:

1. Emergency Luminaires: as indicated on Drawings:

C. Emergency Lighting Unit:

1. Emergency Lighting Unit: as indicated on Drawings.

2.03 EXIT SIGNS

A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:

1. Lamps for AC Operation: LEDs; 50,000 hours minimum rated lamp life.

2. Self-Powered Exit Signs (Battery Type): Internal emergency power unit.

2.04 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

B. Doors, Frames, and Other Internal Access:

1. Smooth operating, free of light leakage under operating conditions.
2. Designed to permit relamping without use of tools.
3. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

2.05 METAL FINISHES

A. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.06 LUMINAIRE SUPPORT COMPONENTS

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for conditions affecting performance of luminaires.

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.

C. Examine walls, floors, roofs, and ceilings for suitable conditions where emergency lighting luminaires will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Supports:

1. Able to maintain luminaire position when testing emergency power unit.
2. Provide support for luminaire and emergency power unit without causing deflection of ceiling or wall.
3. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire and emergency power unit weight and vertical force of 400 percent of luminaire weight.

D. Suspended Luminaire Support:

1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
3. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

E. Ceiling Grid Mounted Luminaires:

1. Secure to any required outlet box.
2. Secure emergency power unit using approved fasteners in a minimum of four locations, spaced near corners of emergency power unit.
3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.

3.03 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.04 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
1. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Prepare test and inspection reports.

SECTION 27 05 26

GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Grounding conductors.
2. Grounding connectors.
3. Grounding busbars.
4. Grounding labeling.

1.2 DEFINITIONS

A. BCT: Bonding conductor for telecommunications.
B. TGB: Telecommunications grounding busbar.
C. TMGB: Telecommunications main grounding busbar.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
B. Comply with UL 467 for grounding and bonding materials and equipment.
C. Comply with TIA-607-B.

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 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. 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.

B. Busbar Connectors: Cast silicon bronze, solderless compression or exothermic-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.

2.4 GROUNDING BUSBARS

A. TGB: Predrilled rectangular bars of hard-drawn solid copper, 1/4 by 2 inches (6.3 by 50 mm) in cross section, length as indicated on Drawings. The busbar shall be for wall mounting, shall be NRTL listed as complying with UL 467, and shall comply with TIA-607-B.

1. Predrilling shall be with holes for use with lugs specified in this Section.
2. Mounting Hardware: Stand-off brackets that provide at least a 2-inch (50-mm) 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.

2.5 IDENTIFICATION

A. Comply with requirements for identification products in Section 270553 "Identification for Communications Systems."

PART 3 EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.
B. Comply with TIA-607-B.

3.2 APPLICATION

A. Conductors: Install solid conductor for No. 8 AWG and smaller and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

1. The bonding conductors between the TGB and structural steel of steel-frame buildings shall not be smaller than No. 6 AWG.

B. Conductor Terminations and Connections:

1. 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 270528 "Pathways for Communications Systems," and bond both ends of the conduit to a TGB.

3.3 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.

3.4 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. Interconnections: Interconnect all TGBs with the 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 unless otherwise indicated.

E. Telecommunications Enclosures and Equipment Racks: Bond metallic components of enclosures to the telecommunications bonding and grounding system. Install top-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.

F. 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.

G. Shielded Cable: Bond the shield of shielded fiber-optic cable to the TGB in communications rooms and spaces. Comply with TIA-568-C.1 and TIA-568-C.2 when grounding shielded balanced twisted-pair cables.

H. 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.

3.5 IDENTIFICATION

A. Labels shall be preprinted or computer-printed type.

1. Label TGB(s) with "fs-TGB," where "fs" is the telecommunications space identifier for the space containing the TGB.
2. Label the BCT and each telecommunications backbone conductor at its attachment point: "WARNING! TELECOMMUNICATIONS BONDING CONDUCTOR. DO NOT REMOVE OR DISCONNECT!"

3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. 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 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.

C. Excessive Ground Resistance: If resistance to ground at the BCT exceeds **5** ohms, notify Architect promptly and include recommendations to reduce ground resistance.
D. Prepare test and inspection reports.

END OF SECTION

SECTION 27 05 28

PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal conduits and fittings.
2. Optical-fiber-cable pathways and fittings.
3. Boxes, enclosures, and cabinets.

1.2 DEFINITIONS

A. RTRC: Reinforced thermosetting resin conduit.

1.3 ACTION SUBMITTALS

A. Product data for the following:

1. Wireways and fittings.
2. Boxes, enclosures, and cabinets.

PART 2 PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

A. Description: Metal raceway of circular cross section with manufacturer-fabricated fittings.

B. General Requirements for Metal Conduits and Fittings:

1. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.
2. Comply with TIA-569-D.

C. EMT: Comply with ANSI C80.3 and UL 797.

D. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. Fittings for EMT:
   a. Material: Steel .
   b. Type: Set screw.
2. Expansion Fittings: PVC or steel to match conduit type, complying with UL-467, rated for environmental conditions where installed, and including flexible external bonding jumper.

2.2 OPTICAL-FIBER-CABLE PATHWAYS AND FITTINGS

A. Description: Comply with UL 2024; flexible-type pathway with a circular cross section, approved for **plenum** installation unless otherwise indicated.

B. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

C. Comply with TIA-569-D.

2.3 HOOKS

A. Description: Prefabricated sheet metal cable supports for telecommunications cable.

B. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

C. Comply with TIA-569-D.

D. **Galvanized** steel.

E. **J** shape.

2.4 BOXES, ENCLOSURES, AND CABINETS

A. Description: Enclosures for communications.

B. General Requirements for Boxes, Enclosures, and Cabinets:

1. Comply with TIA-569-D.
2. Boxes, enclosures, and cabinets installed in wet locations shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for use in wet locations.
3. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
4. Device Box Dimensions: 4-11/16 inches square by 2-1/8 inches deep.
5. Gangable boxes are prohibited.

C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

D. Metal Floor Boxes:

1. Legrand/Wiremold “Evolution” series with large round hinged cover, or prior-approved equal.
2. Material: Cast metal or sheet metal.
3. Type: Fully adjustable Semi-adjustable.
4. Shape: Rectangular with large round opening.
5. Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

PART 3 EXECUTION

3.1 PATHWAY APPLICATION

A. Indoors: Apply pathway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT.
2. Exposed, Not Subject to Severe Physical Damage: EMT.
3. Concealed in Ceilings and Interior Walls and Partitions: EMT.
4. Damp or Wet Locations: GRC .
5. Pathways for Optical-Fiber or Communications Cable in Spaces Used for Environmental Air: Plenum-type, optical-fiber-cable pathway within EMT sleeve.
6. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 units in institutional and commercial kitchens and damp or wet locations.

B. Minimum Pathway Size: 1 inch (25 mm).

C. Pathway Fittings: Compatible with pathways and suitable for use and location.

1. EMT: Use set-screw steel fittings. Comply with NEMA FB 2.10.

D. Install surface pathways only where indicated on Drawings.

3.2 INSTALLATION

A. Comply with the following standards for installation requirements except where requirements on Drawings or in this Section are stricter:

1. NECA 1.
2. NECA/BICSI 568.
3. TIA-569-D.
4. NECA 101
5. NECA 105.

B. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.

C. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

D. Comply with requirements in Section 270529 "Hangers and Supports for Communications Systems" for hangers and supports.

E. Comply with requirements in Section 270544 "Sleeves and Sleeve Seals for Communications Pathways and Cabling" for sleeves and sleeve seals for communications.

F. Keep pathways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.

G. Complete pathway installation before starting conductor installation.

H. Arrange stub-ups so curved portions of bends are not visible above finished slab.

I. Install no more than the equivalent of two 90-degree bends in any pathway run. Support within 12 inches (300 mm) of changes in direction. Utilize long radius ells for all optical-fiber cables.

J. Conceal rigid conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

K. Support conduit within 12 inches (300 mm) of enclosures to which attached.

L. Stub-ups to Above Recessed Ceilings:

1. Use EMT, IMC, or RMC for pathways.

2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

M. Install pathways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus one additional quarter-turn.

N. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure, to assure a continuous ground path.

O. Cut conduit perpendicular to the length. For conduits of 2-inch (50-mm) trade size and larger, use roll cutter or a guide to ensure cut is straight and perpendicular to the length.

P. Install pull wires in empty pathways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Secure pull wire, so it cannot fall into conduit. Cap pathways designated as spare alongside pathways in use.

Q. Pathways for Optical-Fiber and Communications Cable: Install pathways, metal and nonmetallic, rigid and flexible, as follows:

1. 1-Inch (25-mm) Trade Size and Larger: Install pathways in maximum lengths of 75 feet (23 m).

2. Install with a maximum of two 90-degree bends or equivalent for each length of pathway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.

R. Install pathway-sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed pathways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install pathway-sealing fittings according to NFPA 70.

S. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F (17 deg C), and that has straight-run length that exceeds 25 feet (7.6 m). Install in each run of aboveground RMC and EMT that is located where

environmental temperature change may exceed 100 deg F (55 deg C), and that has straight-run length that exceeds 100 feet (30 m).

2. Install expansion fittings at all locations where conduits cross building or structure expansion joints.

3. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

T. Hooks:

1. Size to allow a minimum of 25 percent future capacity without exceeding design capacity limits.

2. Shall be supported by dedicated support wires. Do not use ceiling grid support wire or support rods.

3. Hook spacing shall allow no more than 6 inches (150 mm) of slack. The lowest point of the cables shall be no less than 6 inches (150 mm) adjacent to ceilings, mechanical ductwork and fittings, luminaires, power conduits, power and telecommunications outlets, and other electrical and communications equipment.

4. Space hooks no more than 5 feet (1.5 m) o.c.

5. Provide a hook at each change in direction.

U. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to **center** of box unless otherwise indicated.

V. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surface to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

W. Horizontally separate boxes mounted on opposite sides of walls, so they are not in the same vertical channel.

X. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

Y. Set metal floor boxes level and flush with finished floor surface.

3.3 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR COMMUNICATIONS 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 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 PROTECTION

A. Protect coatings, finishes, and cabinets from damage or deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION

SECTION 27 05 29

HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel slotted support systems for communication raceways.
2. Conduit and cable support devices.
3. Structural steel for fabricated supports and restraints.
4. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
5. Fabricated metal equipment support assemblies.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. 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 Rating: Class 1.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch-(10-mm-) diameter holes at a maximum of 8 inches (200 mm) o.c. in at least one surface.

1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
2. Material for Channel, Fittings, and Accessories: Galvanized steel.
3. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
4. Channel Dimensions: Selected for applicable load criteria.

B. Conduit and Cable Support Devices: Steel clamps, hangers, and associated fittings, designed for types and sizes of raceway or cable to be supported.

C. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M steel plates, shapes, and bars; black and galvanized.

D. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
2. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
3. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
5. Toggle Bolts: **All-steel** springhead type.
6. Hanger Rods: Threaded steel.

PART 3 EXECUTION

3.1 APPLICATION

A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:

1. NECA 1.
2. NECA/BICSI 568.
3. TIA-569-D.
4. NECA 101
5. NECA 105.

B. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

C. Comply with requirements for pathways specified in Section 270528 "Pathways for Communications Systems."

D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

A. Raceway Support Methods: In addition to methods described in NECA 1, EMT may be supported by openings through structure members, according to NFPA 70.

B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).

C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten communications items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Use approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Use expansion anchor fasteners.
5. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts.
6. To Light Steel: Sheet metal screws.
7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that comply with seismic-restraint strength and anchorage requirements.

D. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

END OF SECTION

SECTION 27 05 36

CABLE TRAYS FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Ladder cable tray.
2. Cable tray accessories.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of cable tray.

1. Include data indicating dimensions and finishes for each type of cable tray indicated.

B. Shop Drawings: For each type of cable tray.

1. 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 sides of cable trays.
   c. Vertical elevation of cable trays above the floor or bottom of ceiling structure.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS FOR CABLE TRAYS

A. Cable Trays and Accessories: Identified as defined in NFPA 70 and marked for intended location, application, and grounding.

1. Source Limitations: Obtain cable trays and components from single manufacturer.

2.2 LADDER CABLE TRAY

A. Description:

1. Configuration: Two longitudinal side rails with transverse rungs swaged or welded to side rails, complying with NEMA VE 1.
2. Width: 12 inches (300 mm) unless otherwise indicated on Drawings.
3. Minimum Usable Load Depth: 4 inches (100 mm).
4. Straight Section Lengths: 10 feet (3.0 m), except where shorter lengths are required to facilitate tray assembly.
5. Rung Spacing: 6 inches (150 mm) o.c.
6. Radius-Fitting Rung Spacing: 9 inches (225 mm) at center of tray's width.
7. Minimum Cable-Bearing Surface for Rungs: 7/8-inch (22-mm) width with radius edges.
8. No portion of the rungs shall protrude below the bottom plane of side rails.
9. Structural Performance of Each Rung: Capable of supporting a maximum cable load, with a safety factor of 1.5, plus a 200-lb (90-kg) concentrated load, when tested according to NEMA VE 1.
10. Fitting Minimum Radius: 12 inches (300 mm).
11. Splicing Assemblies: Bolted type using serrated flange locknuts.
12. Splice-Plate Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.

B. Materials and Finishes:

1. Steel:

2.3 CABLE TRAY ACCESSORIES

A. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, of same materials and finishes as cable tray.

B. Barrier Strips: Same materials and finishes as for cable tray.

C. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.

PART 3 EXECUTION

3.1 CABLE TRAY INSTALLATION

A. Install cable trays according to NEMA VE 2.

B. Install cable trays as a complete system, including fasteners, hold-down clips, support systems, barrier strips, adjustable horizontal and vertical splice plates, elbows, reducers, tees, crosses, cable dropouts, adapters, covers, and bonding.

C. Install cable trays so that the tray is accessible for cable installation and all splices are accessible for inspection and adjustment.

D. Remove burrs and sharp edges from cable trays.

E. Fasten cable tray supports to building structure.

F. Place supports so that spans do not exceed maximum spans on schedules and provide clearances shown on Drawings. Install intermediate supports when cable weight exceeds the load-carrying capacity of the tray rungs.

G. Construct supports from channel members, threaded rods, and other appurtenances furnished by cable tray manufacturer. Arrange supports in trapeze or wall-bracket form as required by application.

H. Support bus assembly to prevent twisting from eccentric loading.

I. Install center-hung supports for single-rail trays designed for 60 versus 40 percent eccentric loading condition, with a safety factor of 3.

J. Locate and install supports according to NEMA VE 2. Do not install more than one cable tray splice between supports.

K. Make changes in direction and elevation using manufacturer's recommended fittings.

L. Make cable tray connections using manufacturer's recommended fittings.

M. Install cable trays with enough workspace to permit access for installing cables.

3.2 CABLE TRAY GROUNDING

A. Ground cable trays according to NFPA 70 unless additional grounding is specified. Comply with requirements in Section 270526 "Grounding and Bonding for Communications Systems."

B. Cable trays shall be bonded together with splice plates listed for grounding purposes or with listed bonding jumpers.

C. When using epoxy- or powder-coat painted cable trays as a grounding conductor, completely remove coating at all splice contact points or ground connector attachment. After completing splice-to-grounding bolt attachment, repair the coated surfaces with coating materials recommended by cable tray manufacturer.

3.3 CABLE INSTALLATION

A. Install cables only when each cable tray run has been completed and inspected.

B. Fasten cables on horizontal runs with cable clamps or cable ties according to NEMA VE 2. Tighten clamps only enough to secure the cable, without indenting the cable jacket. Install cable ties with a tool that includes an automatic pressure-limiting device.

C. Fasten cables on vertical runs to cable trays every 18 inches (450 mm).

D. Fasten and support cables that pass from one cable tray to another or drop from cable trays to equipment enclosures. Fasten cables to the cable tray at the point of exit and support cables independent of the enclosure. The cable length between cable trays or between cable tray and enclosure shall be no more than 72 inches (1800 mm).

E. In existing construction, remove inactive or dead cables from cable trays.

3.4 CONNECTIONS

A. Remove paint from all connection points before making connections. Repair paint after the connections are completed.

B. Connect pathways to cable trays according to requirements in NEMA VE 2

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections :

1. After installing cable trays and after electrical circuitry has been energized, survey for compliance with requirements.
2. Visually inspect cable insulation for damage. Correct sharp corners, protuberances in cable trays, vibrations, and thermal expansion and contraction conditions, which may cause or have caused damage.
3. Verify that there are no intruding items such as pipes, hangers, or other equipment in the cable tray.
4. Remove dust deposits, industrial process materials, trash of any description, and any blockage of tray ventilation.
5. Visually inspect each cable tray joint and each ground connection for mechanical continuity. Check bolted connections between sections for corrosion. Clean and retorque in suspect areas.
6. Check for improperly sized or installed bonding jumpers.
7. Check for missing, incorrect, or damaged bolts, bolt heads, or nuts. When found, replace with specified hardware.
8. Perform visual and mechanical checks for adequacy of cable tray grounding; verify that all takeoff raceways are bonded to cable trays. Test entire cable tray system for continuity. Maximum allowable resistance is 1 ohm.

B. Prepare test and inspection reports.

3.6 PROTECTION

A. Protect installed cable trays and cables.

1. Install temporary protection for cables in open trays to safeguard exposed cables against falling objects or debris during construction. Temporary protection for cables and cable tray can be constructed of wood or metal materials and shall remain in place until the risk of damage is over.
2. Repair damage to galvanized finishes with zinc-rich paint recommended by cable tray manufacturer.
3. Repair damage to paint finishes with matching touchup coating recommended by cable tray manufacturer.

END OF SECTION

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SECTION 27 05 53

IDENTIFICATION FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Color and legend requirements for labels and signs.
2. Labels.
3. Cable ties.
4. Fasteners for labels and signs.

1.2 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 communications identification products.

B. Identification Schedule:

1. Outlets: Scaled drawings indicating location and proposed designation.
2. Backbone Cabling: Riser diagram showing each communications room, backbone cable, and proposed backbone cable designation.
3. Racks: Scaled drawings indicating location and proposed designation.
4. Patch Panels: Enlarged scaled drawings showing rack row, number, and proposed designations.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with NFPA 70 and TIA 606-B.

B. Comply with ANSI Z535.4 for safety signs and labels.

C. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces

2.2 COLOR AND LEGEND REQUIREMENTS

A. Equipment Identification Labels:

1. Black letters on a white field.

2.3 LABELS

A. Self-Adhesive Wraparound Labels: **Preprinted, 3-mil- (0.08-mm-) thick, polyester flexible labels with acrylic pressure-sensitive adhesive.**

1. **Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating protective shields over the legend. Labels sized such that the clear shield overlaps the** entire printed legend.

2.4 CABLE TIES

A. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 deg F (23 deg C) according to ASTM D 638: 7000 psi (48.2 MPa).

3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F (Minus 46 to plus 140 deg C).
5. Color: Black.

2.5 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 EXECUTION

3.1 PREPARATION

A. Self-Adhesive Identification Products: Before applying communications identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 INSTALLATION

A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.

B. Install identifying devices before installing acoustical ceilings and similar concealment.

C. Verify identity of each item before installing identification products.

D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.

E. Apply identification devices to surfaces that require finish after completing finish work.

F. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.

G. Self-Adhesive Wraparound Labels:

1. Secure tight to surface at a location with high visibility and accessibility.
2. Provide label 6 inches (150 mm) from cable end.

H. Cable Ties: Plenum rated:

3.3 IDENTIFICATION SCHEDULE

A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.

B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations with high visibility. Identify by system and circuit designation.

C. Accessible Fittings for Raceways and Cables within Buildings: Identify covers of each junction and pull box with self-adhesive labels containing wiring system legend.

1. System legends shall be as follows:
   a. Telecommunications.

D. Faceplates: Label individual faceplates with self-adhesive labels. Place label at top of faceplate. Each faceplate shall be labeled with its individual, sequential designation, composed of the following, in the order listed:

1. Wiring closet designation.
2. Colon.

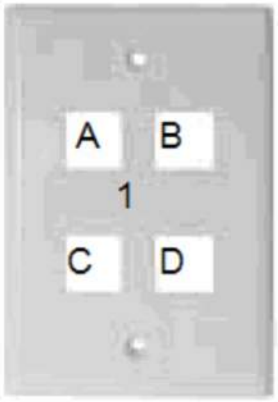
3. Faceplate number.
4. Owner requirements: Each quad plate MUST be labeled with the work station number (1, 2, etc.) and the A, B, C etc. format. Each connection MUST be identified as (1A, 1B, 2A, 2B, etc.) on the corresponding patch panel location.

FIGURE 3

Quad Plate

Ports A, B, C – Data

Port D – Phone



E. Equipment Room Labeling:
   1. Racks, Frames, and Enclosures: Identify front and rear of each with self-adhesive labels containing equipment designation.
   2. Patch Panels: Label individual rows and outlets, starting at to left and working down, with self-adhesive labels.
   3. Data Outlets: Label each outlet with a self-adhesive label indicating the following, in the order listed:
      a. Room number being served.
      b. Colon.
      c. Faceplate number.
      d. Labeled to match the ports on the workstation outlet faceplates mentioned above

F. Backbone Cables: Label each cable with a self-adhesive wraparound label indicating the location of the far or other end of the backbone cable. Patch panel or punch down block where cable is terminated should be labeled identically.

G. Horizontal Cables: Label each cable with a self-adhesive wraparound label indicating the following, in the order listed:
   1. Room number.
   2. Colon.
   3. Faceplate number.

H. Equipment Identification Labels:
   1. Indoor Equipment: Self-adhesive label.

2. Equipment to Be Labeled:
   a. Communications racks and cabinets.
   b. Uninterruptible power supplies.

END OF SECTION

SECTION 27 11 00

COMMUNICATIONS EQUIPMENT ROOM FITTINGS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Backboards.
2. Boxes, enclosures, and cabinets.
3. Power strips.

B. Related Requirements:

1. Section 270536 "Cable Trays for Communications Systems" for cable trays and accessories.
2. Section 271323 "Communications Optical Fiber Backbone Cabling" for optical-fiber data cabling associated with system panels and devices.
3. Section 271513 "Communications Copper Horizontal Cabling" for copper data cabling associated with system panels and devices.

1.2 DEFINITIONS

A. BICSI: Building Industry Consulting Service International.

B. RCDD: Registered communications distribution designer.

C. TGB: Telecommunications grounding bus bar.

1.3 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.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For **Installer,** qualified layout technician, installation supervisor, and field inspector.

1.5 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 direct supervision of RCDD.
2. Installation Supervision: Installation shall be under direct supervision of Installer 2, Copper or Fiber, 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).

B. Backboard Paint: **Light-colored fire-retardant paint**.

2.2 BOXES, ENCLOSURES, AND CABINETS

A. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets shall be listed and labeled for intended location and use.

B. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

C. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

D. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

E. Device Box Dimensions: 4-11/16 inches square by 2-1/8 inches deep.

2.3 POWER STRIPS

A. Comply with requirements in Section 271116 "Communications Racks, Frames, and Enclosures."

B. 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 type.
3. Height: 1 RU..
4. Housing: Metal.
5. Six 20-A, 120-V ac, NEMA WD 6, Configuration 5-20R receptacles.
6. Rear-facing receptacles.
7. LED indicator lights for power and protection status.
8. LED indicator lights for reverse polarity and open outlet ground.
9. Circuit Breaker and Thermal Fusing: When protection is lost, circuit opens and cannot be reset.
10. Cord connected with 15-foot (4.5-m) line cord.
11. Rocker-type on-off switch, illuminated when in on position.
12. Surge Protection: UL 1449, Type 3.
    a. Maximum Surge Current, Line to Neutral: 27 kA
    b. Protection modes shall be line to neutral, line to ground, and neutral to ground.
    c. UL 1449 Voltage Protection Rating for line to neutral and line to ground shall be 600 V and for neutral to ground.

PART 3 EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Comply with BICSI's "Telecommunications Distribution Methods Manual" for layout of communications equipment spaces.

C. Comply with BICSI's "Information Technology Systems Installation Methods Manual" for installation of equipment in communications equipment spaces.

D. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

E. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

F. Backboards:

1. Install from 6 inches (150 mm) to 8 feet, 6 inches (2588 mm) above finished floor. If plywood is fire rated, ensure that fire-rating stamp is visible after installation.

2. Paint all sides of backboard with two coats of paint, leaving fire rating stamp visible.

3. Comply with requirements for backboard installation in BICSI's "Information Technology Systems Installation Methods Manual" and TIA-569-D.

3.2 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."

3.3 FIRESTOPPING

A. Comply with requirements in Section 078413 "Penetration Firestopping."

B. Comply with TIA-569-D, Annex A, "Firestopping."

C. Comply with BICSI's "Information Technology Systems Installation Methods Manual," "Firestopping Practices" Ch.

END OF SECTION

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SECTION 27 11 16
COMMUNICATIONS RACKS, FRAMES, AND ENCLOSURES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. 19-inch equipment racks.
2. Power strips.
3. Grounding.
4. Labeling.

B. Related Requirements:

1. Section 271110 "Communications Equipment Room Fittings" for backboards and accessories.
2. Section 270526 "Grounding and Bonding for Telecommunications Equipment" for TMGBs and TGBs.
3. Section 270536 "Cable Trays for Communications Systems" for cable trays and cable tray accessories.
4. Section 271323 "Communications Optical Fiber Backbone Cabling" for optical-fiber data cabling associated with system panels and devices.
5. Section 271513 "Communications Copper Horizontal Cabling" for copper data cabling associated with system panels and devices.

1.2 DEFINITIONS

A. BICSI: Building Industry Consulting Service International.

B. LAN: Local area network.

C. RCDD: Registered communications distribution designer.

D. TGB: Telecommunications grounding bus bar.

E. TMGB: Telecommunications main grounding bus bar.

1.3 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, certifications, standards compliance, and furnished specialties and accessories.

B. Shop Drawings: For communications racks, frames, and enclosures. 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 TGB and its mounting detail showing standoff insulators and wall-mounting brackets.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.

1.5 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 direct supervision of RCDD.
2. Installation Supervision: Installation shall be under direct supervision of Installer 2, Copper or Fiber, 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 on-site inspection.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. UL listed.

B. RoHS compliant.

2.2 19-INCH EQUIPMENT RACKS

A. Description: Two-post racks with threaded rails designed for mounting telecommunications equipment. Width is compatible with EIA/ECIA 310-E, 19-inch (482.6-mm) equipment mounting with an opening of 17.72-inches (450-mm) between rails.

B. Products by Chatsworth Products Inc (CPI) or prior-approved equal.

C. General Requirements:

1. Frames: Modular units designed for telecommunications terminal support and coordinated with dimensions of units to be supported.
2. Material: Extruded steel .
3. Finish: Manufacturer's standard, baked-polyester powder coat.
4. Color: Black.

D. Floor-Mounted Racks:

1. Overall Height: 84 inches (2133.6 mm).
2. Overall Depth: 29 inches (736.6 mm)
3. Upright Depth: 6 inches (152.4 mm)
4. Two-Post Load Rating: 400 lb (181 kg)
5. Number of Rack Units per Rack: 42 - 48.
    a. Numbering: Every rack units, on interior of rack.
6. Vertical and horizontal cable management channels, top and bottom cable troughs, grounding lug, and a power strip per Section 271100.
7. Base shall have a minimum of four mounting holes for permanent attachment to floor.
8. Top shall have provisions for attaching to cable tray or ceiling.
9. Self-leveling.

E. Cable Management:

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. Refer to Section 271100.

2.4 GROUNDING

A. Comply with requirements in Section 270526 "Grounding and Bonding for Communications Systems" for grounding conductors and connectors.

B. Rack TGBs: 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 TIA-606-B. Predrilling shall be with holes for use with lugs specified in this Section.

1. Rack-Mounted Horizontal TGB: Designed for mounting in 19- 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.

2.5 LABELING

A. Comply with TIA-606-B 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 INSTALLATION

A. Comply with NECA 1.

B. Comply with BICSI TDMM for layout of communications equipment spaces.

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 location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

3.2 GROUNDING

A. Comply with NECA/BICSI 607.

B. Install grounding according to BICSI ITSIMM, "Bonding, Grounding (Earthing) and Electrical Protection" Ch.

C. Locate TGB to minimize length of bonding conductors. Fasten to wall, allowing at least 2 inches (50 mm) of clearance behind TGB. Connect TGB with a minimum No. 4 AWG grounding electrode conductor from TGB to suitable electrical building ground. Connect rack TGB to near TGB or the TMGB.

1. Bond the shield of shielded fiber-optic cable to patch panel, and bond patch panel to TGB or TMGB.

3.3 IDENTIFICATION

A. Coordinate system components, wiring, and cabling complying with TIA-606-B. Comply with requirements in Section 270553 "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-606-B for Class 2 level of administration.

D. Labels shall be machine printed. Type shall be 1/4 inch (6 mm) in height.

END OF SECTION

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SECTION 27 13 23
COMMUNICATIONS OPTICAL FIBER BACKBONE CABLING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. 850 nanometer laser-optimized 50/125 micrometer multimode optical fiber cable (OM4).
2. Optical fiber cable connecting hardware, patch panels, and cross-connects.
3. Cabling identification products.

1.2 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. RCDD: Registered Communications Distribution Designer.

1.3 OPTICAL FIBER BACKBONE CABLING DESCRIPTION

A. Optical fiber 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.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Reviewed and stamped by RCDD.

1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
2. Cabling administration drawings and printouts.
3. Wiring diagrams to show typical wiring schematics including the following:
    a. Telecommunications rooms plans and elevations.
    b. Telecommunications pathways.
    c. Telecommunications system access points.
    d. Telecommunications grounding system.
    e. Cross-connects.
    f. Patch panels.
    g. Patch cords.
4. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.

C. Optical fiber cable testing plan.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer**,** installation supervisor, and field inspector.

B. Source quality-control reports.

C. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For optical fiber cable, splices, and connectors to include in 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. Patch-Panel Units: **One** of each type.
2. Plugs: **Ten** of each type.
3. Jacks: **Ten** of each type.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings 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.

1.9 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 fiber flashlight or optical loss test set.

1.10 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.

1.11 COORDINATION

A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Backbone cabling system shall comply with transmission standards in TIA-568-C.1, when tested according to test procedures of this standard.

B. 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.

C. Telecommunications Pathways and Spaces: Comply with TIA-569-D.

D. Grounding: Comply with TIA-607-B.

2.2 850 NANOMETER LASER-OPTIMIZED, 50/125 MICROMETER, MULTIMODE OPTICAL FIBER CABLE (OM4)

A. Description: Multimode, 50/125-micrometer, 12-strand fiber, shielded (**conductive)** tight buffer, optical fiber cable.

B. Standards:

1. Comply with ICEA S-83-596 for mechanical properties.

2. Comply with TIA-568-C.3 for performance specifications.

3. Comply with TIA-492AAAD for detailed specifications.

C. Conductive cable shall be **steel** or aluminum armored type.

D. Maximum Attenuation: **3.50** dB/km at 850 nm; **1.5** dB/km at 1300 nm.

E. Minimum Overfilled Modal Bandwidth-length Product: 3500 MHz-km at 850 nm; 500 MHz-km at 1300 nm.

F. Minimum Effective Modal Bandwidth-length Product: 4700 MHz-km at 850 nm.

G. Jacket:

1. Jacket Color: Aqua.

2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-D.

3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).

H. 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:

1. Plenum Rated, Conductive: Type OFCP, Type OFNP, Type OFCR, or Type OFNR in metallic conduit installed per NFPA 70, Article 300.22, "Wiring in Ducts, Plenums, and Other Air-Handling Spaces."

2.3 OPTICAL FIBER CABLE HARDWARE

A. Standards:

1. Comply with Fiber Optic Connector Intermateability Standard (FOCIS) specifications of the TIA-604 series.

2. Comply with TIA-568-C.3.

B. 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.

C. Patch Cords: Factory-made, dual-fiber cables in 36-inch (900-mm) lengths.

D. Connector Type: Type LC complying with TIA-604-10-B connectors.

E. Plugs and Plug Assemblies:

1. Male; color-coded modular telecommunications connector designed for termination of a single optical fiber cable.

2. Insertion loss not more than 0.25 dB.

3. Marked to indicate transmission performance.

F. Jacks and Jack Assemblies:

1. Female; quick-connect, simplex and duplex; fixed telecommunications connector designed for termination of a single optical fiber cable.

2. Insertion loss not more than 0.25 dB.

3. Marked to indicate transmission performance.

4. Designed to snap-in to a patch panel or faceplate.

2.4 GROUNDING

A. Comply with requirements in Section 270526 "Grounding and Bonding for Communications Systems" for grounding conductors and connectors.

B. Comply with TIA-607-B.

2.5 IDENTIFICATION PRODUCTS

A. Comply with TIA-606-B 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. Factory test multimode optical fiber cables according to TIA-526-14-B and TIA-568-C.3.

B. Factory test pre-terminated optical fiber cable assemblies according to TIA-526-14-B and TIA-568-C.3.

C. Cable will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

PART 3 EXECUTION

3.1 WIRING METHODS

A. Wiring Method: Install cables in raceways and cable trays. Conceal raceway and cables except in unfinished spaces.

1. Comply with requirements for pathways specified in Section 270528 "Pathways for Communications Systems."

B. 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.

3.2 INSTALLATION OF OPTICAL FIBER BACKBONE CABLES

A. Comply with NECA 1, NECA 301, and NECA/BICSI 568.

B. General Requirements for Optical Fiber Cabling Installation:

1. Comply with TIA-568-C.1 and TIA-568-C.3.
2. Comply with BICSI ITSIMM, Ch. 6, "Cable Termination Practices."
3. Terminate all cables; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
4. 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.
5. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
6. Bundle, lace, and train cable to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, "Cabling Termination Practices" Chapter. Use lacing bars and distribution spools.
7. 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.
8. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
9. In the communications equipment room, provide a 10-foot- (3-m-) long service loop on each end of cable.
10. Pulling Cable: Comply with BICSI ITSIMM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
11. Cable may be terminated on connecting hardware that is rack or cabinet mounted.

C. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

D. Group connecting hardware for cables into separate logical fields.

3.3 FIRESTOPPING

A. Comply with requirements in Section 078413 "Penetration Firestopping."

B. Comply with TIA-569-D, Annex A, "Firestopping."

C. Comply with BICSI ITSIMM, "Firestopping" Chapter.

3.4 GROUNDING

A. Install grounding according to BICSI ITSIMM, "Grounding (Earthing), Bonding, and Electrical Protection" Chapter.

B. Comply with TIA-607-B and NECA/BICSI-607.

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-606-B. Comply with requirements for identification specified in Section 270553 "Identification for Communications Systems."

1. Administration Class: Class 2.
2. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.

B. Paint and label colors for equipment identification shall comply with TIA-606-B for **Class 2** level of administration.

C. Comply with requirements in Section 271523 "Communications Optical Fiber Horizontal Cabling" for cable and asset management software.

D. 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.

E. 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, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors.

F. 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 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.

G. 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 606-B, for the following:

1. Flexible vinyl or polyester that flexes as cables are bent.

3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Visually inspect 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-568-C.1.

2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.

3. Optical Fiber Cable Tests:

a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.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 one direction according to TIA-526-14-B, 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 those calculated according to equation in TIA-568-C.1.

C. 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.

D. Remove and replace cabling where test results indicate that it does not comply with specified requirements.

E. Prepare test and inspection reports.

END OF SECTION

SECTION 27 15 13
COMMUNICATIONS COPPER 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. Category 6 twisted pair cable.
2. Twisted pair cable hardware, including plugs and jacks.
3. Multiuser telecommunications outlet assembly.
4. Cable management system.
5. Cabling identification products.
6. Source quality control requirements for twisted pair cable.

1.3 DEFINITIONS

A. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.

B. EMI: Electromagnetic interference.

C. FTP: Shielded twisted pair.

D. F/FTP: Overall foil screened cable with foil screened twisted pair.

E. F/UTP: Overall foil screened cable with unscreened twisted pair.

F. IDC: Insulation displacement connector.

G. LAN: Local area network.

H. Jack: Also commonly called an "outlet," it is the fixed, female connector.

I. Plug: Also commonly called a "connector," it is the removable, male telecommunications connector.

J. RCDD: Registered Communications Distribution Designer.

K. Screen: A metallic layer, either a foil or braid, placed around a pair or group of conductors.

L. Shield: A metallic layer, either a foil or braid, placed around a pair or group of conductors.

M. S/FTP: Overall braid screened cable with foil screened twisted pair.

N. S/UTP: Overall braid screened cable with unscreened twisted pairs.

O. UTP: Unscreened (unshielded) twisted pair.

1.4 COPPER HORIZONTAL CABLING DESCRIPTION

A. Horizontal cable cabling system shall provide interconnections between Distributor A, Distributor B, or Distributor C, and the equipment outlet, otherwise known as "Cabling Subsystem 1," in the telecommunications cabling system structure. Cabling system consists of horizontal cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for horizontal-to-horizontal cross-connection.

1. TIA-568-C.1 requires that a minimum of two equipment outlets 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 equipment outlet.
3. Bridged taps and splices shall not be installed in the horizontal cabling.

B. A work area is approximately 100 sq. ft. (9.3 sq. m), and includes the components that extend from the equipment outlets 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.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Reviewed and stamped by RCDD.

1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
2. Cabling administration Drawings and printouts.
3. Wiring diagrams and installation details of telecommunications equipment, to show location and layout of telecommunications equipment, including the following:
    a. Telecommunications rooms plans and elevations.
    b. Telecommunications pathways.
    c. Telecommunications system access points.
    d. Telecommunications conductor drop locations.
    e. Typical telecommunications details.
    f. Mechanical, electrical, and plumbing systems.

C. Twisted pair cable testing plan.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For **Installer,** 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.

1.8 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. Connecting Blocks: **One** of each type.
2. Faceplates: **One** of each type.
3. Jacks: **Ten** of each type.
4. Multiuser Telecommunications Outlet Assemblies: **One** of each type.
5. Patch-Panel Units: **One** of each type.
6. Plugs: **Ten** of each type.

1.9 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings 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.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.

1. Test each pair of twisted pair 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.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA-568-C.1, when tested according to test procedures of this standard.

B. Telecommunications Pathways and Spaces: Comply with TIA-569-D.

C. Grounding: Comply with TIA-607-B.

2.2 GENERAL CABLE CHARACTERISTICS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with the applicable standard and NFPA 70 for the following types:

1. Communications, Plenum Rated: Type CMP complying with UL 1685.

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. RoHS compliant.

2.3 CATEGORY 6 TWISTED PAIR CABLE

A. Description: Four-pair, balanced-twisted pair cable, with internal spline, certified to meet transmission characteristics of Category 6 cable at frequencies up to 250MHz.

1. The selected cable must have contiguous, two-foot segment-length markers printed on the cable jacket. The markings must also show cable manufacturer, cable model number or name, cable part number, Cat-6 or Cat-6a designation, a UL or ETL verification designation, a CMP type, and a “tested to 350 MHz” or above designation

B. Manufacturers: CommScope AMP NetConnect or prior-approved equal.

C. Standard: Comply with NEMA WC 66/ICEA S-116-732 and TIA-568-C.2 for Category 6 cables.

D. Conductors: 100-ohm, 23 AWG solid copper.

E. Shielding/Screening: Unshielded twisted pairs (UTP).

F. Cable Rating: Plenum.

G. Jacket: Gray thermoplastic.

2.4 TWISTED PAIR CABLE HARDWARE

A. Description: Hardware designed to connect, splice, and terminate twisted pair copper communications cable.

B. Manufacturers: CommScope AMP NetConnect or prior-approved equal.

C. General Requirements for Twisted Pair Cable Hardware:

1. Comply with the performance requirements of Category 6.

2. Comply with TIA-568-C.2, IDC type, with modules designed for punch-down caps or tools.
3. Cables shall be terminated with connecting hardware of same category or higher.

D. Source Limitations: Obtain twisted pair cable hardware from same manufacturer as twisted pair cable, from single source.

E. Connecting Blocks:
1. 110-style IDC for Category 6.
2. Provide blocks for the number of cables terminated on the block, plus 25 percent spare, integral with connector bodies, including plugs and jacks where indicated.

F. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.
1. Number of Terminals per Field: **One** for each conductor in assigned cables.

G. Patch Panel: Modular panels housing numbered jack units with IDC-type connectors at each jack location for permanent termination of pair groups of installed cables.
1. Features:
a. Universal T568A wiring labels.
b. Labeling areas adjacent to conductors.
c. Replaceable connectors.
d. 48 ports.
2. Construction: 16-gauge steel and mountable on 19-inch (483 mm) equipment racks.
3. Number of Jacks per Field: One for each four-pair conductor group of indicated cables, plus spares and blank positions adequate to suit specified expansion criteria.

H. Patch Cords: Factory-made, four-pair cables in 48-inch (900-mm) lengths; terminated with an eight-position modular plug at each end.
1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure performance. Patch cords shall have latch guards to protect against snagging.

I. Plugs and Plug Assemblies:
1. Male; eight position; color-coded modular telecommunications connector designed for termination of a single four-pair, 100-ohm, unshielded or shielded twisted pair cable.
2. Standard: Comply with TIA-568-C.2.
3. Marked to indicate transmission performance.

J. Jacks and Jack Assemblies:
1. Female; eight position; modular; fixed telecommunications connector designed for termination of a single four-pair, 100-ohm, unshielded or shielded twisted pair cable.
2. Designed to snap-in to a patch panel or faceplate.
3. Standard: Comply with TIA-568-C.2.
4. Marked to indicate transmission performance.

K. Faceplate:
1. **Four** port, vertical single gang faceplates designed to mount to single gang wall boxes.
2. Plastic Faceplate: High-impact plastic. Coordinate color with Section 262726 "Wiring Devices."
3. For use with snap-in jacks accommodating any combination of twisted pair, optical fiber, and coaxial work area cords.

L. Legend:

1. Machine printed, in the field, using adhesive-tape label.
2. Snap-in, clear-label covers and machine-printed paper inserts.

2.5 MULTIUSER TELECOMMUNICATIONS OUTLET ASSEMBLY (MUTOA)

A. Description: MUTOAs shall meet the requirements of "Twisted Pair Cable Hardware" Article.
   1. Number of Terminals per Field: **One** for each conductor in assigned cables.
   2. Mounting: **Recessed in ceiling** and in **Furniture** / Furniture systems.
   3. NRTL listed as complying with UL 50 and UL 1863.
   4. Label shall include maximum length of work area cords, based on TIA-568-C.1.
   5. When installed in plenums used for environmental air, NRTL listed as complying with UL 2043.

2.6 IDENTIFICATION PRODUCTS

A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.7 GROUNDING

A. Comply with requirements in Section 270526 "Grounding and Bonding for Communications Systems" for grounding conductors and connectors.

B. Comply with TIA-607-B.

2.8 SOURCE QUALITY CONTROL

A. Factory test cables on reels according to TIA-568-C.1.

B. Factory test twisted pair cables according to TIA-568-C.2.

C. Cable will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

PART 3 EXECUTION

3.1 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, attics, and 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 270528 "Pathways for Communications Systems."

B. 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. Install conductors parallel with or at right angles to sides and back of enclosure.

3.2 INSTALLATION OF PATHWAYS

A. Comply with requirements for demarcation point, cabinets, and racks specified in Section 271100 "Communications Equipment Room Fittings."

B. Comply with Section 270528 "Pathways for Communications Systems."

C. Comply with Section 270529 "Hangers and Supports for Communications Systems."

D. Comply with Section 270536 "Cable Trays for Communications Systems."

E. Drawings indicate general arrangement of pathways and fittings.

3.3 INSTALLATION OF TWISTED-PAIR HORIZONTAL CABLES

A. Comply with NECA 1 and NECA/BICSI 568.

B. General Requirements for Cabling:

1. Comply with TIA-568-C.0, TIA-568-C.1, and TIA-568-C.2.
2. Comply with BICSI's "Information Transport Systems Installation Methods Manual (ITSIMM), Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section.
3. Install 110-style IDC termination hardware unless otherwise indicated.
4. Do not untwist twisted pair cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.
5. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
6. MUTOA shall not be used as a cross-connect point.
7. Consolidation points may be used only for making a direct connection to equipment outlets:
    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 twisted-pair cables at least 49 feet (15 m) from communications equipment room.
8. 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.
9. Install lacing bars to restrain cables, prevent straining connections, and prevent bending cables to smaller radii than minimums recommended by manufacturer.
10. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI Information Transport Systems Installation Methods Manual , Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section. Use lacing bars and distribution spools.
11. 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.
12. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
13. In the communications equipment room, install a 10-foot- (3-m-) long service loop on each end of cable.
14. Pulling Cable: Comply with BICSI Information Transport Systems Installation Methods Manual, Ch. 5, "Copper Structured Cabling Systems," "Pulling and Installing Cable" Section. Monitor cable pull tensions.

C. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend twisted pair cabling, 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.

D. Group connecting hardware for cables into separate logical fields.

E. Separation from EMI Sources:

1. Comply with recommendations from BICSI's "Telecommunications Distribution Methods Manual" and TIA-569-D for separating unshielded copper 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 (600 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, 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 FIRESTOPPING

A. Comply with requirements in Section 078413 "Penetration Firestopping."

B. Comply with TIA-569-D, Annex A, "Firestopping."

C. Comply with "Firestopping Systems" Article in BISCI's "Telecommunications Distribution Methods Manual."

3.5 GROUNDING

A. Install grounding according to the "Grounding, Bonding, and Electrical Protection" chapter in BICSI's "Telecommunications Distribution Methods Manual."

B. Comply with TIA-607-B and NECA/BICSI-607.

C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall, allowing at least a 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar to suitable electrical building ground, using a minimum No. 4 AWG grounding electrode conductor.

D. Bond metallic equipment to the grounding bus bar, using not smaller than a No. 6 AWG equipment grounding conductor.

3.6 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA-606-B. Comply with requirements for identification specified in Section 270553 "Identification for Communications Systems."

1. Administration Class: Class 2.
2. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.

B. Paint and label colors for equipment identification shall comply with TIA-606-B for Class 2 level of administration, including optional identification requirements of this standard.

C. 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.

D. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors.

E. 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 the device if wire color 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, extended from a panel or cabinet to a building-mounted device, with the name and number of a particular device.
    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.

F. Labels shall be preprinted or computer-printed type, with a printing area and font color that contrast with cable jacket color but still comply with TIA-606-B requirements for the following:

1. Cables use flexible vinyl or polyester that flexes as cables are bent.

3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Visually inspect 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-568-C.1.
2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
3. Test twisted pair 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-568-C.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.

C. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similarly to Table 10.1 in BICSI's "Telecommunications Distribution Methods Manual," or shall be transferred from the instrument to the computer, saved as text files, printed, and submitted.

D. Remove and replace cabling where test results indicate that they do not comply with specified requirements.

E. Prepare test and inspection reports.

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SECTION 28 31 11

MULTIPLEX/ADDRESSABLE FIRE ALARM SYSTEMS

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

A. Scope: This work includes designing and providing a tenant finish addressable fire alarm system as described herein for the portion of Building 56 in the scope of this project. The system shall include all wiring, raceways, pull boxes, terminal cabinets, outlet and mounting boxes, control equipment, alarm and supervisory signal initiating devices, alarm notification appliances, and all other accessories and miscellaneous items required for a complete operating system even though each item is not specifically mentioned or described. If the contractor's proposed system requires additional auxiliary power supplies, they shall be provided in nearest electrical closet.

B. Extent of the Work: The system shall be installed in accordance with the specifications and Electrical construction documents.

C. Repair Service/Replacement Parts: On-site service during the guarantee period shall be provided within 24 hours after notification. All repairs shall be completed within 48 hours after notification.

D. Related Sections: Refer to other Division 26 and 28 sections for:

Cable

Wire

Raceways

Connectors

1.2 QUALITY ASSURANCE

A. Manufacturer Qualifications: All components of each system shall be furnished by a single manufacturer, shall be of current design and shall be in regular and recurrent production.

B. Provide design, materials and devices for a protected premises fire alarm system, complete, conforming to National Fire Protection Association Standard 72, except as otherwise or additionally specified herein. The design shall be shown on shop drawings to be submitted to GSA for review and approval prior to the purchase of materials and any installation of the system at the job site.

C. Approved Equipment: Provide materials, equipment and devices that have been tested by a nationally recognized testing laboratory, such as Underwriters' Laboratories or Factory Mutual Laboratories, and listed or approved for fire protection service when so required by NFPA 72 or this specification.

D. Installer Requirements: Design shall be performed and certified/stamped by a full-time employee of the Installer who shall be either a NICET Level III or IV Fire Alarm Technician or a Colorado Registered Professional Fire Protection Engineer. Fire Alarm Technicians performing the new installation shall be NICET Level II or higher. Installer shall have an office, which has been in existence for at least 3 years, within a 120-kilometer (75 mile) radius of the jobsite. Installation shall be accomplished by an electrical contractor with a minimum of five years' experience in the installation of fire alarm systems. The Contracting Officer may reject any

proposed installer who cannot show evidence of such qualifications. The services of a NICET Level II or higher Fire Alarm Technician provided by the control equipment manufacturer or factory authorized distributor shall be provided to supervise installation, adjustments, and conduct all tests of the system.

E. Service Organization: The contractor shall furnish evidence that the fire alarm equipment supplier has an experienced and effective service organization which carries a stock of repair parts for the system to be furnished. Should the contractor fail to comply with the service requirements of this section, the government will then have the option to make the necessary repairs and back charge the contractor without any loss of warranty or guarantee as provided by the contract documents.

F. Guarantee: The contractor shall guarantee labor, materials, and equipment provided under this contract against defects for a period of one year after the date of final acceptance of this work by the government and the receipt of as-built drawings and schematics of all equipment.

G. Applicable Publications: Provide a system conforming to the requirements of the latest edition of the following publications including all amendments to these publications:

1. American Society for Testing and Materials (ASTM):

   a. E 84 Standard Test Method for Surface Burning Characteristics of Building Materials

   b. E 119 Standard Test Methods for Fire Tests of Building Construction and Materials

2. American Society of Mechanical Engineers (ANSI/ASME):

   a. A17.1 Safety Code for Elevators and Escalators

   b. C62.41 Guide for Surge Voltages in Low Voltage A.C. Power Circuits

3. International Conference of Building Officials (ICBO).

   a. International Building Code

4. National Fire Protection Association (NFPA):

   a. 70 National Electric Code

   b. 72 National Fire Alarm Code

   c. 13 Standard for the Installation of Sprinkler Systems

   d. 20 Standard for the Installation of Centrifugal Fire Pumps

   e. 101 Life Safety Code

   f. 90A Standard for the Installation of Air Conditioning and Ventilating Systems

5. Testing Services or Laboratories: Construct all fire alarm and fire detection equipment in accordance with the latest edition of the following publications from Underwriters Laboratories Inc. (UL), or Factory Mutual Engineering Corporation (FM):

   a. UL 228 - Door Holding Devices

   b. UL 464 - Audible Signal Appliances, Fifth Edition

c. UL 864 - Control Units for Fire Protective Signaling Systems, Sixth Edition

d. UL 1638 - Visual Signaling Appliances Standard

e. UL 1971 - Signaling Devices for the Hearing Impaired

f. UL Fire Protection Equipment Directory

g. UL Electrical Construction Materials Directory

h. FM P7825 Approval Guide

1.3 DEFINITIONS

A. General: Wherever mentioned in this specification or on the drawings the equipment, devices, and functions shall be defined as follows:

1. Alarm Signal: A signal which indicates a state of emergency requiring immediate notification of the fire department and of the building occupants. These are signals such as the operation of a manual pull station, the activation of a waterflow switch in a sprinkler system the operation of a heat detector, or the operation of a pressure switch in a fire suppression system caused by the flow of fire extinguishing agent (e.g. kitchen fire extinguishing system, $C0_2$, etc.).

2. Supervisory Signal: A signal which indicates the impairment of a fire protection system which may prevent its normal use. These are signals from switches, such as a tamper switch; a low air pressure switch; the receipt of an alarm signal from a smoke detector that has gone through alarm verification, the receipt of an alarm signal from an elevator smoke detection control panel or a computer room smoke detection panel, the operation of a duct smoke detector, operation of a high air pressure switch; a generator phase reversal switch; a generator power failure switch; a generator running switch; a fire pump phase reversal switch; a fire pump loss of power switch; or a fire pump running switch.

3. Trouble Signal: A signal which indicates that a fault, such as an open circuit or ground, has occurred in the fire alarm system or in a separate sub-system, whose control panel is monitored by the fire alarm system.

4. Hard Wired System: A system in which alarm and supervisory initiating devices are directly connected, through individual dedicated conductors, to a central control panel without the use of multiplexing circuits or devices.

5. Notification Appliance Circuit: A circuit to which notification appliances are connected to visually and audibly indicate an alarm evacuation signal.

6. Fire Alarm Control Panel (FACP): A master control panel having the features of a fire alarm control panel and to which all fire alarm control panels are interconnected. The panel has central processing, memory, input and output terminals, voice communication system microphones, firefighter's telephone, video display units (VDUs) and printers.

7. Class A Wiring: A circuit that is monitored for integrity such that a single break, a single wire-to-wire short, or a single loss of carrier condition will be indicated by a trouble signal on the FACP no matter where the break, short or loss of carrier condition occurs and will allow all functions of the affect circuit to remain operational. In accordance with NFPA 72, this would be Style 6 or 7 wiring for signaling line circuits, and style Z for notification appliance circuits

8. Class B Wiring: A circuit that is monitored for integrity such that a single break, a single wire-to-wire short, or a single loss of carrier condition will be indicated by a trouble signal

on the FACP no matter where the break, short or loss of carrier condition occurs, but which would prohibit devices beyond the fault, short or carrier loss from remaining operational. In accordance with NFPA 72, this would be Style 4 wiring for signaling line circuits, Style B for initiating device circuits, and Style Y for notification appliance circuits.

9. Signaling Line Circuit: A circuit to which any combination of circuit interfaces, control panels, or transmitters are connected and over which multiple system input signals or output signals, or both, are carried.

10. Manual Pull Station: A fire alarm box as indicated in NFPA 72.

11. Tamper Switch: A valve monitor switch as indicated in NFPA 72.

12. Initiating Device: A system component that originates transmission of a change of state condition, which initiates an appropriate response via the fire alarm system.

13. Fire Alarm Terminal Cabinet (FATC): A steel cabinet, painted red, with locking, hinge-mounted door in which terminal strips are securely mounted. Minimum size is 200 mm x 200 mm (8-inch x 8 inch).

1.4 SYSTEM OPERATION

A. General: Existing fire alarm panel is a Simplex 4100.

1.5 SUBMITTALS

A. Division 1: Refer to Section "SUBMITTALS" for basic information relating to submittal requirements. Submit 6 complete sets of submittals. Partial submittals will not be acceptable and will be returned without review. Before any work is commenced, the submittal must be approved by the GSA Region 9 Safety and Environmental Management Branch Fire Protection Engineer. Manufacturer's data shall be annotated and provided for the following:

1. Fire Alarm Control Panel (FACP) (Including Printers, Covers, Console Rack, Video Display Unit, etc.)

2. Storage Batteries

3. Battery Charger

4. Cabinet

5. Manual Pull Stations

6. Addressable Interface Devices

7. Terminal Cabinets/Assemblies

8. Addressable Relays

9. Remote LCD Annunciator Panel

10. Horn/Strobe Unit

11. Visual Alarm Signal Strobe

12. Smoke Detector

13. Heat Detector

14. Tamper Switch

15. Auxiliary Power Supply

B. Shop Drawings: Submit shop drawings not smaller than 760 mm (30 inches) by 1070 mm (42 inches) unless approved by the GSA Project Manager. As a minimum, the shop drawing submittal shall include the following:

1. Provide point-to-point wiring diagrams showing:

a) the terminals used for all field device connections to all panels the system, including all interconnections between the equipment or systems which are supervised or controlled by the system.

b) all connections from the main FACP to all remote fire alarm control panels or auxiliary power supplies.

c) all internal panel wiring connections and jumper positions.

d) all terminal cabinet wiring.

e) all points of connection for owner furnished equipment, i.e. telephone lines or BAS interface.

2. Provide a complete description of the system operation, including a sequence of operation matrix.

3. Provide a complete list of device addresses and corresponding descriptor readouts.

. Provide scaled floor plans showing the location of all devices, panels, equipment, power sources, raceways and conductors. Show the strobe candela rating for all visual alarm appliances.

5. Provide a riser drawing showing all fire alarm panels, terminal cabinets, and interconnection wiring. Show all field devices and circuit layouts for all floors. Indicate the wiring sequence of all devices and their connections to the control equipment.

6. Provide detailed drawings of the graphic annunciator, including panel construction, artwork, finishes, and all internal and external wiring connections.

7. Provide device mounting details and elevations for all equipment to be installed.

8. Provide battery calculations for all panels showing both the alarm and supervisory power requirements used to size the batteries. Manufacturer's data sheets showing ampere-hour requirements for each system component shall be submitted with the calculations.

9. Provide circuit load calculations to indicate that there is at least 15% spare capacity for notification appliance circuits, and 15% spare capacity for signaling line and initiating device circuits.

10. Provide amplifier circuit load calculations to indicate that the amplifiers have sufficient capacity to simultaneously drive all fire alarm speakers at their 1/2 watt tap plus 25% spare capacity.

11. Provide voltage drop calculations for all strobe notification appliance circuits. Show formulae used and individual calculations of types and number of devices on each circuit. Voltage drop shall not exceed ten percent of the nominal circuit calculations, i.e. 2.4 volts.

12. Provide power supply calculations for all external loads powered from this system, including door holders, door closers, damper motors, door strikes, etc.

13. Provide load information (and calculations, where necessary) for all circuits connected to fire alarm control relay contacts.

14. Provide load calculations for all new circuits connected to the 120 VAC emergency distribution panel. Voltage drop shall not exceed three percent at the farthest load.

15. Submit annotated catalog data showing manufacturer's name, model, voltage, and catalog numbers for all fire alarm equipment and installation components, including wire and cable.

16. Provide a color code schedule for all field wiring circuits.

17. Provide the stamp, seal or registration number, and signature of designer or engineer meeting the requirements of Part 1.02.D.

C. The acceptance testing will not be permitted until the shop drawings are approved.

1.6 OPERATION AND MAINTENANCE MANUALS

A. General: Following the acceptance test, drawings and submittal materials shall be updated as necessary to reflect as-built conditions.

B. Record Drawing Software Copy: Provide two (2) sets CD-ROM's containing CAD based drawings in both DWG and DXF format of all as-built drawings and schematics.

1.7 AS-BUILT DRAWINGS

A. General: Prepare and submit to the Contracting Officer six sets of detailed "As Built Drawings" on CAD. The drawings shall include complete wiring diagrams showing connections between all devices and equipment, both factory and field wired. Include a riser diagram and drawings showing the as-built location of all devices and equipment. The drawings shall show the system as installed, including all deviations from both the project drawings and the approved shop drawings. The drawings shall be prepared on uniform sized sheets not less than 760 mm (30 inches) by 1070 mm (42 inches). These drawings shall be submitted within two weeks after the final acceptance test of the system and two weeks prior to the instruction of government employees.

PART 2 - PRODUCTS

2.01 NOTIFICATION APPLIANCES

A. Visual Alarm Signals:

1. Provide synchronized strobe light visual alarm signals which operate on a supervised twenty-four (24) volt D.C. reverse polarity circuit. The strobe lens shall comply with UL 1971 and conform to the Americans with Disabilities Act. The strobe shall have a xenon flash tube.

2. The strobe light pattern shall be designed and listed for the specific installation location, either wall mounted or ceiling mounted. Each strobe shall be clearly labeled "FIRE" on a minimum of two sides. The lettering shall be horizontal for ceiling mounted locations and vertical for wall mounted locations.

3. The strobe flash output shall be a minimum of 15 candela and a maximum of 110 cd, based on UL standard 1971. The installed strobe's candela rating shall be based upon the actual size of the room or area to be covered, in accordance with NFPA 72.

B. Fire Alarm Speakers:

1. Provide fire alarm speakers conforming to UL 1480 having a minimum of four (4) tap settings and separate terminations for each "in" and "out" connection. At a minimum, tap settings shall include taps of 1/4, ½, 1 and 2 watts. Speakers shall be initially set at the 1/2 watt tap setting; however, setting shall be adjusted to meet sound pressure requirements. Speakers shall have an output rating of 84 dBA at three (3) meters (9.9 feet) as determined by the reverberant room test; data on peak output as determined in an anechoic chamber is not suitable. All speakers shall be capable of installation on standard 100 mm (4 inch) square electrical boxes. Where speakers and strobes are provided in the same location, they may be combined into a single wall or wall/ceiling mounted unit.

2. To ensure audible signals are clearly heard, the sound level shall be at least 70 dBA throughout the office spaces, courtrooms, general building areas and corridors measured 1.5 meters (5 feet) above the floor. The sound level in other areas shall be at least 15 (fifteen) dBA above the average sound level or five (5) dBA above any noise source lasting 60 seconds or longer. Sound level measurements shall be taken with room doors closed

C. Connections:

1. Provide screw terminals for each notification appliance. Terminals shall be designed to accept the size conductors used in this project without modification.

PART 3 - EXECUTION

3.1 GENERAL

A. Locate all fire alarm system devices as required by par. 1.11 above.

B. Coordinate all work with other trades to provide a complete and functional system.

C. Perform all pretesting with interfaces to other trades installed and operational.

3.2 SYSTEM FIELD WIRING

A. Wiring Within Cabinets, Enclosures, Boxes, Junction Boxes and Fittings: Provide wiring installed in a neat and workmanlike manner and installed parallel with or at right angles to the sides and back of any box, enclosure or cabinet. All conductors which are terminated, spliced, or otherwise interrupted in any enclosure, cabinet, mounting or junction box shall be connected to terminal blocks. Mark each terminal in accordance with the wiring diagrams of the system. Make all connections with approved pressure type terminal blocks, which are securely mounted. The use of wire nuts or similar devices shall be prohibited.

B. Alarm Wiring: All wiring shall be new. T-taps are permitted in Style 4 circuits with interconnections occurring on terminal strips.

1. Wire size shall be sufficient to prevent voltage drop problems. Circuits operating at 24 VDC shall not operate at less than 21.6 volts. Circuits operating at any other voltage shall not have a voltage drop exceeding 10% of nominal voltage.

2. Install all conductors in rigid metal conduit or electrical metallic tubing. The use of flexible conduit not exceeding a six-foot length shall be permitted in initiating device circuits and

notification appliance circuits. Run conduit or tubing concealed unless specifically shown otherwise on the drawings.

3. Signaling line circuits and initiating device circuit field wiring shall be solid copper, No. 18 AWG size conductors at a minimum.

4. Visual alarm signal and audible appliance circuits shall be solid copper No. 12 AWG size conductors at a minimum. Speaker circuits shall be solid copper No. 16 AWG size conductors at a minimum.

5. Firefighter telephone circuits shall be No. 18 AWG size conductors as a minimum and shall be terminated in terminal cabinets in an elevator machinery room to the firefighter telephone in each elevator cab.

6. Shielded wiring shall be utilized where recommended by the manufacturer. For shielded wiring, the shield shall be grounded at only one point, which shall be in or adjacent to the FACP, and shall be carried through continuously at each termination location, without grounding.

7. Circuits to fan shutdown systems, door locking systems and elevator recall interfaces shall terminate in terminal cabinets within 3 feet of the controllers for those systems. The completion of those circuits from the terminal cabinets to the appropriate system shall be provided under this Division.

8. Power wiring, operating at 120 VAC minimum, shall be No. 12 AWG size THHN solid copper, minimum.

C. Conductor Terminations: No specific color coding is required for any circuit; however, labeling of any circuit at terminal blocks in fire alarm terminal cabinets (FATC), main fire alarm control panel (MFAP), and remote fire alarm control panels (RFAP) shall be provided at each conductor connection. Each conductor or cable shall have a shrink-wrap label to provide a unique and specific designation. Each FATC, MFAP and RFAP shall contain a laminated drawing which indicates each conductor, its label, circuit and terminal. The laminated drawing shall be neat, using 12 point lettering minimum size, and mounted within each cabinet, panel or unit so that it does not interfere with the wiring or terminals.

3.3 INSTALLATION OF FIRE ALARM INITIATING AND INDICATING DEVICES

A. Notification Appliance Devices: Locate notification appliance devices as described herein. Mount assemblies on walls 2 000 mm (80 inches) above the finished floor or 150 mm (6 inches) below the ceiling, whichever is lower. Ceiling mounted speaker/strobes candela ratings shall conform to NFPA 72.

3.4 TESTS

A. All Notification Appliance Circuit Preliminary and Final Acceptance Tests shall be performed outside of normal building business hours. The Contracting Officer will advise the Contractor of acceptable testing times.

B. Preliminary Testing: Conduct preliminary tests to ensure that all devices and circuits are functioning properly. Tests shall meet the requirements of Paragraph 3.07 of this section. After preliminary testing is complete, provide a letter certifying that the installation is complete and fully operable. The letter shall state that each initiating and indicating device was tested in place and functioned properly. The letter shall also state that all panel functions were tested and operated properly. The letter shall include the names and titles of the witnesses to the preliminary tests. The Contractor and an authorized representative from each supplier of

equipment shall be in attendance at the preliminary testing to make necessary adjustments. The Construction Manager must be present at the preliminary test.

C. Final Acceptance Testing: Notify the Contracting Officer in writing when the system is ready for final acceptance testing. Submit request for test at least 15 calendar days prior to the test date. A final acceptance test will not be scheduled until the O&M Manuals are provided to the Contracting Officer and the following are provided at the job site:

1. Marked-up red line drawings of the system as actually installed

2. The final tests shall be witnessed by a Fire Protection Engineer from the GSA Region 9 Safety and Environmental Management Branch, the Building Engineer and the GSA Project Manager. At this time, any and all required tests shall be repeated at the discretion of the Government. Following acceptance of the system, as-built drawings shall be delivered to the Contracting Officer for review and acceptance.

3.5 MINIMUM SYSTEM TESTS

A. General: Test the system in accordance with the procedures outlined in NFPA 72. The required tests are as follows:

1. Verify that all fire alarm control panels are in the normal condition as detailed in the manufacturer's operating and maintenance manual.

2. Visually inspect all wiring.

3. Activate a building device and ensure the speaker/strobes are operating properly.

4. Verify that red-line drawings are accurate.

5. Measure the current in circuits to assure there is the calculated spare capacity for the circuits.

END OF SECTION