DIVISION 01
GENERAL CONDITIONS

011000 - SUMMARY

011000.1 General

1.1 Work Covered by Contract Documents

A. Project Identification: Project consists of GM VEC Town Common Upgrades.
   1. Project Location: Warren Technical Center
   2. Owner: GM Real Estate & Facilities

B. The Work consists of : Refer to Request for Professional Services (RFPS)

1.2 Owner-Furnished Products

A. Owner will furnish all furniture (FFE) relative to the project. The Contractor's Work includes providing support systems to receive Owner's equipment and plumbing, mechanical, and electrical connections. The Contractor's Work is to also include all assembly and installation of all furniture purchased by the Owner.
   1. Owner will arrange and pay for delivery of Owner-furnished items according to Contractor's Construction Schedule.
   2. After delivery, Owner will inspect delivered items for damage. Contractor shall be present for and assist in Owner's inspection.
   3. If Owner-furnished items are damaged, defective, or missing, Owner will arrange for replacement.
   4. Owner will arrange for manufacturer's field services and for delivery of manufacturer's warranties to Contractor.
   5. Owner will furnish Contractor the earliest possible delivery date for Owner-furnished products. Using Owner-furnished earliest possible delivery dates, Contractor shall designate delivery dates of Owner-furnished items in Contractor's Construction Schedule.
   6. Contractor is responsible for receiving, unloading, and handling Owner-furnished items at Project site.
   7. Contractor is responsible for protecting Owner-furnished items from damage during storage and handling, including damage from exposure to the elements.
   8. If Owner-furnished items are damaged as a result of Contractor's operations, Contractor shall repair or replace them.

1.3 Codes and Standards

A. Unless more stringent requirements are indicated, comply with provisions of the Building Code edition currently adopted and enforced by the local government agency having jurisdiction in the State of Michigan. The applicable edition of indicated standards is the edition referenced by the Building Code. Where an indicated standard is not referenced in the Building Code, the most recently published edition is applicable.

011400 - WORK RESTRICTIONS

011400.1 GENERAL

1.1 Occupancy Requirements

A. Full Owner Occupancy: See Construction General Conditions – GM 1638 3.19.B.

1. Prepare a Certificate of Substantial Completion for each specific portion of the Work to be occupied before Owner occupancy.
2. Obtain a Certificate of Occupancy from authorities having jurisdiction before Owner occupancy.
3. Before partial Owner occupancy, mechanical and electrical systems shall be fully operational, and required tests and inspections shall be successfully completed. On occupancy, Owner will provide, operate, and maintain mechanical and electrical systems serving occupied portions of building.
4. On occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of the building.

1.2 Notice To Public Utilities

A. Governmental agencies that require the Contractor to obtain a permit for the work of this Contract, will require as a condition of the permit that the Contractor shall comply with the requirements of all applicable governing laws.

013100 - PROJECT MANAGEMENT AND COORDINATION

013100.1 GENERAL

1.1 Summary

A. This Section includes administrative provisions for coordinating construction operations on the Project including, but not limited to, the following:

1. General project coordination procedures.
2. Conservation.
3. Coordination Drawings.

4. Administrative and supervisory personnel.
5. Project meetings.

1.2 Project Meeting

A. General: Requirements for weekly project meetings are defined in the Construction General Conditions – GM 1638 9.8, 9.10 and 3.3.3.

B. Pre-construction Conference: Schedule a pre-construction conference before starting construction, at a time convenient to Owner and Architect, but no later than **15** days after execution of the Agreement. Hold the conference at Project site or another convenient location. Conduct the meeting to review responsibilities and personnel assignments.

1. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; manufacturers; suppliers; and other concerned parties shall attend the conference. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Discuss items of significance that could affect progress, including the following:
    a. Tentative construction schedule.
    b. Phasing.
    c. Critical work sequencing.
    d. Designation of responsible personnel.
    e. Procedures for processing field decisions and Change Orders.
    f. Procedures for processing Applications for Payment.
    g. Distribution of the Contract Documents.
    h. Submittal procedures.
    i. Preparation of Record Documents.
    j. Use of the premises.
    k. Responsibility for temporary facilities and utilities.
    l. Parking availability.
    m. Office, work, and storage areas.
    n. Equipment deliveries and priorities.
    o. First aid.

p. Security.

q. Progress cleaning.

r. Working hours.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

013233 - PHOTOGRAPHIC DOCUMENTATION

013233.1 GENERAL

1.1 Summary

A. This Section includes administrative and procedural requirements for the following:

1. Preconstruction photographs.
2. Monthly construction photographs. GM 1638 2.1.M and Construction Special Conditions item 21.
3. Final Completion construction photographs.
4. Preconstruction videotapes.
5. Periodic construction videotapes.
6. Time-lapse sequence construction videotapes.

B. Related Sections include the following:

1. Division 1 Section "Submittal Procedures" for submitting construction photographs.

1.2 Submittals

A. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

B. Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each photograph. Indicate elevation or story of construction. Include the same label information as the corresponding set of photographs.

C. Construction Photographs: Submit electronic prints of each photographic view within seven days of taking photographs.

1. Digital Images: Submit a complete set of digital image electronic files with each submittal of prints.

Identify electronic media with date photographs were taken. Submit images that have the same aspect ratio as the sensor, uncropped.

D. Videotapes: Submit copies of each videotape within seven days of recording.

1. Identification: On each copy provide an applied label with the following information:
    a. Name of Project.
    b. Name and address of photographer.
    c. Name of Architect.
    d. Name of Contractor.
    e. Date videotape was recorded.
    f. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
2. Transcript: Prepared on 8-1/2-by-11-inch paper, punched and bound in heavy-duty, 3-ring, vinyl-covered binders. Mark appropriate identification on front and spine of each binder. Include a cover sheet with the same label information as the corresponding videotape. Include name of Project and date of videotape on each page.

013233.2 PRODUCTS

2.1 Photographic Media

A. Digital Images: Provide images in JPEG format, with minimum sensor size of 2.0 megapixels.

013233.3 EXECUTION

3.1 PHOTOGRAPHS, GENERAL

A. Date Stamp: Unless otherwise indicated, date and time stamp each photograph as it is being taken so stamp is integral to photograph.

B. Field Office Prints: Retain one set of prints of progress photographs in the field office at Project site, available at all times for reference. Identify photographs the same as for those submitted to Architect [**and Construction Manager**].

3.2 CONSTRUCTION PHOTOGRAPHS

A. Preconstruction Photographs: Before starting construction, take color photographs of Project site and surrounding properties from different vantage points.

1. Take photographs to show existing conditions adjacent before starting the Work.

B. Periodic Construction Photographs: Take color photographs monthly with the cutoff date associated with each Application for Payment. Photographer shall select vantage points to best show status of construction and progress since the last photographs were taken. GM 1638 2.1.M and Construction Special Conditions item 21.

C. Architect-Directed Construction Photographs: From time to time, Architect will instruct photographer about number and frequency of color photographs and general directions on vantage points. Photographer shall select actual vantage points and take photographs to best show the status of construction and progress since the last photographs were taken.

   a. Commencement of the Work, through completion of subgrade construction.

   b. Above-grade structural framing.

   c. Exterior building enclosure.

   d. Interior Work, through date of Substantial Completion.

D. Final Completion Construction Photographs: Take color photographs after date of Substantial Completion for submission as Project Record Documents. Architect will direct photographer for desired vantage points.

   1. Do not include date stamp.

E. Additional Photographs: Architect may issue requests for additional photographs, in addition to periodic photographs specified. Additional photographs will be paid for by Change Order and are not included in the Contract Sum.

   1. Photographer will be given three days' notice, where feasible.

   2. In emergency situations, photographer shall take additional photographs within 24 hours of request.

   3. Circumstances that could require additional photographs include, but are not limited to, the following:

      a. Special events planned at Project site.

      b. Immediate follow-up when on-site events result in construction damage or losses.

      c. Photographs to be taken at fabrication locations away from Project site. These photographs are not subject to unit prices or unit-cost allowances.

      d. Substantial Completion of a major phase or component of the Work.

      e. Extra record photographs at time of final acceptance.

      f. Owner's request for special publicity photographs.

END OF SECTION

013323 - SUBMITTAL CODES

013323.1 GENERAL

1.1 Summary

A. Description

1. Submit shop drawings, product data, samples, and other types of submittals in accordance with the GM 1638 Construction General Conditions and the GM Construction Special Conditions for the Project.
2. Specific submittals to be furnished are specified in the other Sections of this Specification. They are identified by a different typeface and bracketed code (e.g. *Item [D]*.

B. Types of Submittals

1. The types of submittals identified in other Sections of this Specification are defined as follows:
    a. B – Bill of Materials: A detailed description of an assembly or components, including quantity. The Bill of Materials can be provided on shop drawings.
    b. C – Certificate: A notarized form or letter attesting to the quality of workmanship or product as measured by standards, codes, or criteria specified in the Specification.
    c. D – Shop Drawings: Drawings, diagrams, schedules, illustrations, and similar data specifically prepared for the work on this Project by the Contractor, Subcontractor, System Integrator, Distributor, or Manufacturer to illustrate a product or particular portion of the work.
    d. G – Guarantee: A written statement guaranteeing the product or a particular portion of the work to be and remain free from defects in materials or workmanship for a definite period of time from date of acceptance of the work. Refer to the Contract Documents, especially GM 1638 Construction General Conditions and the GM Construction Special Conditions for the Project, for warrantee requirements.
    e. L – Letter of Compliance: A written statement confirming that the product or a particular portion of the work conforms to the requirements of the Contract Documents
    f. P – Product Data: Brochures, pictures, illustrations, diagrams, color charts, or similar printed data of a manufactured product that is incorporated in the work.
    g. Q – Qualification: Notarized statements attesting to the quality of workmanship, firm, or individual as measured by standards, codes, or criteria specified in the Specification.
    h. R – Record: Data substantiating the performance of a product or a particular portion of the work, which does not require prior review and approval by the Architect-Engineer, but is required for record purposes only. Performance data and other data may be required.
    i. S – Samples: Physical examples of sufficient size to clearly illustrate functional characteristics of the product or assembly, or to show color, texture, or pattern, as appropriate.
    j. T – Test Report: A Report from a qualified testing agency of actual tests conducted on products, assemblies, or particular completed portions of the work, measured against standards, codes, or criteria specified in the Specification. Each report shall state the values obtained for comparison with the stated standard, code, or criteria specified in the Specification.
    k. U – List of Units provided: List of units provided, with unit identifications per the Contract Documents, unit descriptions, ratings, types, and catalog numbers as required for review purposes.

PART 2 (NOT USED)

PART 3 (NOT USED)

END OF SECTION

017329 - CUTTING AND PATCHING

Refer to GM 1638 Appendix A 5.

017329.1 GENERAL

1.1 Related Documents

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

1.2 Summary

A. This Section includes procedural requirements for cutting and patching.

B. Related Sections include the following:

1. Division 1 Section "Selective Demolition" for demolition of selected portions of the building for alterations.
2. Division 7 Section "Through-Penetration Firestop Systems" for patching fire-rated construction.
3. Divisions 2 through 16 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.
    a. Requirements in this Section apply to mechanical and electrical installations. Refer to Divisions 15 and 16 Sections for other requirements and limitations applicable to cutting and patching mechanical and electrical installations.

1.3 Submittals

A. Cutting and Patching Proposal: Submit a proposal describing procedures at least 10 days before the time cutting and patching will be performed, requesting approval to proceed. Include the following information:

1. Extent: Describe cutting and patching, show how they will be performed, and indicate why they cannot be avoided.
2. Changes to Existing Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building's appearance and other significant visual elements.
3. Products: List products to be used and firms or entities that will perform the Work.
4. Dates: Indicate when cutting and patching will be performed.

5. Utilities: List utilities that cutting and patching procedures will disturb or affect. List utilities that will be relocated and those that will be temporarily out of service. Indicate how long service will be disrupted.
6. Structural Elements: Where cutting and patching involve adding reinforcement to structural elements, submit details and engineering calculations showing integration of reinforcement with original structure.
7. Architect's Approval: Obtain approval of cutting and patching proposal before cutting and patching. Approval does not waive right to later require removal and replacement of unsatisfactory work.

END OF SECTION

DIVISION 02
SITE CONSTRUCTION

024119 - SELECTIVE DEMOLITION

024119.1 GENERAL

1.1 Summary

A. This Section includes the following:

1. Demolition and removal of selected portions of a building or structure.
2. Repair procedures for selective demolition operations.

B. Related Sections include the following:

1. Division 1 Section "Summary" for use of the premises and phasing requirements.
2. Division 1 Section "Work Restrictions" for restrictions on use of the premises due to Owner or tenant occupancy.
3. Division 1 Section "Construction Progress Documentation" for preconstruction photographs taken before selective demolition.
4. Division 1 Section "Photographic Documentation" for preconstruction photographs taken before selective demolition.
5. Division 1 Section "Temporary Facilities and Controls" for temporary construction and environmental-protection measures for selective demolition operations.
6. Division 1 Section "Cutting and Patching" for cutting and patching procedures for selective demolition operations.
7. Division 15 Sections for demolishing, cutting, patching, or relocating mechanical items.
8. Division 16 Sections for demolishing, cutting, patching, or relocating electrical items.

1.2 Definitions

A. Remove: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.

B. Remove and Salvage: Detach items from existing construction and deliver them to Owner.

C. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.

D. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.3 Materials Ownership

A. Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, demolished materials shall become Contractor's property and shall be removed from Project site.

1.4 Submittals

A. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

B. Proposed Dust-Control and Noise-Control Measures: Submit statement or drawing that indicates the measures proposed for use, proposed locations, and proposed time frame for their operation. Identify options if proposed measures are later determined to be inadequate.

C. Schedule of Selective Demolition Activities: Indicate the following:

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
2. Interruption of utility services.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Use of elevator and stairs.
5. Locations of temporary partitions and means of egress[, including for other tenants affected by selective demolition operations].
6. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.

D. Inventory: After selective demolition is complete, submit a list of items that have been removed and salvaged.

E. Predemolition Photographs: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by selective demolition operations. Submit before Work begins.

1.5 Quality Assurance

A. Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project.

B. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

C. Standards: Comply with ANSI A10.6 and NFPA 241.

D. Predemolition Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination." Review methods and procedures related to selective demolition including, but not limited to, the following:

1. Inspect and discuss condition of construction to be selectively demolished.
2. Review structural load limitations of existing structure.
3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.

1.6 Project Conditions

A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted. Provide not less than 72 hours' notice to Owner of activities that will affect Owner's operations.

B. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities.

1. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from authorities having jurisdiction.

C. Owner assumes no responsibility for condition of areas to be selectively demolished.

1. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

D. Storage or sale of removed items or materials on-site will not be permitted.

E. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1. Maintain fire-protection facilities in service during selective demolition operations.

DIVISION 06
WOOD, PLASTICS AND COMPOSITES

061000 - ROUGH CARPENTRY

061000.1 GENERAL

1.1 Summary

A. Section includes rough carpentry items as indicated, as specified or as required to support finished work.

B. Related Work Specified in Other Sections:

1. Finish Carpentry – Division 6.

1.2 Performance Requirements

A. Requirements For Preservative Treatment

1. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with the ground; Category UC3b for exterior construction not in contact with the ground; and Category UC4a for items in contact with the ground.
2. Preservative pressure treated lumber and plywood shall be clean and free of surface deposits.
3. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
4. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.
5. Application: Treat items shown on Drawings and the following:
    1. Wood blocking and furring in contact with masonry or concrete.
    2. Wood floor plates installed over concrete slabs-on-grade.

B. Requirements For Fire Retardant Treatments by Pressure Process

1. Fire retardant treated lumber and plywood shall have a flame spread rating of 25 or less when tested in accordance with ASTM E84 in a test duration of 30 minutes; and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.
2. Use treatment that does not promote corrosion of metal fasteners.
3. Interior Type A fire retardant treated lumber and plywood shall be a low hydroscopic low corrosive type having an equilibrium moisture content of not over 28% at 92% relative humidity after testing in accordance with ASTM D3201. Use where exterior type is ot indicated.
4. Design Value Adjustment Factors: Treated lumber shall be tested according ASTM D5664 and design value adjustment factors shall be calculated according to ASTM D6841. For enclosed roof framing, framing in attic spaces, and where high temperature fire-retardant treatment is indicated, provide material with adjustment factors of not less than 0.85 modulus of elasticity and 0.75 for extreme fiber in bending for Project's climatological zone.
5. After treatment, interior fire retardant lumber 2 inches thick or less shall be kiln dried to a moisture content of 19% or less, and plywood to 15% or less. Kiln temperature shall not exceed 160 degF.
6. Interior fire retardant formulations shall contain no ammonium phosphates, sulfates, or halides.
7. Each piece shall be stamped with the indelible ink marking of an approved independent third party inspection agency (such as Underwriters Laboratories) having a follow up inspection service at the treating plant. Information on the mark shall comply with the building code.
8. Applications: Treat items shown on Drawings and the following:
    1. Concealed blocking.
    2. Framing for interior partitions.
    3. Plywood backing panels.

C. Requirements of Regulatory Agencies

1. In addition to locations indicated or specified, provide fire retardant treated lumber and plywood in

locations required by code, by governing authorities having jurisdiction, or by the Owner's Insurance Underwriter.

1.3 Submittals

A. Furnish submittals for items that are identified in this Section by a different typeface and a bracketed code (*e.g., Item [L]*). Refer to Division 1 General Requirements for definition of codes for types of submittals and the administrative requirements governing submittal procedure. General submittal requirements pertaining to this Section are specified under this Article.

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B. *Treatment Certificates [C]*: Submit certificates for preservative and fire retardant treated lumber and plywood when requested by the governmental authority having jurisdiction. Certificate to be from an independent accredited testing agency having a re examination inspection service at the treating plant.

1.4 Delivery, Storage and Handling

A. Deliver and store lumber and plywood at the project site in a manner to minimize exposure to moisture migration. Provide for air circulation around lumber and panel stacks.

B. Exercise special care in storing, handling and installation of preservative and fire retardant treated lumber and plywood so as to prevent moisture absorption of such items.

061000.2 PRODUCTS

2.1 Wood Material

A. General

1. Each piece of lumber shall meet DOC PS 20 and bear the official trademark and grade of the manufacturer's association or inspection bureau certified by the American Lumber Standards Committee Board of Review. . Lumber shall be seasoned, surfaced 4 sides and kiln or air dried to moisture content specified in the association's rules, except that moisture content shall not exceed 19% and 15% for plywood.

B. Lumber Use And Species

1. Furring, Grounds, and Similar Use: Western Wood Products Association (WWPA) "Standard", "Number 2 Common" or better Douglas Fir Larch, Hem Fir, Pine, Cedar; or Southern Pine Inspection Bureau (SPIB) Number 2 Southern Pine.
2. Nailers, Blocking, Framing, Rough Bucks, and Rough Lumber Not Otherwise Specified: Western Wood Products Association (WWPA) "Utility", Number 3 or better Douglas Fir, Hem Fir, Western Cedars; or Southern Pine Inspection Bureau (SPIB) Number 2KD Southern Pine.
3. Framing for Utility Shelving: Hem-fir or spruce-pine-fir (SPF)"Select Merchantable", or mixed souther pine No.1 grade, (SPIB); sanded 4-sides.

C. Plywood Use And Species

1. Sheathing: Either DOC PS1 or DOC PS 2; American Plywood Association (APA), Structural I, of

thickness indicated.

2. Equipment Backing Panels: DOC PS 1, Exterior, AC, fire-retardant treated, 3/4-inch think unless otherwise indicated.
3. Utility Panels and Shelving: DOC PS ,1 Exterior, C-C Plugged, sanded, 3/4 inch thick unless otherwise noted.

2.2 Fastening Materials

A. General: Use fastening materials of types appropriate for the conditions encountered, including wood to wood, wood to masonry or concrete, and wood to metal. Use anchors as shown for securing blocking, nailers and framing. Threaded stud bolts and nuts, or powder actuated fasteners, shall be used for securing wood to structural framing. Where fasteners are exposed to weather, provide hot-dip zinc coating per ASTM A153.

B. Threaded Studs: Threaded studs for securing wood nailers or other items noted, complete with nut and washer.

1. Bluearc Stud Welding "Shear Connector Studs"
2. Midwest Fasteners, Inc., "Weld Studs".

C. Powder Actuated Fasteners: Drive pin type, threaded, of length to penetrate the steel member and depth of wood member, and a washer of sufficient diameter to secure the wood member. Fasteners and low velocity powder actuated tools by same manufacturer, and meeting NES-NER-272.

1. Hilti, Inc
2. Ramset, Inc

D. Nails and Staples: Galvanized carbon steel, per ASTM F1667.

E. Screws: Galvanized carbon steel per ASME B18.6.1.

F. Lag and Machine Bolts, Washers, Expansion Shields, and Nuts: Zinc coated carbon steel, per ASTM A307, Grade A with ASTM A563 hex nuts and flat washers where indicated.

G. Bar or Strap Anchors: ASTM A36 carbon steel 1/8 inch thick unless otherwise noted, hot dipped galvanized, with 2.0 ounce zinc coating per square foot of surface, per ASTM A123.

H. Expansion Anchors: Carbon-steel zinc-coated per ASTM B633 rated 6 times the load when installed in masonry and 4 times the load installed in concrete as determined by testing per ASTM E488 conducted by a qualified independent testing and inspecting agency .

1. Material: Carbon-steel components, zinc plated to comply with ASTM B633, Class Fe/Zn 5.

2.3 Accessories

A. Water-Repellent Preservative: NWWDA-tested and -accepted formulation containing 3-iodo-2-propynyl butyl carbamate, combined with an insecticide containing chloropyrifos as its active ingredient.

B. Back Painting

1. Primer Sealer: Apply 1 coat in the shop, on back surfaces and edges of rough lumber items that are not treated as described above.
    a. ICI Dulux "Ultra-Hide Alkyd Wood Undercoater"
    b. PPG Industries, Inc. Speedhide 6-6 Interior Undercoater
    c. Benjamin Moore "Alkyd Enamel Underbody 217".
    d. Sherwin-Williams Promar 200 .

061000.3 EXECUTION

3.1 Preparation

A. Provide rough hardware required to complete this Work, including attachments of wood to wood, wood to masonry or concrete and wood to metal. Counterbore holes for nuts and heads of fasteners, and countersink all screws so as to be flush. Drill holes in lumber for fasteners. Furnish rough hardware items, loose, that are scheduled to be pre set in masonry or concrete, to expedite the installation of such Work.

1. In pressure treated wood, drill undersize holes for screws and nails to prevent splitting of wood members.

B. For back painted members, after any such members are cut in the field, apply a brush coat of the same material used in the shop, to reseal the surface.

C. When preservative pressure treated lumber is cut across the grain in the field, apply water repellent to cut end.

D. For fire retardant pressure treated lumber cut across the grain in the field, no supplemental end treatment is required.

E. Field cutting (ripping) along the grain is not allowed for either fire retardant or preservative pressure treated lumber.

3.2 Furring and Grounds

A. Provide wood furring and grounds required to install wood sheathing, gypsum wall board, gypsum and metal lath, and wood paneling to masonry or concrete. Install in parallel rows, spaced at 16 inches on center; and in addition, to frame the perimeters of such areas and corners. Use nominal 1 inch by 3 inch solid stock unless otherwise noted. At metal lath, provide beveled edge to develop good plaster keys.

B. Provide wood furring required to install cabinet work and other finish items to masonry, concrete, gypsum wall board or plaster substrates to properly secure these items.

C. Secure members rigidly in place, at 2 feet on center, maximum, using flush bolts. Where members are applied over stud partition framing, bolt members in place through the substrate and into the metal stud framing.

3.3 Nailers, Blocking, Framing and Rough Bucks

A. Provide nailers, blocking, framing, rough bucks, sheathing and other rough lumber necessary for a complete installation.

B. Anchor wood members to concrete, masonry, or steel as shown, or required, complete with the fasteners specified. If powder actuated fasteners are used, comply with safety requirement of OSHA and fastener manufacturer. Where size and spacing are not shown or noted, secure members with 1/2 inch diameter bolts or threaded studs; not less than 2 for each individual piece; and at not more than 24 inches on center, maximum, for continuous members. Provide washers under bolt heads and nuts. Provide nailers and blocking in long lengths to minimize joints. When joints are necessary, join pieces without projecting edges.

C. Lay sheathing close and nail solidly at each bearing; at not over 6 inches on center at continuous bearing members. Stagger end joints of adjacent sheets, with joint over bearings, in all cases.

3.4 Utility Panels and Shelving

A. Provide utility panels in telephone equipment rooms, electrical equipment rooms and elsewhere as required for

mounting of equipment. Neatly install panels, with close butted joints where more than 1 sheet is required. Expansion bolt the panels to concrete or masonry substrates. At metal stud partitions, bolt panels in place through the substrate and into the metal stud framing. Unless otherwise noted, provide full 8 foot high panels.

B. Provide wood utility shelving in janitors closets, and equipment rooms. Install 1 inch x 3 inch framing to support shelving on ends and at back. Provide plywood shelving, with solid wood nosing on exposed edge; use single piece shelves in each location. Unless otherwise noted, install 5 shelves at each indication for shelving.

062000 - FINISH CARPENTRY

062000.1 GENERAL

1.1 Summary

A. Section includes all finish carpentry work, complete with accessories and related work, as indicated and specified, including but not necessarily limited to the following custom work:

1. Counters, booths and cabinet work.
2. Wood planking at walls.

B. Related Work Specified In Other Sections

1. Rough carpentry Division 6.
2. Electrical Division 16 for Booth light fixtures
3. Sinks in countertops Division 22.

1.2 Submittals

A. Furnish submittals for items that are identified in this Section by a different typeface and a bracketed code (e.g., *Item [L]*). Refer to Division 1 General Requirements for definition of codes for types of submittals and the administrative requirements governing submittal procedure. General submittal requirements pertaining to this Section are specified herein under this Article.

B. *Finish Carpentry Shop Drawings [D]:* Submit for review, completely detailed shop drawings showing all information necessary for the fabrication and erection of all work specified herein. The shop drawings shall show dimensions, construction details, jointing details, wood species and grade, trim, finishes, paneling layout, hardware and details relating to adjacent work.

C. *Finish Carpentry Product Data [P]:* Submit product data on all catalog type components.

D. *Finish Carpentry Material Samples [S]:* Submit samples of each of the following items:

1. Plastic laminate and solid surface material chips of colors, patterns and textures specified.
2. Cabinet hardware, of each item proposed for use.
3. Hardwoods proposed for use.
4. Finish on hardwood items.
5. Upholstery samples of each type of fabric at booths.

6. Felt panels with track system at booths.

E. Submittals of shop drawings, product data, and samples are required for all work of the Section per Division 1, General Requirements.

1.3 Quality Assurance

A. Reference Standard

1. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards"(AWS) for grades of wood, finishes, installation, and other requirements. Comply with AWS grade indicated, or where not otherwise indicated, use Premium grade.
2. Use plastic laminates which conforms to NEMA LD-3.
3. Use grades of lumber, plywood and particleboard as defined by the rules of the recognized association of manufacturers producing the kind or species of lumber, plywood and particleboard specified in this Section. Use only lumber, plywood, and particleboard grade stamped by the inspecting authorities.

1.4 Site Conditions

A. The woodwork manufacturer is responsible for dimensions not controlled by job conditions. Shop drawings shall show all required field measurements. The cooperation of the Contractor and the woodwork manufacturer is required to establish and maintain these field dimensions.

1.5 Delivery, Storage and Handling

A. It is the joint responsibility of the woodwork manufacturer and the Contractor to make certain that woodwork is not delivered until the building and storage areas are sufficiently dry and complete so that the woodwork will not be damaged. The Contractor will replace defective or damaged materials at no cost to the Owner.

B. Do not deliver cabinets until painting and similar operations that could damage woodwork have been completed in installation areas. Do not deliver or install cabinets until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F (16 and 32 deg C) and relative humidity between 25 and 55 percent during the remainder of the construction period.

C. Protect all finished surfaces after installation and finishing from damage and soiling. Maintain protection during subsequent work operations, and remove same upon Owner’s Representative’s acceptance or when instructed by Owner’s Representative.

062000.2 PRODUCTS

2.1 General Materials

A. General

1. Use lumber bearing the official trademark and grade of the manufacturer’s association or inspection bureau under which it was manufactured and graded, except as specified otherwise herein. Use seasoned lumber, surfaced four sides and kiln or air dried to moisture content specified in association’s rules, except that moisture content is limited to a maximum of 10%.
2. Lumber Standards: Comply with DOC PS-20, "American Softwood Lumber Standard," for lumber and with applicable grading rules of inspection agencies certified by the American Lumber Standards Committee Board of Review.

3. Lumber Use And Species
    a. Furring, Nailers, Blocking, and Rough Lumber Not Otherwise Specified: Construction or No. 2 grade lumber of any of the following species:
        1) Hem-fir (NLGA, WCLIB or WWPA).
        2) Spruce-pine-fire (NLGA, NeLMA, WCLIB, or WWPA).
        3) Mixed Southern Pine (SPIB).
4. Softwood Plywood: Comply with DOC PS-1, "Structural Plywood".
5. Hardwood Plywood: Comply with ANSI/HPVA HP-1, "American National Standard for Hardwaood and Decorative Plywood".
6. Particle Board: Comply with ANSI A208.1 Grade M-2 Exterior Glue.
7. Medium-Density Fiberboard: ANSI A208.2, Grade 130.

B. Fire-Retardant Treatment [P]: Where indicated, use products that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency
    1. Use treated materials that comply with requirements of referenced woodworking standard. Do not use materials that are warped, discolored, or otherwise defective..
    2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.
    3. Identify fire-retardant-treated materials with appropriate classification marking of qualified testing agency in the form of removable paper label or imprint on surfaces that will be concealed from view after installation,
    4. Lumber and Plywood: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.
        a. .Kiln dry lumber and plywood after treatment to a maximum moisture content of 19 and 15 percent, respectively.
        b. For items indicated to receive a stained or natural finish, use organic resin chemical formulation.
        c. Mill lumber before treatment and implement special procedures during treatment and drying processes that prevent lumber from warping and developing discolorations from drying sticks or other causes, marring, and other defects affecting appearance of treated woodwork.
    5. Fire-Retardant Particleboard: Panels complying with the following requirements, made from softwood particles and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 25 or less per ASTM E 84.
        a. For panels 3/4 inch (19 mm) thick and less, comply with ANSI A208.1 for Grade M-2 except for the following minimum properties: modulus of rupture, 1600 psi (11 MPa); modulus of elasticity, 300,000 psi (2070 MPa); internal bond, 80 psi (550 kPa); and screw-holding capacity on face and edge, 250 and 225 lbf (1100 and 1000 N), respectively..
        b. For panels 13/16 to 1-1/4 inches (20 to 32 mm) thick, comply with ANSI A208.1 for Grade M-1 except for the following minimum properties: modulus of rupture, 1300 psi (9 MPa); modulus of elasticity, 250,000 psi (1720 MPa); linear expansion, 0.50 percent; and screw-holding capacity on face and edge, 250 and 175 lbf (1100 and 780 N), respectively.

c. Products:

1) cFlakeboard Company Limited "Duraflake FR"

2) SierraPine "Encore FR"

6. Fire-Retardant Fiberboard: Medium-density fiberboard panels complying with ANSI A208.2, made from softwood fibers, synthetic resins, and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 200 or less per ASTM E 84.

a. Products:

1) Panel Source International, Inc. "Pyroblock Platinum"

2) .SierraPine Medite FR

2.2 Plastic Laminate Cores

A. Plastic Laminate Cores

1. Softwood plywood or particle board with exterior glue for countertop cores.
2. Particle board or medium-density fiberboard for casework bodies and interior shelves.

2.3 Plastic Laminates and Accessories

A. Plastic Laminate [P,D,S]

1. Plastic Laminate [S]: Provide high pressure plastic laminate consisting of melamine impregnated surface papers laminated over phenolic impregnated kraft layers under high pressure and heat, as produced by a listed manufacturer and conforming to National Electrical Manufacturers Association NEMA LD-3, with low gloss finish, in colors, patterns, and textures as selected, per approved samples.

a. Manufacturers:

1) Nevamar Laminate

2) Formica Corporation

3) Lamin-Art, Inc.

4) Panolan Industries International, Inc.

5) Wilsonart International, div. of Premark International, Inc.

2. Laminate Cladding:

a. Use Grade HGS for exposed surfaces of countertops, horizontal and vertical surfaces, and edges.

b. Use Grade BKL for backer sheet on concealed backs of panels with exposed laminate surfaces and the underside of countertops.

c. Use Grade HGP for exposed surfaces forming over curved or rounded shapes.

d. Use Grade VGS semi-exposed surfaces other than drawer bodies.

e. Use thermoset decorative panels with PVC or polyester edge banding.

3. Refer to drawings with Finish Material schedule.
4. Bonding Adhesive: Water resistant, in accordance with AWI recommendations, and as recommended by plastic laminate manufacturer. Use resorcinol glue for fire-resistance. Do not use adhesives containing formaldehyde.

5. Back Painting: Apply one coat of primer sealer paint in the shop, on all wood surfaces and edges not covered with plastic laminate backer sheet, and that will be concealed in the finished work. See Section 099000 for acceptable paint manufacturers and types.

2.4 Fasteners

A. Fastening Materials

1. General: Furnish fastening materials of types appropriate for the conditions encountered, including wood to wood, wood to masonry or concrete and wood to metal. Use nails, screws, and other anchoring devices of type, size, material, and finish required for application indicated to provide secure attachment, concealed where possible.
2. Nails and Staples: Galvanized carbon steel, conforming to the requirements of ASTM F1667.Wood Screws: .Galvanized carbon steel per ASME B 18.6.1.Bolts: Steel bolts complying with ASTM A307, Grade A; with ASTM A563 hex nuts and, where indicated, flat washers.Expansion Anchors: Anchor bolt and sleeve assembly of carbon-steel components, zinc plated to comply with ASTM B633, Class Fe/Zn 5 with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry assemblies and equal to four times the load imposed when installed in concrete as determined by testing per ASTM E488 conducted by a qualified independent testing and inspecting agencyAdhesives: Aliphatic resin polyurethane, or resorcinol wood glue recommended for general carpentry use.

2.5 Solid Surface Countertops

A. Solid Surface Material Countertops [P,D]

1. Fabricate tops in one piece, unless otherwise indicated. Comply with solid-surfaceing-material manufacturer's written recommendations for adhesives, sealers, fabrication, and finishing.
    a. Fabricate top with shop applied edges of materials and configuration indicated.
    b. Fabricate tops with loose back splashes for field application.
    c. form joints between components using manufacturer's standard joint adhesive; without conspicuous joints. reinforce with 2 inch wide strip of solid surfacing material.
    d. Drill holes in counter tops for plumbing fittings and soap dispenser in shop

2.6 Plastic Laminate Casework and Hardware

A. Cabinet Work

1. Cabinets [P,D]: Provide cabinets constructed of plywood with all exposed surfaces and edges surfaced with plastic laminate.
    a. AWSQuality Grade: Custom
    b. Wall and Base Cabinet Construction: AWS Flush Overlay design, with cabinet interior finished with plastic laminate backer sheet.
2. Cabinet Hardware [P,S]: Furnish and install all cabinet hardware:
    a. Wire Pulls: Provide solid aluminum pulls for all cabinets, with clear anodized finish. Provide wire pulls 5 inches long, 2-1/2 inches deep and 5/16 inches in diameter.
        1) Engineered Products Co. (EPCO) “MC 402-5”.
        2) Stanley “4485”.
    b. Door Catch: BHMA A156.9, B03141, similar to Engineered Products Co. (EPCO) “No. 1000

Magnetic Catch".

c. Semiconcealed Hinges: BHMA A156.9, B01361; similar to Stanley "1587" or comparable products of Amerock.

1) Provide 2 per door

2) Finish BHMA 652.

d. Concealed Hinges (European Type): BHMA A156.9, B01602, 170 degrees of opening, self-closing, similar to Hafele Duomatic series or comparable products of Amerock, Blum, or Grass.

1) Provide 2 per door

2) Finish: Manufacturer's standard.

e. Adjustable Shelf Standards and Clips: BHMA A156.9, B04071 with shelf rests, B04081, similar to Knape & Vogt "255 series standards and 256 series shelf supports.

f. Shelf Rests: BHMA A156.9, B04013, similar to Knape & Vogt "338CL" shelf rests.

g. Drawer Slides: Grade as noted, side-mounted, full-overtravel extension type, zinc-plated steel or epoxy coated steel with polymer rollers complying with BHMA A156.9, similar to Accuride or comparable products of Hettich, Hafele, or Knape & Vogt:

1) For drawers not more than 3 inches high and 24 inches side, Grade 1.

2) For drawers more than 3 inches high, but less than 6 inches high, and not more than 24 inches wide, Grade 1HD-100

3) For drawers more than 6 inches high or more than 24 inches wide, Grade 1HD-200.

4) For trash bins not more than 20 inches high and 16 inches wide, Grade 1HD-200.

2.7 Wood Frames and Trim

A. Wood Planking

1. Provide walnut planking as shown.

a. AWS Quality Grade: Premium, wood matching approved Samples for species, cut and appearance of shop-applied finish. Fabricate to math profiles and configuration shown on Drawings.

B. Finish [S]:

1. Preparation for Finishing: Comply with requirements of AWS quality standards for sanding, filling, countersunk fasteners, sealing concealed surfaces (backpriming) and similar preparations.

2. Transparent finish for wood planking:

a. Grade: Premium

b. Finish System - 5, conversion varnish:

c. Wash Coat for Closed-Grain Woods: Apply wash-coat sealer to woodwork made from closed gran wood before staining and finishing.

d. Staining: Match Approved sample.

e. Open Finish for Open-Grain Woods: After staining, apply wash coat sealer and allow to dry. Apply paste wood filer and wipe off excess. Tint filer to match stained wood.

f. Sheen: Satin, 15-30

2.8 Felt Panels and Booth Seating

A. Felt Panels

1. Felt panel screens at booths consisting of perforated wool with manufacturers ceiling support system.

a. Manufacturer: Filzfelt Inc.

b. Name: Circle Hanging Panel

c. Content: 100% Wool Design Felt

d. Track System: Manufacturers ceiling hung track system

e. Flammability: ASTM E 84 Class A

f. Colors: Refer to Finish Materials schedule

B. Booth Seating

1. Materials:

Upholstery fabric and vinyl shall be furnished by fabricator, specified by Architect. Refer to finish materials schedule for location of upholstery.

Frames shall be all wood Kilned fired Douglas Fir, BBX Plywood 3/4 or 1" thick as required. (No strand board accepted)

Foam at seat: 1/2" thick 1.8#, 33 ILD poly-foam over 2" thick, 2.2#, 50 ILD, ploy foam: shape for comfort and per drawings. Cover foam with Dacron-Spinell slip sheet.

Foam at seat-back: 2 3/4" thick shaped foam, 1.8#, 33 ILD, poly-foam, shaped for comfort and per drawings. Cover foam with Dacron-Spinell slip sheet

Foam at end, outside back and fillet: 1/2" thick, 1.8#, 33 ILD, poly foam.

No Sag Springs: Sinuous and 8-1/2 gauge springs spaced at 3" centers. All seats to have spring seat construction and to be removable unless otherwise noted.

Cover over springs at seat and booth end. Apply layer of FLW Propex Covering over spring deck with additional layer at booth ends.

Cover over foam at seat. Apply slipsheet Spinell, over foam at seat and back

2.9 Resinous Wall Panels

A. Resinous Wall Panel

1. .Provide resinous wall panels (RP-1) at locations shown on the drawings and identified in the Finish Materials schedule anchored to wall with manufacturers recommended fasteners.

062000.3 EXECUTION

3.1 Installation

A. General Millwork

1. Provide all wood blocking and framing required to support items of finish carpentry. Use fastening materials of types appropriate for the conditions encountered, including wood to wood, wood to masonry, and wood to metal stud framing. Counterbore holes for nuts and bolt heads, and countersink for screws. Use concealed fasteners in exposed surfaces of finish carpentry.
2. Before installing finish carpentry, condition materials to average prevailing humidity in installation areas for a minimum of 24 hours.
3. Do not use materials that are unsound, warped, improperly treated or finished, inadequately seasoned, or too small to fabricate with proper jointing arrangements. Do not use manufactured units with defective surfaces, sizes, or patterns.
4. Furnish millwork in configurations shown and specified. AWI grading will take precedence over joiner details shown on Drawings. Provide tight joints. Miter exterior angles, cope interior angles and returns of trim moldings. Provide blind nailing where practicable. Secure work with finishing nails or screws and glue. Install trim in maximum practical lengths.
5. On surfaces exposed to view, set all nail heads and spackle. Countersink all screw heads and cover with neatly fitted wood plugs to match grain. Sand in accordance with AWI grading. Fit and scribe all work to walls or other finished work in a careful manner, so as not to injure the surface in any way.

B. Plastic Laminate Work

1. Install support framing for countertops not set on base cabinets and anchor to adjacent construction; install countertops on supports and secure thereto, in accordance with reviewed shop drawings. Install base cabinet for counter and anchor to adjacent construction. Make all cut outs in counter. Carefully install all plastic laminate items complete in place, including all incidental items not specifically noted elsewhere, properly aligned, set plumb and rigidly secured. Shim casework and tops level and plumb with concealed shims to achieve a tolerance of 1/8-inch in 8 feet. Provide adjustments, closures, etc., as may be necessary to close to adjacent items and construction. Scribe and closely fit all items to adjacent work. Provide backing, blocking, hanging strips, anchors, bolts, fasteners, etc., necessary for securing work in place. Set all work level and plumb, securely anchored in place. Seal joints at adjacent work with sealant specified in Section 079200.
    a. Fasten cabinets through back, near top and bottom and at ends not more than 16 inches o.c. with the following to suit supporting construction:
        1) No. 10 wafer-head screws sized for not less than 1-1/2 inch penetration into wood blocking or hanging strips.
        2) No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish.
        3) Toggle bolts through metal backing or metal framing behind wall finish.
2. Paint all visible surfaces in plastic laminate work, other than finish plastic laminate itself, such as recesses, reveals, visible rough hardware, etc. Paint to match color of adjacent plastic laminate.

C. Clean up

1. Clean up and dispose of all waste material and refuse that has been brought onto the job or that has accumulated as a result of the work. Leave the work broom clean or better.
2. Replace finish carpentry that is damaged or does not comply with requirements. Finish carpentry may be repaired or refinished if work complies with requirements and show no evidence of repair or refinishing. Adjust joinery for uniform appearance.
3. Touch up any damaged finishes to restore to new matching adjacent areas.

DIVISION 07
THERMAL AND MOISTURE PROTECTION

079200 - JOINT SEALANTS

079200.1 GENERAL

1.1 Summary

A. Section Includes:

1. Acrylic-Latex Joint Sealant (ASTM C834): Seal joints on interior of building that are not subject to movement that require filling for appearance or sanitary reasons. The principal locations are as follows:
    a. Joints between metal frames of all kinds and adjacent construction, in interior walls and partitions.
    b. All interior locations where "sealant" is noted, except if the locations are specified to receive elastomeric sealant.
2. Gasketing as necessary and joint sealants installed between adjacent units of the following work is specified in the following Sections; install joint sealants in joints between the following work and adjacent construction as specified in this Section.
    a. Aluminum Entrances and Storefronts – Division 8.
3. Firestopping sealant and related materials – Division 7.
4. Glazing Work Division 8.

1.2 Performance Requirements

A. Interior joint sealants: Sealants that provide and maintain watertight and airtight joints and seals without the deterioration and staining of adjacent materials

1.3 Submittals

A. Furnish submittals for items that are identified in this Section by a different typeface and a bracketed code (*e.g., Item [L])*. Refer to Division 1 General Requirements for definition of codes for types of submittals and the administrative requirements governing submittal procedure. General submittal requirements pertaining to this Section are specified under this Article.

B. Joint Sealant Data *[P]:* Submit product data describing composition, together with color chart.

C. Sealant Guarantee: Joint sealants shall remain in a serviceable, watertight, elastic, adhesive condition for a period of 5 years from date of final acceptance of the Project. Agree in such written guarantee to make good, at no cost to the Owner, imperfections which may develop in this work during the guarantee period as well as to repair damage to other work caused by such imperfections or the repair of same. Submit guarantees to Owner.

1.4 Quality Assurance

A. Installer Qualifications: The Work of this Section shall be carried out by an approved installer having specialized in this Work as its primary business for at least 5 years, and having performed satisfactorily Work of this type, size and scope. Employ craftsmen who are thoroughly skilled and completely familiar with the specified requirements. Provide the services of a competent foreman or supervisor who shall be available at all times during the progress of the work of this Section.

B. Source Limitations: Obtain and provide sealants of each joint type from 1 manufacturer.

1.5 Product Delivery, Storage and handling

A. Deliver packaged materials to the Project site in their original unopened containers, packages and bundles, bearing labels that identify manufacturer’s name, brand name, and grade or type.

1.6 Project Conditions

A. Do not install compounds when ambient air temperature is less than 40 degF or when recesses are wet or damp; provide temporary heated enclosures to comply with this requirement.

B. Protect adjacent exposed finished surfaces from damage prior to performing work, by masking or other acceptable means. Remove protection when no longer required, and clean the adjacent exposed surfaces of compound deposited upon them.

079200.2 PRODUCTS

2.1 Materials, General

A. Materials, General:

1. Provide joint sealants that are compatible with backing material, accessories, substrates and adjacent sealants for the intended uses based on the testing, recommendations experience and written instructions of the sealant manufacturer.
2. Colors for Exposed Joint Sealants: Provide joint sealant colors as selected by the Architect-Engineer from the manufacturer’s full range of colors.ASTM C920 Class ratings indicated in this Section are minimums. Sealants listed may have performance characteristic better than the indicated Class rating.

2.2 Acrylic Latex Sealants

A. Acrylic Latex Calk: Non sag, 1 part acrylic latex, per ASTM C834, Type OP, Grade NF. Furnish in standard colors as selected.

1. .BASF Construction Chemicals - Building Systems "Sonolac"
2. May National Associates, Inc. subsidiary of Sika Corporation "Bondaflex 600"
3. Pecora Corp. "AC-20 "
4. Sherwin Williams "850A Acrylic Latex Caulk"
5. Tremco "Tremflex 834"

2.3 Accessories

A. Primers:

1. Primers: Types recommended by the compound manufacturers to provide adhesion of the compounds to, and to prevent staining of, adjacent surfaces for all conditions encountered on the Project.

B. Bond Preventive Materials:

1. Bond Preventive Materials: Types recommended by the sealant compound manufacturer to prevent bonding of compound to back surface of recess, for all conditions encountered on the Project.

C. Back Up Material:

1. Back up Material: ASTM C1330 Type C or B of size and density to control sealant. Round, solid section, skinned surfaced, soft foam gasket stock in diameters 1/16 inch to 1/8 inch larger than width of joints in which it is installed. Back up material skin shall be of proper consistency so as not to bond to sealant.

079200.3 EXECUTION

3.1 Preparation

A. Prepare joints to receive compound and verify suit ability. Failure of compound in the future, due to claimed unsuitability of joint, will not be valid. Installation of compound is considered as evidence that joint is suitable to receive compound.

B. Clean recesses which are to receive compound so as to be free of dirt, dust, loose material, oil, grease, form release agents and other substances detrimental to the compound's performance. Remove lacquer and other protective coatings from metal surfaces without damaging the metal finish; use oil free solvents.

C. Apply masking tape to surfaces adjacent to recesses to prevent smearing, staining or damage by sealant contact or by sealant cleaning methods to remove smears. After joint tooling, remove tape without disturbing or damaging the sealant joint.

D. Depth of recess to receive compounds is not to exceed joint width up to a maximum of 1/2 inch. Where depth of recess is in excess of specified depth, place back up material in recess, and force into place under compression, to provide the specified recess depth. Where depth of recess is less than specified depth, cut the back surface of recess to the specified recess depth.

E. Recesses are to be dry when compounds are installed. Prime recesses in accordance with the compound manufacturer's written instructions, to develop proper mechanical adhesion of compound to recess surfaces. Keep primers to recessed areas of joint sealant bond. Prevent spillage and primers from damaging or staining adjacent surfaces.

1. Where depth of recess for sealants is at proper depth, apply bond preventive material to back surface of recess.

3.2 Installation

A. Install materials per manufacturer's directions. Use materials as received from the manufacturers, without additives or adulterations. Use 1 manufacturer's product for each kind of product specified.

1. Mix 2 component sealants per manufacturer's directions, until the sealant components is thoroughly and uniformly blended and install sealant prior to start of curing.

B. Install sealants immediately after adjoining work is in condition to receive such work. Fill all joints completely, regardless of variation of joint widths, and to full depth as prepared, at no extra cost to the Owner. Tool sealants without smearing adjacent surfaces.

1. Install sealants with full and uniform contact with, and adhesion to, side surfaces of recess.

C. Tool face of sealant in recesses smooth and even. At recesses in angular surfaces, finish the sealant with a flat face, flush with face of material at each side. At recesses in flush surfaces, finish the sealant with a concave face, flush with face of material at each side. Surface of sealants shall be free from dirt, stain or other defacements and shall be smooth and uniform in color.

3.3 Adjustment and Cleaning

A. Remove sealant materials not complying with these requirements, reprepare the recesses and install new materials to provide finish work complying with the requirements specified, at no extra cost to the Owner.

B. Clean surfaces adjacent to joint sealants, remove smears or other soiling resulting from application of sealants. At metal surfaces, remove masking tape and other residue. Exercise care in cleaning and removal operations so as not to mar or damage finishes on materials adjacent to joints. Repair or replace marred or damaged materials, at no cost to the Owner.

DIVISION 08
OPENINGS

084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

084113.1 GENERAL

1.1 Summary

A. This Section includes:

1. Interior aluminum storefronts with sliding and swinging glazed doors.

B. Description Of System

1. Storefront system shall be flush glazed, stick type, dry glazed system prepared to receive glass as specified. Provide aluminum horizontal and vertical framing members of size indicated.
2. Door hardware for sliding and swinging aluminum doors and frames.
3. Glass for aluminum storefronts and doors.

1.2 Performance Requirements

A. Provide aluminum entrances and storefronts able to withstand the movement of structural or thermal forces when supporting the dead loads of the system without the aluminum members transferring stress to the glass.

B. Allowable Installation Tolerances

1. Frames:
   a. Deviation from that indicated: Plus or minus 1/4 inch.

b. Deviation from plumb or true horizontal:

1) In 12 feet: 1/8 inch maximum.

2) In 24 feet: 1/4 inch maximum.

c. Offset from true alignment at joints between abutting members in line end to end: 1/16 inch maximum.

2. Doors:

a. Clearance at head and jambs: 3/32 inch maximum.

b. Clearance at bottom of doors: 1/2 inch maximum.

c. Clearance at meeting stiles of pairs of doors: 3/16 inch maximum.

1.3 Submittals

A. Furnish submittals for items that are identified in this Section by a different typeface and a bracketed code (*e.g., Item [L]*). Refer to Division 1 General Requirements for definition of codes for types of submittals and the administrative requirements governing submittal procedure. Additional submittal requirements pertaining to this Section are specified under this Article.

B. *Entrances and Storefront Shop Drawings [D]*: Indicate on shop drawings at a large scale, the construction of the various parts of the work, methods of joining, methods of glazing, thickness of metal, profiles of moldings. Indicate the alloy and finish, and give full and complete instruction regarding concealed joints and screws. Show the reinforcements, anchorage, bracing, stiffeners and structural supports. Show dimensioned layout elevations of entrances and storefront work.

C. Aluminum Framing Samples: Submit samples of substitute aluminum storefront frame members proposed for use that are not specified herein, showing methods of connection at corners, complete with glass and glazing, each with members at least 6 inches long.

D. Anodized Finish: Submit samples of substitute anodized finish proposed for use that is not specified herein.

E. Anodized Finish Guarantee: Furnish to the Owner, in an approved form, warranting the anodized finish will be nonfading, nonconvertible, and permanently a part of the metal surface for a period of five years after acceptance of the building. State in the guarantee that any item showing failure during the guarantee period will be replaced or refinished to the original condition, at no cost to the Owner.

1.4 Quality Assurance

A. Installer Qualifications:

1. The Work of this Section shall be carried out by an installer approved by the manufacturer and assumes engineering responsibility and having specialized in this Work as its primary business for at least 5 years, and having performed satisfactorily Work of this type, size and scope.

2. Employ craftsmen who are thoroughly skilled and completely familiar with the specified requirements.

3. Provide verification of aluminum storefront wall system by a professional engineer licensed in the area of jurisdiction where the project is located and experienced in the product systems specified. Prepare data including calculations and drawings based on standard units (custom units) of the manufacturer as indicated or specified.

1.5 Project Site Conditions

A. Existing Conditions

1. Take measurements at the building to assure proper fitting, fabrication, and erection of the work. Check

dimensions in the field, whether or not shown, upon which the accurate fitting together and building in of the storefront work may depend or which would affect the proper installation of the work of others. Indicate field dimensions on the shop drawings.

B. Closely coordinate this work with the work of others, including construction schedule, wherever this work affects or is affected by the work of others.

C. Fabrication from Established Dimensions: Verify with the Owner's Representative whether field dimensions will delay the construction schedule. Upon approval of the Owner's Representative, proceed with fabrication after receipt of approved shop drawings based on established dimensions without field measurement. Continue coordination of established and field dimensions until curtain wall is installed. Allow extra material, if required, for field fitting and trimming.

D. Protection

1. Protect exposed surfaces from stain, discoloration, corrosion, and other abuse. In addition to providing isolation between dissimilar materials, provide and maintain additional protection during the construction period to protect aluminum from mechanical damage.

2. At completion of construction, remove and dispose of protections, clean exposed aluminum surfaces, and replace damaged members, including members with damaged finish.

E. Sequencing, Scheduling

1. Closely coordinate this work with the work of others, wherever this work affects or is affected by the work of others. Provide all anchors, inserts, supports, and accessories as part of this work.

1.6 Product Delivery, Storage & Handling

A. Wrap, carton, and crate as required to provide physical and climatic protection during loading, shipping and job site storage and handling.

B. Deliver packaged materials to the project site in the manufacturer's original, unopened containers which bear intact, legible and visible labels that identify the manufacturer's name and brand name, the contents, grade and type.

C. Upon delivery, immediately inspect shipments to assure their compliance with the requirements of the Contract Documents and approved submittals, and that products are complete, undamaged and adequately protected. Immediately report damaged, missing, or defective items. Remove broken, damaged or unlabeled items from the site immediately.

D. Store products in accordance with manufacturer's instructions with seals and labels intact, legible, and visible. Store products in a manner to prevent damage, soiling, theft, deterioration and contamination. Marred surfaces, cracked, checked, split or warped materials will be rejected. Store materials subject to damage by climatic conditions in weathertight enclosures. Maintain temperature and humidity within the ranges required or recommended by the manufacturer.

E. Repair or clean items that have been damaged or soiled that can be restored to an "as new" condition at no cost to the Owner. The Owner's Representative shall be the judge of the effectiveness of remedial measures. Additional time or expenses required to secure replacements and to make repairs will not be considered by the Owner's Representative to justify an extension in the Contract time of completion or an increase in the Contract amount.

084113.2 PRODUCTS

2.1 Materials

A. Aluminum Storefront Type

1. Interior Aluminum Storefront Framing System: Provide extruded aluminum interior glazed storefront framing system as follows:
   a. 1-3/4 inches wide by 4 inches deep members, center flush glazed, non thermal break type system, for 3/8 inch thick glass:
      1) Kawneer North America, an Alcoa company “Trifab 400”.
      2) Oldcastle Building Envelope "FG-1000".
   b. 1-3/4 inches wide by 4 1/2 inches deep members, center flush glazed, non thermal break type system, for 3/8 inch thick glass:
      1) Kawneer North America, an Alcoa company “Trifab VersaGlaze 450”.
      2) Tubelite, Inc. “4500 Series”.
      3) Oldcastle Building Envelope "FG-2000".

B. Aluminum Top Hung (Barn Style) Interior Doors

1. Furnish all necessary materials, labor and equipment for the complete installation of aluminum sliding doors, door frames and hardware as shown on the drawings and specified herein.

   Basis of Design: Custom Interior Aluminum Sliding Doors as manufactured by Pinnacle Engineered Products, LLC, Wixom Michigan.

2. Material:

Extrusions shall be of aluminum alloy 6063-T5 extruded within commercial tolerance and free from defects impairing strength and/or durability. Door stile and rail sections to be a minimum of ,125 inch wall thickness with snap-in glazing stop extrusions of ,050 inch minimum wall thickness. Door frame sections to be a minimum of .093 inch wall thickness. Steel tension rods of ,375 inch diameter shall run the full width of the top and bottom door rails and shall be fixed with steel plates and lock nuts. Door glazing shall be by means of an interior and exterior fixed gasket of high quality extruded elastomeric material. lnfill material of up to 1” thick may be accommodated. Active door leaves shall have a continuous wool pile weatherstripping at the interior and exterior of the top door rail.

C. Aluminum Swinging Door Type And Style

1. Narrow Stile Doors, nominal 2 inch wide:
   a. Kawneer North America, an Alcoa company “Narrow Stile 190”.
   b. Tubelite, Inc. “Narrow Stile”.
   c. Oldcastle Building Envelope "NS-212".
2. Storefront System Door Frame: Provide manufacturer’s standard aluminum door frames for storefront framing system specified, complete with applied stops.

D. Aluminum

1. Conform to the standards and designations of the Aluminum Association and to the following ASTM Standards for aluminum:
   a. Sheet and Plate ASTM B209

b. Extruded Bars, Rods, Shapes, Tubes and Wire ASTM B221

c. Standard Structural Shapes ASTM B308

d. Drawn Seamless Tube ASTM B210

e. Extruded Structural Tubes ASTM B429

2. Provide extrusions a minimum 0.125 inch thick except that for glass stops, trim pieces and similar items use minimum 0.050 inch thick material, and sheet metal a minimum of 0.032 inch thick. Provide greater thicknesses and gages necessary to comply with the design criteria specified.

3. In general, use 6063 extrusion alloy of temper T 5 or T 6 and 1100 sheet alloy of temper H14, except that alloys used must be of suitable type to receive the finish specified.

E. Miscellaneous Materials

1. Steel Reinforcement, Clips and Connections: ASTM A36 steel with zinc coating of not less than 1.25 ounces per sq. ft. per ASTM A123; or with zinc-rich corrosion-resistant primer complying with SSPC-PS Guide No. 12.00. Select and prepare surfaces according to standards in SSPC-SP COM.

2. Fasteners: Including nuts, bolts, washers, clips and connectors; in concealed locations of stainless steel, aluminum, or cadmium or zinc coated steel; in exposed locations use aluminum, finished to match exposed finish. Use ASTM A 307 steel bolts, 2024 T4 alloy aluminum fasteners. For fasteners in exposed locations, use flat head type with Phillips screwdriver slots, in countersunk holes. Use approved type expansion shields for securing this work to concrete and masonry construction. Exposed fasteners will only be allowed where specifically approved by the Owner's Representative, otherwise all fasteners shall be concealed.

3. Manufacturers standard door hinges based on height for swinging doors and 1" diameter stainless steel x 12" long door push/pulls on both sides of swinging and sliding doors.

4. Framing Gaskets: Closed cell sponge neoprene, of thickness to be under compression when installed between storefront framing and adjacent construction.

5. Glazing Accessories: Solid neoprene members, of sizes required to produce proper glass setting, and of relative hardness value as follows. Setting Blocks of 70 to 90 Durometer; Spacers of 40 to 50 Durometer.

6. Glazing Gaskets: Closed cell sponge neoprene, EPDM, silicone rubber, or vinyl glazing gaskets, as standard with the storefront system manufacturer, of thickness to be under compression when in final, glazed position.

7. Metal Joint Sealant: Nonhardening, nonskinning, nonsagging, nonbleeding, polyisobutylene or partially vulcanized rubber base sealant, conforming to the requirements of National Association of Architectural Metal Manufacturers' Specification for sealant used in concealed sealing of thin joints in metal work.

8. Sealant Primer: Type recommended by the sealant compound manufacturer to provide adhesion of the compounds to, and to prevent staining of, adjacent surfaces for conditions encountered.

9. Protective Coatings:

a. Zinc-rich corrosion-resistant primer complying with SSPC-PS Guide No. 12.00. Select and prepare surfaces according to standards in SSPC-SP COM.

b. Bituminous paint: Cold-applied asphalt-mastic per SSPC-Paint 12 requirements except containing no asbestos; formulated for 30 mil thickness per coat.

2.2 Aluminum Finishes

A. Anodized Finish

1. *Clear Anodized Finish [S]*: AAMA 611, AA M12C22A41, Class I, 0.018 mm.

2. Exposed surfaces shall be uniform in color and texture, free from scratches, streaks, discolorations, die marks and

other imperfections. The finish shall match the approved samples, within the color variation range as approved.

3. Concealed surfaces may have a mill satin finish, AAMA AA C12C22.

2.3 Fabrication

A. General

1. Fabricate storefront system per approved shop drawings and samples.
2. For outside dimensions and profiles of the various components, follow overall dimensions and details shown. Use manufacturer's standard internal arrangement of unexposed members, reinforcement, connections and fastenings regularly provided with the system specified and to comply with the design criteria.
3. Shop assemble the work to the greatest extent possible for field erection. For those members that cannot be permanently shop assembled, assemble in the shop, mark for identification and disassemble for shipment, to insure accurate assembly and fit in the actual locations.
4. Design and fabricate the storefront system work to prevent distortion to the members or damage to the anchorage and supports due to expansion or contraction.
5. Perform workmanship in accordance with the SPECIFICATION; members not presenting a finished and workmanlike appearance will be rejected. Furnish members true to length so assembling may be done without fillers, unless otherwise noted. Trim projecting edges or corners flush where different members are assembled. Items shall be free from twists, bends, and open joints.
6. Use concealed fastening to greatest extent possible. Where exposed fastening cannot be avoided, countersink fasteners flush with surface. Hold long members together by internal sleeves of similar shape and weld in place, except incorporate means to allow for thermal movement. Weld by the argon gas shielded arc method per AWS D1.1 requirements. Locate welds in areas where the process does not change the finish. Welds must be free from porosity, cracks, holes and other imperfections.
7. Perform cutting, fitting, drilling and tapping to fit work to in place construction and to receive subsequent work. Provide anchors, fasteners and connections required to secure this work together and to adjacent construction.
8. Finish flat surfaces to true planes without waves and buckles and with corners and edges slightly rounded. Cut and fit miters accurately and bring surfaces of adjacent members to smooth, even planes. Fabricate joints to produce hairline joints, without the use of paint or sealants.
9. Provide sharp clean breaks in sheet work with minimum radius of the bends. Refinish any bends showing stretch lines to match adjoining surfaces. Finish curved work to true radius.
10. Provide aluminum trim flashings to match storefront framing, in as long lengths as practical, having joints between sections as required for expansion and contraction, and with matching concealed backer plates behind joints.

B. Dissimilar Materials Isolation

1. Wherever aluminum items are secured to, or are in contact with, steel supporting members or other dissimilar metal surfaces, paint the contact surface of the steel one coat of zinc-rich corrosion-resistant primer. Wherever aluminum items are secured to, or are in contact with, concrete or masonry, paint the aluminum surface one heavy coat of approved alkali resistant bituminous paint. Allow paint coats to dry thoroughly prior to installation of aluminum work.

C. Aluminum Framing

1. Fabricate frames from extruded shapes. Furnish fixed and snap in aluminum glazing stops and resilient glazing gaskets to retain the glass. Size the recesses with rabbet 1/4 inch wider than glass thickness and with a 3/8 inch

minimum grip on the glass.

2. Furnish frames for doors with full length stops at head and jambs, separately applied with concealed clips and flush, exposed fasteners. Provide minimum 3/16 inch thick aluminum plates on interior as reinforcing for hardware attachment. Cut out frames as required to accept hardware. Furnish boxes for strike cutouts. Reinforce jambs with steel channels or buck extended as necessary for securing to building construction.

D. Aluminum Doors

1. Fabricate doors from extruded aluminum members not less that 1 3/4 inch deep, unless otherwise noted. Assemble members to be non sagging; use internal corner reinforcement, tie rods or other method standard with the manufacturer. Provide doors with metal glazing stop arrangement, non removable from the exterior, snap in type on interior. Size the recesses with rabbet 1/4 inch wider than glass thickness and with a 3/8 inch grip on the glass. Furnish glazing gaskets with the stops for setting of glass.

   a. Provide 10 inch high bottom rail on all doors.

2. Provide minimum 3/16 inch thick aluminum plates inside the doors as reinforcing for door hardware attachment. Cut out members as required to accept door hardware. Fill stiles and rails with sound deadening insulation as standard with the manufacturer.

3. At interior door frames provide ANSI/BHMA A 156.16 silencers. Provide three silencers on the strike jamb of single doors and two at the head of frames of double doors.

084113.3 EXECUTION

3.1 Installation

A. General

1. Install and secure storefront system and trim flashings per manufacturer's directions and approved shop drawings.

2. Install supporting members, fasteners, framing, bracing and brackets required to set and connect the storefront system work rigidly and properly to the structural frame and surrounding construction. Where necessary, set anchors separately and when adjacent construction is complete, finish the installation of the storefront system work.

3. Set and temporarily brace or connect the work in place until fully built in or until final connections are made. Remove temporary bracing and connections.

4. Install joint sealants where metal to metal contact occurs within the storefront system, including expansion and contraction joints.

B. Aluminum Framing

1. Erect frames so that verticals are plumb and horizontals are level, within the specified tolerance. Install so that entire frame is in true plumb planes, forming true rectangular openings for glass lights and for doors. Secure frames to adjacent construction with concealed fasteners. Use fasteners near each end, at corners and intersections and at 24 inches on center, maximum, between such defined points. Provide metal shims at each connection. Provide framing gaskets between back of frame and adjacent construction, at all perimeter frame members. Use gaskets shallower than frame depth so that upon installation compression, a sealant recess of not less than 1/4 inch depth is left on both sides of frames.

C. Aluminum Doors

1. Hang doors to swing and glide easily and freely throughout their travel and without touching the floor. When in

closed position, doors shall be in full length contact with stops. Provide clearances in accordance with the specified tolerances.

D. Door Hardware

1. Completely assemble, accurately place, and securely attach specified door hardware to the doors and frames. Install and adjust hardware in accordance with manufacturer's written directions. Set thresholds in mastic bed and secure with flat head machine screws and lead expansion shields.

E. Glazing

1. Handle glass with care to prevent damage. Protect edges against abrasion, pressure and impact. Inspect glass prior to glazing and do not install glass that has damaged edges or damaged surfaces.
2. Do not cut, grind, seam, stone, swipe or otherwise alter the edges or size of heat strengthened, tempered, tinted, heat absorbing, or insulating glass. Do not nip to remove flares or to reduce over size dimensions of any type of glass.
3. Provide setting blocks for all lights of glass, installed at quarter points and per approved shop drawings.
4. Set glass into framed openings, centered in each opening. Install the snap on aluminum glazing stops containing glazing gaskets. Installation must provide a firm, weathertight but resilient clamping grip on the interior face of the glass and to press the exterior face of glass firmly against the glazing gaskets on the exterior frame member.

3.2 Adjusting & Cleaning

A. Exercise care to protect finished surfaces from damage during erection. At completion, remove mastic smears and other foreign materials, and wash the exposed surfaces. Remove removable protective coatings from finished surfaces and clean the finish surfaces per the standard requirements of the storefront system manufacturer. Remove stains and abrasions and restore the finish to match the finish on adjacent surfaces. Remove and replace members that cannot be satisfactorily restored or that are damaged, with new members meeting the requirements of this Section.

B. At completion, replace broken, cracked, and otherwise defective glass and glazing prior to final acceptance, at no additional cost to the Owner.

C. Replace at no additional cost to the Owner, broken or defective glass and glazing that appears during the guarantee period due to incorrectly cut edges, loose setting, binding in the frame, uneven bedding, pinching by glazing clips, or similar causes.

D. Before final acceptance, check and readjust operating door hardware for smooth and correct operation.

088000 - GLAZING

088000.1 GENERAL

1.1 Summary

A. Section Includes:

1. Glass for the following applications:
   a. Aluminum-framed swinging and sliding entrance doors.

b. Aluminum-framed storefront systems, including entrance transoms and sidelights.

B. Related Work Specified In Other Sections:

1. Final cleaning and polishing of glass - General Conditions.

2. Glazing of the following systems and assemblies specified in other Sections, by reference to the requirements of this Section:

a. Aluminum-framed entrances and storefronts - Division 8.

1.2 Performance Requirements

A. General: Provide glazing systems to withstand thermal movements, wind and impact loads without glass breakage from defective manufacturing, fabrication, installation, including glazing accessories and sealant. Glazing systems are to remain airtight and watertight without deterioration or discoloring.

B. Confirm glass sizes indicated by analyzing specified loads and project conditions. Provide annealed, heat strengthened or tempered glass to meet project conditions and specified criteria.

1. Glass Thickness: Select minimum glass thicknesses to comply with requirements of IBC and ASTM E1300.

C. Analyze glass performance and provide glass with properties based on manufacturers published data based on the following properties and procedures:

1. Properties of monolithic glass lites are based on units 6 mm thick.

2. Base properties of laminated glass lites on products specified.

1.3 Submittals

A. Furnish submittals for items that are identified in this Section by a different typeface and a bracketed code (e.g*., Item [L]*). Refer to Division 1 General Requirements for definition of codes for types of submittals and the administrative requirements governing submittal procedure. General submittal requirements pertaining to this Section are specified herein under this Article.

B. Submit manufacturer’s product data on glass and glazing materials where specified.

C. Prior to submittal, obtain written acceptance from the glass manufacturer that glazing details are proper for the types of glass to be used.

D. Where specified, submit samples of each type and kind of glass, with attached label bearing complete descriptions. Glass size 6 inch x 6 inch minimum, 12 inch x 12 inch maximum.

1.4 Quality Assurance

A. Reference Standards

1. Conform to the following specifications and standards for materials and work, as referenced and modified in this Section, and except where superseded by requirements specified in this Section.

a. ASTM C1036 “Specification for Flat Glass”.

b. ASTM C1048 “Specification for Heat Treated Flat Glass Kind HS, Kind FT Coated and Uncoated Glass”.

c. ASTM C1172 "Standard Specification for Laminated Architectural Flat Glass."

2. Size and install glass per the Flat Glass Marketing Association's "Glazing Manual" and "Glazing Sealing Systems Manual", as outlined and modified in the following descriptions.

a. Glass in aluminum frames and doors: Dry glazing, using gaskets furnished with frames, and setting blocks.

b. When using tempered glass, conceal the tong marks behind the glazing stops or use tongless tempered glass.

B. Comply with recommendations of the following publications:

1. GANA "Glazing Manual" and "Laminated Glass Design Guide".

2. AAMA GDSG-1, "Glass Design for Sloped Glazing", and AAMA TIR-A7, "Sloped Glazing Guidelines".

3. SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use", and IGMA TB-3001, "Guidelines for Sloped Glazing".

C. Test for sealant compatibility and adhesion by using the sealant manufacturers standard test that determines the need for priming or use of other methods of joint preparation to obtain adhesion of joint substrates and sealants.

D. Provide Category II safety glass materials complying with testing requirements in 16 CFR 1201 and ANSI Z97.1 Where required by provisions of the building code, or by authorities having jurisdiction, permanently mark safety glazing with certification label of manufacturer, SGCC, or another certification agency acceptable to authorities having jurisdiction.

1.5 Delivery, Storage and Handling

A. Ship all glass and glazing materials to the project site in their original containers, with seals unbroken. Ship all lights of glass to the site bearing the manufacturer's label as to kind and grade, except that labels shall not be affixed to tinted or reflective glass.

B. When storing tinted glass, heat absorbing glass, insulated glass units, and plate or float glass of 1/2 inch and greater thickness, and other glass that would be subject to breakage due to build up of heat stresses, do not store outdoors in partial sun exposure.

C. Do not remove labels from glass lights until after installation, and after acceptance by the Owner's Representative; then remove immediately.

1.6 Project Conditions

A. Environmental Requirements

1. Perform glazing work only when ambient air temperatures are 40 degF. or higher, except that glazing may be performed at lower ambient air temperatures if areas to be glazed are enclosed and heated and all materials are heated to at least 40 degF.

088000.2 PRODUCTS

2.1 Heat Treated Glass

a.

B. Tempered Glass

1. Clear, Fully Tempered Float Glass: Per ASTM C1048, Kind FT, Type I, Class 1, Quality Q3; and comply with requirements for safety glass specified in Quality Assurance Article. Glass must be fabricated at the factory with

roll-wave distortion parallel to bottom edge of glass in install position.

2.2 Glazing Materials

A. General: Provide products of type indicated, complying with the following requirements:

1. Compatibility: Select glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

B. Sealant Glazing Compound: Provide sealant as specified in Division 7. Furnish in manufacturer's standard color to match adjacent finish surfaces and as selected.

1. For butt-glazing joints, use clear silicone sealant, except omit sealant entirely where silicone sealants are not permitted, as specified in Division 7 Joint Sealants Section.

C. Glazing Tape: Provide glazing tape conforming to AAMA 804.1, composed of butyl polyisobutylene rubber in sizes as required and in color as selected from manufacturers standards.

D. Setting Blocks and Spacers. Provide setting blocks and spacers composed of neoprene or EPDM with a Shore A hardness as follows:

1. Setting Blocks: 80 to 90 Durometer.
2. Spacers: 40 to 50 Durometer.

088000.3 EXECUTION

3.1 Installation

A. Handle all glass with care at all times to prevent damage. Protect edges against abrasion, pressure and impact. Inspect all glass prior to glazing and do not install glass that has damaged edges or damaged surfaces.

B. Do not nip glass to remove flares or to reduce oversize dimensions of any type of glass.

C. Do not cut, grind or otherwise alter the edges or the size of heat strengthened, tempered, tinted, heat absorbing or insulating glass.

D. Seal or tape the edges of laminated glass to prevent staining of the interlayer from glazing compounds or other materials.

E. Clean all surfaces contacting glazing materials with solvents and cleaning agents as recommended by glazing material manufacturers, and allow to dry thoroughly.

F. Apply primers to joint surfaces where required for adhesion of sealants, as determined by sealant compatibility and adhesion testing.

G. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

H. Remove and reset all stops as required, securing stops permanently while glazing. Mask surfaces where necessary for protection against smearing of glazing and sealant materials. Sealing and glazing materials that come in contact with one another must be compatible; allow the first material applied to set before applying second material. Place all compounds with appropriate tools; thumb puttying will not be permitted. Remove excess sealants or compounds from glass and adjoining surfaces. Draw all glass lines neat and sharp.

I. Provide setting blocks for all lights of glass, installed at quarter points and per the reference standards.

J. Provide spacers on vertical stops as required and per the reference standards. Apply sealant or compound after installation of spacers.

K. Install glass in hollow metal steel doors and glazing frames and steel channel glazing frames by one of the following methods:

1. Install spacers on stops to center glass in opening, and fill space between stops and glass with sealant compound.
2. Fill space between stops and glass with glazing tape of proper thickness to be under compression when stops are installed.

L. All exterior work shall be weathertight.

3.2 Protection

A. Protection

1. When glass has been set, indicate that the opening has been glazed by hanging or suspending conspicuous flags, banners, festoons, streamers, tape or similar item, from the frame of the glazed opening, extending into or across the glazed opening but not in contact with the glass. Do not apply markers or compounds of any kind directly to the glass surface. Use non staining tape or adhesive for fastening the indicating material to the frames.
2. Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter.

3.3 Adjusting, Cleaning & Patching

A. At the completion of the Work, replace broken, cracked, and otherwise defective glass and glazing prior to final acceptance, without cost to the Owner.

B. Replace at no additional cost to the Owner, all broken or defective glass and glazing that appears during the guarantee period due to incorrectly cut edges, loose setting, binding in the frame, uneven bedding, pinching by glazing clips, or similar causes.

C. Insulating glass units that fog, cloud or have lost their dry seal, will be considered defective, and shall be replaced at no additional cost to the Owner.

3.4 Glass Schedule

1. Drawing Designation GL-1: Float glass, fully tempered.
   a. Applications:
      1) Interior aluminum partitions, doors and sliding doors.
   b. Thickness: 3/8 inch thick at partitions, 1/4 thick at doors fully captured.
   c. Appearance Characteristics:
      1) Clear.

DIVISION 09
FINISHES

092116 - GYPSUM BOARD ASSEMBLIES

092116.1 GENERAL

1.1 Summary

A. Section includes gypsum board work, metal studs and channels, fasteners, accessories, and finishing.

B. Provide gypsum board work as scheduled, noted or detailed, using materials and construction methods as described in the referenced specifications and standards, except as modified by the requirements of this Section. The work includes gypsum board as a finished plane ready for decorative field painting, and as substrate to receive applied finishes such as vinyl fabric wallcovering, ceramic tile, etc.

C. Provide fire-resistance rated gypsum board ceilings as scheduled or noted using materials and construction methods as described for each particular rating in the UL "Fire Resistance Directory" for the UL Design Number selected.

D. Provide fire-resistance rated metal stud and gypsum board partitions as scheduled or noted using materials and construction methods as described for each particular rating in the UL "Fire Resistance Directory" for the UL Design Number selected.

E. Provide fire-resistance rated gypsum board shaftwall systems as scheduled or noted designed for erection from outside the shaft at each floor, using materials and construction methods as described for each particular rating in the UL "Fire Resistance Directory" for the UL Design Number selected.

F. Provide gypsum board fire-resistance rated enclosure of building steel frame as scheduled or noted using materials and construction methods as described for each particular rating in the UL "Fire Resistance Directory" for the UL Design Number selected.

G. Provide sound-attenuating gypsum board partitions as scheduled or noted using materials and construction methods as specified in the manufacturer's description of each particular system, when tested in accordance with the requirements of ASTM E90 and classified according to ASTM E 413 by an accredited, independent testing laboratory.

H. Provide abuse resistant gypsum board partitions as scheduled or noted using methods as specified in the manufacturers specification when tested in accordance of each particular system.

I. Provide moisture resistant gypsum board partitions as scheduled or noted using methods as specified in the manufacturer's specification when tested in accordance with each particular system.

J. Cement Backer Board Work:

   a. Provide cement backer board as specified or noted in lieu of gypsum board for partitions and ceilings to receive ceramic tile. Joint taping and filling is in Section 09300.

K. Related Work Specified in Other Sections

   1. Wood framing, furring and permanent wood grounds - Division 6.
   2. Sound-attenuating blanket insulation and thermal insulation in conjunction with gypsum board work - Division 7.
   3. Joint sealants for expansion, control and perimeter area joints - Division 7.
   4. Gypsum plaster work, complete – Division 9.

5. Ceramic tile work, including setting beds – Division 9.
    a. Also including taping and filling of joints in cement backer board.
6. Acoustical ceilings, except gypsum backer board substrate for adhesive-applied acoustical ceiling tile – Division

L. Products Installed But Not Furnished Under This Section
1. Steel door and glazing frames in metal stud framed gypsum board partitions - furnished in Division 8.
2. Access panels required in gypsum board work but not shown on the Drawings - furnished in DIVISIONS 15 and 16.
3. Access panels in gypsum board work shown on the Drawings - furnished in Division 8.

1.2 Performance Requirements

A. Reference Standards
1. Locally enforced Building Code.
2. ASTM C1396 – Gypsum Wallboard.
3. ASTM C645 – Nonstructural Steel Studs.
4. ASTM C475 – Joint Treatment Materials.
5. ASTM C1002 – Steel Drill Screws for Application of Gypsum Sheet Materials.
6. Underwriters Laboratories (UL) Fire Resistance Directory.

B. Design Criteria
1. The ceiling support system shall limit deflection of the finished ceiling to not more than 1/360 of the span.
2. The finished ceiling shall be at the correct elevation and flat within 1/8 inch in 10 ft., measured in all directions.

C. Preinstallation Meeting
1. Prior to start of each type of gypsum drywall system, and at the direction of the Owner's Representative, meet at the site and review the installation procedures and coordination with other work. Meeting shall include Contractor, Owner's Representative, and major material manufacturers as well as the Installer and other subcontractors whose work must be coordinated with the gypsum drywall work.

1.3 Submittals

A. Furnish product data for items that are identified in this Section by a different typeface and a bracketed code (*e.g., Item [P]*). Refer to Division 1, General Requirements for definition of codes for types of submittals and the administrative requirements governing submittal procedure.

1.4 Product Delivery, Storage & Handling

A. Wrap, carton, and crate as required to provide physical and climatic protection during loading, shipping and job site storage and handling.

B. Deliver packaged materials to the project site in the manufacturer's original, unopened containers which bear intact, legible and visible labels that identify the manufacturer's name and brand name, the contents, grade and type.

C. Upon delivery, immediately inspect shipments to assure their compliance with the requirements of the Contract Documents and approved submittals, and that products are complete, undamaged and adequately protected. Immediately report damaged, missing, or defective items. Remove broken, damaged or unlabeled items from the site immediately.

D. Store products in accordance with manufacturer's instructions with seals and labels intact, legible, and visible. Store products in a manner to prevent damage, soiling, theft, deterioration and contamination. Marred surfaces, cracked, checked split or warped materials will be rejected. Store materials subject to damage by climatic conditions in weather tight enclosures. Maintain temperature and humidity within the ranges required or recommended by the manufacturer.

E. Repair or clean items that have been damaged or soiled that can be restored to an "as new" condition at no cost to the Owner. The Owner's Representative shall be the judge of the effectiveness of remedial measures. Additional time or expenses required to secure replacements and to make repairs will not be considered by the Owner's Representative to justify an extension in the Contract time of completion or an increase in the Contract amount.

1.5 Project Site Conditions

A. Environmental Conditions

1. Apply adhesives and joint finishing compounds only under conditions conducive to a fault-free installation and only when the ambient temperature is above 55 degF.
2. After adhesives and compounds have been installed, provide a circulation of air with exhaust to the exterior, while the adhesives and compounds are drying, including areas above the suspended ceilings.

B. Protection

1. Protect other adjacent in-place finished construction during the execution of this work to prevent damage to such finished construction; repair all damage.
2. Immediately remove adhesive and joint finishing compound droppings from in-place finished construction, so as not to mar or damage such finished construction.

C. Sequencing, Scheduling

1. Cooperate in the sequence of thermal and acoustic insulation installation and setting of mechanical, electrical and other items in or behind gypsum board surfaces.
2. Do not commence work that would conceal items or materials in-place that require inspection until such has been inspected and approved.

D. Verification of Work by Others

1. Examine all surfaces affected by this specification section before starting work. Notify the Owner's Representative, in writing, of any surfaces that are not square, plumb, level and true, or that are not secure and firm. Do not proceed with work on any portions so reported until necessary corrections have been made. Any subsequent claim of the inability to carry out the contract, due to the negligence of other Contractors in the execution of their work or their failure to properly execute their work, shall be held invalid.

092116.2 PRODUCTS

2.1 Materials

A. *Ceiling Carrying Channels [P]*

1. Carrying Channels: Cold rolled, commercial steel sheet with a base-metal thickness of 0.053" and minimum 1/2" wide flanges, shop painted with rust-inhibitive primer or galvanized. Depth 2-1/2 " unless otherwise indicated on Drawings.
    a. Galvanize for exterior soffits.

B. *Grid Suspension System for Gypsum Board Ceilings [P]*

1. ASTM C645, direct-hung system composed of main beams and cross-furring members that interlock.
    a. Armstrong World Industries, Inc.; "Drywall Grid Systems"
    b. Chicago Metallic Corporation; "Drywall Grid System"
    c. USG Corporation; "Drywall Suspension System"

C. *Furring Channels [P]*

1. Screw-Type Rigid Furring: Per ASTM C645; galvanized sheet steel, hat shaped, minimum 25 gage, nominal 2-5/8 inches wide x 7/8 inch deep with 1/2 inch wide flanges.
2. Screw-Type Resilient Furring: Per ASTM C645; galvanized sheet steel, minimum 25 gage, offset flange profile with minimum 1-1/2 inch wide screw-receiving face.
3. Z-Shaped Furring: Per ASTM C645; galvanized sheet steel, minimum 24 gage, with nominal 3/4 inch wide back flange and 1-1/4 inch wide face flange and of same depth as the insulation.

D. *Metal Studs [P]*

1. Metal Studs and Runners: Steel studs and runners per ASTM C645, minimum No. 25 gage cold-rolled steel with galvanized finish, of sizes required to produce overall partition thicknesses shown or scheduled, suitable for screw attachment of gypsum board and with punchouts to accommodate horizontal utility service runs.
    a. Use 20 gage studs adjacent to door frame jambs.
    b. Use 18 gage studs for tile and cementitious backer board.
2. High-Strength Steel Studs and Runners: Framing members specially formed from high-strength steel may be considered.
    a. Minimum base metal thickness: 0.015" for studs manufactured from steel having minimum 50 ksi yield strength may be deemed equivalent to 25 gage steel studs and 0.019" may be deemed equivalent to 20 gage steel studs, provided manufacturer's published test data confirm equivalence; and provided all fire-resistance-rated assemblies using high-strength steel studs and runners that are required for the Project are listed in the UL "Fire-Resistance Directory."
3. Accessories: Furnish manufacturer’s standard galvanized mating floor and ceiling tracks, and all other accessories necessary for installation of studs and tracks.

E. *Gypsum Board [P]*

1. Gypsum Board of type listed, 5/8 inch thick unless indicated otherwise, 48 inches wide, with tapered edges; furnish in as long lengths as practical to minimize end joints. Use the following types where indicated or specified:
    a. Type X: Per ASTM C1396, fire-resistance rated; use for all applications unless otherwise indicated.
    b. Moisture-Resistant Type: Per ASTM C1396.
    c. Plain Type: Per ASTM C1396, 1/2 inch thick; use where specifically indicated.

F. *Cementitious Backer Board [P]*

1. Cementitious Backer Board: 1/2 inch thick, glass-mesh reinforced portland-cement based (not gypsum) cementitious tile backer board for application of ceramic tile in wet areas. Use where indicated. Joint taping and filling is by the ceramic tile trade of Section 093000.
    a. Custom Building Products; “Wonderboard Backerboard”.

b. FinPan; “Util-A-Crete Concrete Backerboard”

c. USG; “DUROCK Cement Board”

G. Joint Treatment Materials [P]

1. Joint Compound and Joint Tape: Products of a single manufacturer, as manufactured or recommended by the gypsum board manufacturer for the particular type of gypsum board used, and per ASTM C475.

H. Hangers And Tie Wire [P]

1. Hangers: Per ASTM A641; soft temper, Class 1 zinc coated steel wire of No. 8 gage minimum; or unperforated, galvanized mild steel flat hangers, 1 inch x 3/16 inch minimum.
2. Tie Wire: Per ASTM A641; soft temper, Class 1 zinc coated steel, Monel or stainless steel wire, minimum No. 16 gage.

I. Metal Accessories [P]

1. Furnish all members per ASTM C1047, formed from galvanized steel sheet or rolled zinc, of proper depth required for total gypsum board thickness specified.
   a. Clinch-On Cornerbead Company
   b. Phillips Manufacturing Co.
   c. SEMCO, a Gibralter Industries Company.
   d. USG
2. Casing Bead: Galvanized steel, minimum No. 26 gage, square angle or channel nose, with perforated wall flange requiring filling compound.
3. Corner Bead: Galvanized steel, minimum 26 gage, perforated wing type requiring filling compound.
4. Control Joint: Zinc V-type with perforated wings requiring filling compound.

J. *Fasteners [P]*

1. Screws: Per ASTM C1002; Type S for 25 gage steel studs and ASTM C954 for 20 gage or heavier steel studs, bugle-head screws with self-drilling point, self-tapping thread; not less than 1 inch long for single layer application and not less than 1-5/8 inch long for double layer.
   a. Use same length screws as used to achieve fire-resistant ratings, for such work.
   b. Use corrosion-resistant treated screws for cement backer board.

092116.3 EXECUTION

3.1 Metal Stud Framing Installation

A. Provide metal stud framing per ASTM C754 and applicable provisions of ASTM C840 to frame all gypsum board partitions, walls and enclosures. Extend framing from top of slab to underside of construction above, except where indicated or specified otherwise. Where framing does not extend to construction above, terminate framing as indicated.

1. Terminate framing at underside of ceilings and secure to ceiling framing at 4’-0” o.c. maximum, or as noted.
2. Terminate framing 4 inches above finish ceiling plane where noted, and provide extension of framing to slab above, at not over 48 inches on center to effect a rigid installation.

B. Use single length, unspliced studs, mounted vertically, spaced at not over 16 inches on center, and set into continuous channel tracks at bottom and top. Secure channel tracks to slabs with either approved screw type fastener or 1/4 inch diameter galvanized bolts, spaced 24 inches on center maximum and at each end of each piece of track. Where top track terminates at ceiling, secure track to metal ceiling suspension system at 48 inches on center maximum. Secure studs to tracks with sheet metal screws at jambs of openings, at corners, intersections, and ends of runs. Secure all other studs into tracks by friction, twisting studs into tracks.

C. Frame intersections and corners with multiple studs per ASTM C754, arranged to support all vertical edges of wallboard. Where metal stud framing abuts concrete or masonry surface, secure abutting stud to surface at 24 inches on center. At expansion joints, provide stud at each side of joint to allow gypsum board to stop at each side of such joints. Reinforce partition framing scheduled or indicated to be surfaced one side only, with a continuous horizontal, 1-1/2 inch channel, in the stud space and located six feet above the floor, secured to each stud; do not extend horizontal reinforcement through the expansion joints.

D. Frame each opening per ASTM C754 with studs at each side of opening; floor track at head, and at sill in opening terminating above the finished floor; jack studs above and below the opening to complete and extend the stud spacing pattern. Frame for metal access doors in all locations shown, and in addition, for metal access doors in this work where required for access by other Trades.

   1. Use 20 gage studs adjacent to door frame jambs.

   2. Use 18 gage studs for cementitious backer board.

E. Erect the metal stud framing in true straight lines, with corners and intersections at right angles and with each surface forming true, plumb planes, unless shown otherwise. Frame openings in true rectangles, of sizes required or shown. Secure all parts together and to adjacent construction in a rigid manner.

F. Receive, set and secure in place, all hollow steel frames occurring in metal stud framing. Secure each frame anchor plate to adjacent stud vertical by bolting or screwing. Expansion bolt the bottom of each frame jamb to the floor with 1/4 inch diameter galvanized bolts.

G. Install all frames as defined with the Door and Hardware Institute “Installation Guide for Doors and Hardware”, Latest Edition, with the ± 1/16” tolerances for frames squareness, plumbness, alignment and twist.

   1. Frames that do not meet the above stated tolerances shall be reinstalled, at no extra cost, to the satisfaction of the Owner’s Representative.

H. For items to be set into or on front of metal stud framing that requires reinforcing inside of the metal stud framing, provide minimum 25 gage steel insert (or other approved anchorage plate insert) minimum 10 inches high and spanning at least 2 studs, in locations where handrails, grab bars, toilet partitions, cabinets and other items are attached to gypsum board partitions. Secure insert to adjacent studs. Review location of insert with installers of items to be attached, to obtain correct insert location.

I. Provide all cutting out, subframing with studs or furring channels or backer plates and finishing with metal accessory trim and joint treatment all openings required for recessed wall equipment.

3.2 Ceiling Framing Installation

A. General

   1. Install ceiling construction to provide true, flat planes as shown, either vertical and plumb, horizontal and level, or sloping, ready for application of metal furring. The reference to ceiling construction applies as well to the construction of drops and soffits, as applicable.

B. Suspended Ceiling Framing

   1. Provide suspension systems for all gypsum board finished, and adhesive-applied acoustic tile on finished gypsum board, ceilings that are indicated as suspended, consisting of cold rolled steel carrying channels hung from concrete slab or steel structural framing above the ceiling plane per ASTM C754.

a. Use 1-1/2 inch carrying channels for hanger spacing up to 4 feet-1 inch.

b. Use 2 inch carrying channels for hanger spacing from 4 feet-2 inches up to 5 feet-1 inch.

c. Use doubled 2 inch carrying channels for hanger spacing over 5 feet-1 inch.

2. Erect carrying channels parallel to walls and to each other, spaced uniformly at not over 4 feet on center. Provide a carrying channel parallel to and within 6 inches of walls and stop channel ends 1/2 inch from walls. Provide carrying channel framing of all openings having dimension of 2 feet-0 inches and over. Furnish channels in as long lengths as practical to minimize joints. Splice the channels by lapping a minimum of 12 inches and double-tying together. Locate splices only at hangers.

   a. At expansion joints parallel to carrying channels, provide separately hung channel at each side of expansion joint.

   b. Where run of carrying channels is perpendicular to expansion joint, stop the channels at each side of expansion joint.

3. Support carrying channels with hangers along each run, spaced not to exceed the spacing specified above for the size of channel used. If ductwork or equipment located in the ceiling plenum area interferes with hanger spacing, provide a trapeze arrangement to support the channels at the proper spacing. Provide a hanger at each corner of each ceiling opening which is to receive a recessed light troffer, diffuser, or grille, and at other points of extra loading.

   a. Do not secure hangers to metal roof deck, metal floor deck not concrete filled, ductwork, conduit, piping, equipment, or support system for any of these.

4. Secure hangers to construction above, in accordance with ASTM C 754 and the following requirements, as applicable, to develop the full strength of the hangers.

   a. Exposed Concrete Slab or Concrete-Filled Metal Floor Deck: Use hanger anchors specifically designed for hanger use.

   b. Steel Beams: Use beam clips.

   c. Steel Trusses and Joists: Wrap around the lower chord member.

5. Secure hangers to carrying channels by wrapping hangers around the channels to develop the full strength of the hangers.

   a. Wire Hangers: Wrap the wire around the steel joists, carrying channels and other fastening points twice and around itself three times.

   b. Steel Band Hangers: Secure the band to the steel joists, carrying channels and other fastening points; wrap the band tightly around the fastening point and bolt to itself.

6. Frame vertical plane of ceiling drops with carrying channels spaced not over 4 feet on center, erected plumb and parallel. Secure channels to horizontal runs at top and bottom; shim as required to produce a true plumb plane.

C. Grid Suspension Systems

1. Provide suspension systems for all gypsum board finished, and adhesive-applied acoustic tile on finished gypsum board, ceilings that are indicated as suspended, consisting of cold rolled steel carrying channels hung from concrete slab or steel structural framing above the ceiling plane per ASTM C754.

D. Direct-Secured Ceiling Framing

1. Provide steel carrying channel framing for all gypsum board finished ceilings and adhesive-applied acoustic tile on finished gypsum board ceilings that are indicated as direct secured, consisting of cold rolled steel carrying channels uniformly spaced at not over 4 feet on center and secured directly to underside of structural framing at not over 4 feet on center. Install channels parallel to walls, and to each other. Provide a channel parallel to and

within 6 inches of walls and stop channel ends 1/2 inch from walls. Secure channels to construction above by tying with two strands of tie wire around the channel and framing member above. Provide steel shims as required to erect carrying channels in a level, true plane.

3.3 Metal Furring Installation

A. Provide appropriate type metal furring per ASTM C754, on the following surfaces:

1. Underside of suspended and direct-secured ceiling and soffit framing.
2. On the underside of metal stair construction.
3. On the room side of framed ceiling drops.
4. To enclose steel framing of pipe, conduits, ductwork and similar items.
5. On concrete, masonry and rigid insulation substrates where shown.
6. For gypsum board finished and adhesive-applied acoustic tile finished gypsum board surfaces where other provisions are not made.
7. Elsewhere as required to support gypsum board at the required lines; and for all surfaces so indicated.

B. Erect metal furring to true lines and levels. Provide all additional metal framing, bracing and supports necessary to install the metal furring rigidly and securely in place.

C. Erect furring in parallel lines, perpendicular to framing and uniformly spaced at not over 24 inches on center for vertical work and not over 16 inches on center for horizontal work. Secure furring to each support by saddle-tying with three strands of tie wire twisted tight, or with screws or clips, or by welding to structural framing. Secure furring to concrete or masonry substrates with fasteners at each end of furring and at 24 inches on center, maximum, between. Secure furring at stair soffits by welding, screwing, or bolting to stair framing. Furnish furring channels in as long lengths as practical to minimize the number of joints. Splice the channels by lapping and double-tying together. Use proper lengths so as to stagger splices in adjacent furring runs. Stop ends of ceiling furring 1/2 inch short of walls. Do not build any furring into masonry walls.

1. At expansion joints parallel to furring run, provide furring channel at each side of expansion joint.
2. Where run of furring is perpendicular to expansion joints, stop the furring channels at each side of expansion joint.
3. Space furring at not over 12 inches on center for cementitious backer boards.

3.4 Gypsum Board Installation

A. General

1. Install gypsum board in accordance with ASTM C840, unless specified otherwise.
2. Provide gypsum board on both sides of stud framed partitions and on one side of all furred areas and over interior concrete and masonry walls, where so indicated. Provide one layer of gypsum board in all locations, except where multiple layers are noted or are required for fire resistance ratings. Cover full height of stud framed partitions with gypsum board, including the portion above ceilings. In all wall and partition work, except where partitions terminate at underside of ceilings, extend wall and partition linings up past edge of ceiling linings, and cope edge of ceiling linings to such vertical surfaces.
3. In wall and partition work, if gypsum board is not obtainable in length to span full height in a single piece, use longest length possible with butted end joints occurring above ceiling line and install gypsum board with long dimension vertical; otherwise install gypsum board with long dimension horizontal; with vertical joints aligned over studs or furring in both cases. At fire-rated walls and partitions, install gypsum board with long dimension vertical and parallel to studs. At metal framed and furred areas, secure gypsum board to each stud, stud track and furring member with screws spaced not over 12 inches on center.

a. In ceiling and soffit work, install gypsum board with long dimension at right angles to furring, with end joints aligned over furring.

b. In partition work, offset horizontal and vertical joints on opposite sides of partition. In all work, offset joints in adjacent rows of gypsum board.

4. Drive all screws so that the screw is driven in until the screw head provides a slight depression below the surface of the gypsum board, but no further; do not break the paper coverings on the board during installation of fasteners. Do not place fasteners closer than 3/8 inch from edges of boards. Pair, not stagger, fasteners at edge joints between adjacent sheets.

5. Grout steel frames at jamb anchor points with setting-type joint compound.

B. Single-Layer Installation

1. Install single layer gypsum board in proper sequence so as not to delay this work. At corners and intersections, install gypsum board to abutted wall studs in time to allow securement of stud of abutting walls through gypsum board to studs of abutted walls.

2. At metal framed and furred areas, secure wallboard to each member with screws spaced at not over 12 inches on center.

3. At wood framed and furred areas, secure gypsum board to each member with screws spaced at not over 12 inches o.c. throughout.

4. At rigid insulation, install gypsum board in strict accordance with the directions of the rigid insulation manufacturer and the gypsum board manufacturer.

a. At unfurred insulated walls, secure gypsum board to insulation with adhesive.

b. At Z-furred insulated walls, secure gypsum board to each furring member with screws spaced at not over 12 inches on center.

C. Two-Layer Installation

1. Install the first layer of gypsum board the same as specified for single-layer installation, except that first layer on walls and partitions may be installed with long dimension horizontal. At fire-rated walls and partitions, install both layers of board with long dimensions vertical and parallel to studs to achieve the fire rating. Use gypsum board type as indicated and appropriate for the condition; do not use water-resistant type for ceilings or soffits.

2. Erect second layer of gypsum board over first layer, in same manner and positioning as specified for single layer installation, offsetting joints in second layer not less than 10 inches from joints in first layer. Secure second layer to first with screws.

3.5 Cement Backer Board Installation

A. Install as specified for gypsum board except:

1. Use cement board manufacturer’s recommended ASTM C954 corrosion-resistant treated screws.

2. Space screws not over 8 inches on center for walls and partitions, and not over 6 inches on center for ceilings.

3. Joint taping and filling will be performed by the ceramic tile trade of Section 093000.

3.6 Metal Joint and Edge Trim

A. Exterior Corner Reinforcement: Provide corner beads and joint compound for the full length of all external gypsum board corners, both vertically and horizontally, and elsewhere as required for the protection of gypsum board. Furnish single length members, without splicing, for each run up to change in direction. Miter or cope beads to fine-line joints at change in direction. Set beads plumb, level and true throughout. Secure beads through gypsum board to framing or furring with screws at maximum 12 inches on center.

B. Casing Beads: Furnish single length members, without splicing, for each run where exposed to view in the finished work. Miter beads at corners and trim to fine line at all joints. Set beads plumb, level and true throughout. Install beads, prior to gypsum board installation, and secure to framing or furring. After gypsum board edge is inserted in bead, finish gypsum board at bead with joint compound to produce smooth, finish surface. Provide casing beads and joint compound at the junction of gypsum board surfaces with:

1. Finish masonry.
2. Door frames and glazing frames not overlapping the gypsum board edges.
3. Window openings.
4. At perimeter of all gypsum board ceilings.
5. At exposed edges of gypsum board.
6. At perimeter of openings for light fixtures, diffusers, grilles, etc.
7. At similar locations to provide a finished edge for the gypsum board.
8. Also provide casing bead at intersection of gypsum board ceilings and walls, placed in the wall plane if walls terminate at ceiling and in the ceiling plane if ceiling terminates at the walls. Where walls and ceiling terminate together, provide casing bead at tops of walls.

C. Internal Corners: Provide tape and joint compound reinforcement at all internal vertical corners and elsewhere as noted or detailed on the Drawings. Do not provide tape and joint compound reinforcement of corners formed by wall and ceiling intersections.

D. Control Joints: Isolate gypsum board from all structural elements, except floors, by metal control joint members or metal trim. Locate control joints where indicated and as follows:

1. At all changes in type of substrate.
2. At control or expansion joints occurring in building construction.
3. In large ceiling areas, not over 50 feet in either direction and to divide ceiling into rectangular areas of not over 2500 square feet.
4. In long walls at maximum spacing of 30 feet:
    a. Locate vertical joints at center of door frame heads; extend vertically from head to top of wall.
    b. Locate vertical joints at door frame jambs; extend joints from top of frame to top of wall at both jambs of door frames on both sides of partition to form a gypsum board transom panel above door.
5. Where gypsum board abuts a wall or ceiling of dissimilar construction.

E. Finish all other exposed joints between gypsum board sheets with tape and joint compound. Fill all screw holes and dimples and other depressions in gypsum board surfaces with joint compound.

F. Apply joint compound in not less than three applications, the first two with joint compound and the last with finishing or topping compound. Apply compounds with trowel or wide knife using sufficient pressure to insure adhesion and to prevent any voids from forming. At joints, embed tape during first application of joint compound. Extend joint compound out a sufficient distance to allow feathering of compound to gypsum board surface. Allow each application to dry prior to applying succeeding layers. Joint compound finished areas shall be smooth and flat, flush with gypsum board on both sides. Sand, with sandpaper, the finished areas as necessary to remove rough spots, bulges, high areas and other imperfections.

3.7 Metal Access Panels

A. Receive and install metal access panels in gypsum board and ceramic and adhesive-applied acoustic tile finished gypsum board surfaces, in locations shown, as specified in Division 8.

B. In addition, receive and install other metal access panels furnished by Mechanical and Electrical Trades as required for access to their installed items.

3.8 Fire-Rated Work

A. Provide fire-rated gypsum board construction where indicated, including proper construction of framing and furring and proper type, thickness, layers and application of gypsum board, to produce the hourly fire-resistance ratings called for ceilings, walls and structural framing protection and to conform to the UL Design Numbers for each system. The requirements for materials, methods of erection and application specified under the appropriate headings of this Section shall apply, except where more stringent requirements are defined for the particular fire-resistance rating for the UL Design Number in the UL "Fire Resistance Directory".

3.9 Sound-Attenuating Partitions

A. Provide sound-attenuating partitions where indicated, including proper construction of framing and furring, and proper thickness and layers of gypsum board to produce the sound-attenuation ratings called for. The requirements for materials, methods of erection and application specified under the appropriate headings of this Section shall apply, except where more stringent requirements are defined for the particular sound-attenuation rating in the manufacturer's product data.

1. Coordinate and sequence the gypsum board work to allow sound-attenuation insulation specified in Division 7 to be installed before closing partitions with gypsum board, and as required to obtain the sound-attenuation ratings required.

B. Install sound attenuation blankets in all sound rated partition walls. Completely fill space between studs to full height of partition wall. Fit carefully behind electrical outlets and other work which penetrates partition wall. Attach to studs and to back face of drywall in accordance with drywall manufacturer's instruction.

C. Where larger items are placed in the sound rated partition, back the item with gypsum board or other material, securely held in place and fill around, the item to the backing material with acoustical sealant to preserve the sound attenuation value required.

D. Extend blankets above partitions and over the suspended acoustical ceilings where indicated.

E. Install joint sealant in sound rated drywall assemblies as follows:

1. At partition walls, provide continuous beads of acoustical sealant at juncture of both faces of runners or plates with floor and ceiling construction, and wherever drywall abuts dissimilar materials. Apply sealant prior to installation of drywall boards.
2. At ceilings, provide continuous beads of sealant wherever drywall abuts dissimilar materials.
3. Provide continuous beads of acoustical sealant behind faces of all control joints. Caulk prior to installation of surface applied control joint accessories and locate at proper depth in joint to allow for insertion of expansion portion of control join accessory.
4. After installation of drywall base layers, cut face layer sheets 1/2" less than floor to ceiling height and position with 1/4" open space between drywall and floor, ceiling and dissimilar vertical construction. Fill 1/4" open space with continuous sealant beads after installation of face layer.
5. At openings and cutouts, fill open spaces between drywall and fixtures, cabinets, ducts and other flush or penetrating items with continuous beads of sealant.
6. Apply sealants along sides and backs of electrical boxes to completely seal all openings and joints.

3.10 Gypsum Board Finish Levels

A. Gypsum Board Finish Levels: Finish panels to levels indicated below according to ASTM C 840, for locations indicated.

1. Level 1: Embed tape at joints in ceiling plenum areas, concealed areas, and where indicated, unless a higher level of finish is required for fire-resistance-rated assemblies and sound-rated assemblies.
2. Level 2: Embed tape and apply separate first coat of joint compound to tape, fasteners, and trim flanges. Use where panels are substrate for tile, acoustical tile or where indicated.
3. Level 3: Embed tape and apply separate first and fill coats of joint compound to tape, fasteners, and trim flanges. Use where panels are substrate for heavy texture coatings and where indicated.
4. Level 4: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges. Use for allpanel surfaces that will be exposed to view under paint coatings or as a substrate for wall coverings, unless otherwise indicated.
5. Level 5: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges, and apply skim coat of joint compound over entire surface. Use where indicated.

3.11 Adjusting & Patching

A. When other adjacent work is done, or when directed by the Owner's Representative, and in sufficient time to allow field painting to be done on schedule, point up around all trim and other set work, repair or replace damaged gypsum board as approved by the Owner's Representative and leave all of this work in condition to comply with the Contract requirements as approved by Owner's Representative, all at no extra cost to the Owner.

093000 - TILING

093000.1 GENERAL

1.1 Summary

A. Scope

1. Provide all material and installation for shown, scheduled or specified, complete with all accessories and trim for a finished installation for the following:
   a. Ceramic wall tile.
   b. Natural cladding stone wall tile (ungrouted)
   c. Metal mosaic wall tile.

B. Related work specified in other sections:

1. Cementitious backer board installed on nonloadbearing steel stud framing - Division 9.

1.2 Submittals

A. Furnish submittals for items that are identified in this Section. Refer to Division 1 for definition of codes for types of submittals and the administrative requirements governing submittal procedure. Additional submittal requirements pertaining to this Section are specified herein under this Article.

B. Samples for Verification:

1. Full-size units of each type and composition of tile and for each color and finish required.
2. Full-size units of each type of trim and accessory for each color and finish required.

C. Submit shop drawings of all special work that is not readily shown on the Drawings or in manufacturer's product data. Include locations of expansion, contraction, control and isolation joints in the tile substrates, and finished tile surfaces.

D. Submit samples of tile units, materials, and colors not specified. Include manufacturers color charts and full range of colors available for each type of grout indicated.

E. Submit manufacturer's product data describing the materials proposed; encircle specific items proposed if product data submitted is a general catalog.

1.3 Quality Assurance

A. Installer Qualifications: Installer shall have completed a minimum of five projects of similar size, scope, and material specified. Provide evidence of successful project performance upon request of the Owner.

B. Source Limitations for Tile: Obtain all tile from one source with resources to provide products from the same production run for each contiguous area of consistent quality in appearance and physical properties without delaying the Work.

C. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from a single manufacturer and each aggregate from one source or producer.

D. Source Limitations for Other Products: Obtain each of the following products specified in this Section through one source from a single manufacturer for each product:

E. Mockups: Construct mockups for each finish and construction specified prior to installation of the Work. Mockup shall demonstrate the installed conditions of material quality and workmanship. Mockups shall comply with the following requirements:

F. Requirements of Regulatory Agencies:

1. Static Coefficient of Friction: For tile installed on walkway surfaces, provide products with the following values as determined by testing identical products per ASTM C1028:

G. Provide tile of Standard Grade, in grade sealed cartons, per ANSI 137.1. Provide tile as manufactured by a member of the Tile Council of North America or by specified manufacturers.

H. Provide manufactured mortars and grouts with hallmarks indicating compliance with referenced standards.

1.4 Product Delivery, Storage & Handling

A. Deliver all tile to the Work in the original, unopened containers, branded or labeled with the proper grade seal per ANSI A137.1. Mark all containers with designations corresponding with the information given on the grade certificates. Containers will be subject to inspection by Owner's Representative before being opened, as well as during the progress of the Work.

B. Deliver manufactured mortars and grouts in sealed moisture-proof containers bearing hallmarks indicating compliance with the Specifications.

C. Deliver mortar and grout additives in sealed containers.

1.5 Environmental Requirements

A. Do not start tile installation over concrete slabs until concrete has cured for at least five days and then aged for 14

additional days, or for such additional time as required for the concrete to have shrunk and attained equilibrium.

B. Install tile when ambient air temperature, and temperatures of all materials, is 50 degF or higher. Provide room temperatures of 50 degF or higher from 24 hours prior to installation to at least five days after completion of installation in areas to receive tile. In addition, comply with minimum temperature recommendations of manufacturers for bonding and grouting materials to be used, and for curing of the same.

1.6 Protection

A. Protect adjoining finished surfaces before beginning tile installation. Protect tile and adjacent construction against damage during progress of the work until completion.

B. Close spaces to traffic and other work where tile is being installed until tile has firmly set. Post appropriate notices and allow no work around freshly tiled walls and no walking on freshly tiled floors for at least 7 days after tile has been set.

C. Cover surfaces such as tiled floors, stools and thresholds with heavy non-staining paper held in place with masking tape as soon as completed.

1.7 Extra Materials

A. Provide extra materials of each material and color specified matching the manufacturer's pattern and color run. Material shall be packaged with a protective cover for long term storage with labels identifying the contents by manufacturer, pattern, color, run, and color code established in the finish schedules.

1. Tile and Trim Units: Provide three-percent of the amount installed of each type, pattern, composition, size, and color in full-size units.

093000.2 PRODUCTS

2.1 Wall Tiles

A. Wall Tile: Interior ceramic tile, Standard Grade per ANSI A137.1, in single units or face-mounted sheets, with bright or matte glazed finish as scheduled, to match colors specified in the Finish Schedule.

1. Crossville, Inc.
    a. Porcelain Stone Wall Tile: Refer to Finish Schedlule (CTW) for types.
2. American Olean
    a. Mosaic Wall Tile: Refer to Finish Schedlule (MMT) for types.
3. Island Stone, Inc.
    a. Natural Cladding Stone Wall Tile: Refer to Finish Schedlule (STN) for types.
    b. Set with Mapei, Kerabond or approved equal setting material.
    c. Provide manufacturers recommended penetrating stone sealer.

B. Wall Tile Trim: Coved internal and bull nose external corners, cap units at top of wainscots, and other shapes required to complete the installation, all of kind, size and glaze to match tile and the conditions, to match colors specified in the Finish Schedule.

C. Wall Tile Coved Bases: Of same material and finish as wall tile, flush-type coved units, 4-1/4 inch x 4-1/4 inch size,

with top to match colors specified in the Finish Schedule.

2.2 Setting Materials

A. Latex-Portland Cement Mortar: Per ANSI A118.4, prepackaged dry mortar mix containing a dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at the Project site. For wall applications, provide nonsagging type mortar.

1. Bostik, Inc.
2. Custom Building Products.
3. Laticrete International, Inc.
4. MAPEI Corporation

2.3 Grouting Materials

A. High-Performance Cement Grout: Per ANSI A118.7 prepackaged dry mortar mix containing a dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at the Project site. For wall applications, provide nonsagging type mortar. Use sanded grout for tile with joint widths 1/8" and larger. Use unsanded grout for tile with joint widths less than 1/8", and with glazed tile.

1. Bostik, Inc.
2. Custom Building Products
3. Laticrete International, Inc.
4. MAPEI Corporation
5. TEC; H.B. Fuler Construction Products, Inc.

2.4 Miscellaneous Materials

A. Grout Sealer: Manufacturer's standard product that does not affect color or appearance of grout.

1. Custom Building Products "Grout Sealer"
2. Southern Grouts and Mortars "Clear penetrating Sealer and Grout Release"
3. TEC; H.B. Fuller Construction Products, Inc. "Grout Guard penetrating Grout Sealer"

093000.3 EXECUTION

3.1 Preparation

A. Inspect all surfaces upon which materials will be applied, and determine if there are any conditions detrimental to a successful tile installation, prior to proceeding with the work. The installation of tile work will be considered an acceptance of the surfaces to be covered, and claims for failure of tile work because of unsatisfactory sub-surfaces will not be allowed.

B. Prepare all surfaces upon which these materials will be applied as required to properly receive them. Remove from the

substrate surfaces all dirt, grease, oil, paint, and other surface contaminations that will prevent proper bonding. Remove all ridges, fins, projections, high spots and other irregularities that would interfere with proper installation work. Wet concrete and masonry substrate surfaces with water, and allow to surface dry, just prior to installing setting beds.

1. Do not wet surfaces to receive epoxy mortar.

3.2 General

A. Install mortar beds of thicknesses required to provide the finish lines, planes, slopes and elevations required. Where floors have drains, slope mortar beds to drains; otherwise floors shall be level and flat. Walls shall be plumb and flat. Bond mortar beds to back-up construction and tile to mortar beds.

B. Form joints between tile units, or tile sheets, in straight continuous lines so that they intersect uniformly with the units and joints running in the opposite direction, plumb and level on walls, parallel to walls on floors. Align tile joints in walls with floor joints, where practical.

1. Provide maximum 1/16-inch wide joints in mosaic tile work.
2. Provide maximum 1/8-inch wide joints in glazed wall tile work.
3. Provide maximum 3/8-inch wide joints in quarry tile work.
4. Provide 1/8-inch wide joints in porcelain paver tile work.

C. Wash all finish surfaces clean, free from mortar, dirt and other defacements.

D. Neatly cut and accurately fit all tile work around piping and other installations, which pierce the tile work, at irregular shaped places, and at the junction with other materials. Do not chip or otherwise damage the surface of the tile during cutting. Grind cut edges smooth and even.

E. Lay out the work as follows:

1. Walls: Where possible, lay out Work so that no tile less than half size occurs. Unless tile Work is required to fill vertical spaces exactly, heights indicated shall be maintained in full courses to produce nearest attainable heights without cutting.
2. Floors: Before applying setting bed, establish borderlines. Center field work in both directions to permit laying pattern with minimum of cut tiles. Lay floor without borders from centerlines outwards. Make necessary adjustments at walls. Set tile base units so that finish surfaces are flush with floor tile and wall tile where the base meets it.

F. Mix and use proprietary or trade-marked materials in strict accordance with manufacturer’s instructions, unless otherwise specified.

G. Provide this work and materials per the Tile Council of America Handbook for Ceramic Tile Installation, American National Standards Institute Standard Specifications; and, to the further requirements specified in this Section.

3.3 Control Joints

A. Construct control joints in tile work per TNCA Handbook EJ171 "Movement Joint Guidelines for Ceramic, Glass, and Stone", complete with filler, back-up and bond breaker as required, and install joint sealant or install preformed metal expansion joints. Match width of control joints with tile joints.

B. For Walls: Provide directly over concrete, masonry, cement tile backer boards and gypsum board control joints, and 12 to 16 feet o.c. vertically and horizontally elsewhere.

3.4 Adjusting & Cleaning

A. Remove all broken, chipped, loose, stained, or otherwise unsatisfactory work, and patch and restore imperfect

materials and workmanship to condition compatible with Contract requirements.

B. When so directed by the Owner's Representative, after other adjacent work is substantially completed, remove and dispose of protective coverings and thoroughly clean all tile and marble work by approved manner, using a non-acidic type cleaner.

3.5 Tile Installation Schedule

3.5.1 interior Wall Installations

A. Thinset Installation Methods for Interior Walls of Construction Indicated

1. Metal Stud-Framed Cementitious Backer Board Substrate: Per TCNA W244C, latex-portland cement mortar and high-performance cement grout.

   a. Tile Type: Refer to Finish Materials Schedule

   b. Grout: Color to be selected by Architect from manufacturers standard colors.

095100 - ACOUSTICAL CEILINGS

095100.1 GENERAL

1.1 Summary

A. Scope

1. The basic suspended acoustic ceiling systems required for the Project are described as follows:

   a. Acoustic Lay-In Panels:

      1) Installed in exposed grid system.

   b. Flexible Wood Panel Grille Ceiling System:

      1) Installed in suspended framing system.

B. Related Work Specified in Other Sections

1. Wood framing, furring and permanent wood grounds - Division 6.

2. Sound-attenuating blanket insulation and thermal insulation in conjunction with acoustical treatment work - Division 7.

3. Support system for recessed lighting - Division 26.

1.2 Performance Requirements

A. Installer Qualifications: Engage an experienced installer who has completed acoustical panel ceilings similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

B. Source Limitations for Ceiling Units: Obtain each acoustical ceiling panel from one source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.

C. Source Limitations for Suspension System: Obtain each suspension system from one source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.

1. Obtain both acoustical ceiling panels and suspension system from the same manufacturer.

1.3 Submittals

A. Furnish submittals for items that are identified in this Section by a different typeface and a bracketed code (*e.g., Item [L]*). Refer to Division 1, General Requirements for definition of codes for types of submittals and the administrative requirements governing submittal procedure. General submittal requirements pertaining to this Section are specified herein under this Article.

B. Flexible Wood Panel Grille Ceiling System Shop Drawings: Submit for review, completely detailed shop drawings showing all information necessary for the fabrication and erection al all work specified herein. The shop drawings shall show dimensions, construction details, jointing details, wood species and grade , trim, finishes, layout, and detail relating to adjacent work.

C. Submit product data only on ceiling grid system, acoustic tile and acoustic panels substituted for base bid materials; clearly indicate the specific items proposed for use if manufacturer's catalogs are submitted.

D. Submit 6 inch square samples of acoustic tile and acoustic panels substituted for those specified.

E. Submit maintenance instructions to the Owner for recommended cleaning materials and methods for tile, panels, and trim. Include precautions for the use of and composition of cleaning materials detrimental to the acoustic materials and trim. Submit per Section 017823.

1.4 Maintenance Submittals

A. Furnish to the Owner extra tile/panel materials for maintenance purposes, not less than 2% (to the nearest full carton) of each type and pattern installed.

1.5 Delivery, Storage & Handling

A. Wrap, carton, and crate as required to provide physical and climatic protection during loading, shipping and job site storage and handling.

B. Deliver packaged materials to the project site in the manufacturer's original, unopened containers which bear intact, legible and visible labels that identify the manufacturer's name and brand name, the contents, grade and type.

C. Upon delivery, immediately inspect shipments to assure their compliance with the requirements of the Contract Documents and approved submittals, and that products are complete, undamaged and adequately protected. Immediately report damaged, missing, or defective items. Remove broken, damaged or unlabeled items from the site immediately.

D. Store products in accordance with manufacturer's instructions with seals and labels intact, legible, and visible. Store products in a manner to prevent damage, soiling, theft, deterioration and contamination. Marred surfaces, cracked, checked split or warped materials will be rejected. Store materials subject to damage by climatic conditions in weather tight enclosures. Maintain temperature and humidity within the ranges required or recommended by the manufacturer.

E. Store materials in original containers in the rooms or areas scheduled for installation of the materials, for not less than 24 hours immediately prior to installation.

F. Repair or clean items that have been damaged or soiled that can be restored to an "as new" condition at no cost to the Owner. The Owner's Representative shall be the judge of the effectiveness of remedial measures. Additional time or expenses required to secure replacements and to make repairs will not be considered by the Owner's Representative to justify an extension in the Contract time of completion or an increase in the Contract amount.

1.6 Project Conditions

A. Environmental Requirements

1. Continuously maintain the rooms or areas scheduled to receive acoustical treatment at not less than 70 degF, and at occupancy humidity, from at least three days prior to installation to at least three days after this work is completed. Schedule the work to eliminate the risk of damage to these materials due to adverse environmental conditions in the rooms or areas when and after this work is installed.

B. Sequencing, Scheduling

1. Cooperate in the sequence of thermal or acoustic insulation installation and setting of mechanical, electrical and other items in or behind the acoustical treatment.

2. Do not commence work that would conceal items or materials in-place that require inspection including mechanical and electrical until such has been inspected and approved by the Owner's Representative.

095100.2 PRODUCTS

2.1 Nodular Reveal Edge Mineral Fiber Panels

A. Reveal-Edged Mineral Acoustical Lay-In Ceiling Panels: ASTM F1264, Type III, Form 1, Pattern E.

1. Natural-Fissured Reveal-Edge Lay-In Ceiling Panels: Mineral fiber construction, 24 inch x 24 inch face size, all four edges face-rabbeted to allow panel surface to extend nominal 3/16 inch below grid surface, proper thickness to produce NRC Grade specified but not less than 3/4 inch thick, white factory-painted exposed surface, with natural fissured face.

a. Use the following with 9/16-inch metal grid system for ACT-1:

1) Armstrong World Industies, Inc. Ultima Tegular #1952

2) CertainTeed Corporation Comparible to Armstrong Ultima Tegular #1952

3) **USG Interiors, Inc.** Comparible to Armstrong Ultima Tegular #1952>

b. Use the following with 9/16-inch metal grid system for ACT-2:

1) Armstrong World Industies, Inc. Georgian High Washability # 794

2) Ultima Georgian High Washability # 794>

3) USG Interiors, Inc. Georgian High Washability # 794>

2. Surface Burning Characteristics: Per ASTM E84.

a. Flame Spread Index: 25 or less (ASTM E1264 Class A).

b. Smoke Developed Index: 50 or less.

3. NRC range of 0.90 per ASTM C423.

2.2 FLEXIBLE WOOD PANEL GRILLE

A. Solid wood slated ceiling/wall system:

1. Manufacturer: Armstrong World Industries, Woodworks Grille, Backer and Dowel.
    a. FWG -1: Refer to drawings for details and finishes.

2.3 Metal Suspension Systems

A. Exposed Metal Grid System For Lay-In Ceiling Panels (ACT-1)

1. Exposed 9/16-Inch 1/8-Inch Slotted Metal Grid System for Lay-In Ceiling Panels: “Heavy-duty” type direct-hung exposed-tee steel grid system per ASTM C635, with 1-1/2 inch high double-web tees having box-shaped 9/16 inch wide exposed face with 1/8 inch wide continuous slot in face.
    a. Armstrong World Industries, Inc. "Silhouette 1/8" Reveal"
    b. Chicago Metallic Corp. “Ultraline 4500”.
    c. USG Interiors Inc. “Fineline DXFF”.
2. Finish: For all exposed surfaces, bonderize and factory-apply a low-gloss pure white colored baked enamel finish to match panels.

B. Exposed Metal Grid System For Lay-In Ceiling Panels (ACT-2)

1. Exposed 15/16-Inch environmentally exposed stainless steel tee system for food preparation areas.
    a. Armstrong World Industries, Inc. "SS Prelude Plus 15/16 Environmental Tee System"
    b. <Chicago Metallic Corp. Comparible to Armstrong SS Prelude Plus 15/16 Environmental Tee System
    c. <USG Interiors Inc. Comparible to Armstrong SS Prelude Plus 15/16 Environmental Tee System

C. Ceiling System Wall Moldings: No. 25 gage commercial quality hemmed-edge angle shape to match grid system specified.

1. At reveal-edge lay-in panels of recessed grid system, provide “W” shaped molding:

[NOTE: ALWAYS USE PARAGRAPH BELOW; VERIFY COLOR.]

D. Ceiling System Metal Closures and Trim: Provide anchors as standard with the manufacturer

2.4 Accessories

A. Hangers: Soft-temper, prestretched, zinc coated steel wire per ASTM A641, with a yield stress load of at least 3 times design load but not less than No. 12 gage, meeting “Heavy-duty” classification of ASTM C 635.

B. Ceiling System Wall Moldings: No. 25 gage commercial quality cold-rolled steel, electro-galvanized, bonderized, and with factory-applied white baked enamel finish; hemmed-edge angle shape to match grid system specified.

1. At reveal-edge lay-in panels of recessed grid system, provide “W” shaped molding:

095100.3 EXECUTION

3.1 Exposed Grid Lay-In Panel Ceiling

A. Layout

1. Install direct-hung exposed grid lay-in acoustic panel ceilings where shown. Install main tees, cross tees, and wall moldings so that bottom flanges are in flat, level plane at finish ceiling elevations. Cross tees supported by main tees shall have identical load carrying capacities of main tees. Arrange grid so that opposite wall edge panels are of equal width but not less than one-half panel width, and lay out and erect the grid system to provide the following panel pattern as shown:

    a. Pattern of 24 inch x 24 inch, with main beam tees spaced 48 inches O.C., primary cross tees at 24 inches O.C., and secondary cross tees at 24 inches O.C.

B. Installation

1. Install exposed ceiling grid per ASTM C 636, approved shop drawings, and as specified in this Section.
2. Erect main beams parallel to main wall and to each other; space uniformly at centers as specified in Paragraph "LAYOUT". Stop ends of main beams 1/2 inch from walls to allow for expansion. Furnish main beams in as long lengths as possible to minimize the number of joints in a run. Join lengths of main beams together at hangers only; use special splice pieces. In all ceilings having recessed lighting fixtures, modify grid framing to provide main beams along and parallel to both long sides of the lighting fixtures; at each 12 inch wide fixture, provide an additional main beam along the long side of fixture. At other items recessed in ceiling and designed to be framed by main beams, provide the additional main beams necessary. Rest ends of main beams on horizontal leg of wall moldings.
3. Support main beams with hangers along each run, spaced at not more than four foot centers; except that in areas of steel framing, provide hangers at each intersection of main beam and framing. If ductwork or equipment located in the ceiling plenum area interferes with hanger spacing, provide a trapeze or other arrangement to support the main beams at the proper spacing. Do not secure hangers to metal roof deck, metal floor deck not concrete filled, ductwork, conduit, piping, equipment, or support system for any of these. Provide an additional hanger at each corner of each opening that is to receive a recessed lighting fixture, and of each opening that has been framed by main beam members. Provide additional hangers at each diffuser, grille and other points of extra loading. Secure hangers to main beams to develop the full strength of the hangers and per manufacturer's published directions. Secure hangers to construction above per ASTM C 636 and the following requirements:

    a. Exposed Concrete Slab or Concrete-Filled Metal Floor Deck: Use hanger anchors specifically designed for hanger use.

    b. Steel Beams: Use beam clips.

    c. Steel Trusses and Joists: Wrap hanger wire around lower chord member.

4. Install primary cross tees at right angles to main beam tees and space uniformly at centers as specified in Paragraph "LAYOUT". Join ends of cross tees to web of main beams with a positive interlock; except that at light fixtures, secure members together with concealed steel clips and bolts. Install tees to produce fine-line joints between flanges of abutting members.

    a. At 24 inch x 24 inch grid pattern, install secondary cross tees at right angles to primary tees and space uniformly at centers as specified in Paragraph "LAYOUT", and secure in a manner similar to primary tees.

5. At all locations where ceilings abut walls, columns and other vertical surfaces, install continuous wall molding to trim the ceiling edges. Install molding with bottom horizontal leg at elevation required to support acoustic panel and to be flush with bottom flange of grid members, and with vertical leg concealed. Mechanically fasten moldings to supporting construction at 24 inches on center and within 6 inches of end of each molding piece. Provide tight, inconspicuous butt joints in molding if several pieces are required in any one run. Miter corners where wall moldings intersect or install matching corner caps.

a. At recessed-grid system for reveal-edge lay-in panels, install "W" shaped wall molding, of profile specified, to retain recessed detail at ceiling perimeters.

b. Install reveal-edge panels with face-rabbeted edges resting on bottom flanges of members, with panel surface extending below the bottom flanges.

c. Where reveal-edge panels are cut to fit grid openings less than full size, neatly and accurately field cut a face-rabbeted edge on the cut edges of those panels to match the width and depth of factory face-rabbeted reveal edges.

3.2 Preparation

A. Inspect all substrates and previously placed work to determine suitability and completeness. The start of this work constitutes an acceptance of the existing conditions, and failure of this work due to unsatisfactory existing conditions shall be corrected at no additional cost to the Owner. Similarly, if this work needs to be removed to correct defects in the substrates or previously placed work, both removal and replacement shall be done at no additional cost to the Owner.

3.3 Adhesive Applied Acoustic Ceiling Tile

A. At all locations where ceilings abut walls, columns and other vertical surfaces, install continuous wall molding to trim the ceiling edge. Install molding with bottom horizontal leg at elevation required to support tile, with vertical leg concealed. Bolt moldings to supporting construction at 24 inches on center and within 6 inches of end of each piece in a molding run. Provide tight, inconspicuous butt joints in molding if several pieces are required in any one run.

B. Install tile in square pattern with joints aligned straight and true in both directions and with one run of joints parallel to main wall. Lay out tile in each room or area to have equal margins at opposite sides of room or area but with terminal tiles not less than one half tile width. Provide all special sizes and shapes to complete each installation. Cut tile neatly and accurately to fit closely around all items piercing the finish ceiling plane. Secure tile to substrate by applying five spots of adhesive to back of tile and pressing tile in place. Apply sufficient pressure to flatten each spot of adhesive to provide adhesion over a two square inch area, minimum, and to leave a 1/8 inch air space between back of tile and substrate surface. Joint the corners of adjacent tile with a metal spline engaged in the kerfs.

3.4 Adjusting & Cleaning

A. After the interior finishing work has been substantially completed, or when directed by the Owner's Representative, inspect all acoustical treatment work. Replace all broken, chipped or damaged work, reset units that are loose or out of place, and touch up all marred surfaces with matching paint. Upon completion of the Project, the acoustical treatment finished surfaces shall be clean, and free from dirt and other markings and in good condition acceptable to the Owner's Representative.

096519 - RESILIENT TILE FLOORING

096519.1 GENERAL

1.1 Summary

A. Scope

1. Provide resilient flooring and wall base work as shown, scheduled, or specified, complete with accessories and trim for a finished installation.

B. Related work specified in other sections:

1. Rough carpentry - Division 6.

1.2 Submittals

A. Furnish submittals for items that are identified in this Section by a different typeface and a bracketed code (*e.g., Item [L]*). Refer to Division 1 General Requirements for definition of codes for types of submittals and the administrative requirements governing submittal procedure. Additional submittal requirements pertaining to this Section are specified herein under this Article.

B. Submit product data for resilient flooring material where specified.

C. Submit samples of any substitute resilient flooring materials that are not specified.

D. Test Report: Submit to show that static-conductive flooring installation complies with requirements of Quality Assurance Article.

E. Submit maintenance data for care and cleaning of resilient flooring materials per Division 1 requirements.

1.3 Maintenance Material Submittal

A. Furnish to the Owner extra materials for maintenance purposes of each material provided, of same lot, run or batch used, including but not limited to the following:

1. Floor Tile: Not less than 2% (to the nearest full carton) of the amount of each type and color installed.

2. Resilient Base: One full carton (24 pieces) of each type and color.

1.4 Quality Assurance

A. Fire Hazard Classification:

1. Fire Hazard Classification: Resilient flooring materials shall have a Critical Radiant Flux Classification of Class I, not less than 0.45 watts/sq. cm. when tested per ASTM E648 or NFPA 253 by a qualified testing agency.

1.5 Product Storage

A. Deliver products to the Project site in manufacturer’s original, unopened cartons and containers, each bearing names of product and manufacturer, Project identification, and shipping and handling instructions.

B. Store products in dry spaces protected from the weather, with ambient temperatures maintained between 50 and 90 degF (10 an 32 degC).

C. Move products into spaces where they will be installed at least 48-hours before installation, unless longer conditioning periods are recommended in writing by the manufacturer.

1.6 Project Conditions

A. Environmental Requirements

1. Rooms or areas scheduled to receive resilient flooring shall be continuously maintained at not less than 70 degF

from at least 48 hours prior to installation to at least one week after installation.

B. Protection

1. Protect completed work from traffic and damage with durable temporary coverings. Do not allow traffic during first 24 hours after installation of resilient flooring materials.

C. Sequencing, Scheduling

1. Do not start installation of resilient flooring until other finish work, including painting, has been completed in each room or area.

096519.2 PRODUCTS

2.1 Solid Vinyl tile

A. *Luxury Plank Flooring Tile[P]:* Face size 4 inch x 6 inch,, per ASTM F1700, pattern extending through entire body of tile. Provide tile to match colors/patterns specified in Finish Schedule. Provide tile having fire hazard classification specified in "Quality Assurance" Article.

1. American Builtrite, “Solid Vinyl Tiles”
2. Mannington Mills, Inc., “Amtico Collections Solid Vinyl Tile”
3. Armstrong World Industries, Inc., “Natural Creations Luxury Vinyl Tile”
4. Centiva, "Vinyl Tile and Plank"
5. Flexco, "Contract Solid Vinyl"
6. Gerflor, "Luxury Vinyl Tile"
7. Johnsonite, A Tarkett Company, "Vinyl Flooring"
8. Roppe Corporation, "Premium Vinyl Tile"

2.2 Resilient Base

A. *Vinyl Resilient Base [P]:* 4 inch and 6 inch high by 1/8 inch thick, conforming to ASTM F1861, Type TV, Group I homogeneous, Style B cove in all areas, in colors to match those specified in Finish Schedule. Provide manufacturer’s standard preformed corner units to match base. Provide in coils of manufacturer's standard lengths.

1. Armstrong World Industries, Inc., “vinyl cove base”
2. Flexco “vinyl cove base”
3. Johnsonite, A Tarkett Company, “vinyl cove base”
4. Roppe Corporation, "vinyl cove base"
5. VPI Corporation, "vinyl cove base"

2.3 Resilient Molding Accessories

A. *Resilient Molding Accessories [P]:* Shapes as indicated, solid standard color as selected or as required to match or coordinate with adjacent resilient floor coverings, of homogeneous vinyl or rubber.

1. Shapes: Provide manufacturer's standard profiles and dimensions for each item, unless otherwise indicated:
   a. Stair-tread nosing
   b. Cap for cove carpet
   c. Cap for cove resilient flooring
   d. Carpet bar for tackless installations
   e. Carpet edge for glue-down applications
   f. Reducer strip for resilient flooring
   g. Joiner for tile and carpet
   h. Transition strips
2. Manufacturers:
   a. Armstrong World Industries, Inc.
   b. Burke Mercer Flooring Products, division of Burke Industries, Inc.
   c. Flexco
   d. Johnsonite, A Tarkett Company
   e. Roppe Corporation, USA

2.4 Installation Accessories

A. Adhesives: Approved waterproof adhesives and cements of brands and types recommended and guaranteed by the approved resilient materials manufacturers for application of resilient materials to the various types of surfaces to be covered.

B. Seamless Installation Accessories
   1. Heat Welding Bead: tile manufacturer's standard sold-vinyl bead for heat-welding seams.
   2. Chemical Bonding Compound: Product of tile manufacturer for chemically bonding seams.

C. Cleaning and Waxing Materials:

Hillyard Chemical Co.	“Super Shine-All” cleaner,
	“Hil-Tex II” sealer, and
	“Super Hil-Brite” wax
Huntington Laboratories,	In“Hawk” cleaner,
	“Umbrella” sealer, and
	“Umbrella Contrast” wax
Vestal Laboratories	“Briten All” cleaner,
	“Sealer 5” sealer, and
	“Style” wax

D. Underlayment Material: Trowelable latex-modified portland cement or blended hydraulic-cement- based formulation provided or approved by the tile manufacturer for application indicated.Installation Accessories for Static-Control Tile
   1. Static-Control Adhesive: For static-control tile installations, provide adhesive supplied or approved by tile

manufacturer. Adhesive shall maintain the electrical continuity of the tile-installation-to-ground connection.

2. Grounding Strips: Provided or approved by tile manufacturer, of type that maintains electrical continuity of tile-installation-to-ground connection.

096519.3 EXECUTION

3.1 Preparation

A. Clean and prepare surfaces as required to receive adhesives and resilient materials. Remove all surface contaminants that would prevent bonding of resilient materials. Remove all dirt, loose and scaly surfaces, mortar and plaster droppings, surface projections and unsound areas.

B. Fill all cracks, holes and low spots to produce a smooth, even surface; use specified manufacturer's approved latex underlayment.

C. Provide Calcium Chloride test on scheduled concrete slab areas to receive resilient flooring according to ASTM F1869, "Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Sub floor Using Anhydrous Calcium Chloride" to insure concrete slab acceptability. Remove curing agents in and around the test area prior to conducting test. Test results shall fall within flooring manufacturer's acceptable levels prior to installation.

D. Provide a 72-hour Qualitative Bond Test in a 48-inch by 48-inch area using the specified adhesives. Remove of curing agents, old adhesives, inhibitors, oil and grease in the scheduled area prior to test to assure proper installation.

E. Provide Alkali test on scheduled concrete slab areas to insure concrete slab acceptability. Remove curing agents in and around the test area prior to conducting test. Test results shall fall within flooring manufacturer's acceptable pH levels prior to installation.

F. Provide waterproof underlayment application where slab fails to meet the tests required prior to installation.

G. For wood subfloors, verify the following:

1. Underlayment over subfloor complies with requirements specified in "Rough Carpentry"- Division 6.

2. Underlayment surface is free of irregularities and substances that may interfere with adhesive bond, show through surface, or stain floor.

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

3.2 Installation

A. General

1. Install all materials as recommended by the manufacturer and per the additional requirements of this Section. Align all joints and lay all joints tight with each finished surface in flush, true plane. Roll or press all materials in place to insure contact with sub-surfaces.

B. Floor Tile

1. Center each room or area with respect to the principal permanent walls and start laying tile from such centers. Apply adhesive to substrates. Lay tiles to show grain or pattern running in one direction only. Where field pattern does not work out to full units at perimeter, lay out the pattern to provide perimeter units of equal width, but not less than half tile wide. Where tile is same pattern and color for adjacent rooms or areas, continue tile through doorways. At depressed floor covers for embedded utility boxes, fill covers with accurately cut and fitted tile firmly cemented to cover.

2. Where tiled floor terminates at an untiled floor, install continuous reducer strip.
3. Install proper type of threshold as scheduled or indicated.

C. Resilient Base

1. Install resilient base in adhesive on all vertical surfaces scheduled and indicated; continue into all recesses, closets, projections, and on toe spaces of equipment or cabinet items as required. Use longest lengths practicable.
2. Install preformed corner units at all corners.
3. Field-form all corners, heating and cooling base as necessary to permanently set the shape; notch and miter cove for inside corners; use long lengths to form corners so as to extend beyond corners as far as possible, but not less than 6 inch from corner.

3.3 Field Quality Control

A. Testing Static-Control Tile Installations: Engage a qualified testing agency to test electrical resistance of static-control resilient flooring for compliance with requirements.

1. Arrange for testing after static-control adhesives have fully cured and static-control resilient flooring has stabilized to ambient conditions and after ground connections are completed.
2. Replace defective flooring installations. Static-control resilient flooring will be considered defective if it does not pass tests and inspections.

3.4 Adjusting & Cleaning

A. Clean adhesives from adjacent finished surfaces as the work progresses; pay all costs incurred if adjacent finished surfaces cannot be cleaned to their original condition and need to be repaired or replaced.

B. Clean all resilient flooring materials upon completion of installation. Apply one coat of sealer and two separate machine-polished coats of wax on all resilient flooring materials, except rubber products. Apply first coat of wax immediately after cleaning and sealing; apply final coat of wax just prior to occupancy by the Owner.

C. When so directed, or prior to final waxing, adjust and straighten misaligned materials, replace or re-cement loose materials and replace broken, cracked, chipped or scratched materials.

096800 - CARPETING

096800.1 GENERAL

1.1 Summary

A. The following manufacturers are approved for supply of Modular Carpet Tiles and Modular Walk-off Tiles only and applicable to GM Facilities North America Facilities:

1. Shaw
2. Interface Americas Inc.

B. Scope

1. Provide all material and installation as shown, scheduled or specified on construction documents, complete with all accessories and trim for a finished installation for the following:

a. Modular carpet tile.

C. Related Work Specified In Other Sections

1. Ceramic tile floors – Division 9.
2. Resilient flooring and base material – Division 9.

1.2 Submittals

A. Furnish submittals for items that are identified in this Section by a different typeface and a bracketed code (*e.g., Item [L]*). Refer to Division 1 for definition of codes for types of submittals and the administrative requirements governing submittal procedure. Additional submittal requirements pertaining to the Section are specified herein under this Article.

B. Product Data: For each type of product indicated. Include manufacturer's written data on physical characteristics, durability, and fade resistance. Include installation recommendations for each type of substrate required.

C. Shop Drawings: Show the following:

1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet.
2. Existing flooring materials to be removed.
3. Existing flooring materials to remain.
4. Carpet type, color, and dye lot.
5. Locations where dye lot changes occur.
6. Seam locations, types, and methods.
7. Type of sub floor.
8. Type of installation.
9. Pattern type, repeat size, location, direction, and starting point.
10. Pile direction.
11. Type, color, and location of insets and borders.
12. Type, color, and location of edge, transition, and other accessory strips.
13. Transition details to other flooring materials.

D. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.

1. Modular Carpet Tile: Full-Size.
2. Exposed Edge Strip and Accessories: 12-inch long.

E. Product Schedule: Use same room and product designations indicated on Drawings and in schedules.

F. Maintenance Data: Include in maintenance manuals specified in Division 1. Include the following:

1. Methods for maintaining carpet, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.

2. Precautions for cleaning materials and methods that could be detrimental to carpet.

1.3 Quality Control

A. Installer Qualifications: Installer shall be certified by the Floor Covering Installation Board and shall have completed a minimum of five projects of similar size, scope, and material specified. Provide evidence of successful project performance upon request of the Owner.

B. Carpeting of each pattern and color shall be from the same dye lot.

C. Requirements of Regulatory Agencies:

1. Carpet shall be tested in accordance with NFPA 253 or ASTM E648 by a qualified testing agency for flame spreading characteristics and achieve the following Critical Radiant Flux Classification:

   a. Class II, not less than 0.22 watts/sq. cm.

2. Where required by authorities having jurisdiction, test carpet, primary and secondary backings for smoke density according to ASTM E662. Provide component testing, unless composite testing is required by authorities having jurisdiction for full composite installation.

D. Performance Characteristics:

1. Dry Breaking Strength: Not less than 100 lbf (445 N) per ASTM D2646.

2. Colorfastness to Crocking: Not less than 4, wet and dry, per AATCC 165.

3. Colorfastness to Light: Not less than 4 after 40 AFU per AATCC 16.

4. Antimicrobial Activity: Not less than 2-mm halo of inhibition for gram-positive bacteria; not less than 1-mm halo of inhibition for gram-negative bacteria; no fungal growth; per AATCC 174.

E. Mockups: Construct mockups for each finish and construction specified prior to installation of the Work. Mockup shall demonstrate the installed conditions of material quality and workmanship. Mockups shall comply with the following requirements:

1. Locate mockups on-site in the location and of the size directed by Owner.

2. Notify Owner within seven days of the dates that the mockups will be constructed.

3. Obtain Owner's approval of mockups before start of the Work.

4. Retain and maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.

5. Remove mockups from Project site when directed by the Owner.

6. Approved mockups installed, as part of the Work area left in an undisturbed condition may become part of the completed Work as inspected and approved by the Owner.

1.4 Product Delivery, Storage & Handling

A. Deliver products to the Project Site in their original unopened packages or containers with manufacturer’s name, brand name, carpet size and dye lot, and other pertinent data clearly marked thereon.

B. Comply with CRI 104.

C. Store products at the Project site in an approved location in their original packages or containers, in a place providing protection from damage and soiling and exposure to wet and damp surfaces, and at a temperature of at least 65 degrees F for not less than 24 hours immediately prior to installation.

1.5 Project Conditions

A. Install carpeting only when ventilation, temperature, and humidity conditions comply with requirements of CRI 104. Spaces shall be enclosed and weathertight, wet work shall be complete and dry, and ambient temperature and humidity conditions shall be as they will exist when the building is occupied.

B. Do not install carpet over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet manufacturer.

C. Where demountable partitions or other items are indicated for installation on top of carpet, install carpet before installing these items.

096800.2 PRODUCTS

2.1 Carpeting and Pads

A. Carpet Tile

1. With synthetic backing for direct glue- down type installation, manufactured by:

a. CPTT-1

1) Manufacturer: Shaw Contract Group
2) Style Number: 5T062
3) Construction: Multi-level pattern loop
4) Fiber: Eco Solution q nylon
5) Dye Method: 77% solution dyed method.
6) Pattern Repeat: None
7) Tufted Weight: 24.0
8) Gauge: 1/12
9) Stitches per inch 10.5
10) Finished Pile Thickness: 0.111
11) Total Thickness: .267
12) Product Size: 18"x36"
13) Primary Backing: Synthetic
14) Protective Treatments: ssp shaw soil protection

b. CPTT-2

1) Manufacturer: Shaw Contract Group
2) Style Number: 5T060
3) Construction: Multi-level pattern loop
4) Fiber: Eco Solution q nylon
5) Dye Method: 66% solution dyed method.
6) Pattern Repeat: None

7) Tufted Weight: 24.0
8) Gauge: 1/12
9) Stitches per inch 10.0
10) Finished Pile Thickness: 0.122
11) Total Thickness: .267
12) Product Size: 18"x36"
13) Primary Backing: Synthetic
14) Protective Treatments: ssp shaw soil protection

c. CPTT-3
1) Match existing borders

2.2 Accessories

A. Carpet Adhesive: Non-toxic, waterproof type adhesive formulated particularly for installing carpet as per manufacturer's recommendations. Submit literature for approval.
1. Use a release-type adhesive for modular carpet tile. Alternatively, use pressure sensitive adhesive tabs or strips.

B. Carpet Reducer Strips: Solid vinyl of thickness to suit carpet, with waterproof type adhesive recommended by reducer strip manufacturer for application of to concrete substrate:
1. Burke Floor division of Burke Industries
2. Johnsonite, a Tarkett company

C. Metal Reducer Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints.
1. Schluter Systems L.P.

D. Protective Paper Covering: Heavy-duty, non-staining construction paper with compatible masking tape:
1. Fortifiber Building Systems Group. "Seekure"

E. Underlayment Materials: Latex-modified hydraulic-cement type as supplied or recommended in writing by the carpet, for patching defects in substrates to receive carpet systems:

096800.3 EXECUTION

3.1 Examination

A. Examine substrates, areas, and conditions for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet performance. Verify that substrates and conditions are satisfactory for carpet installation and comply with manufacturer's written requirements.

3.2 Preparation

A. Clean and prepare surfaces as required to receive adhesives and carpet materials and remove all surface curing compounds, oil, moisture, dirt, loose and scaly surfaces, mortar and plaster droppings, surface projections and unsound areas that would prevent bonding of carpet materials.

B. Fill all cracks, holes and low spots with specified latex underlayment. Grind high spots to produce smooth, even substrate surfaces. Use trowel able leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.

C. Clear away debris and scrape up cementitious deposits from surfaces to receive carpeting; vacuum clean immediately before installation. Check concrete surfaces to ensure no “dusting” through installed carpet; apply sealer where required to prevent dusting.

D. Comply with CRI 104 and carpet manufacturer's written installation instructions.

E. Broom and vacuum clean substrates to be covered immediately before installing carpet. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Proceed with installation only after unsatisfactory conditions have been corrected.

F. Recycling Requirement - Remove and palletize full carpet tiles to be shipped to the selected carpet manufacturer for recycling. There is a minimum 500 square yard requirement to initiate this recycling requirements.

3.3 Installation

A. Modular Carpet Tile and Walk-Off Carpet:

1. Comply with CRI 104, Section 14, "Carpet Modules."
2. Installation Method: As recommended in writing by carpet tile manufacturer.

B. Comply with carpet manufacturer's written recommendations for seam locations and direction of carpet; maintain uniformity of carpet direction and lay of pile. At doorways, center seams under the door in closed position.

C. Do not bridge building expansion joints.

D. Cut and fit carpet to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet manufacturer.

E. Extend carpet into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on sub floor. Use non-permanent, non-staining marking device.

G. Install carpet cushion seams at 90-degree angle with carpet seams.

H. Lay with all rows parallel, with tuft running in the same direction throughout. The use of carpet patch pieces will not be permitted. Accurately cut and fit tight to walls and projections.

I. Install all materials in strict accordance with the manufacturer’s printed instructions, directly to sub-floor floors, using application technique recommended by the adhesive manufacturer.

J. Install carpeting in dye lot and run sequence, matching color and pile height at the juncture of all roll breadths.

K. Install carpet flat, smooth, without bulges, ridges, wrinkles, etc. Lay work true, even, with tight joints, surfaces flush and set firmly against thresholds and divider strips. Scribe to within 1/16-inch of all obstructions.

L. Install transition edge strips at exposed edges of carpet, located in accordance with approved layout shop drawings and where noted or scheduled; use one-piece full lengths for each edge. Anchor strips securely in place.

M. Finished installation shall be free of tears, frays, pulls, loose seams, loose edges, and spots, dirt, soil and stains that

cannot be removed by cleaning.

3.4 Cleaning

A. Perform the following operations immediately after installing carpet:

1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet manufacturer.
2. Remove yarns that protrude from carpet surface.
3. Vacuum carpet using commercial machine with face-beater element.

B. Protect installed carpet to comply with CRI 104, Section 16, "Protection of Indoor Installations."

C. Protect carpet against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet manufacturer.

097200 - WALL COVERINGS

097200.1 GENERAL

1.1 Summary

A. Scope

1. Provide wall treatment as shown, scheduled or specified, with accessories and trim for a complete installation. Include:
   a. Flexible, durable polyester marker board wallcovering.

B. Related Work Specified In Other Sections

1. Gypsum board – Division 9.
2. Resilient surface base - Division 9.
3. Painting- Division 9.

1.2 Submittals

A. Furnish submittals for items that are identified in this Section. Refer to Division 1 General Requirements for definition of codes for types of submittals and the administrative requirements governing submittal procedure. Additional submittal requirements pertaining to this Section are specified herein under this Article.

B. Submit 6 inch x 6-inch size samples of each type, color and pattern of wall covering.

C. Deliver to Owner, copies of wall covering manufacturer’s list of recommended maintenance products and recommended maintenance methods and procedures per Division 1.

D. Turn over to Owner for his use, all usable wall covering excess material and scrap pieces larger than 12 inches in the smallest dimension, packaged and labeled on the package as to what type material and pattern is contained therein and in what area of the building it was used.

E. Provide to Owner testing results required under Quality Control in this section for each wall covering specified.

1.3 Quality Assurance

A. Installer Qualifications: Installer shall have completed a minimum of five projects of similar size, scope, and material specified. Provide evidence of successful project performance upon request of the Owner.

B. Requirements of Regulatory Agencies

1. Fire Hazard Classification: Determined by testing wall covering products and adhesives identical to those provided for the Project. Tests shall be conducted by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

a. Surface Burning Characteristics: For wall coverings having a thickness of 0.036" or more, or not directly applied to wall surface, provide products tested by a qualified testing agency in accordance with ASTM E84. Provide products with testing agency's markings.

1) Flame-Spread Index: 25 or less.

2) Smoke-Developed Index: 450 or less.

b. Fire-Growth Contribution: No flashover and heat and smoke release according to NFPA 286 for any wall covering, or according to NFPA 265 for textile and expanded vinyl wall coverings.

C. Material Uniformity

1. Provide wall covering of each pattern and color from the same factory production run to maintain uniformity of color, pattern, and texture.

D. Mockups: Construct mockups for each finish and construction specified prior to installation of the Work. Mockup shall demonstrate the installed conditions of material quality and workmanship. Mockups shall comply with the following requirements:

1. Locate mockups on-site in the location and of the size directed by Owner.
2. Notify Owner within seven days of the dates that the mockups will be constructed.
3. Obtain Owner's approval of mockups before start of the Work.
4. Retain and maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
5. Remove mockups from Project site when directed by the Owner.
6. Approved mockups installed as part of the Work area left in an undisturbed condition may become part of the completed Work as inspected and approved by the Owner.

1.4 Product Delivery, Storage & Handling

A. Deliver products to site in manufacturer’s original unbroken containers bearing manufacturer’s name, brand name, color, pattern, weight and fire hazard classifications.

B. Store products in their original packages or containers in a dry place having not less than 70 degF temperature for at least 24 hours prior to installation.

C. Transport and store wall covering, adhesives and pastes in heated, dry and enclosed units. Any materials damaged by freezing or moisture will be rejected.

1.5 Project Conditions

A. Existing Conditions

1. Examine all surfaces in place on which specified work is to be applied. Notify Owner's Representative in writing of any defects, which may influence satisfactory completion, and performance of the Work. Commencement of wall covering installation will be construed as work in place being acceptable and satisfying the requirements of this Section.
2. Take field measurements to verify and supplement dimensions shown, and be responsible for accurate fit of the Work.
3. Field verify all surfaces to receive wall covering. Identify questionable joints and transitions.

B. Environmental Requirements

1. Installation: Wall covering when space is enclosed and weathertight, substrate is dry, ceiling work is complete, and ambient temperature and humidity conditions are maintained at values near the conditions intended for final occupancy.
2. Lighting: Install wall covering at lighting levels of not less than 15 foot-candles (160 lux) on the surfaces to receive wall covering.
3. Ventilation: Provide continuous ventilation during installation and for not less than the time recommended by the wall covering manufacturer.

1.6 Extra Materials

A. Provide attic stock materials of each material and color specified matching the manufacturer's pattern and color run. Material shall be packaged with a protective cover for long term storage with labels identifying the contents by manufacturer, pattern, color, run, and color code established in the finish schedules.

1. Wall Covering Material: provide five-percent of the amount of each pattern and color in full-size, undisturbed rolls.

097200.2 PRODUCTS

2.1 Materials

A. Markerboard Wall Coverings

1. Approved Product and Manufacturers:
   a. 3M DI-NOC Whiteboard Finish WH-111.
2. Provide markerboard wall covering where scheduled.

097200.3 EXECUTION

3.1 Examination

A. Examine substrates for compliance with requirements for moisture content and other conditions affecting performance of Work of this Section. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 Preparation

A. Clean wall surfaces receiving wall covering and assure surfaces are free from oils, dirt, dust and other foreign materials detrimental to achieving the required bond and a smooth surface. Patch all holes and cracks in wall surfaces and sand smooth; remove all bumps and protrusions and sand smooth.

B. Prepare substrates to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, and defects.

C. Acclimatize wall covering materials by removing them from packaging in the installation areas not less than 24 hours before installation.

D. Before installing wall covering, remove switch plates, convenience outlet plates and similar items in place, and upon completion of wall covering in an area, replace such removed items.

3.3 Installation

A. Comply with wall coverings manufacturers' written installation instructions applicable to products and applications indicated, except where more stringent requirements apply.

3.4 Adjusting & Cleaning

A. The completed wall covering work shall be free of open joints, air pockets, bubbles, wrinkles, loose joints and edges, mismatched patterns, scratches, tears and gouges, stains, unraveling at cuts and joints, and distorted weaves and patterns.

B. Immediately after hanging wall covering in an area, remove soil and excess adhesive from the wall covering, and adjacent surfaces by manufacturer’s approved methods.

C. Upon completion of the Work or when directed, replace or re-adhere loose wall coverings; replace all torn, scratched, stained, and gouged wall coverings; and clean wall coverings, to the satisfaction of the Owner’s Representative.

099000 - PAINTING AND COATING

099000.1 GENERAL

1.1 Summary

A. Scope

1. Provide all material, labor and equipment to produce painted and finished surfaces as shown and scheduled on the

Drawings and as specified herein, to provide properly finished surfaces throughout. This Section, in conjunction with the color/finish schedules on the Drawings or in the Specifications or issued separately, establishes the scope of the painting work, the surfaces to be painted, and the paint systems to be used.

a. Interior items and surfaces that are exposed.

b. Surface preparation, priming, and finishes in addition to shop primers and treatment of surfaces specified elsewhere.

c. Also included herein is the painting of all exposed mechanical and electrical work such as metal piping (including color coding), conduit, ductwork, supports, ironwork, equipment and fixtures, except items which are factory finished.

d. Also paint existing surfaces where scheduled.

e. Also paint all relocated existing painted items.

f. General Motors GM NAO Piping Systems Identification Standards SD 3-95 (GM-2010) apply to this section.

g. General Motors colors chart, North American Facilities Standard Colors for Facilities, Machinery and Equipment.

2. Do not paint exposed surface where the paint, color or room finish schedules indicate that a surface is not to be painted or remain natural. If the paint, color or room finish schedule does not identify a surface or item to be painted, paint the surface or item the color and finish of adjacent surfaces and materials, even if the schedules do not indicate finish or color. Verify color and finish with the Owner's Representative.

B. Related work specified in other sections:

1. Surface preparation of gypsum board assemblies – Division 9.

2. Substrate sealers for wallcoverings – Division 9.

3. Painting of mechanical and electrical work – Divisions 21, 22, 23 and 26.

4. Providing of temporary protective covers on fire protection sprinkler heads – Division 21.

C. Do not paint the following:

1. Do not paint the following finished metal surfaces:

a. Anodized aluminum.

b. Stainless steel.

c. Chromium plate.

d. Copper.

e. Bronze and brass.

2. Do not paint the following concealed surfaces in inaccessible areas:

a. Cavities behind furred surfaces.

b. Within ceiling plenums.

c. Within pipe and duct shafts.

3. Do not paint the following prefinished or factory finished items:

a. Architectural woodwork, casework, and millwork (solid surface, plastic laminate, or shop-finished wood surfaces).

b. Acoustical wall panels.

c. Metal toilet partitions.

d. Metal lockers.

e. Finished mechanical and electrical equipment.

f. Light fixtures.

4. Do not paint moving and operating parts of equipment.

a. Valve handles, knobs and controls.

b. Damper operators and controls.

c. Linkages.

d. Sensor components.

e. Shafts for fans and motors.

5. Do not paint code inspection labels such as (UL) Underwriters or (FM) Factory Mutual labels.

6. Do not paint identification and utility information labels on mechanical and electrical equipment.

D. Repaint work is required as part of the work specified in this Section. Paint existing painted or finished surfaces that are altered marred or damaged the same as specified for new surfaces. Match color and sheen of existing surfaces unless indicated otherwise. Extend all such painting to a suitable boundary to avoid a patched effect. Suitable boundaries are changes in planes of surfaces such as corners, frames, moldings and recesses.

1.2 Definitions

A. General: Paint includes factory-formulated emulsions, enamels, paints, stains, sealers, varnishes, epoxies and other coatings, whether used as prime, intermediate, or finish coats.

B. Terminology: ASTM D16

C. Exposed Surfaces

1. “Exposed surfaces” means all surfaces or areas visible when the permanent construction is completed, and when all built-in cabinets, fixtures, convector covers, grilles and similar items are in place. “Exposed surfaces” shall include all surfaces or areas in back of cabinets, furniture, equipment and other items that are not built-in or fixed in place, and also shall include all surfaces visible thru grilles, louvers and registers, and all roof-mounted ferrous metal items.

D. Gloss: Range per Master Painter's Institute (MPI).

1. Gloss Level 1 (Designated "Flat"): Matte finish with a maximum gloss of 5 units when measured at 60 degrees and maximum sheen of 10 units when measured at 85 degrees.

2. Gloss Level 3 (Designated "Eggshell"): Low sheen finish with a gloss range between 10 and 25 units when measured at 60 degrees and a sheen range between 10-35 units when measured at 85 degrees.

3. Gloss Level 4 (Designated "Satin"): Low sheen finish with a gloss range between 20 and 35 units when measured at 60 degrees and a minimum sheen of 35 units when measured at 85 degrees.

4. Gloss Level 5 (Designated "Semi-Gloss"): Medium gloss finish with a gloss range between 35 and 70 units when measured at 60 degrees.

5. Gloss Level 6 (Designated "Full Gloss"): High gloss finish with a gloss range between 70 and 85 units when measured at 60 degrees.

E. Ceiling Areas: Reference to “ceilings” is not limited to building areas having finished ceilings. Ceilings in spaces not having a “finished” ceiling is defined as all surfaces above a horizontal plane, the elevation of which is determined by

the bottom surface of the primary structural members supporting the roof deck or floor slab above.

1.3 Submittals

A. Furnish submittals for items that are identified in this Section by a different typeface and a bracketed code (*e.g., Item [L]*). Refer to Division 1 General Requirements for definition of codes for types of submittals and the administrative requirements governing submittal procedure. Additional submittal requirements pertaining to this Section are specified herein under this Article.

B. *Paint Product Data [P]:* Provide product data for each painting system including fillers and primers.

1. Provide a material list of all coatings and paints. Cross reference each specific coating, finishing system and application with each material and identify each material by catalog number of the manufacturer and general classification.
2. Provide manufacturer's application instructions and technical information regarding label analysis, storage and handling.
3. The manufacturer shall certify that coating and paint materials comply with regulations of local jurisdictions and for use of volatile organic compounds (VOC's).
4. Provide Material Safety Data Sheets indicating products are lead and chromate free.

C. Provide color charts from manufacturer's full range of colors for all finish coats indicated.

1. Architect will furnish color chips of selected colors for surfaces to be painted.

D. *Paint Color Samples [S]:* Provide color samples of each color on each material substrate simulating actual conditions and textures.

1. Provide stepped samples showing each coat, including fillers and primers.
2. Label each sample indicating location and application.
    a. Stained or clear wood finishes: Provide 6 by 6 inch samples of wood finishes.
    b. Ferrous metal: Provide 6 inch by 6 inch samples of metal color and finishes.

E. Qualification Data: Provide qualification data for firms and personnel specified in "Quality Assurance" indicating performance, experience and capability. Provide list of references and completed projects, including names and addresses of owners and clients.

1.4 Quality Assurance

A. The Work of this Section shall be carried out by an approved applicator having specialized in this Work as its primary business for at least 5 years, and having performed satisfactorily Work of this type, size and scope.

B. Provide undercoating fillers, primers and finish coating materials from one manufacturer.

C. Sample Areas

1. Paint sample areas not less than 30 square feet, in locations as directed by the Owner's Representative, to establish standards of quality and workmanship to be expected of painting Work on the PROJECT. Sample painted areas will be inspected by the Owner's Representative, and, if approved, will be used as a basis by which the acceptability of the completed painting on the PROJECT will be judged.
2. Apply sample coatings to each surface as indicated in the paint, color or room finish schedules providing specified, sheen, color or texture after permanent lighting has been activated.
3. Color approval will be based on field applied sample areas.

1.5 Delivery Storage & Handling

A. Delivery

1. Deliver specified products to site in unopened, sealed containers bearing manufacturer's name, brand name, type and color of paint, and instructions for application, including the following:
    a. Product name or title of material.
    b. Product description.
    c. Manufacturer's stock number and date of manufacture.
    d. Contents by volume, for pigment and vehicle constituents.
    e. Thinning instructions.
    f. Color name and number.
    g. VOC content.

B. Storage

1. Store products in the space designated for the storage and mixing of paint. Whenever it may be necessary to change the location of storage space, promptly move products to the newly designated space, without additional cost to the Owner.
2. Refer to the article "Protection" in Part 3.
3. Store paint materials in ventilated areas at a minimum temperature of 45 degF [**7 degC**]. Keep containers tightly covered. Maintain containers and storage area in clean condition.
4. Protect paint materials storage space from damage. Remove contaminated rags and waste from premises every day. Take all precautions to prevent fire, including spontaneous combustion.
5. Unless a room or area in the building is designated by the Owner's Representative for storage of paint materials, provide a temporary outside storage shed for storage of paint materials.
6. If the Owner's Representative designates temporary storage space in the building, store materials so that they do not interfere with the Owners operations or the work of others. Move materials when directed to do so by the Owner's Representative at no cost to the Owner. Protect existing surfaces from damage or defacement. On completion of painting operations, leave temporary storage spaces in building clean.
7. Comply with provisions specified under "Fire Protective Measures" of the "Construction General Conditions." Take every precaution to avoid spontaneous combustion. Keep cloths, cotton waste, oily rags, and similar fire hazardous, combustible materials in metal containers. Remove containers from the building every night.

1.6 Project Conditions

A. Environmental Requirements

1. Do not apply water based paints when ambient and surface temperatures are less than 50 degF (10 degC) or greater than 90 degF (32 degC).
2. Do not apply solvent based paints when ambient and surface temperatures are less than 45 degF (7.2 degC) or greater than 95 degF (35 degC).
3. Do not apply paint in damp, rainy, foggy or misty weather or to damp or wet surfaces.
4. Do not apply paint when the relative humidity is greater than 85% or when temperatures are less than 5 degF (3 degC) above the dew point.
    a. Interior painting is allowed in damp and rainy weather when the interior areas are enclosed and heated and

ventilated in accordance with the temperature and humidity requirements of the manufacturer.

B. Provide all scaffolds, drop cloths, ladders and other equipment required for the proper execution of the work.

099000.2 PRODUCTS

2.1 Manufacturers

A. Products: Provide products listed in Part 2 Articles.

B. Manufacturers:

1. Benjamin Moore & Co.
2. Akzo Nobel Paints LLC (International Paint and Devoe Coatings)
3. PPG Industries, Inc. (PPG Paints and Glidden Professional)
4. Sherwin-Williams Co.

2.2 Paint Materials, General

A. Provide approved paint material supplied from approved manufacturer for each paint type required.

B. Provide block fillers, primers, and finish-coat materials that are compatible as one system and compatible for the substrates indicated.

C. Provide manufacturer's best-quality paint material for coatings specified. Provide paints recommended by manufacturers for application indicated. Provide paint containers with manufacturer's standard identification labels.

D. Colors: Match samples.

E. Lead- and chromate free paints and coatings: Provide entirely lead-free and chromate-free paints, including primers, block fillers and subsequent coats. Coatings and paints of any kind containing lead and chromate are prohibited from use in General Motors facilities. If a product containing lead or chromate is specified by brand name, numerical designation, color code number, or by another method, advise the Owner's Representative and provide lead- and chromate free alternative products and colors.

2.3 Preparatory Coats

A. Interior Primer: Interior latex-based or alkyd primer of finish coat manufacturer and recommended in writing by manufacturer for use with finish and on substrate indicated.

1. Ferrous-Metal Substrates: Quick drying, rust-inhibitive metal primer.
2. Zinc-Coated Metal Substrates: Galvanized metal primer.
3. Where manufacturer does not recommend a separate primer formulation on substrate indicated, use paint specified for finish coat.

2.4 Interior Finish Coats

A. Interior Flat Acrylic Paint:

1. Benjamin Moore ; Ultra Spec 500 Interior Flat Finish N536.

2. Glidden Professional ; 1200N Ultra Hide 250 Interior Flat Latex
3. International Paint/Devoe Coatings ; Devcryl 1440 Water-borne Acrylic Matte Primer/Finish
4. PPG Paints ; 6-70 Line SpeedHide Interior Wall Flat-Latex Paint.
5. Sherwin-Williams' ; ProMar 200 Zero VOC Flat B30W2600 Series.

B. Interior Flat Latex-Emulsion Size:

1. Benjamin Moore ; Ultra Spec 500 Interior Flat Finish N536.
2. Glidden Professional ; 1200N Ultra Hide 250 Interior Flat Latex
3. International Paint/Devoe Coatings ; Devcryl 1440 Water-borne Acrylic matte Primer/Finish
4. Pittsburgh Paints ; 6-70 Line SpeedHide Interior Latex Flat Wall Paint.
5. Sherwin-Williams ; ProMar 200 Zero VOC Flat B30W2600 Series.

C. Interior Eggshell Acrylic Enamel:

1. Benjamin Moore ; Ultra Spec 500 Interior Eggshell Finish N538.
2. Glidden Professional ; 1402N Ultra Hide 250 Interior Semi-Gloss
3. International Paint/Devoe Coatings ; Devcryl 1440 Water-borne Acrylic Matte Primer/Finish
4. PPG Paints ; 6-411 Series Speed Hide Eggshell Acrylic Latex Enamel.
5. Sherwin-Williams ; ProMar 200 Zero VOC Eg-Shel B20W2600 Series.

D. Interior Semi-Gloss Acrylic Enamel:

1. Benjamin Moore ; Ultra Spec 500 Interior Semi-Gloss Finish N539.
2. Glidden Professional ; 1406N Ultra Hide 250 Interior Semi-Gloss
3. International Paint/Devoe Coatings ; Devcryl 1449 Water-borne Acrylic Gloss Finish
4. PPG Paints ; 6-500 Series SpeedHide Interior Semi-Gloss Latex.
5. Sherwin-Williams ; ProMar 200 Zero VOC Semi-Gloss B31W2600 Series.

E. Interior Full-Gloss Acrylic Enamel:

1. Benjamin Moore ;Super Spec High Performance DTM Acrylic Gloss Enamel P28.
2. Glidden Professional ; 3028N Ultra Hide 250 Interior/Exterior Acrylic Gloss
3. International Paint/Devoe Coatings ; Devcryl 1449 Water-borne Acrylic Gloss Finish
4. PPG Paints ; 6-8534 SpeedHide Interior/Exterior Latex 100% Acrylic Gloss Enamel.
5. PPG Paints ; 90-374 Pitt-Tech Interior/Exterior High Performance Waterborne High Gloss DTM Industrial
6. Sherwin-Williams ; ProMar 200 Interior Latex Gloss Enamel B21W201.

F. Interior Semi-Gloss Alkyd Enamel:

1. Benjamin Moore ; Advance Waterborne Interior Alkyd Semi-Gloss 0793.
2. Glidden Professional ; 1516N Alkyd 150 Semi-Gloss Interior Enamel
3. International Paint/Devoe Coatings ; Devlac 1431 Alkyd Gloss Enamel Finish (Not Available for OTC jurisdictions)
4. PPG Paints ; 6-1110 Series SpeedHide Interior Enamel Wall & Trim Semi-Gloss Oil.

5. Sherwin-Williams ; ProMar 200 Waterbased Acrylic-Alkyd Semi Gloss B34-8200 Series.

G. Interior Full-Gloss Alkyd Enamel for Gypsum Board and Plaster:

1. Benjamin Moore ; Advance Waterborne Interior Alkyd Gloss N794.
2. International Paint/Devoe Coatings ; Devlac 1431 Alkyd Gloss Enamel Finish (Not Available for OTC jurisdictions)
3. PPG Paints / Glidden Professional ; 7-814 Series PPG Paints Industrial Gloss-Oil Interior/Exterior Enamel.
4. Sherwin-Williams ; Industrial Enamel HS B54WZ Series.

H. Interior Full-Gloss Alkyd Enamel for Wood and Metal Surfaces:

1. Benjamin Moore ; Advance Waterborne Interior Alkyd Gloss N794.
2. International Paint/Devoe Coatings ; Devlac 1431 Alkyd Gloss Enamel Finish (Not Available for OTC jurisdictions)
3. PPG Paints / Glidden Professional ; 7-814 Series PPG Paints Industrial Gloss-Oil Interior/Exterior Enamel.
4. Sherwin-Williams ; Industrial Enamel HS B54WZ Series.

2.5 Interior Wood Stains & Varnishes

A. Open-Grain Wood Filler:

1. Benjamin Moore/Lenmar ; None required.
2. Glidden Professional ; None required.
3. Pittsburgh Paints ; None required.
4. Sherwin-Williams ; Sher-Wood Fast-Fry Filler.
5. Sherwin-Williams ; None recommended.

B. Interior Wood Stain: Alkyd based.

1. Benjamin Moore/Lenmar ; Waterborne Interior Wiping Wood Stain 1WB1300.
2. PPG Paints / Glidden Professional ; 44500 Olympic Interior Semi-Transparent Oil Stain.
3. Sherwin-Williams ; Wood Classics Interior Oil Stain A-48 Series. (Not Available for OTC jurisdictions).

C. Clear Sanding Sealer:

1. Benjamin Moore/Lenmar ; Rapid Seal Dual Purpose Sealer 1Y.519.
2. PPG Paints / Glidden Professional ; 42784 Gloss or 42786 Satin Olympic Interior WB Polyurethane
3. Sherwin-Williams ; Wood Classics Fast Dry Sanding Sealer B26V43. (Not Available for OTC jurisdictions).

D. Interior Alkyd or Polyurethane-Based Clear Satin Varnish:

1. Benjamin Moore/Lenmar ; Aqua-Plastic Waterborne Urethane Satin 1WB.1427.
2. PPG Paints / Glidden Professional ; 42784 Gloss or 42786 Satin Olympic Interior WB Polyurethane.
3. Sherwin-Williams ; Wood Classics Fast Dry Oil Varnish, Satin A66-300 Series. (Not Available for OTC jurisdictions).

E. Interior Waterborne Clear Satin Varnish: Acrylic-based polyurethane.

1. Benjamin Moore/Lenmar ; Aqua-Plastic Waterborne Urethane Satin 1WB.1427.
2. PPG Paints / Glidden Professional ; 42786 Satin Olympic Interior WB Polyurethane
3. Sherwin-Williams ; Wood Classics Waterborne Polyurethane Satin, A68 Series. (Not Available for OTC jurisdictions).

F. Interior Waterborne Clear Gloss Varnish: Acrylic-based polyurethane.

1. Benjamin Moore/Lenmar ; Aqua-Plastic Waterborne Urethane Gloss 1WB.1400.
2. PPG paints / Glidden Professional ; 42784 Gloss Olympic Interior WB Polyurethane.
3. Sherwin-Williams ; Wood Classics Waterborne Polyurethane Gloss, A68 Series. (Not Available for OTC jurisdictions).

099000.3 EXECUTION

3.1 Examination & Acceptance Of Construction In Place

A. Examine construction in place with the applicator on which the work of this Section is dependent. Defects which may influence satisfactory completion and performance of the work of this Section shall be corrected per the requirements of the applicable Section of the Specifications prior to commencement of the work. Do not start work until defects have been corrected and surfaces are cured and dry. Commencement will be construed as construction in place being acceptable for satisfying the requirements of this Section.

B. Coordination: Review primer and undercoating specifications of other sections to provide compatibility of finish coats and substrates. Provide requested information on finish coats to others to ensure compatibility of finish coats and substrates.

1. Notify the Owner’s Representative about compatibility concerns of specified paints and finish coatings and other primers and substrates.

3.2 Preparation Of Surfaces

A. Remove hardware from doors and other miscellaneous hardware, plates, lights and miscellaneous items. Mask and cover items impractical to move or disassemble before preparation of surfaces and painting.

1. Remove masking and covering after painting and reinstall hardware, lights and accessories with workmen skilled in their installation.

B. Clean substrates of grease, oil and materials detrimental to the bonding of the coatings.

1. Schedule cleaning before painting to prevent dusts from cleaning from falling on and damaging newly painted surfaces.

C. Preparation of Surfaces: Provide cleaning and preparation of surfaces according to the written instructions of the manufacturer for each substrate specified.

1. Provide barrier coatings between incompatible primers and surface coats or remove the incompatible primers and reprime with a compatible primer.

D. Prepare surfaces to be painted as part of the Work in accordance with instructions which follow.

1. NOTE: The Work may not require the use of all surface preparation instructions specified.

E. Gypsum Board

1. Before painting, allow joint treatment to dry completely. Clean surfaces of dirt and dust.

F. Plaster

1. Clean free of dirt and dust.
2. Before painting plaster, test surfaces with a moisture-testing device approved by the Owner's Representative. Do not apply primer sealer on plaster surfaces when the moisture content exceeds 8% as determined by the moisture-testing device. Test sufficient areas in each space, and as often as necessary, to determine the proper moisture content for painting.

G. Wood

1. Clean surfaces of dirt, oil and other materials.
2. Sandpaper smooth and remove dust. Surface-scrape knots and pitch pockets and seal with shellac or spar varnish. After priming, fill nail holes, cracks, and other defects with putty or plastic wood matching color of primer. Sand interior wood surfaces between coats.
3. Provide seal, stain or primer on wood for finish carpentry, promptly, upon delivery to the site. Prime all sides and edges of the wood. Backpaint all wood including counters, cabinets and paneling.
4. For wood with transparent finishes, backprime with varnish.
5. Backprime paneling installed on plaster concrete or masonry substrates.
6. Provide seals or primers on the edges, sides, tops, bottoms and cutouts of wood doors, promptly on delivery to the site.

H. Existing Construction

1. Existing Painted Surfaces to be Painted: Paint existing painted surfaces damaged by the Work of this Contract, existing painted items being relocated, and other existing surfaces scheduled or noted to be painted, to match adjacent existing unless noted or specified otherwise.
    a. Remove loose paint by scraping, and sand to feather-edge all areas where paint has been scraped off, chipped or peeled.
    b. Clean free of dirt, dust and other surface accumulations by washing; rinse and allow to dry thoroughly prior to application of new paint materials.
2. Existing Metal Surfaces to be Painted: Prime paint bare areas.

I. Preparation of Primers, Paints and Coatings:

1. Follow manufacturer's written instructions for preparation and mixing.
2. Maintain mixing containers and application equipment in clean condition without residue and other paint contaminants.
3. Stir or mix paints to a uniform consistency.
4. Remove surface films in paint containers. Strain paint materials to remove residue or contaminants.
5. Thin paint material within the limits set in the manufacturer's written instructions. Only use thinners approved by the manufacturer.

3.3 Paint Application

A. General

1. Apply paint in accordance with the paint manufacturer's recommendations and instructions which follow.

2. All spaces shall be broom clean before painting is started.
3. Surfaces to be painted shall be clean, dry, smooth and protected from dampness.
4. Do not finish-paint equipment or piping prior to test and approval.
5. Do not paint piping, duct and equipment surfaces while such surfaces are hot.
6. Make edges of paint adjoining other materials and colors, sharp and clean, without overlapping.
7. Allow each coat of paint to dry at least 24 hours before succeeding coat is applied, unless manufacturer's printed directions recommend otherwise.
8. Paint coats, as specified under "PAINTING SCHEDULE", are intended to cover surfaces perfectly. If surfaces are not adequately covered, as determined by the Owner's Representative, apply further coats to achieve complete coverage of surfaces at no additional cost to Owner.
    a. Each prime coat, intermediate coat, and finish coat shall have a minimum dry film thickness of 1.5 mils unless specified otherwise.
9. Finished work shall be uniform, of approved color, and free from defective brushing, spraying or rolling, and clogging or excessive flooding.
10. Paint exposed surfaces. "Exposed surfaces" means all surfaces or areas visible when the permanent construction is completed, and when all built-in cabinets, fixtures, convector covers, grilles and similar items are in place. "Exposed surfaces" shall include all surfaces or areas in back of cabinets, furniture, equipment and other items that are not built-in or fixed in place, and also shall include all surfaces visible through grilles, louvers and registers, and all roof-mounted ferrous metal items.
11. Surfaces visible through grilles, louvers and registers shall be painted flat black.
12. Apply one prime coat to wall surfaces directly behind fixed or built-in cabinets, millwork or fixtures before final installation.
13. Paint top, sides and bottom edges of all interior and exterior doors.
14. Sand lightly between coats.

B. Scheduling: Promptly apply first cost to surfaces after pretreatment to prevent surface deterioration.
    1. Apply succeeding coats only when the previous coat has dried per manufacturer's instructions. Sand between coats per manufacturer's instructions.
    2. Provide adequate time between coats to allow drying. Do not apply successive coat to tacky or sticky surfaces.
    3. Finish coat must be uniform in color and appearance and must cover the undercoats. If necessary apply additional coats to provide uniform color and appearance.

C. Methods Of Application

SURFACE	PRIMER	INTERMEDIATE COAT(S)	FINISH COAT
Ferrous Metal			
Primed	---	B, R or S	B, R or S
Unprimed	B	B, R or S	B, R or S
Masonry	R or S	R or S	R or S
Gypsum Wallboard	R or S	R or S	R or S
Wood			

Primed	---	B	B
Unprimed	B	B	B
Plaster	R or S	R or S	R or S
Concrete	R or S	R or S	R or S
Non-ferrous Metal			
Primed	---	B, R or S	B, R or S
Unprimed	B	B, R or S	B, R or S

1. Brush (B), Roller (R) or Spray (S) application may be used in accordance with the following:
2. If brush application is preferred where roller or spray is specified, brush application will be allowed provided the filling in of voids and coverage of the surface is equivalent to smooth surface specified.
3. Regardless of the method of application (brush, roller or spray) used, the finished surface shall be smooth and free from runs, sags, utensil marks, or clogs.

D. Small Cracks In Concrete, Masonry And Plaster Surfaces
   1. Before application of succeeding coats, fill with an approved spackling compound, small cracks, holes and other similar imperfections which show up in concrete, masonry and plaster surfaces after the primer-sealer has been applied to the surface.

E. For transparent finishes provide multiple coats to produce a smooth surface of even luster free from cloudiness, drips, brush marks, nail holes and surface imperfections.

F. Final Touch up: At completion after all adjacent work has been completed, touch up and restore finish where damaged.

G. Completed Work: Verify that color, texture and coverage match approved paint samples. Repaint or refinish non-compliant Work and leave in specified condition.

3.4 Colors

A. Colors shall be in accordance with color schedule furnished by the Architect-Engineer. No extras will be approved because of the color variety selected by the Architect-Engineer.

B. Tint the primers and intermediate coats a different color to distinguish between the several coats, and as required by color selected for the final coat.

C. Unless otherwise required by the color schedule, or specified:
   1. Paint ferrous metal items of mechanical and electrical work to match color and sheen of adjacent wall and ceiling surfaces.
   2. Paint surfaces in areas requiring alteration work to match color and sheen of respective existing finishes.

3.5 Clean-Up

A. Remove soiled rags, empty paint containers and other paint debris from the site daily. Dispose of waste materials in a legal manner.

B. Remove paint spatters from adjacent surfaces in a manner that does not damage the surface. Clean or wash adjacent surfaces to restore acceptable finish appearance.

3.6 Protection

A. Protect installed work by others, including work not painted, from damage by painting. Provide appropriate masking and coverings over adjacent construction. Clean, repair, replace or repaint damaged surfaces as approved by the Owner's Representative.

1. Before start of painting, remove finish hardware, accessories, plates and similar items in place, or provide ample protection of such items as approved the Owner's Representative. Do not remove UL labels on doors and frames.
2. Remove doors, if necessary, to paint top and bottom edges.
3. Upon completion of painting, reinstall removed items.
4. Use only workmen skilled in the applicable building trade for removal and replacement of finished items.
5. Close off the various spaces while painting, and exclude dust until the finish is dry. Post "Wet Paint" signs as required to protect newly finished spaces.
6. At completion of this work in a space, remove paint spots from floors, glass and other surfaces. Leave finished space clean and in acceptable condition.
7. At completion of work in area protected by fire protection system, remove the temporary covers on the fire protection sprinkler heads.
8. At completion of painting, remove masking, wrappings, coverings and posted signs.
9. At completion of work in area protected by fire protection system, remove the temporary covers on the fire protection sprinkler heads.

3.7 Painting Schedule

3.7.1 Inclusions

A. Except for those items, surfaces and areas listed under "EXCLUSIONS", include in the work of this Section, the painting of all work that is customarily painted to provide a complete job, including mechanical and electrical work, whether or not each such item, surface or area is specifically shown or specified. Paint work that is not specifically shown or specified, same as similar work or, where no similarity exists, paint with a system directed by the Owner's Representative.

B. Paint unpainted existing surfaces exposed by alteration and removal work where such surfaces will remain exposed in painted areas.

C. Prior to the application of paint, prepare the respective surfaces to receive paint per the requirements specified under "PREPARATION OF SURFACES".

3.7.2 Exclusions

A. Unless one or more of the following items, surfaces or areas are specifically included under a specified paint system to be painted, exclude from painting under this Section, the following:

1. Shop prime painting and products having factory finish.
2. Finished floor, wall and ceiling materials, such as resilient flooring, carpeting, vinyl fabric wall covering, and acoustical ceilings.
3. Plastic laminate-covered surfaces.
4. Copper, stainless steel, brass, bronze and chromium-plated surfaces.
5. Aluminum.

6. Glass.
7. Glazing compound and sealants.
8. Sprayed fireproofing.
9. Concealed construction, such as wall surfaces and mechanical and electrical systems within suspended ceiling spaces, wall shafts, chases and furred spaces.
10. Nameplates and UL labels on doors and frames. Be responsible for ensuring that all nameplates and UL labels are not painted.
11. Gages, thermometers and other recording devices.
12. Moving parts of mechanical equipment, such as shafts, valve stems, etc.

3.7.3 Interior Ferrous Metal Systems

A. Full Gloss Finish

1. Surfaces: Interior steel and zinc-coated [galvanized] surfaces set in floor or mounted in walls where subject to wear, such as: Floor curbs and frames, steel grating, steel stair risers and portions of stringers exposed to foot traffic, steel pipe railings and hand rails, and steel ladders.
2. First Coat; Ferrous Metal Primer: For bare steel and touch up of shop coat.
3. First Coat; Galvanized Metal Primer: For zinc-coated surfaces.
4. Second Coat: Interior Alkyd Gloss Enamel.
5. Third Coat: Interior Alkyd Gloss Enamel.

B. Semi-Gloss Finish

1. Surfaces: Hollow metal frames and doors, steel stair surfaces exposed to public view except risers and portions of stringers exposed to foot traffic, vault door and frame, and elevator and dumbwaiter hoistway doors and frames.
2. First Coat; Ferrous Metal Primer: For bare steel and touch up of shop coat.
3. First Coat; Galvanized Metal Primer: For zinc-coated surfaces.
4. Second Coat: Interior Alkyd Semi-Gloss Enamel.
5. Third Coat: Interior Alkyd Semi-Gloss Enamel.

C. Eggshell Finish

1. Surfaces: Structural steel, steel joists, underside of metal roof deck and floor deck. Also metal surfaces not otherwise specified, exposed to public view at ceilings in toilets and baths, and at walls, such as: Metal access doors, convector covers, bare piping, ducts, grilles, registers, conduit and other miscellaneous paintable metal surfaces.
2. First Coat; Ferrous Metal Primer: For bare steel and touch up of shop coat.
3. First Coat; Galvanized Metal Primer: For zinc-coated surfaces.
4. Second Coat: Interior Acrylic Eggshell Enamel.
5. Third Coat: Interior Acrylic Eggshell Enamel.

D. Flat Finish

1. Surfaces: Interior surfaces of ducts exposed to public view through convector covers, grilles, registers and air intakes in finished spaces; and metal surfaces, except in toilets and baths, exposed to view at ceilings, such as: Bare piping, ducts, grilles, registers, conduit and other miscellaneous paintable metal surfaces.

2. First Coat; Metal Primer: For bare steel and touch up of shop coat.
3. First Coat; Galvanized Metal Primer: For zinc-coated surfaces.
4. Second Coat: Interior Acrylic Flat Enamel.
5. Third Coat: Interior Acrylic Flat Enamel.

E. Interior Eggshell High-Build Epoxy Finish

1. Surfaces: Ferrous metal surfaces in areas noted on the Finish Schedule as “epoxy high build”, including: steel joist and metal deck ceiling construction, hollow metal doors and frames, and metal railings.
2. First Coat: Epoxy Primer; touch up of shop-primed surfaces.
3. First Coat; Barrier Coat: For full coverage as required by manufacturer to achieve full bond of finish coat to substrates.
4. Second Coat: Eggshell High-Build Epoxy Coating; apply to a minimum dry film thickness of 12 mils. Specified DFT may be achieved in one or two coats as recommended by the manufacturer.

F. Machinery Enamel Finish

1. Surfaces: Mechanical equipment, machinery and appliances, including motors, starters and control equipment, such as: Pumps, compressors, fans, unit heaters, ventilators and air conditioning units. Exclude machined parts.
2. First Coat; Ferrous Metal Primer: For bare steel and touch up of shop coat.
3. First Coat; Galvanized Metal Primer: For zinc-coated surfaces.
4. Second Coat: Machinery Enamel.
5. Third Coat: Machinery Enamel.

3.7.4 Interior Gypsum Board Systems

A. Eggshell Finish

1. Surfaces: Gypsum board ceilings in toilets and baths, and surfaces of all gypsum board walls exposed to view.
2. First Coat: Interior Latex Primer-Sealer.
3. Second Coat: Interior Acrylic Eggshell Enamel.
4. Third Coat: Interior Acrylic Eggshell Enamel.

B. Flat Finish

1. Surfaces: Gypsum board ceilings, ceiling drops, and soffits, except in toilets.
2. First Coat: Interior Latex Primer-Sealer.
3. Second Coat: Interior Acrylic Flat Paint.
4. Third Coat: Interior Acrylic Flat Paint.

3.7.5 Interior Wood Clear Finish Systems

A. Satin Polyurethane Wood Varnish System

1. Wood surfaces scheduled to receive transparent finish, including cabinet work and related woodwork.
2. First Coat; Filler: For open grain woods.

3. Second Coat; Stain or bleach: As appropriate.
4. Third Coat: Satin Polyurethane Varnish.
5. Fourth Coat: Satin Polyurethane Varnish.

B. Flat Polyurethane Wood Varnish System

1. Wood surfaces scheduled to receive transparent finish, including cabinet work and related woodwork, doors and frames.
2. First Coat; Filler: For open grain woods.
3. Second Coat; Stain or bleach: As appropriate.
4. Third Coat: Flat Polyurethane Varnish.
5. Fourth Coat: Flat Polyurethane Varnish.

C. Satin Alkyd Wood Varnish System

1. Wood surfaces scheduled to receive transparent finish, including cabinet work and related woodwork, doors and frames.
2. First Coat; Filler: For open grain woods.
3. Second Coat; Stain or bleach: As appropriate.
4. Third Coat: Sealer.
5. Fourth Coat: Satin Alkyd Varnish.
6. Fifth Coat: Satin Alkyd Varnish.

DIVISION 10
SPECIALTIES

100000.13 - MISCELLANEOUS SPECIALTIES

100000.13.1 GENERAL

1.1 Summary

A. This Section includes: The following miscellaneous specialties items, complete with installation devices, fasteners, accessories and incidentals, as specified in this Section and as shown on the Drawings:

1. Wall protection systems:
   a. Corner guards.
2. Television monitor supports.

3. Aluminum Coil Drapery.
4. Tack Boards

1.2 Submittals

A. Furnish submittals for items that are identified in this Section by a different typeface and a bracketed code (*e.g., Item [L]*). Refer to Division 1 General Requirements for definition of codes for types of submittals and the administrative requirements governing submittal procedure. Additional submittal requirements pertaining to this Section are specified herein under this Article.

B. Submit completely detailed shop drawings showing fabricated items and construction, and methods of assembling, joining, seaming, installation and anchorage, giving all information necessary for adjacent and related trades.

C. Submit descriptive data covering catalog items and include manufacturer's printed instructions covering installation.

D. Submit samples of all items or materials herein that require selection and approval of colors, finishes, textures, and patterns as applicable to items specified. Submit color charts for items requiring selections from standard colors.

1.3 Project Conditions

A. Verify the areas, and features where work herein is to tie into construction prior to submittal of shop drawings, fabrication or erection, construction or installation.

B. Protect work herein and adjacent construction against damage during construction and until completion.

C. Take field measurements to verify and supplement dimensions shown.

D. Deliver and install the items so as to expedite the work as a whole. Coordinate this work with adjacent work so that sequencing is properly done and that operating clearances for this work and adjacent work are maintained.

100000.13.2 PRODUCTS

2.1 Fabric-Wrapped Tackable Panels

A. Fabric Wrapped Tack board Panels: Provide 1/2 inch thick fire retardant fabric wrapped tack board acoustic wall panels of sizes shown and specified, where shown of scheduled.

B. Panel Core: 1/2" thick Homosote panels with mechanical fasteners.

C. Fabric: As scheduled.

D. Acceptable Manufacturer: Pinnacle Tackboard Panels

2.2 Aluminum Coil Drapery

A. Furnish all labor, materials and equipment required, and furnish and install aluminum coil draper, indicated on the Drawings, including accessories and work incidental to a complete installation, as shown or specified in this Section.

B. Furnish color, texture and finish selection as scheduled. Upon approval, approved samples shall serve as control samples to verify that installed items comply with approved samples.

C. Submit written guarantee to the Owner, in form acceptable, to the Owner, guaranteeing against all defects in materials and workmanship for a period of two years from date of final acceptance of the project. The guarantee shall include provisions for prompt repair and replacement of any of this work that is defective within the guarantee period and at

no cost to the Owner.

D. Deliver and install the units so as to expedite the work as a whole. Coordinate this work with adjacent work so that sequencing is properly done and that operating clearances for this work and adjacent work are maintained.

E. Size as shown on drawings.

2.3 Wall Protection

A. Corner guards shall be manufactured from stainless steel to match existing.

1. Height: Match existing
2. Finish and Guage: Match existing

2.4 TV Monitor Supports

A. *TV Monitor Support [P]:* Provide and install where indicated on the drawings wall mounted, CCTV monitor support. Provide locking security tray, UL listed features of heavy gage steel construction in fused black epoxy finish with load capacity of 125 pounds. Provide wall support plates, anchors and fasteners for masonry and metal stud construction where indicated on the drawings.

100000.13.3 EXECUTION

3.1 Installation- General

A. Install the specialty items where shown, per manufacturer's directions and approved shop drawings. Anchor components securely in place.

B. Provide all fasteners, anchorages, trim, back up plates and other incidental parts as required to install the work plumb, level, and in a rigid and substantial manner. Use concealed fasteners wherever possible. Where exposed fasteners are necessary, provide them in material and finish to match adjacent surfaces.

3.2 Fabric Wrapped Tackable Panels

A. Install panels on walls as detailed in sizes shown or noted, per manufacturer's directions, so that they are straight, level, plumb and true, and accurately aligned.

3.3 Aluminum Coil Drapery System

A. Mount the tracks at levels shown and securely anchor in place.

B. Install the drapery system on the tracks in arrangements shown.

C. Install the components in required allocations.

3.4 Wall Protection

A. Install corner guards vertically on all outside corners where shown; install with bottom end at top of wall base.

DIVISION 13
SPECIAL CONSTRUCTION

13865 - CONTROL SYSTEMS EQUIPMENT (& APPENDIXES)

SECTION 13865

CONTROL SYSTEMS EQUIPMENT

13865.1 GENERAL

1.1 Summary

A. Section Includes:

1. Provide labor, materials, and equipment as specified in this section of the specifications and as indicated on Drawings, including accessories as required by manufacturer for fully operational installation.
2. All installation work provided shall be per the recommendations of the equipment manufacturers and as required by the manufacturer's installation instructions and shop drawings.
3. Refer to Division 13 Section 13855 - INSTRUMENTATION & CONTROL SYSTEMS for additional control systems equipment requirements.

B. Related Work Specified In Other Sections:

1.2 Quality Assurance

A. Provide per Division 13 Section "Instrumentation and Control Systems - General".

1.3 Submittals

A. Provide per Division 13 Section "Instrumentation and Control Systems - General".

B. Also, furnish submittals for items that are identified in this Section by a different typeface and a bracketed code (*e.g., Item [L]*). Refer to Division 1 General Requirements Section "Submittal Codes" for definitions of codes regarding types of submittals and the administrative requirements governing submittal procedure. Additional submittal requirements pertaining to this Section are specified herein under this Article.

C. Shop drawings submittals shall bear the Contract Documents identifying project name and number, shall be sequentially item numbered. Submit two (2) certified for construction prints and one legibly reproducible copy.

13865.2 PRODUCTS

2.1 Control Panels

A. Main Control Panels MCP

1. *Main Control Panels MCP [B,D]*: Provide a free-standing, totally enclosed, rear access panel of the size and configuration indicated on the Drawings. Panel shall include: Annunciator instrument section; and control console for mounting of pushbuttons and selector switches.
2. Panel shall be factory fabricated and assembled and shipped to the project site for installation as shown on the Drawings and shall, in its final installed state conform to NEMA Type 12 criteria.
3. Panel shall be fabricated with 3/16-inch thick sheet steel front and 1/8 inch sheet steel top and sides over an angle iron frame. Panel shall be of welded construction reinforced with struts to facilitate mounting internal equipment. Provide lifting eyes, one at each corner, for handling of the panel. All exterior seams shall be continuously welded and ground smooth. Doors shall be pan type construction, gasketed with rubber cemented neoprene, with handle and three-point latch. Door shall have full-length piano hinges. Panel base shall be 1/4-inch thick 4-inch high channel. Securely anchor panel to floor. All exterior hardware (screws, hinges, etc.) shall be high-grade steel with polished nickel or chrome plated finish. All interior hardware (screws, nuts, etc.) shall be steel, cadmium plated. Provide latches to hold doors in 90-degree position. Roller latches shall be provided to hold door in closed position.
4. Prime coat all steel surfaces with two coats of an approved primer. Finish coat interior surfaces with two coats of white enamel. Finish coat external surfaces with two coats, color 2.5g 7/2 (Munsell Number). Finish surfaces shall be smooth and free of all runs, ripples and foreign or abrasion defects to present an unblemished appearance in all respects.
5. Panel interior lighting shall be by fluorescent strip light fixtures mounted at the top of the panel. Light fixtures shall be wired to a door switch to energize when the door is open. Fixtures shall come complete with guards. Provide one 120 VAC duplex convenience outlet with ground fault interruption inside the panel. Power for panel interior lighting and convenience outlets to be obtained from separate 480V/277V isolation transformer to 120V secondary. Transformer to be powered from line side of main panel disconnect. Provide separate disconnect, internal enclosure and secondary circuit protection for system.
6. Provide 1/8 x 1 inch isolated copper ground buss bar adjacent to all field wiring terminal blocks for instrumentation cable shield grounds. Provide separate ground bus for equipment ground to 120 VAC powered field devices and separate buss to isolated ground.
7. Provide perforated or slotted plastic covered wire troughs to route all internal panel wiring. Provide separate wire troughs to route all incoming field cables to the terminal blocks and field cables going directly to panel mounted equipment. Size wire troughs for a maximum of 50% fill.
8. Provide front panel layout as indicated on the Drawings, including provisions for future and blank positions. Layout shall, to the extent possible, follow the process flow and system operation. Group front panel mounted devices in a continuous cluster for the process or system being controlled.
9. Provide 120V distribution panel with circuit breakers as required for distribution of 120 VAC throughout the control panel.
10. Where field controls/meters require a separate 120V AC source. Utilize the 120V A.C. power from the main panel. Individually circuit and fuse these 120V A.C. Circuits.
11. Front panel nameplates shall be 1” x 3” engraved white lamicoid with black letters, internal device nameplates may be smaller; both type shall be attached with corrosion resistant screws. Rear of face nameplates shall be attached with silicon adhesive.
12. All engraved legends shall be a minimum 3/16” high block type characters. Legends shall e completely worded without abbreviations, except as approved by the Owner.

13. Pilot lights, switches, and other panel devices shall be furnished with anti-rotation key ways or other to prevent slewing after mounting.
14. Each and every wire shall be tagged at both ends within three inches of each terminal. Tags shall be computer or typewriter generated, vinyl cloth, permanent, non-smearing, self-adhesive markers such as Brady Datab, or 3M Scotchcode. Pre-printed, vinyl cloth, plastic coated, self-adhesive, tape markers as manufactured by W.H. Brady Co., or 3M shall also be acceptable.
15. All 4-20 mA analog instrument signals shall use 1 pair No. 18 AWG shielded cable and shall be run in a separate conduit system from all 120 VAC control and power wiring.
16. Wiring shall not be spliced. Wire shall be run in continuous lengths from screw terminal to screw terminal. Wire service loops shall be provided to permit device removal.
17. All foreign circuit 120 VAC wiring shall be yellow and each foreign circuit shall be provided with a clearly labeled circuit disconnect switch. Foreign circuit disconnect switches shall be switch type terminal blocks complete with engraved nameplates.

B. Local Control Panels LCP

1. *Local Control Panels LCP [B,D]*: Provide a [**free-standing**] [**wall-mounted**], NEMA 1, 4, 4X, 7, 9, 12, one, two or three door panel(s) of the size and configuration indicated on the Drawings.
2. Panel shall be factory fabricated and assembled and shipped to the project site in one piece for installation.
3. Panel shall be fabricated with 14-gage steel. Panel shall be of welded construction reinforced with struts to facilitate mounting internal equipment. Provide lifting eyes for handling of the panel. All exterior seams shall be continuously welded and ground smooth. Door shall be pan type construction, with oil resistant gasket, with key locking handle, three-point latch, fast operating clamp assembly and common keys. Securely anchor panel to floor. All exterior hardware (screws, hinges, etc.) shall be high-grade steel with polished nickel or chrome plated finish. All interior hardware (screws, nuts, etc.) shall be steel, cadmium plated. Provide latches to hold doors in 90deg position. Roller latches shall be provided to hold door in closed position.
4. Prime coat all steel surfaces with two coats of an approved primer. Finish coat exterior surfaces with two coats of paint, color as selected by Owner. Finish coat interior surfaces with two coats of white enamel. Finish surfaces shall be smooth and free of all runs, ripples and foreign or abrasion defects to present an unblemished appearance in all respects.
5. Provide perforated or slotted plastic covered wire troughs to route all internal panel wiring. Provide separate wire troughs to route all incoming field cables to the terminal blocks and field cables going directly to panel mounted equipment. Size wire troughs for a maximum of 50% fill.
6. Panel interior lighting shall be by fluorescent strip light fixtures mounted at the top of the panel. Light fixtures shall be wired to a door switch to energize when the door is open. Fixtures shall come complete with guards.
7. Provide 1/8 x 1 inch isolated copper ground bus for the total length of the panel for instrument grounds. Provide separate ground bus for equipment ground to 120 VAC powered field devices and fractional horsepower motors fed from panel.
8. Front panel layout shall, be as indicated on the drawings.
9. Provide two 120 VAC convenience outlets with ground fault interruption inside the panel.
10. Provide 120-volt distribution panel with circuit breakers as required for distribution of 120 VAC throughout the control panel.
11. Refer to Division 13 Section “Instrumentation and Control Systems - General” for additional control panel requirements.

C. Remote Control Panels (Typical To DDC Panel and Operator Stations)

1. *Remote Control Panels [B,D]*: Provide a free-standing, NEMA 12, one or two door panels of the size and configuration indicated on the Drawings.
2. Panel shall be factory fabricated and assembled and shipped to the project site in one piece for installation.
3. Prime coat all steel surfaces with approved primer. Finish coat exterior surfaces with two coats of paint, color as selected by Division 13 Section "Instrumentation and Control Systems - General". Finish coat interior surfaces with two coats of white enamel. Finish surfaces shall be smooth and free of all runs, ripples and foreign or abrasion defects to present an unblemished appearance in all respects.
4. Provide perforated or slotted plastic covered wire troughs to route all internal panel wiring. Provide separate wire troughs to route all incoming field cables to the terminal blocks and field cables going directly to panel mounted equipment. Size wire troughs for a maximum of 50% fill.

D. Refer to Division 13 Section "Instrumentation and Control Systems - General" for additional control panel requirements.

2.2 Temperature Devices

A. Temperature Transmitters

1. *Temperature Transmitters [P]*: Transmitter shall accept a signal from integral or remote 3-wire 100-ohm platinum resistance type sensor. Output shall be 4-20 mADC 2-wire type with output signal linear with temperature. Loss of input shall force output high (upscale burnout). Accuracy shall be 0.2% of calibrated span. Complete with local indicator and hardware for pipe stand or surface mounting.
2. Platinum resistance sensors shall be 3-wire 100-ohm type with 316 stainless steel sheath and 1/2-inch male pipe thread connector for thermowell mounting. Length to be as required per application. Remote mounted types to have gasketed screw on metal cover type head with field wiring terminals permanently mounted inside the head and provisions for connecting 1/2-inch conduit to the sensor head. For cooling water sump service, sheath shall extend sensor to 3-inches below pump cut-off level.
3. Manufacturer:
    a. Rosemount , Model 444.
    b. Foxboro .
    c. ABB Kent-Taylor.
    d. Burns Engineering Inc .
    e. SMAR – Model TT301.

2.3 Miscellaneous Panel Devices

A. Auto-Manual Stations (HIC)

1. *Auto-Manual Stations [D,P]*: Auto-manual stations shall be direct digital type, furnished with continuous front panel indication of Process Variable and Control Variable. The process variable and control variable scales shall be in engineering units. Indicators shall use dual vertical bar displays utilizing gas discharge segments or other high visibility indication method. Bar type displays shall have a resolution of 2% or better.
2. The stations shall have manual/auto mode indication and pushbuttons for changing control modes. The manual output shall be operator adjustable by the use of increase/decrease pushbuttons. Dry contacts are to be provided for remote indication of manual/auto operation.

3. The station shall provide bumpless transfer between auto and manual modes. Balancing prior to switching modes shall not be required.
4. In automatic mode, the control variable shall be tracked at all times. When the control variable is not received from the PLC, the station shall hold the last control variable value and have the capability of transferring to manual and adjusting the output. The system shall be capable of uninterrupted operation even if the process variable is disconnected from the station.
5. Stations shall be configured so that return of process output signal from loop controller shall automatically transfer the auto/manual station to auto mode. The auto/manual station shall be configured to transfer to the auto mode after a power failure.
6. Each auto-manual station shall be equipped with a loop integrity block which shall allow removal of the station from its housing without interrupting loop continuity.
7. Any prefabricated cables required for installation of the station shall be provided.
8. Manufacturer:
    a. Moore Products Co ., Model 350.
    b. Honeywell Inc., Model UDC 3000.

B. Indicators

1. *Indicators [P]*: Indicators for front panel mounting shall accept 4-20 mADC and 1-5 VDC inputs with a digital display. Display shall be 4-1/2 digits, scaleable in engineering units and shall be 1/8 DIN.
2. Accuracy: 0.5% of indicated span.
3. Manufacturer:
    a. Newport.
    b. Action Instruments .
    c. Simpson.

C. Annunciators

1. *Annunciators [P]:* Annunciator shall be solid state, integral or split architecture type suitable for flush panel mounting. Cabinet windows shall be as indicated on the Drawings.
2. Unit shall come complete with plug in modules, power supplies, nameplate engraving, and all required hardware. Provide a minimum of 20% spare alarm and indication points. The annunciator window quantities shown on the panel layout drawings are approximate and are for relative size reference only.
3. Annunciator Operational Sequence shall be ISA sequence “M” (Panalarm sequence AM) with Acknowledge, Reset, and Test pushbutton switches
4. Annunciator input power shall be 120 VAC. Field voltage for alarm devices shall be 24 VDC.
5. Manufacturer:
    a. Panalarm Div. of Riley Co. Series 90,
    b. Beta Products.

D. Ten Point Annunciators

1. *Ten Point Annunciators [P]:* Provide self-contained ten-point annunciator utilizing solid-state circuitry and led display. Unit shall be compact type suitable for 120 VAC power supply. Alarm points shall be field selectable for normally open or normally closed contact input. Unit shall be suitable for flush panel mounting. Provide watertight door NEMA 4 front panel mounting where indicated. Internally supplied contact voltage shall be 24

VDC.

2. Provide unit with SPDT horn relay and SPDT reflash relay. Horn and reflash contacts shall transfer when any of the ten points is in alarm. Unit shall be complete with acknowledge, reset, and test pushbuttons. Unit shall accept remote acknowledge, reset and test pushbutton inputs. Unit shall have field selectable operational sequences set for ISA Type M sequence.
3. Manufacturer:
    a. Panalarm Div.of Riley Co. Type 910.
    b. Beta Products Model 10.

E. Single Point Annunciators

1. *Single Point Annunciators [P]:* Single point annunciator shall be provided with plug-in type alarm relay and flasher. Provide with a spring action, center-off "Ack/Test" selector switch and lamp mounted on the face of the enclosure. Unit shall use the AF sequence of operation for alarms; input voltage shall be 120 volts AC. Enclosure shall be NEMA 4.
2. Manufacturer:
    a. Model 57P11, Panalarm Div. of Riley Co.
    b. Beta Products .

F. Indicating Current Trip Alarms

1. *Indicating Current Trip Alarms [P]:* Alarm module shall accept a current or voltage input signal and provide two alarm trip points with two independent relay contact closure outputs.

Input Load:	25 ohms @ 4 to 20 mADC
Input Signal:	4 to 20 mADC. Modules shall be provided as intrinsically safe when connected to field mounted transmitter or sensor in a hazardous location - without the use of external barriers.
Display:	Front panel LCD 3-1/2 digit display of input or alarm point settings - front panel switch selectable. Display accuracy +/-0.1% of input span; +/-1 count.
Output:	Dual high and low SPDT relay contacts rated 5 amp @ 117 VAC, 50/60 HZ. or 28 VDC.
Setpoints:	Independently adjustable over the full input range.
Power Input:	24 VDC, 1.5 watts nominal.
Isolation:	500 VAC, input to output to power.
Indicators:	Front panel LEDS shall indicate when relays are energized.
Repeatability:	Trip points shall repeat within 0.1% of input span.
Response Time:	50 milliseconds.

Deadband:	1% of input span.
Mounting:	35 mm din rail surface mounting.
Housing:	Thermoplastic, rail mount din-style with removable terminal blocks.

2. Manufacturer:
    a. Moore Industries , DDA Series.

G. Power Supplies

1. *Power Supplies [D,P]*: The output voltages and current capacity shall be as required by the control system with 20% spare capacity. A 24 VDC supply shall be provided for all field transmitters and transducers with 20% spare capacity.
2. Power Supplies shall be of the high efficiency switched type for operation from 120 VAC +/- 10% input. Supply each unit with voltmeter, fuse, over voltage protection and a common NC failure alarm contact output. Provide local indication of output failure for each separate voltage output. For multiple output supplies the voltmeter shall have an output selector switch.
3. Power supplies shall consist of two individual units to be wired in parallel, through protective diodes, for automatic backup operation. Each unit shall be capable of supplying the full load requirements in case of failure of one of the supplies. Provide capabilities of disconnecting and removing one power supply without effecting operation of the second power supply.
4. Manufacturer:
    a. Acopian Corp.

H. AC Current Transmitters

1. *AC Current Transmitters [P]*: AC current transmitter shall be a self contained unit with integral doughnut transformer, 4-20 mADC 2-wire output signal, 24 VDC powered. Operating temperature range shall be 0 to 158 deg. F., response time 150 milliseconds maximum. Accuracy 0.5% full scale, repeatability 0.25% full scale. AC current ranges: 1 to 600 AMPS full scale, provide suitable range to match each application.
2. Manufacturer:
    a. C.S. Technologies Inc. 420 Series.
    b. Simpson – GIMA Series.

I. AC Current Switches

1. *AC Current Switches [P]:* Current switches shall be powered by induction from the sensed motor circuit conductor. Sealing shall be NEMA 1. Setpoint range shall span from the load device's full load amps to the 50% of its full load amps. Setpoint accuracy shall be +1% of range. Output contact shall be suitable for switching 24 VAC, DDC inputs.
2. Manufacturer:
    a. Veris Industries, Inc ., model Hawkeye 701.
    b. Neilsen-Kuljan, Inc. model SD100.

J. CO Detectors

1. *CO Detectors [D,P]:* Provide a carbon monoxide (CO) monitoring system including controllers, sensors, and any auxiliary devices required to make a complete and functioning CO monitoring system. The system sensors shall operate reliably in an automotive engine test cell environment.

Detecting Points:	The control instrument shall have eight (8) channels minimum.
Location:	QC test area, in each engine test bench room.
Measuring Range:	0 - 100 PPM.
Alarm Setting Range:	0 - 100 PPM.
Display:	Three-digit digital (PPM). Three alarm level LED's (Caution, Warning, & Alarm) per channel.
System Performance:	Repeatability: +/-1.0% Full Scale. Accuracy: +/-5% Full Scale
Outputs:	Relays: 1 Alarm - common; 1 Trouble - common. Relay Contacts: 5 amps, 120 VAC.
Power Input:	120 VAC, 60 Hz., 200 VA Max.
Controller Enclosure:	General Purpose - Panel Mounting including panel and surface mounting hardware, for installation in Owner's control panel.
Sensor Enclosure:	Approved for location in Class 1, Division 1, Groups C & D classified areas.
Sensor Life:	Sensors shall be warranted to have a minimum useful life of one year.
Sensor Distance:	Maximum distance from sensor to controller shall be 2000 feet.

2. Manufacturer:
    a. Sierra Monitor Corp . Sentry Series.
    b. MSA Instrument Div .
    c. Control Instruments Co.
    d. Gas Tech .

K. Push Buttons

1. *Push buttons [P]:* Momentary contact push button units, non-illuminated. Push buttons shall be 30.5 mm, NEMA Type 4/13, watertight and oiltight.
2. Two position push-pull/twist release units, non-illuminated. Push-pull unit shall be 30.5 mm, NEMA Type 4/13, watertight and oiltight.
3. Manufacturer:
    a. Allen-Bradley - Bulletin 800T Series.
    b. Square D – Class 9001 – Type K.

L. Selector Switches

1. *Two-Position Selector Switches [P]:* Two-position, maintained contact, selector switch units, non-illuminated. Selector switches shall be 30.5 mm, NEMA Type 4/13, watertight and oiltight.
2. *Three-Position Selector Switches [P]:* Three-position, spring return to center, selector switch units, non-illuminated. Selector switches shall be 30.5 mm, NEMA Type 4/13, watertight and oiltight.

3. *Three-Position Selector Switches [P]:* Three-position, maintained contact, selector switch units, non-illuminated. Selector switches shall be 30.5 mm, NEMA Type 4/13, watertight and oiltight.
4. *Four-Position Selector Switches [P]:* Four-position, maintained contact, selector switch units, non-illuminated. Selector switches shall be 30.5 mm, NEMA Type 4/13, watertight and oiltight.
5. Manufacturer:
    a. Allen-Bradley - Bulletin 800T Series.
    b. Square D – Class 9001 – Type K.

M. Pilot Lights

1. *Push-To-Test Pilot Light Units [P]:* Pilot lights shall be 30.5 mm, NEMA Type 4/13, watertight and oiltight. Lens colors shall be green, amber, blue, white, or clear as indicated on the Drawings.
2. Manufacturer:
    a. Allen-Bradley - Bulletin 800T Series.
    b. Square D – Class 9001 – Type K.

N. Control Relays

1. *Control Relays [P]:* Relays shall be of modular type with convertible contacts. Relay contacts shall have a minimum ten amp continuous rating.
2. Master Control relays shall have contacts rated for 20 Amp continuous carrying current.
3. Furnished surge suppressors (made by relay manufacturer) to be installed across the coil of each DC control relay.
4. Manufacturer:
    a. Allen-Bradley - Bulletin 700 Type P and PK Direct Drive Cartridge Relays.
    b. Square D – Class 8501 – Type X and XMO.

O. Reset Timers

1. *Reset Timers [P]:* Timers are to be synchronous motor driven. Timing is to be achieved through the use of an external clutch drive mechanism.
2. Repeatability: ± 3/4% of Full Scale.
3. Reset Time: 200 ms.
4. Voltage: 120V (+10%, -15%), 50/60 Hz
5. Output Rating: 10 Amp -1/4 HP - 120/240 VAC
6. Power On Response: 30 ms Clutch Pull in 4 ms Drop Out.
7. Dial Setting Accuracy: 2% of Full Scale.
8. Minimum Setting: 3% of Full Scale.
9. Manufacturer:
    a. Eagle Signal Controls - BR 1.

P. Panel Mounted Repeat Cycle Timers

1. *Panel Mounted Repeat Cycle Timers [P]:* Times shall be capable of:
    a. Four time ranges from 99.99 seconds to 99 hours: 99 minutes.
    b. Four operating modes for the programmed set of relay contacts.

c. Cycle progress display either down from the setpoint to zero, or up from zero to the setpoint.

d. Standard start operation with a momentary control switch. Close to start, resets automatically.

2. Timer shall have a 0.3-inch high, four digit LED display.

3. Manufacturer:

a. Eagle Signal Controls - CT53-1-A6.

Q. Electronic Integrator/Totalizer

1. *Electronic Integrator/Totalizer [P]:* Provide surface-mounted electronic module to convert linear analog signal input into a variable pulse rate output proportional to the input to drive an electro-mechanical counter for totalization of flow.

Input:	4-20mA Current Loop.
Output:	SPST Isolated Relay Contract.
Accuracy:	0.1% of calibrated span.
Repeatability:	0.02% of calibrated span.
Power:	120 Volt AC, 50/60 Hz.

2. Manufacturer:

a. Adtech.

R. Level Indicators

1. *Level Indicators [P]:* Indicators for front panel mounting shall accept 4 to 20 mADC and 1 to 5 VDC inputs with a digital display. Shall be equipped with 16-step dimming via front panel buttons.

2. Bar Display: Shall be vertical 40-segment Tricolor LED (Red, Green, & Yellow). Scale of bar display shall be “0 to 100%”.

3. Digital display: Shall be 5 digits, scaleable in engineering units. Scale of digital display shall match range of process monitored (Example: 0 to 20 feet or 0 to 240 inches).

4. Relay Contacts: Unit shall be provided with 4 (four) form C relays with field programmable set points.

5. Accuracy: DC: +0.01% FS.

6. Manufacturer:

a. Weschler -BG252TC Tricolor Bargraph.

S. Flow Indicator

1. *Flow Indicators [P]:* Indicators for front panel mounting shall accept 4 to 20 mADC and 1 to 5 VDC inputs with a digital display. Shall be equipped with 16 step dimming via front panel buttons.

2. Bar Display: Shall be horizontal 40 segment Tricolor LED (Red, Green, & Yellow). Scale of bar display shall be “0 to 100%”.

3. Digital display: Shall be 5 digits, scaleable in engineering units. Scale of digital display shall match range of process monitored (Example: 0 to 20 feet or 0 to 240 inches).

4. Relay Contacts: Unit shall be provided with 4 (four) form C relays with field programmable set points.

5. Accuracy: DC: +0.01% FS.

6. Manufacturer:

a. Weschler -BH252TC Tricolor Bargraph.

T. Alarm Horn – Panel Mounted

1. *Alarm Horn – Panel Mounted [P]:* Horn shall be semi-flush mounted.
2. Horn shall be vibrating type.
3. Voltage: 120 VAC.
4. Manufacturer:
    a. Edwards Systems Technology - 884D-N5.

U. Alarm Horn – Speaker Cone and Projector

1. *Alarm Horn – Speaker Cone and Projector [P]:* The alarm horn construction shall be a rugged speaker cone and projector that are constructed of spun aluminum. The die-cast aluminum alarm horn enclosure shall house the internal amplification circuitry, tone module and gain control.
2. Horn shall be solid-state design.
3. Horn shall have built in gain control to allow adjustment of volume from 86dBA to 110dBA at 10 (ten) feet.
4. Alarm tone shall be continuous (steady horn).
5. Voltage: 24VDC.
6. Manufacturer:
    a. Federal Signal - 350GC and TM6 Steady Horn Module.

V. Rotating Beacon

1. *Rotating Beacon [P]:* The rotating beacon shall feature a parabolic reflector that rotates around a long life lamp, providing 60 flashes per minute in all directions.
2. The housing shall be rated for NEMA Type 3R applications and be constructed to IP41.
3. The lamp shall be rated for 40,000 hours MTBF.
4. Furnish colored dome as indicated on the drawings.
5. Voltage: 120VAC
6. Manufacturer:
    a. Federal Signal – Vitalite Rotating Warning Light – Model 121S.

W. Panel Digital Indicators

1. *Digital Indicators [P]:* Control panel digital indicators shall have four LED or LCD digits. Panel indicators shall receive 24 VDC binary coded decimal (BCD) signals and 24 VDC strobe signals from the wastewater treatment system PLC. Displays shall be a minimum of 1” in height.
2. Manufacturer:
    a. Cincinnati Electrosystms Inc., Model 4161-4-24.

X. Signal Conditioner/Isolator

1. *Signal Conditioner/Isolator [P]:* Provide process grade instruments for isolation of field mounted transmitters to panel mounted controllers and indicators. Instrument linearity to be better than 0.05% of full scale.
2. Each isolator shall be suitable for the signal types as required for each application.
3. Manufacturer:

a. Moore Industries Inc., Model SCT.

b. Rochester Instruments.

c. Action Instruments.

d. Adtech .

e. Acromag.

Y. Chart Recorders

1. *Chart Recorder [P]:* 4 Pen Recorders: Where indicated on the Drawings, provide solid-state programmable type 4 pen recorders suitable for use with 4-20 mA inputs. Pen colors shall be red, green, blue, and the continuous writing type. Recording accuracy shall be ±0.5% with a dead band of 0.2% of span.
2. Recorder shall be suitable for panel mounting with easily replaceable fan fold chart paper, and 120 VAC power supply. Each recorder shall include six programmable alarm functions with digital printout of alarm on and off times.
3. Twelve (12) replacement charts and pens (of each color) shall be furnished with each chart recorder.
4. Manufacturer:
    a. Yokogawa Series UR 1000.
    b. Chessel Model 346.
    c. Honeywell.

2.4 Commercial HVAC Products

A. Space Thermostats

1. *Space Thermostats [P]:* Pneumatic, wall mounted, lock-shield type equipped with thermometer and currently cataloged case. Thermostats shall have an adjustable differential, minimum setting no greater than 1-1/2 deg. F over a temperature range of approximately 55 deg. F to 85 deg. F. Covers and finishes shall be manufacturer's standard with finish as selected by the Architect-Engineer.
2. Provide insulating bases for thermostats located on exterior walls. Thermostat guards shall be industrial duty cast metal or wire guard type. Mount guards and thermostats on separate bases.
3. Manufacturer:
    a. Honeywell .
    b. JohnsonControls .
    c. Siemens .
    d. Invensys .

B. Line Voltage Thermostats

1. *Line Voltage Thermostats [P]:* Integral manual On-Off-Auto selector switch type if indicated, maximum differential of 2 deg. F, concealed temperature adjustment cover design as approved. Line voltage thermostats shall be rated for the load, single or two-pole as required. Thermostat covers and finishes shall be manufacturer's standard with finishes as selected by the Architect-Engineer.
2. Provide insulating bases for thermostats located on exterior walls. Thermostat guards in office areas shall be finished metal type. Thermostat guards in shop and maintenance areas shall be industrial duty cast metal or wire guard type. Guards and thermostats shall be mounted on separate bases.

3. Provide thermostat with visible or concealed thermometer and visible or concealed set point adjustment as follows:

OCCUPANCY	SET POINT ADJUSTMENT	THERMOMETER
Factory Areas	Concealed	Concealed
Warehouse Areas	Concealed	Concealed
Toilet Areas	Concealed	Concealed
Corridors	Concealed	Concealed
Equipment Rooms	Accessible	Visible
Cafeterias	Concealed	Concealed
Kitchens	Concealed	Concealed
Dining Rooms	Concealed	Concealed
Conference Rooms	Accessible	Visible
Private Offices	Accessible	Visible
General Office Areas	Concealed	Concealed
Lobbies	Concealed	Concealed
Medical Areas	Accessible	Visible
Laboratories	Accessible	Visible

4. Manufacturer:
    a. Honeywell.
    b. Johnson Controls.
    c. Siemens.
    d. Invensys.

C. Energy Conservation Thermostats

D. High Temp. Thermostats (Firestat)

1. *High Temp. Thermostats (Firestat) [P]:* FM approved or UL listed, factory set at indicated temperature, automatic reset shall have a 25 deg. F differential.
2. Manufacturer:
    a. Thermotec .

E. Electric Low Limit Thermostats

1. *Electric Low Limit Thermostats [P]*: Duct type, UL listed, range 30 to 60 deg. F. Sensing element shall be a 20-foot long capillary tube responding to the lowest temperature sensed along any 12 inches of bulb length. Switch shall be SPST 120/240 VAC, rated for 10 amps at 120 volts full load. Unit shall be manually reset. Provide on low limit thermostat for each 20 square feet or fraction thereof of coil surface area.
2. Manufacturer:
    a. Honeywell.

b. Johnson Controls.

c. Siemens.

d. Invensys.

F. Electronic Temperature Sensors (DDC)

1. *Electronic Temperature Sensors (DDC) [P]:* Provide an RTD type temperature-sensing element. Sensor accuracy shall be better than or equal to 1% over a 200 deg. F span. Sensing element type shall be as indicated on the Drawings or as required for the service. Provide a stainless steel well for immersion service.
2. Manufacturer:
    a. Temperature sensor to be by the same manufacturer as system DDC controller whenever possible.
    b. Approved manufacturers component must be suitable for connection to the controller provided under this contract.
        1) Vaisala Sensor Systems.
        2) HY-CAL Engineering.

G. Field Mounted Temperature Controllers

1. *Field Mounted Temperature Controllers [P]:* Bi-metallic rod and tube or liquid-filled averaging type direct acting or reverse acting as required, with adjustable throttling range, scale range 35 to 150 deg. F and adjustable set point over the full range.
2. Manufacturer:
    a. Honeywell.
    b. Johnson Controls.
    c. Siemens.
    d. Invensys.

H. Airstream Temperature Controllers

1. *Airstream Temperature Controllers [P]:* Remote capillary tube type for proportioning action with adjustable setpoint over the full operating range and adjustable-throttling range.
2. Airstream thermostats for averaging service shall have a remote capillary element not less than twice as long as the longest side of the airstream cross-section and of a type suitable for averaging service. Liquid filled bulb or equivalent. Gas or vapor filled bulbs are not acceptable for averaging service. Capillary shall be located to sense average duct temperature.
3. Manufacturer:
    a. Honeywell.
    b. Johnson Controls.
    c. Siemens.
    d. Invensys.

I. Immersion Temperature Controllers

1. *Immersion Temperature Controllers [P]:* Remote bulb type, or functionally equivalent bimetallic rod and tube type, for proportioning action with adjustable setpoint over the full operating range and adjustable throttling range. Provide a stainless steel separable socket for each thermal element.

J. Outdoor Reset Temperature Controllers

1. *Outdoor Reset Temperature Controllers [P]:* Remote bulb type, or functionally equivalent bi-metallic rod-and-tube type for proportioning action with an adjustable throttling range, scale range 100 deg. F to 200 deg. F and with adjustable setpoint over the full range. Mount unit indoors with sensing bulb mounted outdoors with sunshield or solar compensator as required.
2. Manufacturer:
    a. Honeywell.
    b. Johnson Controls.
    c. Siemens.
    d. Invensys.

K. Thermometers

1. *Thermometers [P]*: Provide thermometers adjacent to each duct, immersion thermostat, temperature sensor, where indicated on the Drawings. Thermometers shall be of the remote bulb type with a minimum 4-1/2 inch diameter dial. Thermometers shall have aluminum case, brass or stainless steel movement, white face with black scale markings, liquid or mercury filled thermal system and with copper or brass bulb. Units shall have adjustment provisions for calibration without removing pointer. Provide thermowells for immersion service and extension necks for insulated ducts and piping.
2. Capillary shall have bronze braided armor and shall be ambient temperature compensated if required to maintain specified accuracy at all ambient extremes. Case shall be ambient temperature compensated. Accuracy shall be plus or minus 1% or better of scale range. Maximum scale divisions shall be 2 deg. F. Select scale ranges such that all expected temperatures are within the range but that it does not extend beyond the extremes more than 25 degrees.
3. Locate dial such that it can be easily red from floor level or operating platform. Provide sufficient capillary length and necessary bulb supports within air streams.
4. Manufacturer:
    a. Ashcroft.
    b. Honeywell.
    c. Johnson Controls.
    d. Siemens.
    e. Invensys.
    f. Trerice.

L. Strap-On Aquastats

1. *Strap-on Aquastats [P]:* UL listed, provided with a suitable removable spring clip for attaching aquastat to pipe and a snap-acting SPST switch. Switch setpoint shall be as indicated. Electrical rating shall be 10 amperes, 120V AC.
2. Manufacturer:
    a. Honeywell.
    b. Johnson Controls.
    c. Siemens.
    d. Invensys.

M. Electronic Humidity Transmitters (DDC)

1. *Electronic Humidity Transmitters [P]*: Provide a temperature compensated humidity sensor. Sensor accuracy shall be better than or equal to +/- 1% RH over a range of 0 to 100% RH.
2. Manufacturer:
    a. Humidity transmitter to be by the same manufacturer as system DDC controller provided.
    b. Approved manufacturers component must be suitable for connection to the controller provided.
        1) Vaisala Sensor Systems.
        2) HY-CAL Engineering.

N. Electric-Pneumatic Transducers (DDC)

1. *Electric/Pneumatic Transducers [P]:* Provide a transducer that will accept a variable input signal from the DDC controller and provide a direct-acting, proportional pneumatic signal of 3 to 15 PSI to operate pneumatic actuators. Transducer to have a minimum air capacity of 0.2 CFM.
2. Manufacturer:
    a. Transducer to be by the same manufacturer as system DDC controller whenever possible.
    b. Approved manufacturers, component must be suitable for connection to the controller used.
        1) Action Instruments.
        2) Rochester Instruments.
        3) Moore Industries.
        4) Fairchild.
        5) Masoneilan.
        6) Fisher Controls.
        7) Act.

O. Step Controllers

1. *Step Controllers [P]:* Step controller shall consist of electric operator actuating a cam and step switch assembly. Enclose all electrical components and mount on a base. Operator may be mounted external to enclosure. Switch action shall be SPDT and rated for the load. Controller shall be UL listed.
2. Manufacturer:
    a. Honeywell.
    b. Johnson Controls.
    c. Siemens.
    d. Invensys.

P. Differential Pressure Transmitters (DDC)

1. *Differential Pressure Transmitters [P]:* Provide a transmitter for water or air service. Range shall be suitable for the application conditions. Transmitter accuracy shall be better than or equal to 3% of the transmitter span. Transmitter output shall be compatible with the controller used.
2. Manufacturer:
    a. Dwyer.

b. Setra Systems.

c. Robinson-Halpern.

Q. Water Flow Switches

1. *Water Flow Switches [P]:* UL listed, suitable for all service application conditions. Body minimum working pressure rating shall equal or exceed service pressure. Switch electrical rating shall be 230 VAC/3.7 ampere, 115 VAC/7.4 ampere and 125 VAC 115-230 VAC pilot duty. Unit shall have two SPST normally open switches. Actuating flow rate shall be field adjustable for the specified and indicated service. Switch location shall preclude exposure to turbulent or pulsating flow conditions. Flow switch shall not cause pressure drop exceeding 2 PSI at maximum system flow rate.

2. Manufacturer:

a. McDonnell-Miller.

b. Johnson Controls.

R. Air Flow Switches

1. *Air Flow Switches [P]:* UL listed, suitable for the application conditions. Provide SPDT switch with an electrical rating of not less than 7 amps at 120V AC.

2. Manufacturer:

a. McDonnell-Miller.

S. Air Flow Stations

1. *Air Flow Stations (Inline) [P]:* Provide an inline type, duct mounted airflow station. Unit to be provided with an air straightener grid section designed to eliminate tumbling and non-directional airflow in the ductwork. Type of air straightener grid section shall be based on relative location to fans and elbows in ductwork. Airflow measuring element shall provide total pressure and static pressure outputs proportional to the airflow using multiple averaging pressure probes.

2. *Air Flow Station (Insertion) [P]:* Provide an insertion type, duct mounted airflow station. Airflow measuring element shall provide total pressure and static pressure outputs proportional to the airflow using multiple averaging pressure probes. Probes shall use tube-inside-tube type construction for pressure sensing. Minimum accuracy shall be +/- 2% of total flow.

3. Provide each flow station with a volume meter mounted on the flow station. Meter shall be a diaphragm actuated differential pressure gauge. Scale shall be calibrated in CFM to read volume.

4. Install airflow stations per manufacturer's recommendations.

5. Manufacturer:

a. Cambridge - Model FMS-F, Model FMS-D, Model FMS-A.

b. Air Monitor - Model Fan E, Model D.A.M.D.

c. Brandt - Model FLP 1000, Model SSK 1000.

T. Solenoid Valves

1. *Solenoid Valves [P]:* UL Listed, heavy duty, field-mounted valves with brass or bronze body and stainless steel trim for 200-PSI WOG service. Rate solenoid for 120 VAC power supply; valves normally open (NO) or normally closed (NC) per indicated service application. Provide manual override operation.

2. Manufacturer:

a. Automatic Switch Co. (ASCO) .

b. Magnetrol Valve Corp.

U. Electrical Switches And Pilot Lights

1. *Electrical Switches and Pilot Lights [P]:* Manual switches used for control of systems shall be NEMA 4/13 type with push-button or toggle operator and maintained or momentary contacts to provide required function. Pilot lights shall be NEMA 4/13 type with "Push-To-Test" function with integral transformer for 6-volt bulbs.
2. Manufacturer:
   a. Allen-Bradley.
   b. Square D.
   c. General Electric.

V. Program Clocks

1. *Program Clocks [P]:* Seven day, 4 pole (2 NC - 2 NO) 10-amp contacts, electric clock for 120V AC operation.
2. Manufacturer:
   a. Honeywell.
   b. Johnson Controls.
   c. Siemens.
   d. Invensys.

W. Limit Switches

1. *Limit Switches [P]:* Oil-tight type with operator as necessary to provide required function.
2. Manufacturer:
   a. Allen-Bradley.
   b. General Electric.
   c. Square D.

X. Electrical System Accessories

1. *Electrical System Accessories [B,P]:* Provide transformers, relays, solenoid valves, switches, pilot lights, and other devices and accessories required to complete indicated system. Refer to 13856 Series Sections.

13865.3 EXECUTION

3.1 Control Component Installation

A. Provide per Sections 13855, and 13856 and as required by equipment manufacturer for proper component operation.

END OF SECTION

WFG/wp

DIVISION 15
MECHANICAL SYSTEMS

15050 - BASIC MECHANICAL MATERIALS AND METHODS

15050.1 GENERAL

1.1 Scope of Work

A. This Section includes "General Mechanical Work" that describes the general materials, engineering, design, and installation requirements that apply to Mechanical Systems provided by the Mechanical Trades.

B. In addition, the Mechanical Systems Work described by this Section, is not limited to Mechanical Trades Work only; Work described, applies to all phases and interfaces of Mechanical Work, including Work of other Trades, that shall be the responsibility of this Contractor.

C. Work Specified In This Section

1. This Section includes BASIC MECHANICAL MATERIALS AND METHODS applicable to the Work.
2. ELECTRICAL Work, except as otherwise specified or indicated, shall be provided as part of Work under Division 16 Sections.
3. INSTRUMENT AND CONTROL Work, except as otherwise specified or indicated, shall be provided as part of Work under Division 13 Sections.
4. Provide, as part of the Work under Division 15 and referencing Sections, Electrical Work necessary for the operation of a component, assembly, package or system, but which is not specified or indicated to be provided as part of the Work under Division 16 Sections, in accordance with applicable provisions of Division 16 Sections.
5. Provide, as part of the Work under Division 15 Sections, Instrument and Control Work necessary for the operation of a component, assembly or system but which is not specified or indicated to be provided as part of the Work under Division 13 Sections, in accordance with applicable provisions of Division 13 Sections.

D. Prohibited Construction Materials

1. Use of silicone sealants and other silicone derived products and asbestos containing products, are not allowed on-site and are strictly prohibited in this Project.

E. Seismic Considerations

F. Coordination

1. Process And Cleaning Fluid Waste Control

    a. All process fluids [chemicals], including flushing and cleaning solvents where specified, shall be coordinated, received, handled, stored, dispensed, utilized, and together with resultant waste, shall be disposed of in accordance with requirements of Owner's Representative's On Site Chemical Management Function, who shall be, sufficiently in advance of the Work, advised of proposed activity, schedule, waste product concentrations and quantities, and as applicable, furnished with Materials and Safety Data Sheets for each product involved.

    b. Special care shall be exercised in handling/disposing of spills/wastes, to prevent injury to personnel, damage to facility/equipment, fire and pollution of environment.

G. Basic Electrical Requirements

1. Electric power service shall be provided to factory assembled Division 15 and referenced Sections Work, in accordance with the following, unless otherwise specified or indicated:

    a. Where "packaged" equipment or systems are specified, one or more power services may be required as part of the Work under Division 16 Sections. Any required intercomponent or interassembly power, control, or instrument wiring for proper operation or functioning, shall be provided as part of the Equipment Supply scope of Work under Division 15 Sections.

    b. Where "packaged self contained" equipment is specified, only one power supply shall be provided as part of Work under Division 16 Sections, except as otherwise modified or supplemented by the Contract Documents for that item. All other electrical equipment including disconnect switch, starters, and wiring shall be provided as part of the Equipment Supply scope of Work under Division 15 Sections.

2. Provide local fused disconnect switches and safety devices at all specified factory assembled, skid mounted equipment motors.

3. Electrical Work provided under Division 15 Sections shall conform to applicable UL, NEMA and NEC (ANSI/NFPA 70) Standards and Codes, and applicable material and installation requirements of Division 16 Sections.

4. Electrical Work, where specified, shall comply with the applicable requirements of NFPA 79/SAE/HS 1738 Supplement, Electrical Standard for Industrial Machinery (Formerly JIC Standards).

5. Electrical Work shall comply with applicable space hazard requirements of ANSI/NFPA 70 NEC Article 500.

6. Instrument and Control Work provided under Division 15 Sections shall conform to the applicable material and installation requirements of Division 13 Sections.

7. Refer to ELECTRICAL and CONTROLS SYSTEMS Drawings and Divisions 13.8 and 16 Sections for specific provisions for and arrangement of interfacing components and circuits related to Division 15 Sections Work.

8. For components/assemblies/systems provided with electrical requirements other than those specified, include as part of the Work under Division 15 Sections, transformers, wiring, components and Work necessary to the proper operation/functioning thereof.

9. Electrical ratings shall comply with ANSI/IEEE Std 141 and as follows:

    a. Electric power supply/service. 4160, 480 and 208 volts, 3 phase, 60 hertz (Hz) and 120 volts, 1 phase 60 hertz (Hz), hereinafter referred to as 4160 VAC, 480 VAC, 208 VAC and 120 VAC respectively.

b. Electric motors. 4000, 460 and 208 volts, 3 phase, 60 hertz (Hz); 115 volt, 1 phase, 60 hertz (Hz), hereinafter referred to as 4000 VAC, 460 VAC, 208 VAC and 115 VAC respectively.

10. Provide wiring, which is external to electrical enclosures, within conduit, except where otherwise specified or indicated.

11. Coordinate the number of N.O. and N.C. and isolated contacts to be provided under Division 15 Sections to accommodate equipment/functions/interfaces specified or indicated by the Contract Documents.

12. Electrical testing of motors is specified as part of Work under Division 16 Sections.

H. Vibration Control

1. Static and dynamic balancing requirements, vibration criteria, vibration isolation requirements, submittals, shop and field testing, shall conform to the requirements of GM Specification No. V1.0 "Vibration Standard For New and Rebuilt Machinery and Equipment."

2. Design limit under installed, operating conditions, equipment and piping vibration measured at specified or approved points, in mils peak-peak displacement or velocity in inches/second, shall not exceed the following:

a. Limits specified in the latest edition of the ASHRAE Handbook: HVAC Applications, Sound and Vibration Control Section.

b. Limits for motors per NEMA MG-1 Standards.

I. Noise Control

1. Noise control requirements including submittals, design criteria, products noise reduction measures, shop and field testing, shall conform to the requirements of .GM Specification No. SL 1.0 "Sound Level Specification For The Purchase Of New and Rebuilt Machinery, Powertools, and Equipment."

2. GM Vendors Sound Data Form and Certification Sheet, Form GM-1676, shall be submitted for the following equipment:

a. All motor driven equipment with motors ¾ hp and above.

b. Variable frequency drives.

c. Steam pressure reducing stations.

d. The final sound pressure level measured at any point 4 feet above room floor level, shall not exceed either the NC curve specified below in any octave band from 63 to 8000 hertz or the overall A-weighted sound pressure level, specified below:

Type of Area	Noise Criterion Maximum (A-Weighted)	
	NC Maximum Limit	Sound Pressure Level (db)
Office – Fully Enclosed	30	38
Office – Open Plan & Hallways	35	42
Conference Room	35	42
Classroom/Training Room	40	47
Engineering Rooms/Laboratory Area	45	52
Computer Room	50	57
Power Plant Control Room	55	62

e. It is the Contractor/Vendor's responsibility to meet the above limits either through providing equipment with sound power levels capable of meeting these limits, given the system design and its operation with all equipment and accessories or through the addition of sound attenuating materials or equipment.

f. If the owner has any reason to believe the above limits are being exceeded, it will be the Contractor/Vendor's responsibility to provide to the owner, at no cost to the owner, certified sound pressure level readings both A-weighted and by octave band to verify system performance.

J. Related Work Specified In Other Sections

1. Division 1 Section "Summary of Work."
2. Division 1 Section "Submittal Codes."
3. Division 9 Section "Painting."
4. Division 3 Section "Cast-In-Place Concrete."
5. Division 16 Sections for Electrical Work, except as otherwise specified.
6. Division 13 Sections for Instruments and Controls, except as otherwise specified.
7. Division 15 Section "Aboveground Piping Systems."
8. Division 15 Section "Valves."
9. Division 15 Section "Piping Specialties."
10. Division 15 Section "Pumping Equipment."
11. Division 15 Section "Thermal Insulation."
12. Division 15 Section "Plumbing Fixtures and Equipment."
13. Division 15 Section "Testing and Balancing"
14. Division 15 Section "Steam and Condensate Specialties and Equipment."

K. Related Work Specified In Other Contracts

L. Pre-Purchase Contract Assignment

M. Owner Furnished Materials And Equipment

1. Materials and equipment which shall be installed as part of the Work under this Contract and which are Owner "furnished" or Owner "pre-purchased" and "assigned" to this Contract are hereinafter referred to as "Owner furnished".
2. Materials and equipment identified by the Contract Documents as "Owner furnished, Contractor installed" will be furnished to the Contractor. stored on site, or supplied FOB commercial carriers for unloading by the Contractor upon prior agreement with the Owner. All demurrage charges resulting from delay on the part of the Contractor in unloading transport shall be paid by the Contractor. See paragraph INSTALLATION.
3. Review all data from the manufacturing source of Owner furnished materials or equipment and which lists items which the manufacturer will ship "loose" for installation as part of the work of this Contract, in order to effect a satisfactorily functioning component, assembly or system.
4. The Owner will provide the services of an authorized representative of the manufacturer for certain

Owner furnished equipment in accordance with the Contract Documents. Verify that such arrangements have been made. If the services of the authorized representative of the manufacturer are required in addition to those provided by the Owner, bear all costs of those additional services.

5. List of Owner "furnished" equipment:
    a. Refer to Drawings for material and equipment that are Owner "furnished".
    b. Refer to Division 1 Section "Summary of Work," for materials and equipment that are Owner "furnished".

1.2 Quality Assurance

A. General

1. Comply with the requirements of the GENERAL CONDITIONS and the SPECIAL CONDITIONS which form a part of the Contract Documents.
2. In the performance of the Work, comply with the requirements of the Contract Documents and of the equipment manufacturer, whichever is the most stringent.
3. A deviation from Specifications which is not explicitly proposed/identified as a deviation, is subject to removal/replacement at any time after discovery and notification of the Contractor, at no additional cost to the Owner.

B. Requirements Of Regulatory Agencies, Codes And Standards

1. Provide materials and equipment and execute the Work, including tests and inspections, in compliance with the applicable provisions of the Federal, State and Local Government laws and ordinances and referenced codes and standards current, unless excepted, as of the issue date of this SPECIFICATION including applicable provisions of the Occupational Safety and Health Act (OSHA) and Environmental Protection Authorities (EPA) having jurisdiction. Governing laws, ordinances, codes and standards constitute minimum requirements. All more stringent requirements of the Contract Documents shall modify, supplement and supersede applicable portions of governing laws, ordinances, codes and standards.

C. Referenced Specifications And Standards

1. The provisions of the REFERENCED Specifications AND STANDARDS, as applicable and referenced under Articles of this Section or other Division 15 Sections, govern the quality of materials, workmanship, and installation required under the Contract.
2. AABC Associated Air Balance Council.
3. AGA- American Gas Association.
4. AISC American Institute of Steel Construction.
5. AMCA Air Moving and Conditioning Association.
6. ANSI American National Standards Institute.
7. ARI American Refrigeration Institute.
8. ASHRAE American Society of Heating, Refrigeration and Air Conditioning Engineers.
9. ASME American Society of Mechanical Engineers.
10. ASPE American Society of Plumbing Engineers.
11. ASTM American Society for Testing and Materials.
12. AWWA American Water Works Association.

13. AWS American Welding Society.
14. BOCA Building Officials and Code Administrators International.
15. CISPI Cast Iron Soil Pipe Institute.
16. EPA Environmental Protection Agency
17. FM Associated Factory Mutual Fire Insurance Companies.
18. Swiss-Re GAP, Swiss-Re General Assets Protection, formerly known as IRI, and GE GAP.
19. HI Hydraulic Institute.
20. IEEE Institute of Electrical and
21. MSS Manufacturer's Standardization Society.
22. NACE National Association of Corrosion Engineers.
23. NBBPVI National Board of Boiler and Pressure Vessel Inspectors.
24. NFPA National Fluid Power Association.
25. NFPA National Fire Protection Association.
26. NSF National Sanitation Foundation
27. OSHA Occupational Safety and Health Act.
28. PDI Plumbing and Drainage Institute.
29. PFI Piping Fabrication Institute.
30. SMACNA Sheet Metal and Air Conditioning Contractors National Association.
31. SSPC Steel Structures Painting Council.
32. STI Steel Tank Institute.
33. UL Underwriter's Laboratories.
34. Perform all welding, brazing, soldering and cutting work in conformance with requirements of Contract Documents and applicable provisions of the following:
    a. American National Standards (ANSI) B31.1 Power Piping with current Addenda.
    b. American National Standards (ANSI) B31.3 Process Piping with current Addenda.
    c. American Society of Mechanical Engineers (ASME), Boiler and Pressure Vessel Code, Section IX, 1986 Edition, as amended by any Addenda.
    d. American Welding Society (AWS) D1.1 Latest Revision. Structural Welding Code.
    e. American Welding Society (AWS), Brazing and Soldering Manuals.

D. Owner's Specifications/Standards

E. General Motors Standards And Specifications:

1. GM Form NO. GM-1774: Electrical Installation Standard EI-1 for Buildings and Facilities. Source: Boise Cascade Office Products.
2. Standard Specification No. 7E-TA for High Efficiency Industrial AC Electric Motors, Totally Enclosed Types "T" Frame Dimensions.
3. Standard Specification No. 12E for the Purchase of Motor Control Centers and Combination Motor Starters 600 Volts and Below by General Motors Corporation.

4. GM Form No. HS-1738 SAE Electrical Standard for Industrial Machinery-Supplement to NFPA 79 – HS-1738 – Source: Boise Cascade Office Products.
5. Document SAE HS-1738 and other documents are available from Boise Cascade (1800-421-4676). Written requests for copies must be accompanied by a Purchase Order number or check.
6. NAO Piping Identification Standard, SD3-95.
7. General Motors Lubricant Standard, GM LS1.
8. General Motors Design for Health and Safety Standard DHS-3
9. UAW-GM Lockout Energy Control training manual #LK101BK

F. UAW-GM Lockout Energy Control Placarding Tool (e-Plac)

G. Source Quality Control

1. Perform manufacturer's standard and any special shop tests for the Work, each component to ensure compliance with intent of the Specifications.
2. Materials and equipment shall be the products of manufacturers regularly engaged in the manufacture of such products, shall essentially duplicate equipment that has been in satisfactory service at least 2 years prior to issue date of the Contract and shall be supported by a service organization that is reasonably convenient to the site.
3. Lubricants: Verify with equipment manufacturers, that proposed equipment required lubricants also: comply with GM Standard LS1; maybe used in proposed equipment with no adverse operating results or conditions; with no resulting compromise of warranty conditions.

1.3 Submittals

A. General

1. Furnish submittals for materials, equipment and elements of work that are identified in the Division 15 Sections by a different typeface and a bracketed code (e.g., Item [L]). Refer to Division 1 Section "Submittal Codes" for a definition of the codes used for different types of submittals, and the administrative requirements governing the submittal procedure. Additional submittal requirements pertaining to this and other sections are specified in the General Conditions, and as supplemented herein under this Article.
2. Review of shop drawings does not constitute approval of a proposed deviation from the Contract Documents which is not specifically noted and identified as a deviation in the shop drawings submitted for review.
3. Partial/piece meal submittal of assemblies/systems is not acceptable and these will be returned without review.
4. Delays incurred due to disapproved submittals are the Contractor's responsibility.
5. Shop drawings submittals shall bear the Contract Documents identifying project name and number, shall be sequentially item numbered. Submit two (2) certified for construction prints and one legibly reproducible copy.

B. *Proposal Data [L]*

1. BID DATA APPENDICES constitute part of the BIDDER's PROPOSAL. Failure to complete these forms constitutes sufficient reason for BIDDER's PROPOSAL to be rejected. No prior to award resubmission opportunity will occur.
2. Provide with PROPOSAL, prior to award of Contract, a MATERIALS AND EQUIPMENT SOURCE

LIST, as the basis for all of the proposed Work.

3. Sub Vendor Technical Services. Include in LUMP SUM PRICE, separately stated cost of technical assistance services of each authorized representatives of the various product manufacturers, during proposed materials/equipment assembly, installation, start up, training of Owner's operating and maintenance personnel, debugging and acceptance testing. Include labor, materials, travel, per diem and any other costs as part of the "field engineer" work.
4. Deviations/Exceptions to Specifications. Descriptively state and price each proposed exception or deviation, referenced to a specific paragraph, describe benefits which accrue to the Owner, price each item and incorporate with PROPOSAL. In the event that an exception to the Contract Documents involves a price change, provide cost as a VOLUNTARY ALTERNATE PRICE. Unless specifically stated otherwise in PROPOSAL, the Owner will assume that PROPOSAL is made without any deviation from "PLANS and SPECS" and Contractor shall be held responsible for every requirement thereof.
5. Subsequent to Contract award, any proposed Deviation from the Bid Basis MATERIALS AND EQUIPMENT SOURCE LIST, shall be submitted, in writing and with documentation as required, together with any cost benefit to the Owner, to the Owner or the Owner's Representative, for approval

C. *Materials And Equipment Source List [B]*

1. Upon request and prior to placing orders for materials and equipment, submit for approval, a list of manufacturing sources from which the Contractor proposes to acquire materials and equipment to be incorporated into the Work. Source approvals are tentative and are subject to approval of submittals/shop drawings verifying compliance with the Contract Documents.
2. Specified manufacturers with or without model designation, shall be acceptable only where the manufacturer's product complies with or is modified as necessary to comply with specified and indicated requirements, and inclusion of a manufacturer's name as an acceptable product source does not void any specified criteria.
3. Materials and equipment not specified or indicated as to manufacturer, but necessary for complete functioning systems, shall be provided from sources optional to the Contractor, but conforming to the quality levels and functional requirements for corresponding materials and equipment specified.

D. *Proof Of Compliance [L]*

1. e UL Label or Listing with re examination by UL and FM Label or Approved Product Listing will be accepted as evidence that the material or equipment conforms to certain minimums, but not necessarily to all specified requirements.

E. *Samples and Mock-ups [S]*

1. Provide samples or mock ups where specified or indicated by (S).

F. Materials Safety Data Sheets (MSDS)

1. Provide *OSHA Form 174 equivalent Materials Safety Data Sheets [P]* for all chemistry/solvent containing products proposed/furnished/used/handled. Distribute data in compliance with "right to know" regulations.
2. Develop and maintain a data log for all chemicals/solvents/flushing wastes to be tracked/accounted for on a daily, weekly, and monthly basis, during construction, and deliver same to Owner, together with certification of proper disposal, prior to final acceptance.

G. Shop Drawings And Product Data [D,P]

1. Prior to fabrication or procurement of materials or equipment, submit certified shop drawings covering materials and equipment proposed under this Contract. Shop drawings shall delineate any provisions for obtaining required performance under project service conditions. Submitted performance data shall be

inherently certified to be applicable to intended project service conditions.

2. Submittals shall exclude data which is not pertinent to objective of submittal. Submitted items shall be identified as to intended use. Submittals which are not clearly identified as to pertinent constituents and intended use will not be reviewed, at Contractor's risk of delay.
3. Shop drawings shall bear the Contract Documents Project Name, Architect-Engineers Project No., Addenda/Bulletin No., Item Name, Mark No. System or Point Of Use description, Drawing No., Specification Section, Article, and Page No.
4. Each shop drawing submittal shall bear mark-ups and certification of checking for completeness of submittal and compliance with Contract Documents by the Contractor's ENGINEER, otherwise submittal will not be reviewed, at Contractor's risk of delay.

H. Shop drawings for Work specified to comply with criteria specified under Divisions 13 and 16 Sections shall be submitted in compliance with additional specific requirements specified thereunder.

I. Submit required copies of BID DATA APPENDIX, certified as corrected to and complying with accepted PROPOSAL and reflecting as designed/as built criteria.

J. Shop drawings submittals shall include required copies of. clearly delineated verifications of compliance with the elements of the Contract Documents, performance, details of configuration, construction, materials suitable for the service, support, functional ancillary provisions, utilities including power connections, wiring diagrams and sequence of operations, installation details for construction field conditions, other Section and other contract work interface data, etc.

K. Shop drawings shall include:

a. CD or floppy electronic media.
b. Software and Drawings hard copy.
c. Piping and Instrumentation Diagrams.
d. Sequences of Operation.
e. Power and control panels, wiring.
f. Control schematics.
g. Electrical system and instruments/controls systems interfaces with external circuits which are part of Work of this Contract and other contracts.
h. Piping systems including external systems interfaces which are part of the Work of this Contract and other contracts.
i. System and equipment plans, elevations, arrangement drawings, selected views.
j. System and equipment Sections, details.
k. Product data shall include performance data and complete description of all equipment and components provided, including catalog cuts, bills of materials, illustrations and other descriptive data.

L. Submit integrated electrical drawings including power, control and instrument wiring interfacing with work under separate contracts for field work as well as factory assembled work. Manufacturer's electrical drawings are acceptable only when modified and supplemented to exactly reflect Contract conditions. The "system" of drawings shall include. overall schematic diagram of the entire system of power circuitry detailing the number of and wire and conduit sizes, wiring diagrams showing the wiring layout of component assemblies or systems, interconnection wiring diagrams showing terminations of the interconnecting conductors between component assemblies, systems, control devices, remote monitoring/control functions, and control panels with

interconnections, sequence of operation for components, assemblies or systems.

M. For programmable logic controllers (PLC's) supplied, provide the following:

l. Drawings indicating detailed input/output connections.

m. Input/output lists describing function of each input and output and associated addresses.

n. Complete wiring diagrams showing communication cable interconnections including. Central processor, I/O drives, power supplies, RS 232/other interfaces and all other required equipment.

N. Where software programs for programmable logic controllers are supplied, provide the following:

1. Complete software documentation including analog input/output registers, timer/counter registers, internal coils used and all other information required to allow future software additions without disturbing resident programs.
2. Commented and fully documented ladder diagrams of initial software programs.
3. Three copies of program tapes with final, debugged programs. Supply tapes after complete, field testing of software programs and Owner acceptance.
4. Ladder diagrams complete with full documentation of final software programs which duplicate in hard copy the program tapes described in Item 3 above.
5. If construction conditions mandate deviations from Contract Documents, details of such deviations, including changes in related portions of the project and the reasons therefore, shall be submitted as "shop drawings" for approval.

O. Submit recommended Field Start Up and Acceptance Testing Procedures specific to systems and conditions of this project, for Owner evaluation/revision/concurrence.

P. On completion of the Work, and prior to acceptance thereof, two sets of high quality AutoCad drawings in CD format and in updated WFG Graphic Standard (NAO 0067) of the "as built" Drawings, and the "as-built" 3D model shall be delivered to the Owner or WFG Capital Project Manager."

Q. Start Up/Debugging Schedule/Checklist/Inspection

R. Operation And Maintenance Data [D]

1. Provide per Division 1 Section "Operating and Maintenance Data" and as supplemented herein.
2. After start up, issue the O & M Manual (hard copies) with addenda/revisions to all recipients of the O & M Manual within 10 working days following acceptance of the system.
3. Manuals shall incorporate data to enable operators and maintenance personnel to understand the equipment, its potentialities, performance, limitations and maintenance needs. Data on design, construction, installation and operating features shall be included. Data submitted shall exclude or obliterate content which is not applicable to equipment purchased under the Contract.
4. Manuals shall include the following:
    a. Bid Data Appendix (if applicable).
    b. Software, hard copy (if applicable).
    c. P & ID, Drawings, Schematics Diagrams (See Shop Drawing requirements).
    d. System OEM (Original Equipment Manufacture) components and assembly drawings as built.
    e. Equipment brochures, data and catalog cuts including:
        1) Performance. Normal and abnormal conditions.
        2) Installation.

3) Operation. Normal and abnormal conditions.

4) Trouble shooting.

5) Safety precautions.

6) Maintenance and repair.

7) Nearest authorized OEM representative and stocking spare parts source.

8) Pass thru OEM materials and equipment guarantee/warranty.

5. Unless noted otherwise, provide Owner with two (2) hard copies of the O&M manuals.
6. Provide Owner with Four (4) CD copies of the entire O&M manual set.

S. Tools/Keys

1. Provide complete set of special tools as required for field maintenance. Provide a locked tool box and four keys for each set of tools.
2. Provide four sets of keys to all lock equipped control enclosures.

T. *Test Reports [T]*

1. Deliver test data required by the Contract Documents prior to final acceptance.
2. Test data shall include final set points of devices.
3. Detailed field test procedures, and where required factory test procedures, shall be submitted for approval at least 60 days before actual testing begins. Procedures used shall be bound with TEST REPORTS.

U.*Lockout Placards [D,S]*

1. Prepare and submit Black and White Lockout Placards. Lockout placards shall be on equipment or system at “green tag” acceptance of safety buy-off process (power on).
2. Prepare and submit Full Color Lockout Placards. Lockout placards shall be on equipment or system at “manila tag” acceptance of safety buy-off process (final acceptance).
3. All placards shall be prepared with the GM e-Plac Excel® software tool.

1.4 Operating and Maintenance Personnel Training [D,S]

A. Provide concurrent with check out, debugging and start up, a coordinated training program oriented to needs of operating personnel and maintenance personnel, sufficiently prior to acceptance of the Work, upon mutually satisfactory arrangement with the Owner.

B. Submit detailed Training Program Schedule and topic outline encompassing Contractor furnished systems, for approval by the Owner.

C. Provide (2) two copies of [sound) [video) [DVD) recordings of the O&M personnel training instructions for Owner’s future use.

D. Provide a total of not less than specified or approved “class room” and all necessary “field” hours, in addition to requirements specified elsewhere, encompassing mechanical, electrical, chemical, pollution and safety aspects, sufficient for personnel to operate and maintain systems and consistently achieve specified objectives.

E. Product, systems technicians, start up engineers, complemented by instrument engineers, supplemented by Contractor’s staff, shall comprise the training staff.

F. Training materials shall include samples, shop drawings, operating and maintenance manuals, demonstrations,

specified reports/data, installed and functioning systems, and the like.

G. Provide Owner with (2) two CD's, each containing active (word/excel format) and .PDF file copies of all training materials approved and used for Owners O&M Personnel training courses.

1.5 Project Conditions

A. Sequencing

1. Make all connections to existing systems during designated periods, upon written approval of Owner and at no increase in the Contract Sum.
2. Coordinate/ schedule sufficiently early delivery of equipment and subsequent installation Work with interfacing Work for required access, subsequent structural work, drainage provisions, external systems connections, concrete work and the like.
3. Skid mounted equipment shall be modular/sectionalized with alignment pins, as indicated or necessary, to pass through restricting access provisions, vertically or horizontally (if so designed) without field disassembly. Any disassembly and reassembly of equipment systems for access purposes shall be at no additional cost to Owner.
4. Provide equipment access including ladders to vessel manholes and locate access doors/manholes to accommodate indicated installation access provisions/constraints with maximum safety and convenience for Owner's personnel. Verify access orientation with General Arrangement Drawings before release of equipment/vessels for fabrication.

B. Existing Facilities

1. Do not interrupt existing utilities, except as specified or when approved in writing, and then only after temporary utility services have been approved and provided. INTERRUPTIONS must be scheduled to suit Owner requirements.
2. Verify conditions and constraints of existing work. Where existing connections require modification in order to match or connect work under this Contract, provide all necessary labor, materials, and equipment to accomplish the Work. In addition, maintain integrity of the existing systems. Rectify any contamination, degradation of cleanliness or damage to the existing systems to the satisfaction of the Owner. Provide all Work so required at no increase in the Contract Sum.

C. Removal Of Mechanical Equipment And Fixtures

1. Disconnect mechanical work to be removed at the nearest convenient connection to existing services which are to remain. Disconnect the mechanical equipment and fixtures at fittings or header valves and plug or cap. Do not remove such equipment until approved by the Owner.
2. All materials and equipment which are removed, except for those items indicated to be relocated or delivered to Owner storage or directed to be relocated or delivered to Owner storage by the Owner, shall become the property of the Contractor and shall be promptly removed from the site.

D. Asbestos Removal/Remediation Work

1. Asbestos removal and remediation Work shall be done under separate Contracts.

E. Housekeeping/Safeguarding Construction

1. Perform operations during construction and upon completion of the Work of this Contract in accordance with the applicable requirements of NFPA Standard No. 241 and the Contract Documents.

F. Trades Interference

1. Space and elevation occupancy and sequence of occupancy shall be scheduled/coordinated or resolved, by the Contractor, to preclude any codes, trades or structures interferences between present and future Work by this Contractor and other CONTRACTORS working in the area, at no additional cost to the Owner.
2. Coordinate underground piping, conduits, cables and substructures and aboveground piping, wiring, lighting fixtures, mechanical/electrical, ducting, building equipment, process equipment, control panels, and other construction, to facilitate the installation of this Work and compliance with applicable codes.

1.6 Guarantee/Warranty

A. *Guarantee/Warranty [G]:* The guarantee shall comply with requirements of General Conditions, except where supplemented or superseded by specific requirements of Divisions 15 and 13 Sections.

B. For heating, ventilating and air conditioning systems, the minimum guarantee period shall be extended to include one complete heating season and one complete cooling season after final acceptance.

C. Pass through to Owner, all OEM materials, equipment and performance guarantee/warranty and bind copies thereof in Maintenance Manuals.

D. The guarantee shall warrant that the Work and execution thereof i.e. workmanship, materials, equipment and systems, and performance thereof, shall meet the specified/indicated requirements, for the specified period after final acceptance or if deficient, shall be reworked or replaced promptly, to meet requirements of the Contract Documents, at no additional cost to the Owner.

E. Subsequent to final acceptance, the Owner reserves the option to request performance tests throughout the guarantee period, in accordance with the requirements of the Article entitled, “FIELD TESTS DURING GUARANTEE PERIOD”.

1.7 Product Inspection, Delivery, Storage, Handling

A. Materials/Equipment Inspection

1. The Owner’s Representatives shall be granted the right to inspect and be present at the factory, upon any reasonable occasion, during the manufacture, assembly and pre shipment shop testing, operation/simulation for all equipment covered by this Contract.
2. Provide Owner with written notice two weeks prior to schedule date for conducting all tests required by the Contract Documents.
3. All material and equipment, workmanship and performance thereof, shall be subjected to inspection and test after its delivery to the site. In case any articles are found to be defective in material or workmanship or otherwise not in conformity with the SPECIFICATION requirements, Owner shall have the right to reject such articles or require their correction.
4. Rejected Work requiring correction shall be removed by and at the expense of the Contractor. Promptly remove such Work and proceed with the replacement and/or correction thereof, since the Owner may contract for or otherwise replace and/or correct such Work, and charge to the Contractor, the excess cost occasioned the Owner.

B. Shipping/Storage/Handling

1. Protect materials and equipment, including surface finish, against detrimental conditions within Contractor’s control, including freezing and corrosion, during transport, storage, receipt, erection, connection, and until acceptance within Owner’s adequately environmentally controlled space.
2. Match mark disassembled components. Close and seal open ends and maintain so until connection, in

compliance with specified cleanliness requirements. Modularize, reinforce, brace, pack for shipment and handling per applicable commerce requirements and for handling within constraints of site destination available access.

3. When storing equipment off site, keep in dry, protected, environmentally controlled space, at a temperature range of 40 to 90 degF, humidity range to prevent condensation, packaged/sealed to prevent incursion of detrimental particulate.
4. Nitrogen blanket, desiccant protection and shrink wrapping is suggested where applicable.
5. The Owner shall be informed of the fact when equipment will be stored off site.

C. Helicopter Lifts

1. If helicopters are used as the lifting means when placing above grade materials, equipment or structures, make all arrangements, obtain all approvals, schedule the Work to preclude interference with any other Work, take all necessary safety precautions, and assume complete responsibility for the results of this activity.

15050.2 PRODUCTS

2.1 General

A. The Contract Documents define process concepts, materials and equipment, systems duty, capacity, operating conditions and product requirements, setting forth minimum requirements and details which will assist the BIDDER in the preparation of his Proposal and the successful Contractor in assuming responsibility for the whole Work.

B. These minimum requirements and details shall not be construed as relieving the Contractor from providing all Work in accordance with the necessary expertise and capacity, even though some items of Work may not be complete or specifically mentioned or indicated, to suit the needs of the required Work.

C. Where any project condition would adversely affect the continuous service performance or capability of indicated products, de-rate, modify, or propose replacement of the product, as necessary to obtain continuous service performance required by the Contract Documents.

2.2 Cleaning and Waste Solvent and Process Fluid Inventory

A. Provide Owner approved virgin or reclaimed cleaning solvent which is safe and non reactive with containment materials and process fluids.

B. Waste cleaning solvent inventory and aggregate waste flushing process fluid, apportioned by process fluid system storage/pipe size/length, shall be disposed of to an Owner selected and approved, EPA licensed/authorized/approved waste reclaim/disposal facility. The Contractor shall provide Owner with a legal “paper trail” documentation of proper disposal before final payment.

2.3 Industrial AC Electric Motors

A. General

1. *Motors [C, D, L, P]:* Motors shall conform to GM Standard Specification No. 7E-TA for High Efficiency Industrial AC Electric Motors, in conjunction with IEEE Standard 841 for Petroleum and Chemical Industry-Severe Duty, Totally Enclosed Fan Cooled, Types "T" Frame Dimensions, unless otherwise specified or approved for special conditions.

B. Service Requirements

1. Duty requirements include:
    a. A motor minimum service factor of 1.0 with sizing at loads imposed by normal service operation of equipment to preclude brake horsepower requirements in excess of 100% of the nameplate horsepower.
2. Sufficient torque to accelerate connected load to full rated speed within 20 seconds with 80% of rated voltage maintained at motor terminals during the starting period.
3. Suitability for across the line, full voltage starting.
4. Suitability of insulation class for duty ambient.
5. Suitability of enclosures for space atmosphere.
    a. Motors under 1/4 horsepower. 115 volts single phase, 60 hertz, permanent, split capacitor start induction run squirrel cage type, unless otherwise approved.
    b. Motors 1/4 horsepower and over: 460 volts, 3 phase, 60 hertz, squirrel cage induction type, NEMA Design B, unless otherwise specified. Refer to Electrical Equipment Specification No. 7E-TA for list of approved motor manufacturers.
    c. Two speed motors shall be two winding type.
    d. Motors driven by electronic variable speed drives shall meet the requirements of NEMA MG1, Part 31, Definite Purpose Inverter-Fed Motors.

2.4 Miscellaneous Materials

A. *Equipment Grout [P]:*

1. TYPE NS Non Shrink Grout: Premixed, nonshrink grout, consisting of aggregate base, Portland cement and sand, with all necessary plasticizers, densifiers and other control ingredients. Nonmetallic Grout: ASTM 1107, Grade B:
    a. Manufacturer:
        1) Euclid Chemical Co. "Euco N S Grout".
        2) L & M Construction Chemicals "Crystex".
        3) Master Builders "Masterflow 713"
        4) Five Star Products Inc.
        5) Plasite Protective Coating Corp.
        6) Sika Corp.
2. TYPE EP Water/Chemical/Oil Resistant Epoxy Grout: Premixed, nonshrink grout, consisting of plastic resins base, with appropriate modifiers:
    a. Manufacturer:
        1) Euclid Chemical Co.

2) Master Builders
3) Five Star Products Inc.
4) Blome Cements Co.
5) Sika Corp.
6) Sauereisen Cements Co.

B. Steel Primer Coatings [P]:

1. TYPE A: Polyamide blend high build epoxy or urethane for manufacturer required substrate.
    a. Manufacturer:
        1) Ameron “Amerlock 400”
        2) Carboline “Carbomastic 15 or Low Temp 242”
2. TYPE B: Inorganic zinc rich coating for manufacturer required substrate.
    a. Manufacturer:
        1) Ameron, “Dimetcote”.
        2) Carboline Carbo Zinc No. 11.
        3) Tnemec 92 zinc.

15050.3 EXECUTION

3.1 General

A. Execute the Work, in accordance with the Contract Documents, to provide the Owner with first class materials, equipment, state of the art workmanship and expertise and appearance/finish, subject to the closest inspection by the Contractor, whether or not the Owner or authorities having jurisdiction, perform any part of the inspection.

B. Execute the Work in accordance with requirements of referenced codes, standards and regulations, the Contractor’s proffered experience in building specified systems, requirements of authorities having jurisdiction and where specified, in accordance with submitted and approved procedures.

C. Perform the Work and provide required expertise, in accordance with manufacturer’s published and written project specific instructions, and where necessary for proper execution of the Work or where specified, under the specific direction of a competent authorized technical representative of the manufacturer.

D. Materials and equipment furnished, and Work done, shall be subject to inspection by the Owner and authorities having jurisdiction. Such inspection shall not relieve the Contractor’s responsibility for furnishing qualified labor and material in strict accordance with these Specifications.

E. Materials and equipment not meeting specified requirements shall be rejected and replaced at once with materials or equipment of the specified type and quality, at no additional cost to the Owner.

F. Systems shall be complete in all details, interfaces and ancillaries necessary to the specified Work, and even though not all items of Work necessary thereto are specifically mentioned by the Contract Documents, they shall be provided.

G. Provide, subject to Owner's approval, all modifications to ancillary facilities required by the proposed equipment, at no increase in Contract Sum.

H. During construction and testing procedures, maintain integrity of existing structures.

I. Provide for and fit materials and equipment into available installation, maintenance access/clearance space indicated; otherwise, notify the Owner in advance of the Work.

J. Provide, maintain and enforce safety and environmental protection provisions necessary to the Work, including OSHA "Lockout" provisions, during construction and testing, whether or not delineated on the Drawings.

K. Provide "Lockout" placards for Owner use in black and white format at "green tag" stage of safety buy-off and full color format at "manila tag" stage of final safety buy-off.

L. When unloading delivery trucks containing combustible and flammable liquid fuels, process fluids, especially [Gasoline), [Windshield Washer Fluid) [methanol) and [Paint Thinner), for the first fill, exercise special care to have site and municipal fire protection and environmental control personnel and equipment standing by, in event of spill.

M. Refer to referenced SOURCES for applicable requirements which are modified or supplemented herein.

N. No changes or deviations from this SPECIFICATION shall be permitted without prior written approval and credit to Owner where due.

O. It is incumbent upon the Contractor to ensure Owner's Representative witnessing and inspection of Work before closure.

3.2 Installation and Application Instructions

A. General

1. Furnish, apply, install, adjust, test and operate all materials, equipment and systems in conformance with the approved/certified shop drawings and manufacturer's published instructions, except as more stringently modified and supplemented by the Contract Documents. In the event of conflict between manufacturer's specific criteria and the Contract Documents, bring such conditions to the Architect-Engineer's attention for resolution, to result in construction best suited to project conditions.

2. The procedures and means employed for doing the various classes of Work shall be at the option of the Contractor, subject to the Contract Documents, to provide the Owner with first class materials, workmanship, and acceptable appearance/finish, subject to the closest inspection by the Contractor himself, whether or not the Architect-Engineer performs any part of the inspection.

B. Installation

1. Unload, receive, store, relocate, handle, uncrate, inspect, check, clean, assemble, rig, install, test and adjust all materials and equipment, each in its proper location with constraints as indicated or specified herein, complete with ancillary items, in satisfactory operation condition.

2. Set equipment to accurate line and grade, leveling equipment as required with metallic shims or filler plates.

3. Provide grouting; aligning equipment components, anchor bolts; drilling dowel holes and doweling equipment bases; vibration isolation.

4. Cut shims from shim stock, sheet or plate steel or corrosion resistant metal sized for full bearing surfaces. Remove shims after grouting if so required by the manufacturer.

5. Provide field balancing; couplings, belts and guards.

6. Maintain tolerances in leveling, alignment and vibration and other specific installation requirements for each class of Work in accordance with manufacturer's published installation instructions, unless otherwise specified.
7. Provide epoxy grout where specified and where grout is exposed to corrodent/oil exposed service, otherwise provide premixed, non-shrink grout, mixed and applied in accordance with the manufacturer's recommendation. Grout shall be complete, continuous and free from voids.
8. Furnish and position anchor bolts per approved/certified shop drawings, except as otherwise indicated. Locate per approved/certified shop drawings, underfloor conduit, drain lines and hub outlets within or directly adjacent to equipment base and as closely as possible to equipment connections.

C. Thermal Metal Joining And Cutting

1. Each party performing thermal metal joining and cutting shall be responsible for the quality of Work done by his organization and shall repair/replace, in accordance with specified requirements, any Work not performed in accordance with these Specifications.
2. All welding, brazing, soldering, and cutting work shall conform to the following codes and supplementary requirements.
    a. ASME Boiler and Pressure Vessel Code (BPVC) and Addenda, Section I, VIII and IX as applicable.
    b. ASME/ANSI B31.1 Power Piping Code and Addenda.
    c. ASME/ANSI B31.3 Process Piping Code and Addenda
    d. AWS D1.1 Structural Welding Code and Addenda.
    e. AWS Brazing Handbook.
    f. ASTM B 828 Standard Practice for Making Capillary joints by Soldering of Copper and Copper Alloy Tube and Fittings.
    g. CDA Copper Development Association Guide Specification for Copper and Copper Alloy Building Piping Systems.
    h. State/Local Codes.
    i. Best Practice of the Trade.
3. Orbital welding is acceptable in all pipe sizes, shall be code compliant when executed by operators in accordance with manufacturer's instructions. Orbital welder operators shall be qualified on site by manufacturer/Contractor, in presence of Owner's Representative.
4. Welders and welding procedures employed on tanks, pressure vessels and pressure piping and specified work, shall be qualified per ASME/BPVC Section IX. Provide for each project material/joining method, a Welding Procedure Specification QW 842 (WPS), a corresponding Procedure Qualification Record QW 843 (PQR) and for personnel currently qualified to execute each WPS, a Welder or Welding Operator Qualification Test QW 844 (WOQ). WPS and PQR established by National Certified Pipe Welding Bureau (NCPWB), Hartford Steam Boiler Insurance Inspection (HSBII) and the like are acceptable. For each WPS employ personnel with current WOQ experience as defined by ASME/NCPWB/HSBII. Where a WOQ is more than three years old, the welder shall be re qualified; where the welder has not been employed on applicable WOQ within the past three months, requalification is also required. File for record, each applicable WPS/PQR/WOQ.
5. Perform soft soldering of copper and alloys per ASTM B 828 and CDA Guide Specification, unless otherwise approved.

3.3 Building and Other Surface Penetrations

A. General

1. Provide all openings and sleeves required for this Work in cooperation with the Work under other Sections, and as indicated on the Drawings.

2. Surface penetrations shall be as described below and in conformance with applicable code requirements:
    a. Smoke proof/smoke rated where penetration of a smoke barrier occurs.
    b. Fire proof/fire rated where penetration of a fire barrier occurs.
    c. Watertight below grade.
    d. Weathertight above grade.
    e. Gas and vapor tight to preclude gas or vapor entry into conditioned or occupied spaces.
    f. Sound tight wherever necessary to preclude sound transmission to or between occupied spaces.
    g. Vibration isolated from penetrated structure.
    h. Toxic or deleterious substance tight where necessary to protect space content or occupant.
    i. Explosion proof where flammable liquids are stored or where flammable vapors are generated or where flammable gases may accumulate.
3. Utilize indicated openings and if necessary, upon prior approval, modify equipment or other work to suit, at no increase in Contract Sum. In the event that indicated openings cannot be utilized, revise indicated openings or, if necessary, close indicated openings and provide new openings, all as part of the work of this Contract, at no increase in Contract Sum. Advise the Architect-Engineer of the need for revision of indicated openings, closure of indicated openings or replacement new openings prior to award of Contract so that a design can be made. After award of Contract, costs related to design and shop drawing approval of indicated opening revision and closure and replacement new openings shall be borne by the Contractor.
4. Provide all calking, flashings and counterflashings required to maintain integrity of sanitation and weather protection at all mechanical systems penetrations of building boundary surfaces.
5. Building surface penetrations and finish and execution thereof shall be by personnel skilled in the Work, compatible with specified function and contiguous surfaces and acceptable to the Architect-Engineer.

B. Cutting

1. To avoid unnecessary after the fact cutting of building surfaces. Provide all support inserts, sleeves, anchors, footings, foundations, chases, openings, drainage provisions and the like during construction, in sufficient time for appropriate trades to accommodate these items in the normal course of construction.
2. Do not cut, burn or weld, structural parts of the building without the written authority of the Architect-Engineer. Welding to building structural steel, where authorized, shall be done by certified welders only.
3. Do not place flame producing equipment on any roof without the written authority of the Owner.
4. Use concrete/masonry saws for cutting openings in existing concrete/masonry surfaces.

3.4 Supporting Elements

A. General

1. Provide all supporting elements, including supplementary structural steel and ancillary devices necessary to support the Work, in accordance with specified and indicated requirements and applicable codes and standards.
2. During construction and testing procedures, maintain the structural integrity of existing Work by providing temporary shoring, bracing and reinforcing to safely support/restrain the live and dead loads imposed on the Work by material, workmen, testing or inclement weather conditions.

B. Fastening To Building Structures

1. The methods of attaching or fastening equipment or equipment supports or hangers to the building structure shall be subject to approval by Owner's Representative at all times. Submit shop drawings or samples for approval before proceeding with the Work.
2. Welding to or cutting of building steel will not be permitted.
3. Equipment or piping shall not be attached to or supported from the roof deck, from removable or knockout panels, or temporary walls or partitions.

3.5 Painting and Finishing

A. Provide manufacturer's standard color finish paint system, on all equipment that has a published catalog finish, except as otherwise specified.

B. Bring all finished materials/equipment surfaces damaged prior to final acceptance to "as new" condition by touch up, or replacement with original manufacturer's finish, including paint/coating/plating/galvanizing/high lustre polishing finishes.

C. Shop or field fabricated bare supplementary steel or metal fabrications shall have rough/sharp surfaces/edges removed, shall be thoroughly cleaned free of dirt, rust, oil, grease, weld slag, etc. and prime painted with TYPE A or TYPE B primer specified under Division 9 Section "Painting.".

D. Field fabricated bare iron or steel items required for installation of work under this Division shall have rough or sharp edges removed, be thoroughly cleaned of dirt, rust, weld slag, grease or oil and prime painted with one of the following. Rust Oleum No. 7086 or Tnemec 1009**.**

E. Insulation system for piping, ducting and equipment surfaces [includes) [may include) an integral finish or a finish coating requiring no additional painting, except for specified identification.

F. Provide shop applied prime paint on all other mechanical equipment, compatible with specified finish, except as otherwise specified.

G. Finish painting, including all necessary prime painting of unpainted Division 15 Sections Work surfaces is specified as part of the Work of Division 9 Section "Painting," unless otherwise specified.

3.6 Mechanical Systems Identification

A. General

1. Refer to NAO Piping Systems Identification Standards, SD 3-95, GM-2010, for Recommended Color Coding for Safe Identification of Piping Systems.
2. Provide a coordinated identification system which conforms to ANSI A13.1 and ANSI Z53.1 and which provides the specific colors specified herein. The system shall include:
    a. Framed and plastic protected diagrammatic layout of all systems, identifying and showing

distribution elements, equipment, automatic or manual control location.

b. Metal tag identified valves, systems components and equipment.

c. Marked location of access doors.

d. Marked location of mechanical systems controls.

e. Color code and service identified piping and equipment.

f. Color code and service identified air handling system ductwork and equipment.

3. Apply the permanent mechanical systems identification work after completion of painting and finishing of the systems and components to be identified.

4. *Piping Identification Schedule [D]:* Submit the entire identification system, including color codes, label legends and tag designations which are coordinated with the DRAWING nomenclature, for approval by the Architect-Engineer, prior to proceeding with the work.

   a. The following "sample list" contains recommended label legends for commonly used media systems. This list was taken from the NAO Piping Systems Identification Standard.

Media Name	Color	Color Code
COMPRESSED AIR - 90 PSIG	BLUE	GMS 06
FIRE PROTECTION	RED	GMS 01
COLD DOMESTIC WATER	GREEN	GMS 08
HOT DOMESTIC WATER	GREEN	GMS 08
NON-POTABLE WATER	ORANGE	GMS 15
COOLING TOWER WATER - SUPPLY	ORANGE	GMS 15
COOLING TOWER WATER - RETURN	ORANGE	GMS 15
CHILLED WATER - SUPPLY	ORANGE	GMS 15
CHILLED WATER - RETURN	ORANGE	GMS 15
REFRIGERANT	ORANGE	GMS 15
SANITARY	ORANGE	GMS 15
STORM	ORANGE	GMS 15
STORM - OVERFLOW	ORANGE	GMS 15
NATURAL GAS - 25 PSIG	YELLOW	GMS 14
CHEMICAL FEED SYSTEM	----------	GMS 18
INDUSTRIAL WASTE - GRAVITY	ORANGE	GMS 15
INDUSTRIAL WASTE - PUMPED	ORANGE	GMS 15
STEAM – 40 PSIG	ALUMINUM	GMS 24
STEAM CONDENSATE	ALUMINUM	GMS 24
STEAM CONDENSATE - PUMPED	ALUMINUM	GMS 24
REVERSE OSMOSIS WATER	ORANGE	GMS 15

b. **Do not** label any piping systems as "City Water", within the facility.

5. Piping identification labels shall indicate full media name without any abbreviations. Furthermore, clearly indicate media pressure rating and flow direction, when required (e.g. NATURAL GAS - 25 PSIG à).

B. Diagrams [D]:

1. System Flow Diagrams shall be provided within each mechanical equipment room, and or for each self contained pre-manufactured system provided for this project.

C. Metal Tags [P,S,U]:

1. Provide all valves and equipment with corrosion resistant identification tags, minimum 2” diameter, brass, which can be easily read from floor level wired in place with No. 12 copper wire or equivalent brass chain and where applicable, give Contract DOCUMENT equipment designation number. Wiring of tags shall be accomplished in a manner that will allow equipment operation thru normal cycles without removal of tag.
2. Tags shall identify the following:
   a. Valve or equipment type (for example ball valve BA).
   b. Area (for example Bldg. 100A).
   c. Service (for example NPW).
   d. Series number (for example #1).
   e. Sample Tag: VBA NPW 100A 1.

D. Identification [P]:

1. Refer to NAO Piping Systems Identification Standards, SD 3-95, GM-2010, for Recommended Color Coding for Safe Identification of Piping Systems,
2. Locate legends and flow arrows in accordance with the following:
   a. Every 40 feet in straight runs.
   b. At each side of each building surface penetration.
   c. At branches and risers.
   d. In congested piping areas
   e. At every sectionalizing or main shutoff valve.
   f. At each point where required to clearly identify system service.
   g. At each access door.
   h. At each point of connection to equipment.
3. Provide legend letters of the following heights:

Outside Diameter of	Height of Legend Letters	Width of Color Band

Pipe or Covering		
Less than 1-1/4"	1/2"	8"
1-1/2" to 2"	3/4"	8"
2-1/2" to 6"	1-1/4"	12"
6-1/2" to 10"	2-1/2"	24"
greater than 10"	3-1/2"	32"

4. When identification cannot be placed or retained on a surface for any reason, provide color coded double faced sign panels supported from such surface by brass chain or by rigid means. Where one line is concealed from view by another, hang panels on lines to indicate location and direction of flow. Use 18 gage black sheet metal, 1/16" thick embossed aluminum, or 1/16" thick vacuum embossed plastic.
5. Where normal flow is in one direction provide a single arrow. Where flow is normally reversible, provide double arrow.
6. Where surfaces are adjacent to each other, line up and locate legends to be visible from the floor. Make all legend outlines neat, free of fuzziness and other irregularities.
7. Make stencils of corrosion resisting metal, and upon completion of the work, deliver full set of stencils to Owner.
8. Impregnated fabric or solid polyvinyl chloride plastic sheet, adhesive coated, commercially available identification legends are acceptable. Furnish materials suitable for continuous service at surface temperatures from 10 degF to 160 degF in relative humidities to 90% and for seasonal weather exposure without loss of attachment to surface being identified. Should failure by loss of adhesion occur, repair contaminated surfaces and provide legend panels or stencil painted legends at no increase in the Contract Sum.
    a. Seton Name Plate Corp. "Snap On".
    b. W.H. Brady Co.
    c. Panduit Corp.
    d. Markel.

3.7 Protective Coatings

A. Primers and protective coatings shall be provided as part of Work under Division 15 Sections where so specified, otherwise as part of Work under Division 9 Section "Painting," and Division 9 Section "High Performance Coatings," to the extent specified or indicated on the Drawings.

B. Equipment which will be subject to abnormal conditions of high temperature, corrosive environment, etc., shall have finishes and/or protective coatings suitable for the service.

3.8 Cleaning/Process Fluid Waste Control

A. Process Fluids: All process fluids chemicals, including cleaning solvents, shall be received, handled, stored, dispensed, utilized, and together with resultant waste, shall be disposed of in accordance with requirements of the Local Environmental Protection Authority and Owner's On Site Chemical Coordinator, who shall be,

sufficiently in advance of the Work, advised of proposed activity, schedule, waste product concentrations and quantities, and furnished with Materials and Safety Data Sheets for each product involved.

B. Special care shall be exercised in handling/disposing of spills/wastes, to prevent injury to personnel, damage to facility/equipment, fire and pollution of environment.

C. Waste fluids shall be removed off site to approved disposal facilities.

D. Paper Audit Trail [L R]: For materials which are disposed of off site, provide the Owner with paper audit trail and certification of disposal in accordance with the requirements specified and of authorities having jurisdiction.

3.9 Field Quality Control

A. General

1. Prior to acceptance of the Work, operate and test each completed system in conjunction with interfacing **[contracts) [Sections)** work, and in the presence of the Insurance Underwriters, and authorities having jurisdiction. Test systems per requirements of the local Fire Department, local Natural Gas Supplier, other applicable governing codes and the requirements specified herein. Provide all Work materials, equipment and man power as required to properly execute each test.

2. Coordinate and schedule testing provisions with Owner as to source of Owner furnished special test fluids, spill prevention/containment thereof with respect to other related construction/inspection/test activities, and like concerns.

3. Test Procedures: Develop the test procedures to demonstrate the satisfactory operation, within design intent, of each piece of equipment and each system. The test procedures, at minimum, shall be in compliance with the test procedures and methods recommended by the equipment suppliers/manufacturers. Submit the proposed test procedures to the Owner/Architect-Engineer for review 30 days prior to start of testing.

4. Notify the Owner/Architect-Engineer not less than ten working days prior to scheduled date of each test and request that a representative of the Owner/Architect-Engineer witness each test.

B. Structural Integrity/Leak/Performance

C. Acceptance/Miscellaneous Testing

1. Refer to Articles under the various Division 15 Sections, Division 13 Sections and Division 16 Sections for coordination and applicable requirements.

D. Vibration Testing

1. Refer to Articles under the various Division 15 Sections for applicable requirements.

E. Tank/Piping Grounding

1. Test all flammable and combustible fluids systems containing tank grounds and related piping systems bonding and grounding for electrical continuity. Joint resistance shall be not greater than 2 ohms.

F. Systems Start Up

1. Adjust all parts of the various systems to function within the framework of design intent and operating characteristics specified or published by the equipment manufacturers. Bring into service condition all components, assemblies and systems prior to operation for any purpose, as required by the component, assembly or system manufacturer and the

Contract Documents.

2. In the event that temporary use of systems before all parts are complete is necessary and approved by the Owner, adjust all parts to preclude damage and provide means to render temporary system use as effective as possible at no increase in Contract Sum.
3. Provide the services of an authorized technical representative of the manufacturer, satisfactory to the Owner, in the event that the Contractor is unable to satisfactorily adjust any component, assembly or system and for Owner's personnel training. Arrangement for such services and costs thereof are to be borne by the Contractor.

G. Systems Operation Demonstration

1. Calibrate and adjust, monitoring and control devices, accessories, equipment and components for stable and accurate operation to meet the design intent and to obtain optimum performance from each system. Final adjustment checking shall be performed while the systems are in full operation under full load conditions. Cause every device to function manually and automatically, as intended, to insure its proper operation.
2. After calibrations, adjustment, and checking have been completed and systems are operational, devise a program to demonstrate to the Owner/Architect-Engineer and Owner's operating personnel the complete and correct functioning of all control systems and equipment in manual and fully automatic modes. These demonstrations shall consist of operating the controls through their normal full ranges and sequences. Simulate/induce, abnormal or emergency conditions to demonstrate proper functioning of safety devices or provisions. Readjust settings to their correct values and observe ability of systems to establish the desired conditions, noting abnormal deviations. Make necessary repairs, replacements or adjustments on items or systems which fail to perform satisfactorily and repeat tests to demonstrate compliance with the design intent. Demonstrate:
    a. Systems product delivery to point of use at specified/required quality, quantity, pressure,
    b. Temperature control,
    c. Pressure control,
    d. Simulate operation under part load, full load, detrimental conditions and determine system response.
    e. Compliance with all other requirements to consistently deliver specified product/performance.
    f. "Fault recovery" procedures and system response.
3. Notify the Owner, sufficiently in advance of above scheduled Work, so that the Owner's operating and maintenance personnel may be present for concurrent training purposes.
4. Upon satisfactory completion of each test, submit a written report to the Owner/Architect-Engineer, including copies of test data to support the satisfactory completion, attesting to the adequacy and satisfactory performance of each piece of equipment and each system.
5. If testing indicates inadequacy of the equipment or the system, immediately notify the Owner/Architect-Engineer and expedite the effecting of necessary change outs or repairs to the equipment or to the system. After the equipment or the system has been corrected, retest the equipment or the system until satisfactory performance is demonstrated. Then comply with Paragraph D above.

3.10 System Operation

A. Provide all necessary skilled staff and supervision man hours to continuously operate and maintain systems during operation for Contractor's convenience, and as required by the Contract Documents during systems start up, check out, adjustment/calibration, break in, demonstration, performance testing, noise/vibration testing,

acceptance testing, personnel training, and environmental conditions/concerns, and subsequently until final acceptance by the Owner.

B. Equipment and systems shall be brought into proper operating condition prior to the operation of any equipment for any purpose or duration and subsequently, shall be put into appropriate and protective idle/standby condition on shut down, in accordance with the requirements of the Contract Documents which includes all pertinent manufacturer's requirements and recommendations.

C. The cost of water, fuels and electricity supplied through Owner's meters will be borne by the Owner.

3.11 Follow-up Field Quality Control

A. Upon acceptance of the Work by the Owner, the guarantee period shall begin. At the same time, the Owner will assume responsibility for operation and supply of expendables.

3.12 Field Tests During Guarantee Period

A. Testing to determine/verify compliance with requirements of Contract Documents shall be performed per the following:

1. Test and testing procedures for items not delineated in Contract Documents, shall be mutually agreed upon, in writing, prior to start of testing.
2. Specially requested test activity participant's costs shall be borne by:
    a. The Owner if compliance is verified.
    b. The Contractor if testing indicates failure to comply.

B. Testing shall be performed in the presence of the Owner, or his designated representative.

C. If the testing or retesting of the Work provided under this Contract should indicate failure to meet the requirements of the Contract Documents, the Contractor shall be responsible for whatever addition, modification or replacements may be necessary to provide the Owner with a system which fully conforms to these requirements. Repair work shall be scheduled at a time convenient to the facility being served

3.13 Testing Services By Owner

A. The Owner may employ the services of one or more testing agencies for the Owner's purposes, such as validating Contractor's data. Any information or assistance furnished by these agencies shall not relieve the Contractor of his responsibility for his Work and the rectification of any Work which is not in compliance with the Contract Documents, without additional cost to the Owner.

3.14 Owner-Furnished Equipment Installation

A. Uncrate and examine all equipment furnished by the Owner which is to be installed, and immediately notify the Owner, in writing, of any damaged material or missing parts. Moving, erecting, or installing of any Owner furnished equipment shall be construed to indicate that it has been accepted in good condition; assume the responsibility and liability for its protection, unless it can be proven that any later discovered damage is due to faulty workmanship or inferior component parts thereof, necessary to the satisfactory and safe operation of the item.

B. Furnish all labor and materials not furnished by Owner, but necessary to a seamless interface, complete and satisfactorily functioning Work.

C. If helicopters are used as the lifting means when placing roof mounted units, make all arrangements, obtain all approvals, schedule the Work to preclude interference with any other work, take all necessary safety precautions, and assume complete responsibility for the results of this activity.

D. Protect all materials and equipment from damage from the time it is removed from the point of receipt or storage until acceptance by the Owner.

E. All tolerances in leveling, alignment and vibration and other specific installation requirements for each classification of work shall be subject to manufacturer's installation instructions.

F. Perform installation, assembly of items shipped "loose" by manufacturer including intercomponent and interassembly piping and wiring, field terminal hook up, start up, testing, debugging and related work based on approved shop drawings, and under the direction of an authorized representative of manufacturer.

G. Provide as required all miscellaneous conduit, wiring, piping, and fittings necessary for the complete installation of the system.

H. END OF SECTION

15080 - THERMAL INSULATION

15080.1 GENERAL

1.1 Summary

A. Section Includes:

1. Provide the various types of thermal insulation as shown, scheduled or specified. Include all accessories and components for properly functioning installations.

B. Piping Systems Thermal Insulation

1. Indoor

a. Piping Systems - Fibrous Glass Insulation:

MINIMUM INSULATION THICKNESS FOR PIPE SIZES*							
Piping System Types	**Fluid Temp. Range deg F.**	**Runouts Up to 2 in. and 8 ft. length**	**1 and Less**	**1-1/4 to 2**	**2-1/2 to 4**	**5 and 6**	**8 and Larger**
Heating Systems Steam & Hot Water							
High Pressure/Temp	306-450	1.5	2.5	2.5	3.0	3.5	3.5
Medium Pressure/Temp	251-305	1.5	2.0	2.5	2.5	3.0	3.0
Low Pressure/Temp	201-250	1.0	1.5	1.5	2.0	2.0	2.0

Low Temperature	120-200	0.5	1.0	1.0	1.5	1.5	1.5
Steam Condensate	Any	1.0	1.0	1.5	2.0	2.0	2.0

**Insulation thickness based on insualtion having thermal resistances in range of 4.0 to 4.6 h x F x sq. ft/BTU per inch of thickness on a flat surface at a mean temperature of 75 degF.*

b. Piping Systems - Calcium Silicate Insulation:

MINIMUM INSULATION THICKNESS FOR PIPE SIZES*							
Piping System Types	**Fluid Temp. Range deg F.**	**Runouts Up to 2 in. and 8 ft. length**	**1 and Less**	**1-1/4 to 2**	**2-1/2 to 4**	**5 and 6**	**8 and Larger**
Heating Systems Steam & Hot Water							
High Pressure/Temp	306-450	2.5	5.0	5.0	5.0	5.5	5.5
Medium Pressure/Temp	251-305	2.5	4.5	4.5	4.5	5.0	5.0
Low Pressure/Temp	201-250	2.0	3.0	3.0	3.5	3.5	3.5
Low Temperature	120-200	1.0	2.5	2.5	2.5	2.5	2.5
Steam Condensate	Any	2.0	2.5	3.0	3.5	3.5	3.5

1) Steam Systems, over 60 PSIG. Fibrous glass or calcium silicate.
2) Steam Systems, 15 to 60 PSIG. Fibrous glass or calcium silicate.
3) Steam Systems, 0 to 15 PSIG. Fibrous glass or calcium silicate.
4) Steam Condensate Systems. Fibrous glass or calcium silicate.
5) Domestic Hot Water Systems. Fibrous glass.
6) Domestic Cold Water Systems. Fibrous glass with vapor barrier.

c. Piping systems shall be insulated with the following insulation thickness, heat traced as indicated and covered with a sealed aluminum jacket as follows:

2. Piping Systems Accessories And Equipment

a. Systems where a vapor barrier is required shall be provided with “Thermal-Hanger Shield Inserts” at all pipe supports.

C. Piping Systems Anti Condensation Insulation

1. General

a. Systems subject to exterior condensation because of internal fluids and pipe exterior ambient conditions shall be insulated per the following minimum thickness with a vapor barrier, and "Thermal-Hanger Shield Inserts" at all pipe supports.

2. Piping Systems Inside Buildings (Except Paint Shops)

Piping System	Min. Thickness (inches)	Remarks
Cold Domestic (Potable) Water	1	Fibrous glass
Chilled Water Supply/Return	1	Fibrous glass
Coil Drain Piping	1	Fibrous glass
Rain Conductors	1/2	Fibrous glass
Air Compressor Intake	1	Fibrous glass
Softened Water Piping	1	Fibrous glass
Sanitary Waste	1	Fibrous glass
(Cold) Non-Potable Water	1	Fibrous glass
Industrial Waste Systems	1/2	Fibrous glass
Coolant Systems, Machining	1/2	Fibrous glass
Cooling Tower Water	1	Fibrous glass

3. Piping Systems And Equipment Surfaces
    a. Cementitious material applied to surfaces as indicated.

D. Air Handling Systems Thermal Insulation
    1. Indoor
        a. Ducts, plenums, enclosures and fans not installed in enclosures shall be thermally insulated to extent indicated.
            1) Flexible fibrous glass with vapor barrier where concealed from view.
            2) Flexible fibrous glass with vapor barrier and glass cloth jacket.
        b. Cementitious material applied to surfaces as indicated.

E. Related work specified in other sections:
    1. Division 15 Section "Basic Mechanical Materials and Methods."

1.2 Submittals

A. Furnish submittals for items that are identified in this Section by a different typeface and a bracketed code (e.g., Item [L]). Refer to Division 1 General Requirements Section "Submittal Codes" for definitions of codes regarding types of submittals and the administrative requirements governing submittal procedure. Additional submittal requirements pertaining to this Section are specified herein under this Article.

B. Show provisions for obtaining required performance under project service conditions.

C. Shop drawings [D]: Provide shop drawings for insulation, adhesives, coatings, mastics, sealants and solvents. Drawings shall be accompanied by a Material Safety Data Sheet similar to Form OSHA 174. Where flammable

product application performance requirements are such that a non flammable substitute would fail, submit alternative product with complete information for approval.

D. Test Reports [P,T]: Provide copies of performance test data.

E. Certificate [C]: Submit certificate that materials performance data to be applicable under project service conditions.

1.3 Owner-Furnished Products

A. Products which shall be installed as part of the Work under this Contract and which are Owner "furnished" or Owner "prepurchased" and "assigned" to this Contract are hereinafter referred to as "Owner furnished".

B. Products identified by the Contract Documents as Owner furnished, Contractor installed will be furnished to the Contractor, stored on site, or supplied FOB commercial carriers for unloading by the Contractor from transport at the site, or shipped to points designated by Contractor upon prior agreement with the Owner. The Contractor shall pay all demurrage charges resulting from delay on the part of the Contractor in unloading transport. See paragraph Installation.

C. Review all data from the manufacturing source of Owner furnished products and which lists items which the manufacturer will ship "loose" for installation as part of the work of this Contract, in order to effect a satisfactory functioning component, assembly or system.

15080.2 PRODUCTS

A. Provide noncombustible thermal system materials per NFPA 255 and ASTM E 84. Provide insulation with a Flame Spread Classification of 25 and a maximum Smoke Developed Classification of 35, 50 (fibrous glass), or 150 (cellular elastomer).

2.1 Calcium Silicate

A. *Asbestos free hydrous calcium silicate [P]:* With mineral binder, reinforcing fiber and free chloride ion content of less than 300 PPM and per ASTM C 533. Fittings insulation per ASTM C 450.

1. Manufacturer:
    a. Johns Manville Corp. "Thermo-12 Calcium Silicate"
    b. Calsilite Corp. "Calsilite Insulation"
    c. PABCO Corp. "SuperCaltemp, Type NA"

B. Block insulation:

2. Manufacturer:
    a. Johns Manville Corp. "Thermo-12"
    b. Calsilite Corp. "Calsilite Insulation"
    c. PABCO Corp. SuperCaltemp "Type NA".

2.2 Cellular Elastomer

A. *Cellular elastomer [P]:* Insulation shall conform to ASTM C177 or C518] and have thermal conductivity not greater than 0.30 Btu inch/hour, square foot, degF. at 75 deg. mean temperature and vapor permeability (ASTM E 96), not greater than 0.10 perm inch. In thicknesses of 1" and less, it shall have a flame spread classification (ASTM E 84, NFPA 255) not greater than 25, and specific optical smoke density (NFPA 258) averaging not greater than 150.

1. Manufacturer:

   a. .Armacell, Armaflex AP (For higher temperature installations (above 220 deg. F) use Armacell, AP Armaflex FS or approved equal.)

   b. Johns Manville Aerotube AP and II.

   c. Rubatex R-180-FS

B. Insulation thicknesses shall be as listed in Part 1. Contact adhesive shall be as supplied by the insulation manufacturer.

2. Manufacturer:

   a. .Armacell 520 Adhesive , or approved equal.

   b. Johns Manville 57 Adhesive.

   c. Rubatex 373 Adhesive.

2.3 Cellular Glass

A. *Cellular Glass [P]:* Cellular glass insulation shall be inorganic, foamed or cellulated glass, per ASTM C 552, annealed and set to form a rigid incombustible material with hermetically sealed cells.

1. Manufacturer:

   a. Cell -U-Foam.

   b. Pittsburgh Corning "Foamglass"

2.4 Fibrous Glass

A. A. Ductwork insulation [P]*:* Fiberglass blanket insulation shall conform to ASTM C553 and have thermal conductivity not greater than 0.32 Btu inch/hour square foot Degree F. at 75 Degree F. mean temperature. Vapor barrier facing shall be a laminate of minimum 1 mil thickness aluminum foil exterior surface, glass fiber reinforcement, and kraft paper. The facing shall have water vapor permeance (ASTM E96, Procedure A) not greater than 0.5 perms.

1. Manufacturer:

   1) CertainTeed Type 75 FSK Standard Duct Wrap .

   2) Johns Manville R-Series Microlite with FSK

   3) Knauf Duct Wrap with Multi-Purpose FSK

   4) .Owens/Corning All Service Faced Duct Wrap

B. B. Ductwork insulation [P]*:* Insulation board shall conform to ASTM C612 Class 2 and have thermal conductivity not greater than 0.26 Btu inch/hour square foot Degree F. at 75 Degree F. mean temperature. Density of insulation board shall be 6.0 lbs/cubic foot. Vapor barrier facing shall be a laminate of white kraft paper exterior surface, glass fiber reinforcement, and minimum 1 mil thickness aluminum foil. The facing shall

have water vapor permeance (ASTM E96, Procedure A) of not more than 0.2 perms and puncture resistance (ASTM D781) not less than 50 units.

1. Manufacturer:

    5) CertainTeed 1B600 ASJ Industrial Insulation Board

    6) Johns Manville Type 817 AP Spin-Glass

    7) Knauf 6PCF-ASJ Insulation Board

    8) Owens/Corning Type 705 ASJ-25 Fiberglas Insulation

C. Piping barrel insulation [P]*:* Insulation shall conform to ASTM C547 Class 1 and have thermal conductivity not greater than 0.26 Btu inch/hour, square foot, deg. F at 75 deg. F. mean temperature. Vapor barrier jacket shall be a laminate of white kraft paper exterior surface, glass fiber reinforcement, and minimum 1 mil thickness aluminum foil. The jacket shall have water vapor permeance (ASTM E96, Procedure A) of not more than 0.02 perms, and puncture resistance (ASTM D781) not less than 50 units.

1. Manufacturer:

    9) Johns Manville Micro-Lok AP-T Plus

    10) Knauf ASJ/SSL Pipe Insulation

    11) Owens/Corning Fiberglass ASJ/SSL-II

D. Pipe fitting insulation [P]*:* Insulate flanges, couplings, fittings, and valves with either fiberglass blanket insulation or segments of pipe insulation, secured with 20 gage annealed stainless steel wire and given a smoothing coat of insulating and finishing cement. Thickness of insulation on fittings and valves shall be equal to that on the adjacent pipe. Thermal conductivity of fiberglass blanket insulation shall not be greater than 0.28 Btu. inch/hour, square foot, deg. F. at 75 deg F. mean temperature (density 1.0 PCF). Insulating and finishing cement shall be as supplied by the following approved manufactures under these trade names:

1. Manufacturer:

    12) Celotex MW-1 Insulating and Finishing Cement

    13) Pabco Pabcote One Coat Insulating Cement

E. E. Hot equipment insulation [P]*:* Insulation board shall conform to ASTM C612 Class 2 and shall have thermal conductivity not greater than 0.26 Btu inch/hour square foot Degree F. at 75 Degree F. mean temperature and not greater than 0.35 Btu inch/hour square foot Degree F. at 200 Degree F. mean temperature.

1. Manufacturer:

    14) CertainTeed 1B600 ASJ Industrial Insulation Board

    15) Johns Manville i.< Type 817 Spin-Glass

    16) Knauf 6PCF-ASJ Insulation Board

    17) Owens/Corning Type 705 ASJ Fiberglass

F. Pipe insulation with vapor barrier [P]*:*

1. Manufacturer:

    18) Johns Manville Corp. "Flame-Safe AP-T"

    19) Owens-Corning Fiberglas "ASJ/SSL-II"

    20) Knauf Fiber Glass GmbH "ASJ-SSL"

    21) Manson "ASJ-SSL"

G. Pipe insulation without vapor barrier [P]:

1. Manufacturer:

22) Johns Manville Corp. "Flame-Safe AP-T"

23) Owens-Corning Fiberglass "ASJ-SSL-II"

24) Knauf Fiber Glass GmbH "ASJ-SSL"

25) Manson "ASJ-SSL"

H. Flexible insulation [P]:

1. Manufacturer:

26) Johns Manville Corp. "Microlite-FSK"

27) Owens-Corning Fiberglass "Faced Duct Wrap Commercial Grade"

I. Rigid insulation [P]:

1. Manufacturer:

28) Johns Manville Corp. "Spintex" No. 414 (6 lbs./cu. ft.) with Type GVB facing.

29) Owens-Corning Fiberglass "Fiberglass" Type 705 (6 lbs./cu. ft.) with Type ASJ-2 5 facing

30) *Knauf, 6PCF with ASJ facing*

2.5 Mineral Fiber

A. *Mineral fiber insulation [P]:* As an MfrMdloption and subject to approval, may be used in lieu of calcium silicate or fibrous glass. Insulation manufactured as a continuous molding per ASTM C 585. Nominal density 10 lbs./cu. ft., K factor of 0.26 at 75 degF and suitable for service temperatures up to 1200 degF per ASTM C 547.

B. *Piping insulation [P]:*

1. Manufacturer:

a. Fibrex "Epitherm 1200"

b. Carborundum Fiberfrax

C. *Block insulation [P]:*

1. Manufacturer:

a. Fibrex "Epitherm 1200"

b. Carborundum Fiberfrax

D. Blanket insulation [P]:

1. Manufacturer:

a. Fibrex mineral fiber blanket, faced or unfaced

b. Other approved by Owner.

2.6 Jackets and Accessories

A. Polyvinylchloride Jacket [P]: Polyvinylchloride, 0.010 inches thick, per FS L P 535, Composition A. Type II, manufacturer's standard color. Use manufacturer's standard joint adhesive.
    1. Manufacturer:
        a. Johns Manville Corp. "Zeston"
        b. Other approved by Owner.

B. Vinyl Jacket [P]: Vinyl, fiberglass scrim, and metallized polyester jacket:
    1. Manufacturer:
        a. Stauffer Chemical Ultra-Jacket
        b. Other approved by Owner.

C. Fittings Jackets [P]:
    1. Polyvinylchloride, 0.010 inches thick, per FS L P 535, Composition A, Type II, manufacturer's standard color. Use manufacturer's standard joint adhesive.
        a. Manufacturer:
            1) CEEL-CO "Light-Gage"
            2) Proto Corp. "LoSmoke"
            3) Johns Manville Corp. "Zeston"
    2. Fibrous glass, molded or routed. Use manufacturer's standard joint adhesive.
        a. Manufacturer:
            1) Hamfab Corp. "Fitting Covers"
            2) Poncho, Inc. "Poncho"
            3) Great Lakes Inc. "Speedline"
    3. Aluminum, approximately 0.032 inches thick, smooth, two piece.
        a. Manufacturer:
            1) General Aluminum Supply Corp., Kansas City, Mo.
            2) Other approved by Owner.

D. Straps [P]: AISI Type stainless steel, 15 mils thick, 1/2 inch wide.

E. Joint sealant [P]*:* Aluminum pigmented butyl polymer.
    1. Manufacturer:
        a. Foster Div., H. B. Fuller Co. "Elastolar Sealant, Aluminum 95-44"
        b. Childers "Chil-Joint CP-70"

2.7 Miscellaneous Materials

A. *Insulating and Finishing Cement [P]:*
    1. Manufacturer:
        a. Celotex MW-1 Insulating and Finishing Cement
        b. .Pabco Pabcote One Coat Insulating Cement

B. *Vapor Barrier Mastic [P]:*

1. Manufacturer:
    a. Childers CP-30.
    b. Insul-Coustic 1-C 501.

C. Adhesives [P]:

1. Manufacturer:
    a. Foster Div., H. B. Fuller Co. LAGFAS 81-42W or Spark-Fas 85-20
    b. Insul-Coustic Div., Berma Products Corp.
    c. Vimasco Corp.

D. *Lagging adhesives [P]:*

1. Manufacturer:
    a. Foster Div., Amchem Products Inc. "Seal-Fas" 30-36.
    b. Insul-Coustic "I-C-102"

E. Sealants [P]:

1. Manufacturer:
    a. Foster Div., H. B. Fuller Co. "Elastolar" 95-44
    b. Insul-Coustic Div., Berma Products Corp.
    c. Vimasco Corp.

F. Coatings [P]:

1. Manufacturer:
    a. Foster Div., H. B. Fuller Co. Monolar/Weather Rite 46-50
    b. Insul-Coustic "I-C-551"

G. *Glass cloth [P]:* Plain weave per ASTM D 579 Type 723 or 723.1. Weight not less than 7.23 ounces per yard before sizing.

H. *Glass lagging tape [P]:* Elastic knitted cloth per MIL C 20079, Type II Class 3. Weight 11 ounces per yard.

1. Manufacturer:
    a. Foster Div., H. B. Fuller Co. "Seal-Fas" Glass Lagging Tape
    b. Other approved by Owner.

I. Wire: Annealed, 18 gage, Type 430 or 304 stainless steel.

J. Cementitious material [P]:

1. Manufacturer:
    a. Seculate of North America "Seculate"
    b. Other approved by Owner.

15080.3 EXECUTION

·Obtain permission of Architect-Engineer before starting insulation Work on any piping.

·Test work shall be completed before insulation Work is started.

·Use insulating materials as specified for each class of service.

·Where pipes pass through floors or walls, continue insulation through sleeves.

INSTALLATION

- General
    - Apply insulation and jacketing where specified or indicated, per manufacturers published instructions and as specified.
    - Clean surfaces free of oil, grease, dust and deleterious substances before insulation adhesives or mastic are applied. Provide solvent cleaning required to bring surfaces to such condition.
    - Make joints tight, with insulation lengths tightly butted against each other. Where lengths are cut, make cuts smooth and square, without breaking end surfaces. Where insulation terminates, neatly taper ends and seal or finish as specified. Where pipe insulation terminates in finished areas, install chrome plated end caps. Direct longitudinal seams of exposed insulation away from normal view where possible.
    - Shape contours smooth and continuous on exposed work. Smoothly and securely paste down cemented laps and tapes. Apply adhesives on a full-coverage basis except where otherwise specified. Make vapor barrier continuous over vapor sealed insulation.
    - Insulate metal, such as anchors, in contact with low temperature surfaces and projecting beyond the finished insulation surfaces to prevent condensation. Insulate the projecting metal with 1/2 of the specified insulation thickness to a distance not less than 4 times the specified insulation thickness.
    - Insulate pipe lines and equipment surfaces within reach of personnel walking areas and having a surface temperature over 140 degF. Consider “within reach” all areas 7 feet above floors, roofs or walkways or within 3 feet of elevated walkways at the sides.
    - In pedestrian or vehicular traffic areas, protect insulated horizontal pipe 7 feet or less above the floor and insulated vertical pipe from the floor line to 8 feet above the floor with nonintegral jackets and required accessories.
    - Insulate flanges and grooved couplings, when couplings are permitted in insulated systems, the same thickness as the piping or by approved proprietary methods and materials.
    - Install pipe, duct, and equipment insulation, vapor barrier jacket materials, and insulated surface penetrations and seal all joints, surfaces, seams, fittings, valves, etc. to maintain vapor barrier continuity under systems application conditions as specified herein and in accordance with NICA/MICA/trade/manufacturer recommended practice. Seal-off insulation to the pipe, with specified/required/ suitable vapor barrier compound:.
        - Every 24 feet for on-the-run piping; each branch connection; at all flanges and soft fittings insulation; at all penetrations/terminations and like places where water/moisture ingress/condensation could occur.
        - Seal-off to the insulation vapor barrier jacket, fittings/valve enclosures/supports/accessories etc. Isolate support inserts from on-run insulation.
        - Typical on-run-of-pipe seals shall be made by bedding insulation bore in two inch wide vapor barrier mastic then sealing abutting faces with vapor barrier to jacket.
        - At terminations, seal similarly adding cloth reinforcement and second coat of vapor barrier mastic.

Apply similar seals at valve bonnets, supports, piping accessories.

- Provide access scaffolding, for use during insulation application, to prevent damage to vapor barrier/acoustic treatment jackets of piping systems. The Owner shall repair all such damage prior to acceptance of work.

- Piping Systems
  - Cold Domestic Water, Cooling Tower Water And, Chilled Water Piping
    - Vapor seal insulation on fitting and valves in cold piping systems and domestic water systems by applying a layer of open weave glass cloth fabric embedded between two flood coats of vapor barrier mastic. Lap fabric 2” onto adjacent pipe insulation.
    - Cement laps on longitudinal and butt joints with a vapor barrier adhesive.
  - Hot Water Heating And Hot Domestic Water Piping
    - Cement laps on longitudinal seams and butt joints with adhesive. Vapor barrier continuity not required.
    - Cover fittings and valves with an approved insulation cement, blocks of an approved insulating material and insulation cement, or mitered segments of the pipe insulation to a thickness equal to that of the adjacent pipe insulation. On fittings and valves, install an outer jacket of glass cloth with adhesive.
  - Steam And Condensate
    - Install factory jacketed fibrous glass insulation per manufacturer’s instructions.
    - Cover calcium silicate piping insulation with presized glass cloth. Jacket may be field or factory applied. Securely cement jackets, flaps and bands in place with adhesive. Overlap jacket not less than 1-1/2 inch. Butt joint jacketing bands not less than 4 inch wide.
    - Fabricate fittings from segmented pipe insulation sections, bed in insulating cement and wire in place. Fill voids with insulating cement and provide 1/4 inch thick final coating. Impregnate glass lagging tape with adhesive, wrap on a 50% overlap basis and blend tape smoothly into adjacent jacketing. Apply additional adhesive as required for smooth contour.
    - Finish exposed-to-view insulation with a 6 mil dry film of coating. Color as selected by the Architect-Engineer.
    - Thermally insulate and sound isolate pressure regulating station piping and all valve and flange surfaces for a distance of 10 pipe diameters upstream of the station and 10 pipe diameters downstream of the first elbow downstream of the station with specified thickness of calcium silicate and lead sheeting. Prior to application of insulation jacketing, apply 1/64 inch thick lead sheet per recommendations of the Lead Industries Association. Insulation may be applied in two layers with lead sheet taped between layers.
  - Rain Conductors
    - Insulate nonvertical pipe and fittings including connection to roof or area drain body.
  - Roof Drain Sump And Roof Drain Pan
    - Attach insulation by mechanical means and with adhesive. Insulate roof drain body in a vapor tight manner.
  - Boiler Breeching And Stacks

- Insulate breeching and stacks inside building only.

- Sanitary Waste Nonvertical Aboveground Piping
  - Insulate nonvertical pipe, fittings and miscellaneous surfaces in areas where damage from dripping condensate might occur over finished areas.
- Air Compressor Intake Piping
  - Insulate as specified for Cold Domestic Water Piping inside building from wall to compressor intake.
- Glycol Piping
  - Insulate as specified for Hot Domestic Water Piping and with nonintegral aluminum jacket for weather exposed locations.
- Pumped Sanitary Waste Piping
  - Insulate as specified for Cold Domestic Water Piping with nonintegral aluminum jacket for weather exposed locations.
- Chilled Brine Piping
  - Insulate as specified for Chilled Water Piping.
- Outdoor Steam And Condensate Piping
  - Insulate as specified for Steam Piping with added nonintegral sealed aluminum jacket. Refer to Paragraph on Jackets.
- Outdoor Cold Domestic Water Piping
  - Insulate as specified for Cold Domestic Water with added nonintegral sealed aluminum jacket. Refer to Paragraph on Jackets.
- Outdoor Chilled Water Supply And Return Piping
  - Insulate as specified for Outdoor Cold Domestic Water Piping.
- Outdoor Cooling Tower Water Supply And Return Piping
  - Insulate as specified for Outdoor Cold Domestic Water Piping.
- Outdoor Fire Protection Water Piping
  - Insulate as specified for Outdoor Cold Domestic Water Piping.
- Refrigerant Suction And Coil Drainage Piping
  - Insulate all surfaces with cellular elastomer insulation attached with adhesive recommended by the insulation manufacturer for the specified purpose. Apply adhesive and insulation per manufacturer's instructions.
  - Finish surfaces exposed to view or ultra-violet light with application of a coating recommended by the manufacturer per his instructions.

- Tanks And Equipment To Receive Rigid Fibrous Glass
  - Insulate all surfaces, apply insulation with edges tightly butted. Secure insulation with 18 gage annealed stainless steel wire or 1/2 inch x 0.015 inches stainless steel bands on 12 inch maximum centers for large areas. Where required, provide welding studs, clips or angles as anchors for wires and bands.
  - Apply a coat of insulating cement, leave the finish on this coat rough and allow to dry before applying a final

coat of finish cement troweled to a smooth finish. Over this finish, paste on an outer jacket of glass cloth.

- Tanks And Equipment To Receive Flexible Fibrous Glass
    - Cover equipment by attaching insulation with adhesive applied in 6 inch strips on 12 inch centers. Tightly butt the insulation and lap vapor barrier jacket minimum 2 inches at joints. Secure laps with vapor barrier adhesive. Finish seal joints with vapor barrier adhesive.
    - Terminate and seal insulation where thermometers, controls, linkages, connections, test connections and access doors occur in equipment so as not to interfere with their function or replacement.
    - Seal terminating edges of insulation by lapping vapor barrier jacket to equipment and secure with vapor barrier adhesive. Further wrap full circumference with vapor barrier tape set in vapor barrier adhesive.
- Tanks And Equipment To Receive Cellular Elastomer
    - Insulate all surfaces with cellular elastomer insulation attached and joined into continuous sheet with adhesive recommended by the insulation manufacturer for the specified purposes. Apply adhesive to both surfaces to be joined and seal all butt joints with adhesive per manufacturer's instructions.
    - Finish surfaces exposed to view or ultra-violet light with application of a coating recommended by the manufacturer per his instructions.
- Air Handling System Surfaces
    - On rectangular surfaces 10 inches or less wide apply the insulation with adhesive to the top, sides, and bottom of the duct. On rectangular surfaces more than 16 inches wide apply the insulation with adhesive to the top, side, impaled on pins stud welded to the bottom. Apply sufficient pins to the bottom to insure contact of the insulation with the sheet metal. Install speed nuts or clips to the pins. Where the pins have perforated the vapor seal facing, cut the pins close to the speed nuts and apply a patch of vapor seal tape to restore the vapor seal.
    - Apply adhesive to contact surfaces between the insulation and the metal. Furnish brush-on fire proof type adhesives. Butt insulation sheets together firmly, tape joints with a vapor barrier tape, and cement down facing tabs.
- Air Handling Systems Components And Equipment To Receive Rigid Fibrous Glass
    - Fasten insulation hangers to outside of metal surface on 12 inch centers in both directions using hanger adhesive or weld on hangers using weld pin technique. Impale insulation over hangers. Seal over fasteners with indoor vapor barrier coating or matching pressure sensitive tape patches. Apply top and bottom panels to lap side panels. Lap insulation boards at corners and seal joints with vapor barrier tape set in vapor barrier lap adhesive.
    - Terminate and seal the insulation where thermometers, controls, linkages, flexible connections, test connections and access doors occur in the ductwork so as not to interfere with their function or replacement. Seal terminating edges of insulation with indoor vapor barrier coating.
    - Single sheet access doors and access panels shall be insulated separately so as to be operable. Vapor seal insulation edges with indoor vapor barrier coating.
    - Concealed - no further finish required.
    - Exposed - no further finish required.
- Jackets
    - Overlap joints 2 inches and for outdoor installation include joint sealant. Fittings jackets shall be two piece of the same material as the jacket or when approved by the Architect-Engineer for indoor use may be PVC or molded or routed fiberglass.

- Cementitious Material
    - Apply per manufacturer's instructions.

3.1 Workmanship

A. Obtain permission of Architect-Engineer before starting insulation Work on any piping. Test work shall be completed before insulation Work is started.

B. Use insulating materials as specified for each class of service. Where pipes pass through floors or walls, continue insulation through sleeves.

3.2 Installation

A. General

1. Apply insulation and jacketing where specified or indicated, per manufacturers published instructions and as specified.
2. Clean surfaces free of oil, grease, dust and deleterious substances before insulation adhesives or mastic are applied. Provide solvent cleaning required to bring surfaces to such condition.
3. Make joints tight, with insulation lengths tightly butted against each other. Where lengths are cut, make cuts smooth and square, without breaking end surfaces. Where insulation terminates, neatly taper ends and seal or finish as specified. Where pipe insulation terminates in finished areas, install chrome plated end caps. Direct longitudinal seams of exposed insulation away from normal view where possible.
4. Shape contours smooth and continuous on exposed work. Smoothly and securely paste down cemented laps and tapes. Apply adhesives on a full coverage basis except where otherwise specified. Make vapor barrier continuous over vapor sealed insulation.
5. Insulate metal, such as anchors, in contact with low temperature surfaces and projecting beyond the finished insulation surfaces to prevent condensation. Insulate the projecting metal with 1/2 of the specified insulation thickness to a distance not less than 4 times the specified insulation thickness.
6. Insulate pipe lines and equipment surfaces within reach of personnel walking areas and having a surface temperature over 140 degF. Consider "within reach" all areas 7 feet above floors, roofs or walkways or within 3 feet of elevated walkways at the sides.
7. In pedestrian or vehicular traffic areas, protect insulated horizontal pipe 7 feet or less above the floor and insulated vertical pipe from the floor line to 8 feet above the floor with nonintegral jackets and required accessories.
8. Insulate flanges and grooved couplings, when couplings are permitted in insulated systems, the same thickness as the piping or by approved proprietary methods and materials.
9. Install pipe, duct, and equipment insulation, vapor barrier jacket materials, and insulated surface penetrations and seal all joints, surfaces, seams, fittings, valves, etc. to maintain vapor barrier continuity under systems application conditions as specified herein and in accordance with NICA/MICA/trade/manufacturer recommended practice. Seal off insulation to the pipe, with specified/required/ suitable vapor barrier compound:.
    a. Every 24 feet for on the run piping; each branch connection; at all flanges and soft fittings insulation; at all penetrations/terminations and like places where water/moisture ingress/condensation could occur.

b. Seal off to the insulation vapor barrier jacket, fittings/valve enclosures/supports/accessories etc. Isolate support inserts from on run insulation.

c. Typical on run of pipe seals shall be made by bedding insulation bore in two inch wide vapor barrier mastic then sealing abutting faces with vapor barrier to jacket.

d. At terminations, seal similarly adding cloth reinforcement and second coat of vapor barrier mastic. Apply similar seals at valve bonnets, supports, piping accessories.

e. Provide access scaffolding, for use during insulation application, to prevent damage to vapor barrier/acoustic treatment jackets of piping systems. The Owner shall repair all such damage prior to acceptance of work.

B. Piping Systems

1. Cold Domestic Water Piping

a. Vapor seal insulation on fitting and valves in cold piping systems and domestic water systems by applying a layer of open weave glass cloth fabric embedded between two flood coats of vapor barrier mastic. Lap fabric 2” onto adjacent pipe insulation.

b. Cement laps on longitudinal and butt joints with a vapor barrier adhesive.

2. Hot Domestic Water Piping

a. Cement laps on longitudinal seams and butt joints with adhesive. Vapor barrier continuity not required.

b. Cover fittings and valves with an approved insulation cement, blocks of an approved insulating material and insulation cement, or mitered segments of the pipe insulation to a thickness equal to that of the adjacent pipe insulation. On fittings and valves, install an outer jacket of glass cloth with adhesive.

3. Steam And Condensate

a. Install factory jacketed fibrous glass insulation per manufacturer’s instructions.

b. Cover calcium silicate piping insulation with presized glass cloth. Jacket may be field or factory applied. Securely cement jackets, flaps and bands in place with adhesive. Overlap jacket not less than 1 1/2 inch. Butt joint jacketing bands not less than 4 inch wide.

c. Fabricate fittings from segmented pipe insulation sections, bed in insulating cement and wire in place. Fill voids with insulating cement and provide 1/4 inch thick final coating. Impregnate glass lagging tape with adhesive, wrap on a 50% overlap basis and blend tape smoothly into adjacent jacketing. Apply additional adhesive as required for smooth contour.

d. Finish exposed to view insulation with a 6 mil dry film of coating. Color as selected by the Architect-Engineer.

e. Thermally insulate and sound isolate pressure regulating station piping and all valve and flange surfaces for a distance of 10 pipe diameters upstream of the station and 10 pipe diameters downstream of the first elbow downstream of the station with specified thickness of calcium silicate and lead sheeting. Prior to application of insulation jacketing, apply 1/64 inch thick lead sheet per recommendations of the Lead Industries Association. Insulation may be applied in two layers with lead sheet taped between layers.

C. Jackets

1. Overlap joints 2 inches and for outdoor installation include joint sealant. Fittings jackets shall be two piece of the same material as the jacket or when approved by the Architect-Engineer for indoor use may be PVC or molded or routed fiberglass.

D. Cementitious Material

1. Apply per manufacturer's instructions.

3.3 Owner-Furnished Materials Installation

A. Uncrate and examine all materials furnished by the Owner which is to be installed, and immediately notify the Owner, in writing, of any damaged materials. Moving, or installing of any Owner furnished materials shall be construed to indicate that it has been accepted in good condition; assume the responsibility and liability for its protection, unless it can be proven that any later discovered damage is due to inferior material furnished by the manufacturer or as provided herein above.

B. Protect all materials and equipment from damage from the time it is removed from the point of receipt or storage until acceptance by the Owner.

3.4 Field Quality Control

A. Testing

1. When testing insulation conductance at any point, consider insulation conductance required by the Specifications as maximum, not average. If insulation conductance is found by test to exceed the stipulated maximum, either replace or add additional and complete insulation and finishing to bring system to the required maximum conductance.

Media Symbol	Media Description	Media Temp. Range (Deg F)	Pipe Size (Inches)	Insulation Material	Insul. Thickness & Density	Vapor Barrier

15105 - ABOVEGROUND PIPING SYSTEMS

15105.1 GENERAL

SUMMARY

A. Section Includes

1. Refer to Division 15 Section “Basic Mechanical Materials and Methods” for additional requirements.
2. Provide complete, operating piping systems with materials of construction and methods of fabrication, assembly, support, erection, testing and interim operation in compliance with the requirements specified herein and requirements of applicable codes and the authorities having jurisdiction.

B. Related Work Specified In Other Sections:

1. Division 7 Section "Joint Sealants"
2. Division 7 Section "Firestopping"
3. Division 15 Section “Basic Mechanical Materials and Methods.”
4. Division 15 Section “Valves.”
5. Division 15 Section “Piping Specialties.”
6. Division 15 Section “Thermal Insulation.”
7. Division 15 Section “Plumbing Fixtures and Equipment.”
8. Division 15 Section "Testing and Balancing"
9. Division 15 Section “Hydronic Systems Specialties and Equipment.”
10. Division 15 Section “Steam and Condensate Specialties and Equipment.”
11. Division 13 Section “Control Systems Equipment.”
12. Division 16 Sections for Electrical Work.

PIPE SYSTEM HANGERS

A. Definitions

1. MSS: Manufacturers Standardization Society for the Valve and Fittings Industry.
2. Terminology: As defined within MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

B. Performance Requirements

1. Design channel support, and heavy-duty trapeze systems for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.

QUALITY ASSURANCE

A. Refer to Division 15 Section “Basic Mechanical Materials and Methods” for applicable requirements.

B. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

C. Engineering Responsibility: Design and preparation of Shop Drawings and calculations for each multiple pipe support and trapeze by a qualified professional engineer.

D. Engineering Responsibility: Design and preparation of Shop Drawings and calculations for each multiple pipe support, trapeze, and seismic restraint by a qualified professional engineer.

1. Professional Engineer Qualifications: A professional engineer is one who is legally qualified to practice within the jurisdiction where the Project is located, and who is experienced in providing engineering services of the kind required. Engineering services are defined as those performed for installations of piping systems, hangers and supports that are similar to those indicated for this Project in material, design, use, and extent.

E. Provide listing/approval stamp, label, or other marking on equipment made to specified standards.

F. Listing and Labeling: Provide equipment and accessories specified in this Section that are listed and labeled.

1. Terms "Listed" and "Labeled": As defined in National Electrical Code, Article 100.
2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.

G. Handling Flammable Liquids: Collect, remove, and legally dispose of any liquids obtained from existing drips and traps. Carefully handle any liquids to avoid spillage and potential ignition. Notify GM Representative and any applicable Utility supplier. Handle flammable liquids used by Installer with proper precautions and do not leave on premises from end of one day to beginning of next day. Store all flammable liquids in only approved, identified/labeled containers, and in approved locations.

H. Interruption of Services: Provide written notification to each affected user, when utilities supplies will be turned off. Notification should be given with a minimum of 7 working days prior to event.

I. Work Interruptions: Leave piping systems in safe condition when interruptions in work occur during the repairs or alterations to existing piping systems.

SUBMITTALS

A. Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections. See Specification Section 01340 for definition of submittal codes.

B. System Components [B, C, D, L]: Submit product data including rated capacities of selected models where applicable, weights including (shipping, installed, and operating), furnished options and accessories, installation instructions including those for safety devices, pressure-reducing requirements, valves, and steam traps. Include

flow and performance curves for pumps, and pressure drop curves for diverting fittings and calibrated plug valves, and similar equipment.

C. Hanger Components [B, C, D, L]: Submit product data for each type of pipe hanger, channel support system component, and thermal hanger shield indicated.

D. Shop Drawings [D]: Include detailed piping system layout drawings (plan and elevation views), piping sizes, calculations and coefficients used, materials and equipment classification and identification, component pressure/temperature rating, rated capacity, detailed piping and equipment supports and restraints, detailed pipe anchors, special pipe support assemblies, alignment guides, and expansion joints and loops, special installation requirements, catalogue data and other data necessary to verify compliance with Contract Documents.

E. Coordination Drawings [D]: For all equipment and piping systems. Include piping relationship to other services (Electrical, Mechanical, Process Equipment, building structure, Etc.) that serve same work area. Include all wall, roof, and floor penetration locations and sizes.

F. Manuals [B, C, D, G, L, P, T, U]: Maintenance data for all provided materials, equipment, tanks, specialty items, and standard or special-duty valves. This information shall also be included in the Operation and Maintenance Manuals, specified in Division 1 Section "Contract Closeout."

G. Structural Application [B, D]: Submit proposed proprietary supplementary structural members application.

H. Testing [R, S, T]: Water Samples, Test Results, and Reports as specified in the "Field Quality Control", for Potable and DI water piping system installations.

I. Building Connections [D]: Submit proposed connections to building structure. Welding to building structural steel components is not permitted, without prior written approval from the GM Structural Engineer.

J. Test or Inspection Reports [T]: Submit copies of structural integrity, leakage and performance and acceptance test data.

K. Hanger Shop Drawings [D, L, P]: Shall be submitted, signed and sealed by a qualified professional engineer for multiple piping supports and trapeze hangers. Include design calculations and indicate size and characteristics of components and fabrication details.

L. Welding Certificates [C]: Copies of certificates for welding procedures and operators.

OPERATING AND MAINTENANCE PERSONNEL TRAINING

A. Refer to Division 15 Section “Basic Mechanical Materials and Methods” for applicable requirements.

PROJECT COORDINATION

A. Coordinate the layout and installation of piping and equipment with other installations including but not limited to electrical power distribution, drainage systems, H&V or HVAC systems, building structure, and process equipment installations.

B. Coordinate pipe sleeve installation for foundations, walls, and floor penetrations.

C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. Roof specialties are specified in Division 7 Sections.

D. Coordinate pipe fitting pressure classes with products specified in this and related Sections.

E. Coordinate the size and location of equipment concrete housekeeping pads. Provide cast anchor-bolt inserts for pad. Concrete, reinforcement, and formwork requirements are specified in Division 3 Sections.

F. Coordinate requirements for firestopping specified in Division 7 for fire and smoke wall and floor assemblies.

GUARANTEE/WARRANTY

A. Refer to Division 15 Section “Basic Mechanical Materials and Methods” for applicable requirements. Unless noted elsewhere, Warranty shall be for a period of two years from date of substantial completion.

1.1 PIPE SYSTEM HANGERS

A. Definitions

1. MSS: Manufacturers Standardization Society for the Valve and Fittings Industry.
2. Terminology: As defined within MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

B. Performance Requirements

1. Design channel support, and heavy-duty trapeze systems for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
2. Design seismic restraint hangers and supports for piping and equipment based on code requirements, and local seismic zone classification. Obtain approval from authorities having jurisdiction for seismic restraint hangers and supports for piping and equipment.

1.2 QUALITY ASSURANCE

A. Refer to Division 15 Section “Basic Mechanical Materials and Methods” for applicable requirements.

B. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

C. Engineering Responsibility: Design and preparation of Shop Drawings and calculations for each multiple pipe support and trapeze by a qualified professional engineer.

D. Provide listing/approval stamp, label, or other marking on equipment made to specified standards.

E. Listing and Labeling: Provide equipment and accessories specified in this Section that are listed and labeled.

1. Terms "Listed" and "Labeled": As defined in National Electrical Code, Article 100.
2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.

F. Handling Flammable Liquids: Collect, remove, and legally dispose of any liquids obtained from existing drips and traps. Carefully handle any liquids to avoid spillage and potential ignition. Notify GM Representative and any applicable Utility supplier. Handle flammable liquids used by Installer with proper precautions and do not leave on premises from end of one day to beginning of next day. Store all flammable liquids in only approved, identified/labeled containers, and in approved locations.

G. Interruption of Services: Provide written notification to each affected user, when utilities supplies will be turned off. Notification should be given with a minimum of 7 working days prior to event.

H. Work Interruptions: Leave piping systems in safe condition when interruptions in work occur during the repairs or alterations to existing piping systems.

1.3 SUBMITTALS

A. Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections. See Specification Section 01340 for definition of submittal codes.

B. *System Components [B, C, D, L]:* Submit product data including rated capacities of selected models where applicable, weights including (shipping, installed, and operating), furnished options and accessories, installation instructions including those for safety devices, pressure-reducing requirements, valves, and steam traps. Include flow and performance curves for pumps, and pressure drop curves for diverting fittings and calibrated plug valves, and similar equipment.

C. *Hanger Components [B, C, D, L]:* Submit product data for each type of pipe hanger, channel support system component, and thermal hanger shield indicated.

D. *Equipment & Tank Drawings [D]:* Submit shop drawings detailing equipment and tank assemblies, indicating dimensions, weights, loadings, required clearances, method of field assembly, assembled or loose shipped components, and location and size of each field connection.

E. *Shop Drawings [D]:* Include detailed piping system layout drawings (plan and elevation views), piping sizes, calculations and coefficients used, materials and equipment classification and identification, component pressure/temperature rating, rated capacity, detailed piping and equipment supports and restraints, detailed pipe anchors, special pipe support assemblies, alignment guides, and expansion joints and loops, special installation requirements, catalogue data and other data necessary to verify compliance with Contract Documents.

F. *Coordination Drawings [D]:* For all equipment and piping systems. Include piping relationship to other services (Electrical, Mechanical, Process Equipment, building structure, Etc.) that serve same work area. Include all wall, roof, and floor penetration locations and sizes.

G. *Manuals [B, C, D, G, L, P, T, U]:* Maintenance data for all provided materials, equipment, tanks, specialty items, and standard or special-duty valves. This information shall also be included in the Operation and Maintenance Manuals, specified in Division 1 Section "Contract Closeout."

H. *Structural Application [B, D]:* Submit proposed proprietary supplementary structural members application.

I. *Testing [R, S, T]:* Water Samples, Test Results, and Reports as specified in the "Field Quality Control", for Potable and DI water piping system installations.

J. *Building Connections [D]:* Submit proposed connections to building structure. Welding to building structural steel components is not permitted, without prior written approval from the GM Structural Engineer.

K. *Test or Inspection Reports [T]:* Submit copies of structural integrity, leakage and performance and acceptance test data.

L. *Hanger Shop Drawings [D, L, P]:* Shall be submitted, signed and sealed by a qualified professional engineer for multiple piping supports and trapeze hangers. Include design calculations and indicate size and characteristics of components and fabrication details.

M. *Welding Certificates [C]:* Copies of certificates for welding procedures and operators.

1.4 OPERATING AND MAINTENANCE PERSONNEL TRAINING

A. Refer to Division 15 Section “Basic Mechanical Materials and Methods” for applicable requirements.

1.5 PROJECT COORDINATION

A. Coordinate the layout and installation of piping and equipment with other installations including but not limited to electrical power distribution, drainage systems, H&V or HVAC systems, building structure, and process equipment installations.

B. Coordinate pipe sleeve installation for foundations, walls, and floor penetrations.

C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. Roof specialties are specified in Division 7 Sections.

D. Coordinate pipe fitting pressure classes with products specified in this and related Sections.

E. Coordinate the size and location of equipment concrete housekeeping pads. Provide cast anchor-bolt inserts for pad. Concrete, reinforcement, and formwork requirements are specified in Division 3 Sections.

F. Coordinate requirements for firestopping specified in Division 7 for fire and smoke wall and floor assemblies.

1.6 GUARANTEE/WARRANTY

A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for applicable requirements. Unless noted elsewhere, Warranty shall be for a period of two years from date of substantial completion.

15105.2 PRODUCTS

GENERAL

A. Piping systems materials: Piping systems materials and components which are not manufactured in the U.S.A. shall be identified as such.

B. Piping Systems Bill of Materials [B]: Submit source identification with bill of materials for all piping components including documentation of compliance with specified criteria. Such materials shall be subject to testing sufficient to confirm compliance, as may be deemed necessary by the Owner, and in the event of non-compliance, to subsequent removal/replacement, all, including testing, at no additional cost to the Owner.

C. Internally corroded pipe, fittings, or components shall be rejected. These materials shall be segregated from stockpiled materials, and removed from the job site immediately.

D. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for additional product requirements.

2.1 Steel Pipe and Fittings

A. Contractor(s) shall provide and install materials complying with the requirements of this Section and any Amendments, Clarifications, or Restrictions that are listed within the description of each specific piping type found above in Part 1 of this Document.

2.1.1 Type BCS-150, Black Carbon Steel

High strength, except where joining cast iron.

Pipe:	
1/8 Thru 3	Schedule 40 or Schedule 80 black carbon steel; ASTM A 53, Type E, Electric-Resistance Welded or Type S, Seamless, Grade B
4 Thru 10	Schedule 40 black carbon steel; ASTM A 53, Grade B, Type E, Electric-Resistance Welded or Type S, Seamless, Grade B.
12 Thru 26	0.375 inch wall, black carbon steel; ASTM A 53,

	Grade B, Type E, Electric-Resistance Welded or Type S, Seamless, Grade B.
28 and larger	0.375 inch wall, black carbon steel; API 5L, Grade B, Type E or S, with mill varnish.
Screwed couplings:	
1/8 thru 2	Extra heavy tapered thread black carbon steel.

Screwed unions:	
1/8 Thru 2	Class 150 and 300 female screwed malleable iron with ground joint and brass to iron seat, ANSI B16.39.
Welded unions:	
1/8 Thru 1-1/2	2000 or 3000 PSI WOG, AAR, forged steel socket weld; ASTM A 105, Grade II and ANSI B16.11.

Flanges:	
2-1/2 AND UP	1. Class 150 or 300 RF forged steel slip-on or welding neck to match pipe wall thickness and valve flanges; ANSI B16.5 thru 24 inches; MS SP-44 for sizes over 24 inches.
	2. For large diameter flanges, AWWA/ANSI to 144-inches; CM Flanges 800-435-2643; PEK 800-648-9597; CAB 404-934-3101.
Flanges, Orifice:	Class 300 forged steel, welding neck, to match pipe wall thickness, drilled, tapped, ANSI B16.36.
Screwed fittings:	
1/8 Thru 2	Class 150 WSP banded malleable iron screwed; ASTM A 197 and ANSI B16.3 rated 150 PSI at 350 degF and 300 PSI at 150 degF non-shock.
Steel Pipe Nipples for Chilled Water, Heating Hot Water, and Condenser Water Systems	For 2-inch NPS and smaller- ASTM A 733, made from ASTM A 53, Schedule 40, carbon steel, seamless For 2-1/2-inch NPS and larger - ASTM A 733, made from ASTM A 53, Schedule 40, carbon steel, electric-resistance welded
Welding fittings:	Steel butt weld to match pipe wall thickness; ASTM A 234 and ANSI B16.9. Weldolets are permitted up to 2/3 run size.
Socket fittings:	Forged steel; ASTM A 105, Grade II and ANSI B16.11, to match pipe wall thickness.

Grooved mechanical joint fittings to be used for condenser water systems only.	ASTM A 536, Grade 65-45-12 ductile iron. ASTM A 47 (ASTM A 47M), Grade 32510 malleable iron. ASTM A 53, Type F, E, or S, Grade B fabricated steel, or ASTM A 106, Grade B steel fittings with grooves or shoulders designed to accept grooved end couplings.
Grooved mechanical joint couplings to be used for condenser water systems only.	Ductile, or malleable-iron housing, with a synthetic rubber gasket of a central cavity pressure-responsive design. Manufactured assembly to be supplied complete with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
Gaskets [C, P]*:*	See specific piping system described in PART 1 of this specification for acceptable gasket materials.
Bolts [S]:	High strength, except where joining cast iron.

2.1.2 Type BCS-HS, Black Carbon Steel

1/8 Thru 3	Schedule 40 or Schedule 80 black carbon steel; ASTM A 53, Type E or S or ASTM A-106 Type S.
4 Thru 10	Schedule 40 or Schedule 80 black carbon steel; ASTM A 53, Grade B, Type E or S.
12 Thru 26	0.375 inch wall black carbon steel; ASTM A 53, Grade B, Type E or S.
26 and larger	0.375 inch wall black carbon steel; API 5L, Grade B, Type E or S with mill varnish.
Steel pipe nipples	ASTM A 733, made of ASTM A 53, Schedules 40 and 80, carbon steel, seamless for 2-inch NPS and smaller, and electric-resistance welded for 2-1/2-inch NPS and larger
Screwed couplings:	
1/8 Thru 2	Extra heavy tapered thread black carbon steel.
Screwed unions:	
1/8 Thru 2	3000 PSI WSP Female screwed forged steel with ground joint seat.
Welded unions:	
1/8 Thru 1-1/2	2000 or 3000 PSI WOG, AAR, forged steel socket weld; ASTM A 105, Grade II and ANSI B16.11.

Flanges:	
2-1/2 and up	Class 150 or 300 RF forged steel raised face welding neck to match valve flanges; ANSI B16.5.
Flanges, Orifice:	Class 300 forged steel, welding neck, to match pipe wall thickness, drilled, tapped, ANSI B16.36.
Screwed fittings:	
1/8 Thru 2	Class 150 or 300 banded malleable iron screwed; ASTM A 197 ANSI B16.3.
Welding fittings:	Steel butt weld to match pipe wall thickness; ASTM A 234 and ANSI B16.9. Weldolets are permitted up to 2/3 of run size.
Socket fittings:	Forged steel; ASTM A 105 Grade II and ANSI B16.11 to match pipe wall thickness.
Gaskets [C, P]*:*	See specific piping system described in PART 1 of this specification for acceptable gasket materials.
Bolts [S]:	High strength material group 1.1.

2.1.3 Type BCS-300, Black Carbon Steel

Pipe:	
1/8 Thru 2	Schedule 40 or Schedule 80 black carbon steel; ASTM A 53, Type E or S or ASTM A-106, Type S.
2-1/2 Thru 10	Schedule 40 black carbon steel; ASTM A 53, Grade B, Type E or S.
12 Thru 18	0.500 inch wall black carbon steel; ASTM A 53, Grade B, Type E or S.
Screwed couplings:	
1/8 Thru 2	Class 3000 tapered thread ANSI B16.11 forged carbon steel.
Screwed unions:	
1/8 Thru 2	Class 3000 type female screwed forged steel with ground ball to cone joint, MSS SP-83.
Welded unions:	
1/8 Thru 1-1/2	Class 3000 type forged steel socket weld; ASTM A 105, Grade II, and ANSI B16.11, MSS SP-83.

Flanges:	Class 300 RF forged steel welding neck to match pipe wall thickness; ASTM A 181, Grade I, ANSI B16.5.
Flanges, Orifice:	Class 300 forged steel, welding neck, to match pipe wall thickness, drilled, tapped, ANSI B16.36.
Screwed fittings:	
1/8 Thru 2	Class 3000 forged steel screwed; ASTM A 105 Grade II and ANSI B16.11.
Welding fittings:	Steel butt welding to match pipe wall thickness; ASTM A 234 and ANSI B16.9.
Socket fittings:	Class 3000 forged steel; ASTM A 105, Grade II and ANSI B16.11 to match pipe wall thickness.
Gaskets *[C, P]*:	See specific piping system described in PART 1 of this specification for acceptable gasket materials.
Bolts [S]:	High strength bolts.

2.1.4 Type BCS-HP, Black Carbon Steel

Pipe:	
UP TO 2	Schedule 40 or Schedule 80 black carbon steel; ASTM A 106, Grade B, Type S.
2-1/2 Thru 10	Schedule 40 or Schedule 80 black carbon steel; ASTM A 53 or A 106, Grade B, Type S.
12 AND LARGER	0.500 inch wall, black carbon steel; ASTM A 53 or A 106, Grade B, Type S.
Socket fitting:	
Up to 2	Class 3000 PSI forged steel, socket weld; ASTM A 105, Grade II and ANSI B16.11.
Welding fittings:	Steel buttweld seamless; ASTM A 234, Grade WPB and ANSI B16.9 to match pipe wall thickness.
Flanges:	Class 300 RF, 400 or 600 weld neck, forged steel; ASTM A 181 and ANSI B16.5.
Flanges, Orifice:	Class 300 forged steel, welding neck, to match pipe wall thickness, drilled, tapped, ANSI B16.36.
Gaskets *[C, P]*:	TYPE SPW, TYPE GRAF.
Bolts [S]:	High strength.

2.1.5 Type GCS-150, Galvanized Carbon Steel

Pipe:	Schedule 40 galvanized carbon steel; ASTM A 53 Type E or S, Grade A or B, for domestic water systems.
Pipe Nipples	ASTM A 733, made from ASTM A 53 or ASTM A 106, Schedule 40, seamless, steel pipe
Screwed Fittings:	Class 150 banded galvanized malleable iron screwed; ASTM A 197 and ANSI B16.3.
	ASME B16.4, Class 125, galvanized, with threads according to ASME B1.20.1. Furnish Class 250 fittings if required to match piping.
Screwed Unions:	ANSI B16.39, Class 150 female screwed malleable iron with ground joint and metal to metal bronze seating surface, female threads conforming to ASME B1.20.1, Furnish Class 300 unions if required to match piping.
Galvanized Steel Grooved Fittings: Only where approved.	ASTM A 47 malleable-iron casting, ASTM A 106 steel pipe, with dimensions matching steel pipe.
2-1/2 and up	Class 125 cast iron flanged fittings; ASTM A 126, Class A and ANSI B16.1. Provide Class 250 flanges when required by mating pipe.
Grooved Mechanical Couplings:	Two galvanized ductile-iron housings, with a synthetic rubber gasket of a central cavity pressure-responsive design. Manufactured assembly to be supplied complete with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings. 2 1/2"-12" Rigid: Victaulic Style 107 and 07 2 1/2"-12" Flexible: Victaulic Style 177 and 77 14"-24" Rigid: Victaulic Style W07 14"-24" Flexible: Victaulic Style W77

Flanges:	Class 125, ASME B16.1. Furnish Class 250 flanges if required to match piping.
Special requirements	For cold water service, clean damaged galvanized surfaces oil-free with solvent and touch-up with a zinc rich coating or Type “A” primer.
Ferrous Expansion Joints *[C, P]:*	Compound, galvanized steel fitting with telescoping body and slip-pipe section. Include 150-psig minimum pressure rating, packing rings, packing, limit rods, chrome-plated finish on slip-pipe section, flanged

	ends, and AWWA C550 epoxy interior coating
Ferrous, Double Expansion Joints [C, P]*:*	Compound, galvanized steel fitting with telescoping body and 2 slip-pipe sections. Include 150-psig minimum pressure rating, packing rings, packing, limit rods, chrome-plated finish on slip-pipe sections, flanged ends, and AWWA C550 epoxy interior coating
Gaskets [C, P]*:*	CS, GRAF, or RR see service requirements in Part 1 of this specification.
Bolts [S]:	High strength

2.1.6 Type GCS-300, Galvanized Carbon Steel

Pipe:	
1/8 Thru 3/4	Steel, Schedule 40, or Schedule 80 galvanized, ASTM A 106
1 and up	Steel, Schedule 80, galvanized, ASTM A 106 or A 53, Grade B.
Fittings:	
1/8 Thru 2	Malleable iron, 300 PSI galvanized, ASTM A 197, screwed ends, ANSI B 16.3.
Plugs:	Steel, galvanized, 300 PSI, ASTM A 105 or A 181, Grade 2, screwed ends ANSI B16.14.
Flanges:	Steel, ASTM A 105, Grade 1, Class [300) [600 ring type joint), threaded, ANSI B16.5.
Nipples:	
1/8 Thru 2	Steel, Schedule 80, galvanized, ASTM A 106 or A 53, Grade B.
Special requirements:	For cold water service, clean damaged galvanized surfaces oil-free with solvent and touch-up with a zinc-rich coating or Type “A” primer.
Gaskets [C, P]:	See specific piping system described in PART 1 of this specification for acceptable gasket materials.
Bolts [S]:	High strength

2.1.7 Type GCS-DWV, Galvanized Carbon Steel Drainage

Pipe:	Schedule 40 galvanized carbon steel, ASTM A 53.
Fittings:	Recessed pattern, cast iron, screwed, ANSI B16.12 or Class 125 cast iron flanges and flanged fittings, ASTM A 126, Class A, ANSI B16.1.
	1. At the Contractor's option for storm service, mechanically coupled grooved type.
Manufacturer:	Victaulic. Rigid: Style 107 or 07 Flexible: Style 77
	Grukvlok.
Gaskets [C, P]:	NBR
Bolts [S]:	General Service

2.2 Cast Iron Pipe and Fittings

2.2.1 Type CISP, Cast Iron Soil Pipe

1. Pipe and fittings: Per ASTM A 74 with oakum and lead packed joints.
2. Elastomer gaskets [P]: Per ASTM C 564.

2.2.2 Type CISP-H, Cast Iron Soil Pipe-Hubless

1. Pipe and fittings: Hubless per ASTM A 888 and CISPI 301, coated inside and outside with coal tar enamel. Pipe with eccentrically cast, thin walls will not be accepted.
2. Joint: Conforming to CISPI 301 and ASTM A 888 use of a neoprene sleeve and two stainless steel clamps per joint.

2.3 Copper Pipe and Fittings

1.

A.GENERALLY SELECT AS FOLLOWS:

1. SIZE (O.D.) NON-POTABLE AND DOMESTIC WATER SERVICE, COMP. AIR, HHW, REF, STEAM, CRYOGENIC, OTHER GASES.
2. 1/4 - 3/4 95-5 95-5 BRZ.
3. 1 - 2 1/2 95-5 BRZ. BRZ.
4. 2 3/4 - 4 95-5 BRZ. BRZ.

5. 5 -8 95-5 BRZ. BRZ.

2.3.1 Type CPR-BJ, Copper Brazed Joint

Tubing:	Type L, and or M water tube on Domestic Water Piping systems, seamless copper tubing; ASTM B 88 hard drawn.
	For use on chilled water, heating hot water, and condenser water systems – Annealed Temper copper tube per ASTM B88 Type K.
Pipe Nipples:	Schedule 40 Red Brass or Copper.
Brazing fittings:	150 PSI wrought copper socket joint; ANSI B16.22. Cup depths and tolerances per MIL F-1183.
Unions:	150 PSI wrought copper socket joint; ANSI B16.22. Cup depths and tolerances per MIL F-1183.
Flared fittings:	45 degree flared forged brass; ANSI B70.1.
Manufacturer:	Imperial-Eastman.
	Crawford.
	Parker-Hannifin.
Flanges:	Class 150 or Class 300 socket joint bronze ANSI B16.24.
Gaskets [C, P]:	See specific piping system described in PART 1 of this specification for acceptable gasket materials.
Bolts [S]:	High strength

2.3.2 Type CPR-SJ, Copper Solder Joint

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Tubing:	Type L seamless copper tubing, ASTM B 88. Hard drawn for horizontal and exposed vertical lines. Annealed or acceptable for small concealed lines.

Solder fittings:	150 PSI wrought copper solder joint type, ANSI

	B16.22.
Manufacturer:	Mueller Brass “Streamline”.
	Nibco, Inc.
Flared fittings:	Cast bronze, ANSI B16.26; forged brass, ANSI B70.1.
Manufacturer:	Imperial-Eastman.
	Nibco, Inc.
Compression fittings *[C, P]*:	Sleeve compression type, brass.
Manufacturer:	Crawford “Swagelok”.
	Imperial-Eastman “Hi-Duty”.
	Parker-Hannifin “CPI”.
Pipe nipples:	Schedule 40 Red brass or copper.
Flanges:	Class 150 PSI WSP solder joint, ANSI B16.24.
Gaskets [C, P]:	See specific piping system described in PART 1 of this specification for acceptable gasket materials.
Bolts [S]:	High strength

2.3.3 Type CPR-OX, Copper Brazed Joint

Tubing:	Underground Type K seamless copper, ASTM B 88, annealed.
Tubing:	All other Type K seamless copper, ASTM B 88, hard drawn.
Pipe Nipples:	Schedule 40 Red Brass or Copper.
Fittings:	Wrought copper socket joint type; ANSI B16.22. Cup depths and tolerances per MIL-F-1183.
Unions:	Wrought copper socket joint type; ANSI B16.22. Cup depths and tolerances per MIL-F-1183.
Cleaning:	Materials shall be factory cleaned and packaged for oxygen service in accordance with CDA Cleanliness Specifications and NFPA-565.

2.3.4 Type CPR-DWV, Copper Drainage

Tubing:	ASTM B 306, Type DWV copper.
Fittings:	Cast bronze drainage fittings, ANSI B16.23.

2.3.5 Type CPR- INS, Copper-Insulated

Tubing:	Seamless, insulated Type K; ASTM B 88.
Brazing fittings:	150 PSI wrought copper socket joint; ANSI B16.22. Cup depth and tolerance per MIL-F-1183.
Joints:	Brazed.
Insulation [P]:	Not less than 2 inches thick, suitable for 250 degF continuous service temperature; factory molded closed cell polyurethane foam, not less than 2.5 lbs./cu. ft. Jacket insulation with white, extruded, rigid virgin Type 2 polyvinyl chloride - minimum wall thickness 60 mils to 4 inches OD, 85 mils to 6-5/8 inches OD and 110 mils to 12-3/4 inches OD. Factory insulate fittings.
Manufacturer:	TPCO, Inc. “X-50” Pre-Insulated Pipe.
	Insul-8 Corp.

2.4 Flange Gaskets

A. *TYPE CS [D,P]:* General service compressed air, hot water service and where specified. Compressed non-asbestos composition sheet blend of synthetic fibers with SBR binder, non-stick coating, 1/16 inch thick. Shop drawing submitted shall include manufacturers recommended torque for specified general service and high strength bolts, for all pipe sizes based on maximum systems pressure/temperature encountered but not less than 150 PSIG at maximum service temperature of 366 degF and 1/16 inch thick gasket.

1. Manufacturer:
    a. Garlock , Blue Gard Style 3200 (Derated to 450 degF)
    b. Chesterton Style 192 (Derated to 700 degF)

B. *TYPE RR [D, P]:* Cold, non-deionized, non-process water service. Red rubber, full face, for up to 6 inch diameter pipe, 1/16 inch thick, per, ASTM D 2000, No. 2AA 705A13L16. For 6 inch and larger pipe, 1/8 inch thick, ASTM D 2000, No. 2AA 705813L16.

1. Manufacturer:
    a. Sepco “No. 20”.
    b. John Crane Style 555 for pressures not exceeding 90 PSI or Style 666 reinforced for pressures not exceeding 140 PSI.

D. *TYPE FRS [D,P]*: API 601/607 and NFPA-30/30A/50/51/54/58 fluids, firesafe. For ANSI Class 150 and 300 flanges: spiral-wound Type 316/321/347 stainless steel,- Mica filled; with external centering-rings and internal rings where required for fluid side erosion control, 0.175 inch thick; rated for minimum 1600 degF, product/service as recommended by manufacturer for the application. Apply 30,000 psi initial bolt stress, unless otherwise recommended. Provide **samples** upon request. Submit shop drawings with manufacturer's materials/construction/gasket stress/initial-final bolt stress/bolt torque recommendations for each process application. Proposed gaskets which are not of Base Bid manufacture shall be submitted per requirements for proposed deviation to prove equivalency.

1. Manufacturer:
    a. Flexitallic STYLE LSI.
    b. Lamons Gasket Co.
    c. Manville, Spiratallic.
    d. Metallo Gasket Co.

E. *TYPE GRAF [D,P]:* Steam. Flexible graphite, T-316 or Hastelloy foil reinforced, 1/16 inch thick, (suitable for TYPE 304/316 stainless steel flanges) product/service recommended by manufacturer.

1. Manufacturer:
    a. John Crane Style 264/GHR/GTB.
    b. Chesterton Style 193.
    c. Sepco Style GHR/GTB.
    d. Union Carbide.

F. *TYPE NBR [D,P]:* For water, glycol, Freon TF/PCA, nitrogen, soap solution, certain soluble oils, aromatics [toluene-xylene). Buna-N, premium grade formulation, proposed product/service recommended by manufacturer, 1/16 inch thick, 70 Shore A Durometer, (225 degF maximum).

1. Manufacturer:
    a. John Crane Style 900
    b. Galock Style 8495 (Prime)

G. *TYPE PTFE [D,P]:* For solvents, chemicals, 66 deg Baume sulfuric acid. Plain, unreinforced polytetrafluoroethylene, (Teflon), 1/16 inch thick.

1. Manufacturer:
    a. John Crane Style 68C/15

b. AW Chesterton Style 2000

I. *TYPE RTFE [D,P]:* For solvents, chemicals 66deg Baume sulfuric acid. Perforated Type 304 stainless steel insert encapsulated with polytetrafluoroethylene (Teflon), 3/32 inch thick, thru 12 inches.

1. Manufacturer:

a. Garlock Style HP3560.

J. *TYPE SI [D,P]:* For oxygen, ozone. Silicone, 1/32 inch thick, [50) [60) Shore A Durometer, [-60 to 400 degF maximum, 150 psig).

1. Manufacturer:

a. John Crane Style 2001/50A, Style 2002/60A

K. *TYPE SPW [D, P]:* Conforming to API 601/607. Low seating stress, spiral wound; dead-soft TYPE 316 stainless steel, unless otherwise specified or recommended by manufacturer for specific product/service; 0.175 inch thick, with 0.125 inch thick external centering and internal rings. For frequently temperature/pressure cycled low pressure process loops, use Type SPW/ Flexitallic LSI gaskets. For internal combustion engine exhaust provide AISI TYPE 321/347 construction with Mica fill, rated for not less than 1600 degF. For manufacturer recommended, process specific, general and certain chemical service, service to 1000 degF, use graphite fill, typically: natural gas; steam and condensate. For manufacturer recommended, process specific, chemical service, service to 400 degF, use Teflon or graphite fill or Mica fill. Apply 30,000 psi bolt stress, unless otherwise application recommended. Provide **samples** upon request. Submit shop drawings with manufacturer's materials/compatibility/construction/gasket stress/initial-final bolt stress/bolt torque recommendations for each process application. Proposed Low Stress Internal ring gaskets which are not Base Bid manufacture shall be submitted per requirements for proposed deviation to prove equivalency.

1. Manufacturer:

a. Flexitallic STYLE LSI (Low Stress) for Class150 and Class 300 flanges; STYLE CGI for Class 600 and up.

b. Fluorocarbon, Metallic Gasket Div. For Class 600 flanges and up, unless otherwise approved.

c. Lamons Gasket Co.: STYLE WRI: For Class 600 flanges and up, unless otherwise approved.

d. Manville Spirotallic: For Class 600 flanges and up, unless otherwise approved.

e. Metallo Gasket Co. For Class 600 flanges and up, unless otherwise approved.

L. *TYPE HTT [D, P]:* High continuous temperature, oxygenated or other fluid exposure, service in excess of 1700 degF, manufactured from vermiculite. Gasket/bolt stress required for tight sealing shall not bend Class 150 or Class 300 flanges. See manufacturer's data for required bolt type/torque.

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1. Manufacturer:

a. Flexitallic Type "Thermiculite"

2.5 Bolting

A. General Requirements: Bolting shall be certified "made in USA" and furnished with visually identifiable manufacturing source/quality.

B. *General Service Bolting [C.P.S]:* Heavy hex head or stud per ASTM A 307, Grade B and hex nuts per ANSI B18.2.2. Square head bolts and nuts are not acceptable.

C. *High Strength Bolting [C,P,S]:* For all ANSI Class 150 or 300 flanged joints per ANSI B31.1 Table 108.52, except where Class 125 and special case Class 250 cast iron flanges occur. Heavy hex head or stud alloy steel per ASTM A 193, Grade B7 and semi-finished heavy hex nuts per ASTM A 194, Grade 2H. Square head bolts and nuts are not acceptable. Color code to be visually identifiable in field.

D. *Corrosion Resistant Bolting [C,P,S]:* Stainless steel, Type 304, semi finished regular hex head bolts, ASTM A 193, Grade B8, NC thread with stainless steel, Type 303, semi finished regular hex head nuts, ASTM A 194, Grade 8F, NC thread. Square head bolts and nuts are not acceptable. Certified made in USA, and visually identifiable in field.

E. *High Strength High Temperature, Bolting High Nickel[C, P, S]:* High nickel (26% Ni/15% Cr) nominal steel, working range to 800 degF, UNC-2A thread full thread studs, ASTM A 453, Grade B660 Class B with, UNC-2B thread, heavy hex head nuts, ASTM A 453, Grade B660 Class B NOTE: This material has a coefficient of expansion similar to that of austenitic stainless steel.

F. *High Strength High Temperature Bolting, Ferritic [C, P, S]:* Ferritic stainless steel, working range -0 to 900 degF, Type 410, UNC-2A thread full thread studs, ASTM A 193, Grade B6 with ferritic stainless steel, UNC-2B thread, heavy hex head nuts, ASTM A 194, Grade 6.

G. *High Strength High Temperature Bolting, Nimonic [C, P, S]:*Nimonic alloy steel, working range to 1500 degF, Alloy N07080, UNC-2A thread full thread studs, ASTM B 637 , Alloy N07080 (Nimonic 80A), with same alloy steel, UNC-2B thread, heavy hex head nuts. **WARNING:** No acceptable deviation. Contractor shall import/purchase this product from UK at the start of project to meet Project Schedules.

H. High Strength Alloy Bolting,[C, P, S]: Alloy steel, working range to 600 degF, UNC-2A thread full thread studs, ASTM A 434, [Grade BB 90 ksi tensile) [Grade BC 110 ksi) [Grade BD 130 ksi), UNC-2B thread, heavy hex head nuts, ASTM A 434, [Grade BB 90 ksi tensile) [Grade BC 110 ksi) [Grade BD 130 ksi). NOTE: This material has a coefficient of expansion similar to that of austenitic stainless steel.

2.6 Manufactured Pipe Hanger Component Materials

A. Manufacturers: Subject to compliance with the project requirements, provide manufactured pipe hanger materials produced by one of the following:

1. *Pipe Hangers [B, C, D, P]:*
    a. B-Line Systems, Inc.
    b. Grinnell Corp.
    c. Michigan Hanger Co., Inc.
    d. National Pipe Hanger Corp.
    e. Piping Technology & Products, Inc.

2. *Channel Support Systems [B, C, D, P]:*
    a. B-Line Systems, Inc.
    b. Grinnell Corp.; Power-Strut Unit.
    c. Michigan Hanger Co., Inc.
    d. National Pipe Hanger Corp.
    e. Unistrut Corp.
3. *Thermal-Hanger Shield Inserts [C,P]:*
    a. PHS Industries Inc.
    b. Value Engineering Products Inc.
    c. Pipe Shields, Inc.
4. *Protection Shields [C, P]: Protection shields shall be welded to or secured to pipe clevis hangers with locking tabs*
    a. Cooper B-Line Systems, Inc. – Figure B3153 with "Loc" Tabs
    b. National Pipe Hanger Corporation , Figure 220 with welded shield
5. *Powder-Actuated Fastener Systems [C, P]:*
    a. Hilti, Inc.
    b. ITW Ramset, Red Head.

2.7 Manufactured Support Units

A. *Pipe Hangers, Supports, and Components [P]:* MSS SP-58, factory-fabricated components. Refer to Part 3 of this specification for the requirements indicating where to use specific hanger and support types.
    1. Galvanized, Metallic Coatings: For piping and equipment that will not have field-applied finish.
    2. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.

B. *Channel Support Systems [D, P]:* MFMA-2, factory-fabricated components for field assembly.
    1. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.
    2. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.

C. *Thermal-Hanger Shield Inserts [P]:* 100-psi minimum compressive-strength insulation, encased in sheet metal shield.
    1. Material for Cold Piping: ASTM C 552, Type I cellular glass or water-repellent-treated, ASTM C 533, Type I calcium silicate with vapor barrier.
    2. Material for Cold Piping: ASTM C 552, Type I cellular glass with vapor barrier.
    3. Material for Cold Piping: Water-repellent-treated, ASTM C 533, Type I calcium silicate with vapor barrier.

4. Material for Hot Piping: ASTM C 552, Type I cellular glass or water-repellent-treated, ASTM C 533, Type I calcium silicate.
5. Material for Hot Piping: ASTM C 552, Type I cellular glass.
6. Material for Hot Piping: Water-repellent-treated, ASTM C 533, Type I calcium silicate.
7. For Trapeze or Clamped System: Insert and shield cover entire circumference of pipe.
8. For Clevis or Band Hanger: Insert and shield cover lower 180 degrees of pipe.
9. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.8 Miscellaneous Pipe Supporting Materials

A. *Powder-Actuated Drive-Pin Fasteners [P]:* Powder-actuated-type, drive-pin attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.

B. *Mechanical-Anchor Fasteners [P]:* Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.

C. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars, black and galvanized.

D. *Pipe Support Grout [P]:* Grout shall comply with ASTM C 1107, Grade B, and shall be factory pre-mixed and packaged, non-shrink and non-metallic, dry, hydraulic-cement grout.

1. Characteristics: Post hardening and volume adjusting; recommended for both interior and exterior applications.
2. Properties: Non-staining, non-corrosive, and non-gaseous.
3. Design Strength: 5000-psi , 28-day compressive strength.

E. Pipe Hanger Thread Locking Thread locking compound shall be used on all single nut installations for any pipe hanging components (ie. Horizontal clevis bolt):

1. Loctite #248 Anaerobic Threadlocking Stick Application
2. Loctite #268 Anaerobic Threadlocking Stick Application

2.9 Rooftop Pipe Supports

A. Prefabricated pipe support system:

1. Design and supply prefabricated pipe support system. Design shall be prepared by rooftop piping support system OEM only.
2. Bases: injection molded plastic, structurally reinforced.
3. Framing: fabricated steel to ASTM A570 Grade 33 (stainless steel Type 304 to ASTM A 167), roll formed 2.7 mm (12 ga) thick tubular sections. Tubing perforated with nominal 9/16" diameter holes on nominal 2" centers on 3 sides.
4. Supports: materials as specified above.
5. Clamps, bolts, nuts and washers to suit installation, same material as framing members.

6. Roof pads to suit roof construction.

B. Acceptable Manufacturers:

1. Portable Pipe Hangers

15105.3 EXECUTION

GENERAL

A. Execute the Work in compliance with Division 15 Section “Basic Mechanical Material and Methods.”

B. Minimum acceptable piping size shall be 3/4-Inch NPS, unless specifically noted otherwise on Project Drawings.

C. Examine roughing-in for compliance with requirements for installation tolerances and other conditions affecting performance of piping systems. Do not proceed with installation until unsatisfactory conditions have been corrected.

D. Install all flanges, unions, transitions, special fittings, and valves with pressure ratings that are at least the same, or higher than, the piping system pressure rating, except as otherwise specified.

E. Install piping and accessories adjacent to equipment to allow access to the equipment and piping for service and maintenance.

F. Install supports and anchors in compliance with all the requirements of Section "Supporting Elements." Do not exceed 10’-0” maximum horizontal or vertical spacing between pipe hangers:

G. Install valves according to Division 15 Section "Valves."

1. Drawings indicate the valve types to be used. Where the specific valve types are not indicated, the following requirements shall apply:
    a. Shutoff Duty: Use ball or butterfly type valves.
    b. Throttling Duty: Use globe or butterfly type valves.
    c. Do not use check valves in piping between reciprocating air compressors and air receivers.

PIPING SYSTEMS INSTALLATION

B. General

1. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic information regarding joint construction requirements for all piping materials.
2. Mechanical joint assembly shall be in accordance with the fitting manufacturer's written instructions.
3. Construct piping systems in accordance with ANSI B31.1 latest edition and supplementary requirements specified herein, unless noted otherwise
4. **WARNING:** Pressurized piping systems are subject to a routine depressurization operation or operation at reduced pressures. Contractor shall take such precautions as are necessary to accommodate, during construction, standard operating conditions as regards proper joint making, anchorage, guiding, expansion/contraction, water hammer potential, slopes, drainage, vacuum formation, vacuum breakers, vents, venting capacity and the like.
5. Install off-ground pipe storage and pipe cleaning stations as required that are acceptable to Owner, comprised of cleaning means/devices which include. punch-out brushes; high pressure compressed air

lances; high pressure water (to 30,000 psi). The objectives are to install piping systems so clean that Work under Article 3.03 and resultant waste water is minimized and such that Owner rejection of dirty installation work is simultaneously minimized. Need for pipe cleaning station may be minimized upon Owner approval if fresh mill-run and end-sealed pipe is furnished.

6. Locate groups of pipes parallel to each other, but spaced to permit applying insulation, testing, and servicing of all inline devices, instruments, and valves.

C. Fabrication, Assembly, Erection

1. Clean pipe, tubing, fittings, valves, equipment and accessories of extraneous foreign material and dry the components before installation into their respective systems. During construction, protect open ends of pipe, fittings and valves to prevent the admission of foreign matter. Place plugs in the ends of installed work at the end of the day and whenever work stops. Use commercially manufactured plugs. Fabricate pipe to measurements established on the project site; work pipe into place without springing or forcing. Provide for absorbing movement without undue stress in any part of the system.
2. Install piping straight and true, with approved offsets to increase headroom and avoid obstructions. Pipe installation shall clear electrical bus ducts by 4’-0” unless otherwise approved. Provide shielding/pans where crossing over electrical bus ducts and specified drainage and venting where piping offsets are required.
3. Install control valves in locations accessible and as close to equipment as possible, or as indicated.
4. Install bypass piping around any system control valve with a globe valve sized to handle the full range of flow through the control valve. Where multiple, parallel control valves are installed, only one bypass is required.
5. Pipe sizes for the supply and return from any equipment connection, shall be same size as the equipment connection, unless otherwise indicated.
6. Use standard long sweep pipe fittings for changes in direction. No mitered joints or field fabricated pipe bends will be permitted. Short radius elbows may be used where specified or specifically authorized by the Architect-Engineer. Copper tubing may be bent in the field with the use of approved tube bending equipment.
7. Make tee connections with screwed tee fittings or specified welded connections. Make welded branch connections with either welding tees or forged branch outlet fittings per ASTM A 105, ANSI B16.9 and ANSI B16.11. For forged branch outlets, furnish forged fittings flared for improved flow where attached to the run, reinforced against external strains and to full pipe-bursting strength requirements. “Fishmouth” connections are not acceptable.
8. Take off branches from mains at an angle of 45 degrees or 90 degrees above horizontal, unless otherwise indicated. Pitch up branches taken from the tops of mains, pitch down those taken from the bottom of the mains. Make connections to eliminate air pockets, insure unrestricted circulation and complete drainage of the system.
9. Unless noted otherwise, provide unions for lines 2-inch NPS and smaller, or bolted flanges for 2-1/2-Inch lines and larger, adjacent to equipment, valves and piping accessories from the piping system to permit removal. Make final connections to equipment with unions or flanges (as described above) located between the equipment and system isolation valve located adjacent to the equipment.
10. Provide and install eccentric reducers for horizontal piping containing non-condensable gases, where pipe is reducing in size in the direction of airflow, with bottoms of both pipes and reducer flush.
11. Provide and install eccentric reducers for horizontal piping containing liquids, where pipe is reducing in size in the direction of flow, with the top of both pipes and reducer flush.
12. Install flexible connectors at the inlet and discharge connections to pumps (except in-line pumps) and all

other vibration-producing equipment. Provide internal shielding where process flow may damage internal flexible connector components.

13. Expansion bend configuration shall be as indicated. Make expansion U-bends from pipe sections and long radius welding elbows. Cold spring expansion bends with indicated cold spring and weld into the line, which shall be anchored before removing the spreader from the expansion U-bend.

14. Upon prior approval and within systems limitations, make pipe bends of Grade A seamless, or where approved of electric resistance welded pipe, of not less than five pipe diameters radius by cold bending with hydraulic benders for pipe sized to 4 inch NPS. Bent pipe with wrinkles, kinks, flattening, wall thickness variation and other defects will be rejected.
15. Leave joints, including welds, flanges, and fittings, un-insulated and exposed for inspection during the system pressure testing.

16. Provide expansion joints on rain conductors at building expansion joints and where indicated.
17. Anchor rain conductors to building structure near roof drain to protect roof drain from pipe expansion stresses.
18. Horizontal piping containing liquids and vapors condensable at system ambient conditions shall have an upward grade of 1 inch per 40 feet in the direction of flow.
19. Horizontal piping containing non-condensable gases shall have an upward grade of 1 inch per 100 feet in the direction of flow.
20. Slope horizontal drain and waste piping in the direction of flow not less than minimum grade required by applicable code.
21. When permitted to use grooved pipe and fittings, assemble joints with coupling, gasket, lubricant, and bolts supplied from a single source. Assemble grooved fittings and pipe according to coupling and fitting manufacturer's written instructions.
22. For liquid lines, manual air vents shall be installed at all system high points, at heating or cooling coils, and elsewhere as required for system air venting. Route drain piping from air vent discharge to process floor drain.

23. For liquid lines (except potable water), automatic air vents shall be installed at all high points, at heating or cooling coils, and elsewhere as required for system air venting. Provide a manual isolation root valve at the piping main for servicing each automatic air vent. For testing automatic vents, provide a branch line between this manual isolation valve and the automatic vent, routed down the nearest column and terminating with a plugged 1/2” manual ball valve 4”-0 AFF, protected in the web of the column. Route drain piping from the automatic air vent discharge to the nearest process waste floor drain.
24. Install pressure relief or pressure-limiting devices so they are accessible and may be readily operated. Test each device to determine the actual pressure at which they will operate, and examine for leakage when device is in the closed position.

25. Install manual, automatic, and control valves in accessible locations, and where they are protected from damage. Tag valves with metal tag indicating utility service and valve number. Attach tags to valves with metal chain. Coordinate and identify valve numbers on process/system flow sheets.

26. Install all exposed piping at right angles or parallel to building walls and structure. Diagonal runs are not permitted, unless expressly indicated.
27. Install strainers on the upstream side of each pressure-regulating valve, pressure-control valve, pressure-reducing valve, solenoid valves, traps, in-line pumps, and as indicated. Provide a minimum 3/4-inch NPS nipple and ball valve in the blow-down connection of strainers 2-inch NPS and larger, but nipple/valve/cap shall not be smaller than the blow-down connection provided on strainers.
28. Provide piping system anchors to ensure the proper direction of piping expansion and contraction. Install pipe guides, expansion joints, and expansion loops as indicated.
29. For piping systems insulated with vapor barriers, support locations shall be provided with “Thermal-Hanger Shield Inserts” or “Protection Shields”.

30. Special requirements for Water Distribution Piping Systems:
    a. Provide and install sectional valves close to mains on each branch and riser serving plumbing fixtures or equipment, and where indicated on the drawings. Use gate or ball valves for piping 2-inch NPS and smaller, and use gate or butterfly valves for piping 2-1/2-inch NPS and larger.
    b. Provide and install shutoff valves on each water supply to equipment, on each supply to plumbing fixtures without supply stops, and where indicated on the drawings. Use gate or ball valves for piping 2-inch NPS and smaller, and use gate or butterfly valves for piping 2-1/2-inch NPS and larger.
    c. Provide and install drain valves for equipment, at the base of each water riser, at low points in horizontal piping, and where required to drain water piping.
        1) Install stop-and-waste drain valves where indicated
    d. Provide and install balancing valves in each hot-water circulation return branch, on the discharge side of each pump and or circulator, and where indicated on the drawings. Use ball valves for piping 2-inch NPS and smaller, and butterfly valves for piping 2-1/2-inch NPS and larger. Refer to balancing valves in Division 15 Section "Plumbing Specialties".
    e. Provide and install Calibrated Balancing Valves in each hot-water circulation return branch, discharge side of each pump and circulator, and where indicated. Refer to calibrated balancing valves in Division 15 Section "Plumbing Specialties".
    f. Support vertical piping and tubing at base of risers, at each floor, and where shown on drawings.

31. Special requirements for Steam and Condensate Systems:
    a. Install piping system drains at the low points of all mains, risers, and branch lines consisting of a tee fitting, 3/4-inch NPS ball valve, and short 3/4-inch NPS threaded nipple and cap.
    b. In 2 pipe systems, install steam supply piping at a uniform grade of 0.2%, downward in the direction of flow.
    c. In 1 pipe systems, install steam supply piping at a uniform grade of 0.2%, upward in the direction of flow.
    d. Install condensate return piping at a uniform grade of 0.4%, downward in direction of flow.
    e. Branch connections to steam mains shall be installed using 45-degree fittings in the main with branch line connected on the top of the main. 90-degree tee fittings may be used when 45-degree

fittings are impractical. Where the length of the branch takeoff is less than 10 feet, the branch line shall be pitched downward toward mains at a slope of 0.4%.

f. Provide and install a safety valve downstream from each reducing valve.

g. Slope condensate return lines towards flash tanks. If more than one condensate line discharges into a flash tank, install a swing check valve in each condensate line. Provide a thermostatic air vent atop tank, vented outside of building. Install inverted bucket or float and thermostatic trap on the low-pressure condensate outlet that is sized for three times the condensate load. Provide and install a safety relief valve at tank top, insulate discharge line and extend to a safe discharge location outside of the building. Provide and install a pressure gage, gate valve, and swing check valve on the low-pressure (flash) steam outlet from the tank.

h. Install steam traps in accessible locations within 48 inches to connected equipment. Unless otherwise indicated, install a gate valve, strainer, and union just upstream from traps, and install a union, check valve, and gate valve downstream from a trap.

i. Install pressure-reducing valves, in an accessible location for maintenance and testing, required to regulate system pressure.

j. Provide a piping bypass around each reducing valve installed, with a globe blocking valve equal in size to area of reducing valve seat ring.

k. Install gate valves with flanges or unions around each reducing valve.

l. Provide and install a pressure gauge on the low-pressure side of each reducing valve and one upstream and one downstream of the shutoff valve.

1) On 2-stage reducing stations, install a drip trap and pressure gauge upstream from second stage reducing valve.

m. Install safety valves according to ASME B31.1, and comply with ASME Boiler and Pressure Vessel Code for installation requirements. Pipe the safety valve discharge to atmosphere outside of the building, without stop valves. Install drip-pan elbow fitting adjacent to the safety valve discharge, pipe drain connection from the drip-pan to the nearest floor drain.

n. Install vacuum breakers downstream from control valves and bypasses, and close to coil inlet connections.

o. Install a pressure gauge at coil inlet connections.

p. Pipe outlets from coils to drip legs and trap. Traps shall be sized at 3 times the condensate load of equipment, with 1/2-psig differential.

q. Piping sizes for supply and returns shall be the same size as the equipment connections.

D.Joints

1. Ream pipe ends. Make up screwed joints with joint compound. Apply joint compound to the male thread only; prevent compound from reaching the interior of the pipe. Provide leak-tight joints without stressing fittings.

2. Where required, make up screwed joints with Teflon tape per manufacturer’s instructions.

3. Assemble flanged joints per ANSI/ASME B31.1, ANSI/ASME B16.5 and NFPA 30, 50, 51, 58, as applicable. Clean all flange serrations of leak causing filler and inspect for damage. Assemble flanged joints with fresh-stock gasket and specified hex head nuts, bolts or studs. Make clearance between flange faces such that the connections can be gasketed and bolted tight without strain on the piping system. Align flange faces parallel and bores concentric; center gaskets on the flange faces without projection into the bore. Apply graphite to both sides of steam piping joint gaskets. Use 1/16 inch sheet gasket, except as

otherwise specified.

4. Use high strength bolting ASTM A 193/194, per ANSI B31.1 TABLE 108.52 preferentially to ASTM A307 general service bolting except where ANSI B16.1 Class 125 and special case Class 250 cast iron flanges occur. Use stainless steel bolting with specified corrosion resistant system. Lubricate carbon steel bolts with oil and graphite before assembly to insure uniform bolt stressing. Draw up and tighten bolts in staggered sequence to prevent unequal gasket compression and deformation of the flanges. Do not mate a flange with a raised face to a companion flange with a flat face; machine the raised face down to a smooth matching surface and use a full face gasket. After the piping system has been tested and is in service at its maximum temperature, check bolting torque to provide required gasket stress.
5. Use professional quality torque wrenches to confirm/develop required gasket stress initially. The following table (courtesy Garlock Customer Service) provides samples of required per-bolt-torque for 1/16" thick Garlock 3200 gaskets, to develop a gasket stress of nominal 3350 psi for Class 150, up to 150 psi/365degF maximum service duty. If it is necessary to use 1/8" thick gasket, increase torque by nominal 30%. Retorquing a used heated or leaking gasket may cause cracking. Use high strength bolting as specified.

Flange Size	Torque Ft. lbs./Bolt
10"	158
12"	185
14"	230
16"	220
18"	330
20"	290
24"	420
30"	430
36"	500

6. Cut copper tubing square for socket joints; remove burrs with approved cutting and reaming tools. Clean inside of fittings and outside surfaces of tubes in joint area with stainless steel wool before assembly of joint. Apply joint flux, filler material and heat source per manufacturer's instructions to provide proper capillary action to fill the socket space and to achieve 100% of shear-line strength. For non-flanged valves in copper piping include screwed ends with end adapters to suit mechanical connections, unless filler jointing is specified or indicated for a given application. Remake copper joints which fail pressure tests with new materials including pipe or tubing fittings and filler metal.
7. Cut copper tubing square for mechanical joints; remove burrs with approved cutting and reaming tools. Do not work-harden copper surfaces; in case of doubt, cut off tube ends or anneal ends by heating to a temperature and air cooling per manufacturer's instructions.
8. Make joints in thermoplastic and thermoset plastic piping per manufacturer's instructions, except as more stringently required herein.

E. Joints Of Dissimilar Metals

1. At connections between piping systems, hangers, and equipment of dissimilar metals, insulate the piping or equipment from direct contact with the hangers using dielectric insulating materials. Insulate nonferrous piping against direct contact with the building steel by insulating the contact point of the hanger and pipe or the hanger and building steel.

F. Joints - Welded/Brazed

1. Welding/brazing procedures and welder/brazer qualification, testing and certification shall comply with the latest revisions of all applicable ASME Boiler and Pressure Vessel Codes, Section 1 and ANSI/ASME Codes, B31 series.
2. Before any welding or brazing is performed, submit to the Owner a copy of Contractor's Standard (PQR) Welding/Brazing Procedure Specification (WPS)/(BPS) together with the related Procedure Qualification Record as required by Section IX of the ASME Boiler and Pressure Vessel Code. Exception. At the Owner's option, Owner will furnish the Welding Procedure Specification and Procedure Qualification Requirements.
3. Before any welding/brazing is performed, submit to the Owner a copy of the Welding Test or Welder/Brazer Performance Operator Qualification (WPQ)/(BPQ) Test as required by Section IX of the ASME Boiler and Pressure Vessel Code and in compliance with QW-320/QB-320 for currency of certification. Exception. At the Owner's option, Owner will conduct Welding/Brazing Test or Welder/Brazer Operator Qualification Tests.
4. Each party performing welding shall be responsible for the quality of welding/brazing done by his organization and shall repair or replace any work not in accordance with these specifications.
5. During welding stainless steel piping, and during brazing copper tubing/piping, purge continuously with argon or nitrogen, and allow purge gas to escape to atmosphere through a restrictor. Use a minimum flow of 10-15 cubic feet per hour of purge gas per restrictor, but in all cases, use sufficient purge gas to prevent oxidation.
6. For natural gas systems, use only materials suitable for natural gas systems. For brazed joints use only brazing alloys having a melting point greater than 1000 deg F. Brazing alloys containing phosphorus shall not be permitted.

G.Instrument And Piping Specialty Connections

1. Install pressure sensing device connections, temperature sensing device thermal wells and similar piping specialty connections with full size fitting, reducer fitting, or welding coupling. **Drilling and tapping of pipe wall for connection is prohibited.**
2. For Division 13 Sections I & C Work, provide instrument connections, except thermal wells, with specified isolating valves at the point of connection to the system. For I & C work temperature sensors, provide connection fitting only. Plug for testing.
3. Install thermometers on compressor discharge piping, air dryer suction and discharge piping, cooling tower supplies and returns, on receiver tanks, and where indicated.
4. Install isolation valves and pressure gages on pump suction piping, compressor and pump discharge piping, on receiver tanks, on both sides of pressure regulators, and where indicated.
5. Locate instrument connections per manufacturer's instructions for accurate read-out of function sensed. Locate instruments for easy reading from normal operating levels.
6. Provide pigtails for steam pressure gauges. Use pipe or flexible tubing and fittings on remote pressure gauge connections. Tubing shall be pressure rated copper with nonferrous fittings. Provide bar stock

needle shut-off valves or pulsation dampeners as specified or indicated.

H. Type CISP, Cast Iron Soil Pipe

1. Install per CISPI Cast Iron Soil Pipe and Fittings Handbook except as modified by the Contract Documents.
2. Provide lead and oakum joints in vertical piping where rigid joint alignment is required or where floor drains are caulked. Make joints with one pouring of molten lead, calked to produce a liquid-tight joint without stressing hub or spigot. Where lead is driven 1/4 inch or more below face of hub, remove lead and remake joint.

I. Type CISP-H, Cast Iron Soil Pipe

1. Install per CISPI Cast Iron Soil Pipe and Fittings Handbook except as modified by the Contract Documents.
2. Make joints using neoprene sleeve and stainless steel clamps per manufacturer's instructions to produce a liquid-tight joint without stressing sleeve.

J. Grooved Couplings And Fittings

1. Use grooved couplings and fittings only in specified piping systems. Select manufacturer's recommended gaskets for the service.
2. For straight runs, provide rigid couplings and pipe guides at each end of run. At changes of direction, provide sufficient but not less than two flexible couplings to accommodate pipe movement without imposing bending moments on rigid joints. Grooved system components shall be obtained from a single manufacturing source. At pumps, provide welded piping joints, unless otherwise approved.

K. Air Vents

1. Install air vent valves at all pressurized liquid piping systems and equipment water box high points and where indicated.
2. Provide automatic air vent valves with isolation valves in condenser water box, water lines, except potable water lines, and drainage piping to points indicated or to points of disposal approved by the authorities having jurisdiction. Other vents shall be manual type installed in easily accessible locations.

L. Drain Valves

1. Install drains at all low points in mains, risers, and branch lines. Drains shall consist of a tee fitting, minimum sized ball valve of 3/4-inch, and 3/4-inch NPS threaded nipple and cap.

M. Piping Drip and Sediment Traps

1. Provide drip and sediment traps at system low points and points where condensate may collect.
2. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use minimum-length nipple of 3 pipe diameters, but not less than 3 inches long, and same size as connected pipe. Install with space between bottom of drip and floor for removal of plug or cap.
3. Locate where readily accessible to permit cleaning and emptying. Do not install where condensate would be subject to freezing.
4. For Compressed Air piping, provide drain legs and drain traps at the end of each main, branch, and any low point in piping system, and at every 500 foot maximum interval, for primary and secondary

horizontal compressed-air mains.

N. Sleeves/Seals/Flashing

1. Refer to Division 15 Section “Basic Mechanical Material and Methods” for additional requirements. Comply with UL requirements for fire stopping.
2. Lay out sleeve installation work in advance of placing of slabs or construction of walls and set sleeves necessary to the work. Where pipe sleeves are required in existing slabs and masonry, use core drills to make the holes and set sleeves in place with a two-component epoxy adhesive. Plug sleeves indicated for future use.
3. Make sleeves which extend through floors, roofs, load bearing walls and fire barriers, continuous and of diameter large enough to accommodate pipe, insulation and jacketing, with a minimum 1 inch clearance.
4. Sleeves thru steel decks shall be welded with a continuous weld to the deck.
5. Set sleeves flush with walls, under sides of suspended slabs and top surface of floors in finished spaces. Set sleeves flush with walls and 2 inches above finished floor in manufacturing and equipment room spaces, unless otherwise indicated.
6. Seal pipe passing thru aboveground sleeves weathertight with packing and calking. Calk inserts exposed to weather.
7. Pack the space between a pipe, bare or insulated, and the inside of a pipe sleeve or a construction surface penetration. Where a vapor barrier is required, fill the space between a pipe, bare or insulated, and the inside of a pipe sleeve or construction surface penetration with a calk to a depth of 3/8 inches. Clean surfaces to be calked of oil and grease. Cover with a loosely fitting metal collar on both sides of the wall.
8. Where indicated, seal pipe to sleeve with mechanically expandable inserts.
9. Flash sleeves penetrating roof surfaces water and weathertight with a one piece lead sheet. In the roof plane, extend the flashing not less than 8 inches in all directions from the sleeve surface. Along the sleeve barrel extend the flashing up, then turn down into sleeve for at least 2 inches. Smoothly dress to sleeve ID. Install metal umbrella counter flashing on vent line over the flashed sleeve. Braze or weld skirt onto the vent pipe passing through the sleeve.
10. Set and extend plumbing vent lead flashing around pipe for a minimum of 6 inches from edge of pipe around the vent pipe for a minimum of 12 inches above the roof. Carry the lead sleeve inside the bottom of an inverted hub connection or vent fitting. Turn in the lead sleeve a minimum of 2 inches at the top of the vent and hammer smooth on the inside.

SUPPORTING ELEMENTS

A. Installation

1. Provide necessary piping and equipment supporting elements including. building structure attachments; supplementary steel; hanger rods, stanchions and fixtures; vertical pipe attachments; horizontal pipe attachments; anchors; guides spring supports according to the referenced codes, standards, and requirements specified. Support piping and equipment from building structure. Do not support piping and equipment from roof deck, other pipe, duct or equipment.

2. Comply with MSS SP-69 and MSS SP-89 to properly install hangers, supports, clamps, and attachments as required to support piping from building structure.

3. Install pipe and equipment supports and hangers complete with all necessary inserts, bolts, rods, nuts, washers, and other accessories.

4. Pipe and equipment supports and hangers shall be installed such that piping loads, both live and dead, and the stresses from pipe movement during construction and operation will not be transmitted to connected equipment.

5. After all pipe hanging components are installed, provide thread locking compound on all single nut installations to secure nuts from vibration loosening. (i.e. Horizontal clevis bolt):

6. Piping supports and hangers shall be installed to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9, "Building Services Piping," are not exceeded.

7. Use copper plated or plastic coated supporting element in contact with copper tubing.

8. Hang piping parallel with the lines of the building, unless otherwise indicated. Space piping and components so a threaded pipe fitting may be removed between adjacent pipes and so there will be not less than 1/2 inch of clear space between finished surfaces and piping. Arrange hangers on adjacent parallel service lines in line with each other.

9. In lieu of separate hangers, heavy-duty steel trapeze hangers for parallel service systems piping, may be placed on same elevation adjusted for proper pitch. Spacing of trapeze hangers shall be the closest interval required for any size pipe supported. Piping with common support elements shall have compatible support and vibration isolation. To maintain fixed positions on trapeze, provide bracing allowing for varying thermal expansion of each system supported.

10. Field fabricated heavy-duty steel trapezes shall fabricated from shapes made of ASTM A 36/A 36M steel selected for the loads being supported. Weld steel according to AWS D-1.1. Pipes of various sizes may be supported together, but trapezes shall be spaced based on the smallest pipe size supported, or install intermediate supports for smaller diameter pipes. Piping spans shall be as specified above for individual pipe hangers.

11. Manufactured channel support systems may be arranged for groupings of parallel pipe runs on field-assembled support systems. Field assemble and install according to all manufacturer's written instructions.

12. Piping with pulsating fluid flow shall be supported independently of other piping.

13. Flange loads on connected equipment shall not exceed 75% of maximum allowed by equipment manufacturer. Flange loads in liquid containing systems shall be checked in the presence of the Architect-Engineer when piping is full of liquid. No flange load is allowed on pumps, vibration isolated equipment or flexible connectors.

14. Install hangers and supports to allow for controlled thermal and seismic movement of piping systems, and to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

15. Spring supports shall be installed within manufacturer’s specified limitations. Provide constant support type spring supports where significant vertical movement occurs and where necessary to avoid transfer of load from support to support or onto connected equipment. ;Provide variable support type spring supports located at points subject to vertical piping movement.

16. Incorporate pipe anchors into piping systems to maintain permanent pipe positions. Install four alignment guides for the piping adjacent to and on each side of pipe expansion loops and expansion joints to maintain alignment. Construct anchors to secure entire circumference of the pipe.

17. Where necessary, brace piping and supports against reaction, sway and vibration.

18. Install turnbuckles, swing eyes and clevises to accommodate temperature changes, pipe accessibility, and adjustment for load and pitch. Rod couplings are not acceptable.

19. Install hangers and supports for piping at intervals specified, at locations not more than 3 feet from the ends of

each runout, and not over 25% of specified interval from each change in direction of piping.

20. Base the load rating for pipe support elements on loads imposed by the weight of insulated pipe filled with water. The span deflection of supporting elements shall not exceed slope gradient of pipe.

21. For Schedule 40 and Schedule 80 ferrous pipe and copper tube supports use the following minimum rod size in inches and maximum allowable hanger spacing in feet. For concentrated loads, such as valves, reduce allowable span accordingly.

22. Support vertical piping runs at each floor, or at a maximum of 10'- 0" on center.

MAXIMUM ALLOWABLE HORIZONTAL SPANS							
PIPE SIZE		ROD SIZE	STEEL PIPE**			COPPER TUBE	FRP
			Steam & Liquids	Gas and Air	Natural Gas		
1/2		3/8	6	7	6	5*	Continuous
3/4 - 1		3/8	6	8	7	5	Continuous
1-1/4 - 1-1/2		3/8	7	8	8	7	Continuous
2		3/8	9	12	8	8	6
2-1/2 - 3		1/2	10	13	10	9	6
4 - 5		5/8	13	16	10	--	8
6		3/4	16	20	10	--	8
8 - 10		7/8	19	24	10	--	10
12 AND ABOVE		As indicated on the Drawings					

* Except where continuous support is specified.

** Bulk mains (fire protection service) using grooved couplings, provide two hangers for each 20 feet of length.

a. PVC,CPVC, PE AND PPL

1-1/2 and smaller	Provide continuous supports.
2 AND LARGER	Support as recommended by the manufacturer.

b. CAST IRON PIPE

All sizes	10 feet, but not less than two supports per pipe length.

c. GLASS PIPE

ALL SIZES	Support as recommended by the manufacturer.

23. Support vertical risers independently of connected horizontal piping whenever practical, with supports at the base and at intervals to accommodate system range of load with thermal conditions. Guide for lateral stability. Provide one rigid support for risers subject to expansion at approximately 1/3 point from the top or at base unless otherwise indicated. Fit horizontal piping contiguous to moving risers with two spring supports, spaced immediately adjacent to

riser.

24. For risers at temperatures of 100 degF or less place riser clamps under fittings. Support carbon steel pipe at each operating level or floor and at not more than 15-foot intervals for pipe 2 inches and smaller, and at not more than 20 foot intervals for pipe 2-1/2 inches and larger.

25. After the piping systems have been installed, tested and placed in satisfactory operation, firmly tighten hanger rod nut and jam nut and upset threads to prevent movement of fasteners.

26. Attach pipe anchors and pipe alignment guides to the building structure as indicated. If not indicated, the method used is optional to the Contractor, subject to approval by the Architect-Engineer. In the case of structural steel, make attachment by clamping per the American Institute of Steel Construction Specification for the Design, Fabrication and Erection of Structural Steel for Building. Do not weld to structural steel without written approval of Architect-Engineer.

27. Attach supporting elements connected to structural steel columns to preclude vertical slippage and cascading failure. Column attachment includes compression bolting of friction plates with a service duty factor of 5 on each flange face. Include on one plate a supported bolting shelf or other weldment for attachment of other supporting system elements. Submit complete shop drawings.

28. Locate pipe hangers and other supporting elements from roof purlins or top chord of jack trusses. Supporting elements shall not be supported from the top chord of roof or carrying trusses except at panel points. Total of all supported loads on a purlin or top chord of jack trusses between panel points shall be such as to produce a moment no greater than the moment produced by a one kip concentrated load at midspan of the purlin or jack truss or by the uniform mechanical (utility) loads indicated on the Drawings. When the total loads exceed the above criteria, provide additional support beams framed into a roof purlin or jack truss top chord or bearing on the roof or carrying truss top chord panel point. Purlins used for supporting electrical lighting fixtures and/or electrical power duct or cable tray shall be considered fully loaded. Supplemental steel required for support and to spread loads to adjacent purlins shall be furnished and installed by the Contractor. Building structural steel shall not be reinforced by the contractor except as approved by the Architect-Engineer

29. Where eccentric loading beam clamps are approved, locate eccentric loading support elements to minimize structural member torsion load.

30. Limit the location of supporting elements for piping and equipment when supported from roof to panel points of the bar joists and limit the allowable load on the bar joist such that the loads produce a moment no greater than the moment produced by 1 kip load at mid-span of bar joist or by the uniform (utility) load specified on the Drawings.

31. When the hanger load exceeds the above limits, provide additional structural support as required. When an additional member is used, support the added member at the panel points. Stabilize member by connection to adjacent roof bar joists. Supplemental support steel shall be furnished and installed by the Contractor.

32. Consider bar joists used for supporting fire protection sprinkler mains, electrical lighting fixtures, and electrical power duct or cable tray as fully loaded. Supplemental support steel shall be furnished and installed by the Contractor.

33. Building structural steel, including bar joists shall not be reinforced by the contractor except as approved by the Architect-Engineer in writing.

34. Use approved cast-in-place inserts or built-in anchors for attachment to concrete structure. Size inserts and anchors for the total applied load with a safety factor per applicable codes but in no case less than 5. Coordinate installation of all imbedded items with the Work under other Sections. Install imbedded items per manufacturer's instructions. Position anchorage and imbedded items as indicated and support against displacement during placing of concrete. Cutting or repositioning of concrete beam or girder to accommodate inserts will not be allowed. Provide

removable closures in imbedded device openings to prevent entry of concrete.

35. Provide concrete building slab attachments spaced within the maximum piping span length indicated in MSS SP-69. Install additional attachments at all concentrated loads, such as expansion joints, flanges, guides, strainers, and valves, also at changes in direction of piping. Concrete inserts shall be installed before concrete is placed; inserts shall be fastened to forms with reinforcing bars installed through the openings at the top of inserts.

37. Install mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install all fasteners according to the Manufacturer's written instructions.

38. Support piping and equipment from concrete building frame, not from roof or floor slabs unless otherwise indicated.

39. Use cast-in-place inserts in concrete beams and girders. Masonry and other drilled anchors will not be permitted. Use wedge type inserts on vertical surfaces only.

40. Attach piping supports to the side of concrete joists. Provide supplementary support steel as required. Cast-in-place or drilled anchors will not be permitted in the bottom of concrete joists.

41. Each insert shall be capable of supporting 1 kip unless otherwise indicated.

42. Where attachment by cast-in-place inserts is not possible, specified or approved masonry anchor devices may be used after submission of test criteria and receipt of written approval by the Architect-Engineer.

B. Insulated Piping

1. Attach clamps and spacers directly to piping. Install thermal-hanger shield insert with clamp sized to match OD of insert. Do not exceed pipe stress limits according to ASME B31.9.

2. Install MSS SP-58, Type 39 protection saddles, if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches the specified piping system 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 arc of 180 degrees. Securely cement shields to insulation. Install shields with clevis or band hangers only.

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. Thermal Hanger-Shields shall be provided and installed with the following dimensions, based on the piping sizes listed. Shields shall be insulated with the same material and thickness as the piping being supported.

Dimensions for Pipe Covering Protection Shields						
Nominal Pipe or Tubing Size		Minimum Length of Shields		Minimum Thickness of Shield Material		
Inches	Millimeters	Inches	Millimeters	Gage	Inches	Millimeters
¼ – 3 1/2	7 – 90	12	305	18	.048	1.22
4	100	12	305	16	.060	1.52

5 and 6	125 and 150	18	457	16	.060	1.52
8 – 14	200 – 350	24	610	14	.075	1.91
16 – 24	400 – 600	24	610	12	.105	2.67

a. The protection shield gages listed in the table above, are for use with band type hangers only. Where point loading supports are installed, increase the minimum shield thickness and length by at least one pipe-grouping requirement.

b. When shields are used with roller supports, the shield thickness shall be increased by a minimum of one pipe grouping requirement, and the shield length shall be increased to maintain the rolling point of contact within the middle third of the shield length.

c. Shields shall be supplied with clevis and shall be secured by welding or locking tabs only.

5. Thermal Hanger-Shields shall be provided and installed with insert material having a length as long as the protective shield.

6. Where pipe insulation vapor barriers are required, the vapor barrier shall extend 2 inches (51mm) beyond the shield and overlap the outside circumference by at least 2 inches (51mm).

C. Pipe Anchors

1. For pipe line service temperatures under 250 degF, fabricate anchors from steel plate or structural shapes.

2. Construct anchors for pipe line service temperatures over 250 degF from piping components such as shaped nipples, saddles and flanges. For main anchors, weld a full size extra strong nipple with or without a saddle to the pipe. For intermediate anchors, weld a 2/3 line size extra strong nipple to the pipe. Weld a 150 PSIG slip-on flange to the bottom of the nipple and set in grout to provide anchor bolt area.

D. Pipe Guides

1. Control expansion joint movement by installing two rigid pipe guides on each side of the expansion joint. Spacing shall be as follows:

	Maximum Distance		Maximum Distance Between Intermediate Guides (Ft.) for tabulated pressures, (PSIG)							
Nom. Pipe Size (In.)	Exp. Joint to First Guide	First to Second Guide	50	100	150	200	250	300	350	400
3	1’-0”	3’-6”	21	19	17	16	15	14	13	13
4	1’-4”	4’-8”	35	29	25	22	20	19	18	17
6	2’-0”	7’-0”	57	44	37	32	29	27	25	23
8	2’-8”	9’-4”	66	52	45	40	36	33	31	29
10	3’-4”	11’-8”	91	69	58	51	46	42	39	36
12	4’-0”	14’-0”	107	79	66	58	52	48	44	41
14	4’-8”	16’-4”	115	85	71	62	56	51	47	
16	5’-4”	18’-8”	127	94	78	68	61	56	52	

18	6’-0”	21’-0”	139	102	85	74	67	61	56	
20	6’-8”	23’-4”	151	110	91	80	71			
24	8’-0”	28’-0”	172	125	103	89	80			
30	10’-0”	35’-0”	200	144	118	103	92			

E. Roof Mounted Piping

1. Manufacturer site responsibilities:
   a. Provide on site assistance and inspection as required for installation.
   b. Provide layout drawing with detailed locations for each hanger.
2. Support system installation:
   a. Remove roofing ballast and debris from areas of base location as required.
   b. Adhere roofing pad to roof membrane with adhesion system as recommended by manufacturer.
   c. Set frame legs into bases and assemble supports.
   d. Remove excess adhesive from frame, bases and pads.
   e. Replace roof ballast up to edge of base.

PIPE SUPPORT AND HANGER APPLICATION GUIDE

H.General Requirements

1. Furnish supporting elements per ANSI B31.1 with Addenda, Manufacturers Standardization Society for the Valve and Fittings Industry MSS SP-58, and MSS SP-69, except as otherwise modified and supplemented herein. Supporting elements, including structural members, rods, threaded fasteners, “U” bolts, etc., exposed to weather shall be hot dip galvanized after fabrication. Stainless steel components are acceptable in lieu of hot-dip galvanized carbon steel. Use of raw carbon steel fasteners in weather exposed locations is prohibited. Copper piping or tubing shall be isolated from supports by plastisol coatings or rubber or plastic insert. Pre-insulated supports exposed to weather shall have a weatherproof jacket.
2. There are other specific hanger requirements specified within sections specifying equipment and related systems. Contractor shall review all specification sections provided with this project and comply with all requirements.
3. As piping and supports are installed, adjust hangers to distribute loads equally in all support components, at building attachment points, and to achieve indicated slope of piping systems.
4. Clean all field welds and abraded areas of shop applied paint, and paint all exposed areas immediately after erecting hangers and supports. Use the same paint/primer materials as used for shop painting. Comply with SSPC-PA 1 requirements for field touch-up of all shop painted surfaces.
   a. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
5. Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 9 Section "Painting."
6. For all galvanized surfaces, clean welds, bolted connections, and all abraded areas then apply an approved galvanizing-repair paint to comply with ASTM A 780.

I. Material Designation

1. “TYPE” designations are based on MSS SP-58 and MSS SP-69. Support elements, except for mill rolled

supplementary steel, shall be catalogued, load rated, commercially manufactured products.

J. Building Structure Attachments, supply and install the following types of attachment materials unless otherwise indicated.

1. Anchor Devices, Concrete and Masonry: Per Group 1, Group II, TYPE 2, Class 2, Style 1 and Style 2, Group III and Group VIII of FS FF-S-325A. Furnish cast-in floor type equipment anchor devices with adjustable positions. Furnish built in anchor devices for masonry.
2. Beam Clamps: Center loading TYPE 21, 28, 29, and 30, unless otherwise specified or indicated. When it is determined by the Architect/Engineer that it is not possible to use center loading beam clamps, eccentric loading beam clamps, TYPE 20, 25, and 27 with jam nuts may be used within the following limitations. for loads equivalent to water piping sizes 2 inches and less; for loads equivalent to water piping sizes 2 inch through 10 inch provided two counterbalancing clamps are used per point of pipe support and pipe is mounted on trapeze. Where more than one rod is used per point of support, determine rod diameter per referenced standards. Miscellaneous structural steel, cantilevered from a structural beam in order to support piping, is prohibited.
3. "C" Clamps. Use of "C" clamps and beam clamps of "C" pattern and any modification thereof is prohibited.
4. Inserts, Concrete: TYPE 18. When applied to loads equivalent to piping in sizes 2 inch IPS and larger, and where otherwise required by imposed loads, a one foot length of 1/2 inch reinforcing rod shall be inserted and wired through wing slots. Proprietary type continuous inserts may be proposed and shall be submitted for approval.

K. Horizontal Pipe Attachments, supply and install the following types of attachment materials unless otherwise indicated.

1. Adjustable Steel Clevis Hangers (MSS TYPE 1) with jam nuts: For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30 (DN15 to DN750).
2. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS TYPE 3): For suspension of pipes, NPS 3/4 to NPS 24 (DN20 to DN600), requiring clamp flexibility and up to 4 inches (100 mm) of insulation.
3. Steel Pipe Clamps (MSS TYPE 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24 (DN15 to DN600), if little or no insulation is required.
4. Pipe Hangers (MSS TYPE 5) with jam nuts: For suspension of pipes, NPS 1/2 to NPS 4 (DN15 to DN100), to allow off-center closure for hanger installation before pipe erection.
5. Adjustable Steel Band Hangers (MSS TYPE 7) with jam nuts: For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8 (DN15 to DN200).
6. Adjustable Band Hangers (MSS TYPE 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8 (DN15 to DN200).
7. Adjustable Swivel-Ring Band Hangers (MSS TYPE 10) with jam nuts: For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2 (DN15 to DN50).
8. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS TYPE 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8 (DN10 to DN200).
9. Pipe Saddle Supports (MSS TYPE 36): For support of pipes, NPS 4 to NPS 36 (DN100 to DN900), with steel pipe base stanchion support and cast-iron floor flange.
10. Pipe Stanchion Saddles (MSS TYPE 37): For support of pipes, NPS 4 to NPS 36 (DN100 to DN900), with steel pipe base stanchion support and cast-iron floor flange and with U-bolt to retain pipe.
11. Adjustable Pipe Saddle Supports (MSS TYPE 38): For stanchion-type support for pipes, NPS 2-1/2 to

NPS 36 (DN65 to DN900), if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.

12. Single Pipe Rolls (MSS TYPE 41): For suspension of pipes, NPS 8 to NPS 30 (DN200 to DN750), from two rods if longitudinal movement caused by expansion and contraction might occur.
13. Adjustable Roller Hangers (MSS TYPE 43) with jam nuts: For suspension of pipes, NPS 2-1/2 to NPS 6 (DN65 to DN150), from single rod if horizontal movement caused by expansion and contraction might occur.
14. Complete Pipe Rolls (MSS TYPE 44): For support of pipes, NPS 2 to NPS 42 (DN50 to DN1050), if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
15. Pipe Roll and Plate Units (MSS TYPE 45): For support of pipes, NPS 2 to NPS 24 (DN50 to DN600), if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
16. Adjustable Pipe Roll and Base Units (MSS TYPE 46): For support of pipes, NPS 2 to NPS 30 (DN50 to DN750), if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

L. Vertical-Piping Attachments, supply and install the following types of attachment materials unless otherwise indicated.

1. Extension Pipe or Riser Clamps (MSS TYPE 8): For support of pipe risers, NPS 3/4 to NPS 20 (DN20 to DN500).
2. Carbon- or Alloy-Steel Riser Clamps (MSS TYPE 42): For support of pipe risers, NPS 3/4 to NPS 20 (DN20 to DN500), if longer ends are required for riser clamps.

M. Hanger-Rod Attachments, supply and install the following types of attachment materials unless otherwise indicated.

1. Steel Turnbuckles (MSS TYPE 13): For adjustment up to 6 inches (150 mm) for heavy loads.
2. Steel Clevises (MSS TYPE 14): For 120 to 450 deg F (49 to 232 deg C) piping installations.
3. Malleable-Iron Sockets (MSS TYPE 16): For attaching hanger rods to various types of building attachments.
4. Steel Weldless Eye Nuts (MSS TYPE 17): For 120 to 450 deg F (49 to 232 deg C) piping installations.

N. Building Attachments, supply and install the following types of attachment materials unless otherwise indicated.

1. Steel or Malleable Concrete Inserts (MSS TYPE 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Side-Beam or Channel Clamps (MSS TYPE 20) for pipes up to NPS 2 (DN50): For attaching to bottom flange of beams, channels, or angles.
3. Center-Beam Clamps (MSS TYPE 21): For attaching to center of bottom flange of beams.
4. Top-Beam Clamps (MSS TYPE 25) for pipes up to NPS 2 (DN50): For top of beams if hanger rod is required tangent to flange edge.
5. Side-Beam Clamps (MSS TYPE 27) with jam nuts and for pipes up to NPS 2 (DN100): For bottom of steel I-beams.
6. Steel-Beam Clamps with Eye Nuts (MSS TYPE 28): For attaching to bottom of steel I-beams for heavy loads.

7. Linked-Steel Clamps with Eye Nuts (MSS TYPE 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
8. Malleable Beam Clamps with Extension Pieces (MSS TYPE 30): For attaching to structural steel.
9. 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 (340 kg).
    b. Medium (MSS TYPE 32): 1500 lb (675 kg).
    c. Heavy (MSS TYPE 33): 3000 lb (1350 kg).

O. Saddles and Shields, supply and install the following materials unless otherwise indicated.

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 by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe, 360-degree insert of high-density, 100-psi (690-kPa) minimum compressive-strength, water-repellent-treated calcium silicate or cellular-glass pipe insulation, same thickness as adjoining insulation with vapor barrier and encased in 360-degree sheet metal shield.
4. Piping shields shall be welded to clevis hangers or secured with locking tabs only.

P. Spring Hangers and Supports, supply and install the following materials unless otherwise indicated.

1. Restraint-Control Devices (MSS TYPE 47): Where indicated to control piping movement.
2. Spring Cushions (MSS TYPE 48): For light loads if vertical movement does not exceed 1-1/4 inches (32 mm).
3. Spring-Cushion Roll Hangers (MSS TYPE 49): For equipping Type 41 roll hanger with springs.
4. Spring Sway Braces (MSS TYPE 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS TYPE 51): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS TYPE 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS TYPE 53): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
    a. Horizontal (MSS TYPE 54): Mounted horizontally.
    b. Vertical (MSS TYPE 55): Mounted vertically.

Q. Supplementary Steel

1. Where it is necessary to frame structural members between existing members or where structural members are used in lieu of commercially rated supports, install such supplementary steel per the American Institute of Steel Construction Specification for the Design, Fabrication and Erection of Structural Steel for Buildings. Connections to existing steel shall be clamps unless otherwise approved by

the Architect-Engineer.

2. Where these members are weather exposed, provide hot dip galvanized after fabrication (HDGAF) construction.

FIELD QUALITY CONTROL

A. General

1. Refer to Division 15 Section "Basic Mechanical Material and Methods." for additional requirements.
2. *Cleaning, Flushing, and Disinfection Procedures [B,D,P];* Provide submittals describing in detail, all cleaning, flushing, and disinfection procedures that are to be performed for this project.
3. During installation of piping systems, notify the authorities having jurisdiction, with at least 24 hours notice, before inspections must be made. Perform tests and work specified below as required in the presence of the authorities having jurisdiction, the Owner's Representative, and the Owner. Document results of inspections.
    a. Rough-In Inspection: Arrange for inspection of piping before concealing after rough-ins are complete.
    b. Final Inspection: Arrange for final inspection by authorities having jurisdiction to ensure compliance with requirements.
    c. If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and schedule reinspection with the authorities having jurisdiction.
    d. Prepare inspection reports and have them signed by authorities having jurisdiction, provide copies to the Architect-Engineer, and the Owner.

B. Cleaning, Finishing, And Protection

1. Clean interior of piping system to remove dirt and debris as work is proceeding.
2. Protect drains, and other points where dirt can enter the underground piping systems, during the construction period to avoid clogging with dirt and debris and to prevent damage from traffic and other construction activities.
3. Exposed PVC Piping - Protect plumbing vents and piping exposed to sunlight or other sources of heat. Piping surface temperatures in excess of 140 deg. F are unacceptable, and shall result in the replacement of damaged piping materials by the installing contractor.
4. Upon completion of work for each system, clean and protect work. Just prior to final acceptance, perform additional cleaning as necessary to provide clean equipment and areas to the OWNER.

C. Flushing Work

1. GENERAL
    a. Provide temporary and permanent piping, equipment and materials required for flushing work. Coordinate cleaning of connections to existing systems with Architect-Engineer.
    b. If equipment and piping systems are not properly cleaned and flushed, pay for resultant damage, necessary cleaning and flushing of systems to which connection was made and subsequent inspection, at no increase in Contract Sum.
    c. Flush and drain dead ends.
    d. Submit for approval proposed means of disposal of flushing water.
    e. Flush and clean oil system as specified.
2. WATER SYSTEMS FLUSHING

a. Flush aboveground potable water, cooling water, chilled water, heating hot water, condenser water systems after successful hydrostatic and leak testing and cleaning operations per the following procedure:

1) Open valves and pipe plugs at all system levels.

2) Clean system storage vessels, return tanks, compression tanks, expansion tanks, sumps and basins.

3) Protect pumping equipment from damage by installation of bypass piping or temporary strainers and screens.

4) Install temporary flushing filters or strainers.

5) Remove or disconnect system items, which may be damaged during flushing operations.

6) Open and close valves during flushing to remove debris from valve bodies and seats.

7) Drain system, disassemble, inspect, clean, repair and reassemble critical sectionalizing valves, especially gate valves, control valves, expansion provisions and permanent and temporary strainers.

8) Drain open and inspect, clean, repair and reassemble system storage vessels, return tanks, compression tanks, expansion tanks, water heaters, pumps, sumps and basins as required to insure cleanliness of the entire system.

9) Adjust control valves.

b. Close-up system for disinfePerform work per NFPA 327 “Cleaning Small Tanks and Containers” and NFPA 30 “Flammable Liquids Code”, except as modified and supplemented by the Contract Documents.

c. Perform flushing by utilizing the same liquid used when the system is operating. Flush after structural integrity tests have been performed.

d. Take necessary fire protection precautions, including electrical grounding of static charges. Submit operation procedures for review by the Owner not less than 10 working days in advance of the Work.

e. Maximum particle size remaining in system after flushing shall not exceed manufacturer’s written recommendations or 50 microns, whichever is smaller. Provide necessary filters to accomplish this limitation.

f. Provide temporary piping and pumps if necessary to circulate liquids for not less than 4 hours through system parts, except pre-cleaned portions.

g. Clean cleanable filters or strainers. Replace non-cleanable filters.

h. Remove flushing liquid from the site immediately upon withdrawal from system. Submit for approval proposed means of disposal of flushing liquid.

1) ction (where required) of specified service.

2) Inspect and repair as required all permanent equipment used for flushing operations.

3) Remove temporary strainers after systems have been placed into normal operation for not less than 2 weeks.

D. Disinfection of Potable Water Systems

1. GENERAL

a. Use purging and disinfecting procedures prescribed by the authorities having jurisdiction. If a method is not prescribed by the local authorities having jurisdiction, utilize the procedure described in either AWWA C651 or AWWA C652, or as described below.

b. Under direction of Owner's Water Treatment Laboratory, disinfect potable water systems and extension from existing systems connection with an approved chlorine solution as specified, prior to system acceptance in accordance with applicable codes. Apply chlorinated solution at the point of line origin nearest to existing chlorinated supply.

2. MATERIALS

a. Chlorine solution encompasses not less than 50 parts per million (PPM) of available chlorine material composed of chlorine gas, calcium hypochlorite or commercial laundry bleach with minimum 5.25% available chlorine. Calcium hypochlorite. "HTH"; "Perchloron"; "Pittchlor"; Laundry bleach. "Clorox"; "Roman Cleanser".

MATERIAL REQUIRED FOR 1000 GALLONS OF SOLUTION			
SOLUTION STRENGTH	25 PPM	50 PPM	100 PPM
CALCIUM HYPOCHLORITE (LBS)	0.3	0.6	1.2
LAUNDRY BLEACH (GALLONS)	0.5	1.0	2.0

3. PROCEDURES

a. Line being disinfected shall stand for a minimum of 24 hours. Disinfecting solution shall produce no less than 10 PPM chlorine residual at extreme end of line at the end of the retention period. After 24 hours flush out the disinfecting solution until the combined available chlorine residual is less than 1 PPM. Maintain flushing velocity at 6 FPS, unless higher velocities were achieved in previous flushing and unless otherwise approved.

b. Bacteriological count shall be made by the Department of Public Health; if count is within United States Public Health Service Recommendations and local code requirements, the system may be put into service. Repeat the disinfection process until specified results are obtained.

c. Thoroughly disinfect pipe, valves, cocks, fittings hoses, containers and miscellaneous items used for connection of new piping to an existing facility, immediately prior to installation. Clean and disinfect materials involved with a solution containing not less than 2000 PPM available chlorine and flushed with potable, i.e., disinfected water. A 2000 PPM chlorine solution may be obtained by mixing 1 gallon of commercial laundry bleach per 25 gallons of water. Preclude contamination of disinfected materials prior to installation.

E. Cleaning Of Steam And Condensate Systems

1. Provide temporary vent piping to atmosphere, and protect architectural surfaces.
2. Ensure that all water from Hydrostatic testing of piping systems have been properly drained from the system. Verify all low points and traps.
3. Support and bracing to restrain reactive forces.

4. Protect or disconnect system components which may sustain damage as a result of purging.
5. Close isolating valves.
6. Safety precautions and procedures shall be followed. Evacuate personnel not directly involved in purging.
7. Slowly open steam supply warm-up valve to slowly warm steam lines using live steam.
8. Once lines are up to heat, slowly open main steam supply valve to purge steam lines using live steam.
9. After purging steam lines, open steam trap bypass valves to purge condensate lines to waste. Provide sufficient cooling water at drains to prevent discharge exceeding 135 degF into drainage system.
10. After completion of purging, replace removed components, disassemble and clean strainers and place system in normal service.

F. Steam Blow

1. Drawings indicate temporary and permanent provisions for steam blow piping cleaning which shall be supplemented by the Contractor as required to accomplish the Work.

G. Steam And Condensate Line Purging

1. Preliminary purging/lancing shall be done with high velocity/high pressure dry compressed air.
2. High pressure (to 30,000 psi), low volume, high velocity water may be used for purging.
3. Final purging shall be done with facility steam when it becomes available, or at the Contractor's option, by use of rental, semi-trailer mounted, self-contained, high pressure boiler with capacity to generate velocities in excess of (6,000) feet per minute.
4. Flash rust and idle-time corrosion shall be prevented/controlled in acceptable manner.
5. Cleanliness shall be indicated by condition of blow-off dirt indicating target/catch surface. Submit proposed target construction details.
6. Provide temporary and permanent vent/blow-off piping to atmosphere, including, anchor/support and bracing to restrain reactive forces and protect or disconnect systems components which may sustain damage during or as a result of purging/blow-off. Contractor shall include the cost of removing and replacing architectural finishes/siding, and protecting and washing building surfaces to eliminate iron oxide dirt/stain. Use large polyethylene sheets where necessary.
7. Safety precautions shall be operational. Evacuate personnel not directly involved in purging from area of the Work.
8. Open steam trap bypass valves, to purge "condensate" lines to waste. Provide sufficient cooling water at drain to prevent temperature exceeding 135 degF at drainage system. Run condensate to waste until approved by the water treatment laboratory as free of oil, iron oxide and deleterious substances and suitable for return to boiler.
9. After completion of purging, replace removed components, disassemble and clean strainers and any debris exposed valves and place system in safe mode, ready for next phase of Work.
10. When steam system is operational, flush all condensate returns to waste with cooling to limit temperature in sewer as indicated on the Drawings. Continue to purge as condensate is received from new piping in distribution system coming on line for first time, until condensate is deemed by the water treatment laboratory as fit quality for entry into boiler.

H. Piping Systems Testing

1. GENERAL

a. Perform initial service leak test per applicable requirements of ANSI/ASME B 31.1 Code for Power Piping on all piping systems.

b. Prior to acceptance of the WORK, pressure test piping systems, including connections to any existing systems, in the presence of the ARCHITECT-ENGINEER, Owners Representative, and the Authorities having jurisdiction per respective and applicable governing codes, and requirements of this section. Conduct tests prior to concealing any pipe or insulating pipe joints..

c. Test piping systems per their respective and applicable governing codes and the requirements specified. Hydrostatic testing of pressure pipe systems shall be at 1-1/2 times maximum operating pressure, and pneumatic testing shall be at 1.25 times maximum operating pressure, except as otherwise specified. Do not test plastic piping systems pneumatically.

d. Provide all necessary equipment and materials and make all necessary test connections required to properly execute tests. Make tests before piping surfaces are concealed.

e. For Hydrostatic and pneumatic testing, install 4” x 8” valve tags for each valve located within a test circuit, identifying the pressure test circuit number and correct valve position for testing purposes.

f. Water for test purposes will be furnished by the Owner. Obtain water from point(s) designated by the Architect-Engineer. Remove promptly temporary connections upon completion of testing or when directed by the Architect-Engineer.

g. Pneumatic tests shall only be performed utilizing dry, oil-free compressed air, carbon dioxide or nitrogen gas unless otherwise specified or approved. Use nitrogen for final test/purge where flammables/combustibles occur and where specified.

h. Do not perform pneumatic testing until all personnel not directly involved in performing and witnessing the testing have been evacuated from the area. Pneumatic testing shall require preliminary testing at a pressure not exceeding 5 PSI.

i. Preliminary pneumatic testing at 5 PSI requires swabbing joints with a commercial leak detector solution and subsequent observation for bubbles. In the event that testing demonstrates that leakage rate exceeds specified limits, determine the source(s) of leakage, repair or replace

defective materials and workmanship, and retest the installation to specified requirements. Test during steady state ambient temperature conditions. Non-metallic systems testing shall be per manufacturer's recommendations and requirements specified. Immediately repair detected leaks or defects in the system.

j. Other than standard piping flanges, plugs, caps and valves, use only commercially manufactured expandable elastomer plugs for sealing off piping for test purposes. The safe test pressure rating of plug used shall be not less than two times the actual test pressure being applied. Expandable elastomer plugs shall not be used for piping which could develop sufficient reactive force to cause damage to a structure, other piping or cause moving of thrust or anchor provisions in case of blow-out.

k. If required due to weather conditions, take the necessary precautions required to prevent freezing of water used for testing. Include information in the written test procedure submitted for approval, regarding these proposed provisions.

l. Take precautions to vent the expansive force of compressed air trapped during high pressure hydrostatic testing to preclude injury and damage.

m. Check system components such as valves for functional operation under system test pressure.

n. Do not add test media to a system during the systems hold test for the period as specified.

o. Components shall be removed from piping systems during testing whenever the component may sustain damage due to test pressure or test media. After completion of the test, the component shall be reinstalled and a test shall be reapplied at the component pressure rating.

p. System components such as valves shall be checked for functional operation under system test pressure. If the hydrostatic test pressure exceeds the component manufacturers rating, the termination block valves shall remain open during the test and the system shall be blocked by other means.

q. Existing steam and hot water piping connected to piping to be tested shall be shut off, drained and cooled before testing.

r. Provide calibrated chart recorders for documentation of the pressure testing process, and verification of failed and successful test completion. The test chart recordings shall include the system pressurization period, the "Hold Test" period, and system depressurization. Contractor pressure testing team leader shall sign each recording, and list the name of the system tested, identification of physical test circuit limits, system operating pressure, maximum test pressure, and date of test. Copies of all successful and failed test recordings shall be included within test records provided to the Owner and Engineer.

s. Remake leaking gasket joints with new gaskets and new flange bolting and destroy old bolting. Where welded, grooved or threaded joints fail, submit proposed method of repair for approval by the ARCHITECT-ENGINEER. Testing shall take place during steady state ambient temperature conditions.

t. The connection between new piping and existing piping shall be separately tested. Pressure specified in governing code shall be maintained on the joint for not less than 30 minutes or the time it takes to examine all system joints, whichever is longer.

u. In the event testing demonstrates leakage rates in excess of specified limits, determine source(s) of leakage, repair or replace defective workmanship and materials with new materials, and retest installation until compliance with specified requirements.

v. Upon completion of any test, promptly report test results in writing to the Owner, Owner's

Representative, Architect-Engineer and the Authorities having Jurisdiction.

w. Prepare and maintain all test records of piping systems tests. Records shall show Architect-Engineer and Contractor personnel responsibilities, dates, test gage identification numbers, ambient temperature, pressure ranges, rates of pressure drop and leakage rates. Two record copies of acceptance tests shall be delivered to the Architect-Engineer after acceptance.

2. POTABLE WATER SUPPLY MAINS

a. Test backflow prevention at connections between potable water and nonpotable water for proper functioning under conditions normal to application. Test shall be by Certified Tester.

3. GRAVITY DRAINAGE PIPING SYSTEMS TESTING

a. Prior to acceptance of the work, test completed systems in the presence of the Owner, Owner's Representative, the Architect-Engineer and Authorities having Jurisdiction.

b. Test drainage piping systems per their respective and applicable governing codes and the requirements specified in this Section. Provide necessary equipment and materials and make necessary test connections required to properly execute tests.

c. Irrespective of any regulation to the contrary, test drainage and waste piping hydraulically by filling system to its highest point or at a static head of 10 feet, whichever is greater. Leakage at any joint shall be sufficient cause for rejection and renewal of joint unless joint can be calked as specified or taken up sufficiently to stop leakage.

d. Leave uncovered and unconcealed all new, altered, extended, or replaced drainage and vent piping until it has been tested and accepted.

e. Roughing-In Plumbing Test Procedure: Test drainage and vent piping on completion of roughing-in. Close openings in piping system and fill to the highest point with water to overflowing, but not less than 10 feet of head (30 kPa). Water level must not drop from the period before inspection starts through completion of inspection. Inspect all joints for leaks.

f. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug each vent-stack opening on roofs and building drains where they leave the building. Introduce air into the piping system equal to a pressure of 1-inch wg (250 Pa). Use a manometer inserted in the trap of a water closet on the system under test to measure this pressure. Air pressure must remain constant without introducing additional air for the period of inspection. Inspect plumbing fixture connections for gas and water leaks.

g. Air tests may be substituted (with Owner's Approval) in lieu of hydraulic tests by forcing air into the closed system at a uniform pressure sufficient to balance a column of 10" HG in height or a pressure of 5 PSI.

h. Repair leaks and defects using new materials and retest piping or portion thereof until acceptance.

i. Leaks and or loss in water level or test pressure, shall constitute a failed test.

j. Prepare reports for tests and required corrective action, including inspection sign-off reports by A/E or Owner's Representative witnessing the test(s).

4. ACCEPTANCE PRESSURE TESTING

a. Perform acceptance pressure testing as follows:

	Nominal Operating			Purging Read	Permissible Press. Drop & Hold

Service	Operating Press. (PSI)	Test Type, and Test Medium	Full Test Press (PSI)	Reqd. After Test (*)	Drop & Hold Period (PSI/Hours)
City Water		Hydro			2/2
Condensate, Gravity		Hydro			2/2
Potable Water		Hydro			2/2
Steam/Condensate		Hydro		Yes	2/2

b. * See "Post Pressure Test, Compressed Air Purging" below.

c. "Permissible Pressure Drop" column in table above shall refer to loss of standing water column level for 10'-0 water column hydrostatic testing.

d. Test unlisted systems in accordance with applicable code.

e. Prepare steam and condensate piping according to ASME B31.9.

5. *Hydrostatic Pressure Testing of Piping Systems [B,D,L,R]:*

a. Provide written test procedures for Hydrostatic tests, for Owners, and Architect-Engineer review. Review and approval shall be obtained prior to the start of any testing. The written procedure shall, at a minimum, contain the following items:

1) Fully describe the test circuit or system to be tested. Provide a colored piping drawing outlining the piping that will be tested in each circuit.

2) Identify preliminary testing and full test pressures for each piping test loop shown on the pressure test circuit drawings listed above.

3) Identify all valve locations and positions (opened or closed) for test purposes.

4) Examine systems and identify any in-line devices or equipment that must be isolated or removed from the circuit during the test due to over-pressurization concerns.

5) Describe the pressure test injection manifold location, configuration, and components including chart recorder location and connection.

6) Identify the test medium to be used.

7) Identify required safety precautions that will be utilized for personnel and equipment protection.

8) Describe the pre-test filling procedures including the identification of all venting locations and methods.

9) Define the methods of joint inspection that will be used

10) Describe the procedure for post test system depressurization and draining including locations.

11) Describe post test system blow-down (purging) with compressed air to remove moisture in specified systems (see Pressure Testing Schedule).

b. Leave joints, including welds, un-insulated and exposed for inspection during the system hydrostatic pressure test.

c. Isolate all equipment that shall not be subjected to test pressures. If a valve is to be used to isolate equipment, the valve shall be capable of sealing against test pressure without damage to valve or equipment, otherwise properly sized blinds shall be installed to isolate equipment. Flanged joints where blinds are inserted to isolate equipment shall be service tested.

d. Provide temporary restraints for expansion. If temporary restraints are impractical, isolate expansion joints from testing.

e. Install a properly sized relief valve set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test. Safety valves shall be capable of relieving the overpressure at a higher rate than is the injection manifold capable of pressurizing the system.

f. Use ambient temperature water as testing medium, except where there is risk of damage due to

freezing. Another liquid may be used if it is safe for workers and compatible with piping system components.

g. Use taps installed at the high points of system to release trapped air while filling system. Use drip legs installed at system low points for complete removal of liquid. Install additional high point vents and low point drains as required to facilitate testing, drainage, and flushing.

h. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the design pressure, or 150 psig which ever is higher. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test.

i. Check to verify that stress due to pressure at the bottom of vertical runs does not exceed either 90% of specified minimum yield strength or 1.7 times "SE" value in Appendix A of ASME B31.9, Code for Pressure Piping, "Building Services Piping."

j. After hydrostatic test pressure has been applied for a minimum of 10 minutes, remove the pressure injection source from the system, examine all piping, joints, and connections for leakage. Eliminate all leaks by tightening, repairing, or replacing components as appropriate **only after all test pressure has been released from the system.** Once leaks are repaired, and systems have been restored to test conditions, repeat hydrostatic test until there are no leaks.

k. Prepare a written report of testing noting all locations where repairs were made, and provide copies to the Owner, Owners Representative, the Architect-Engineer, and Authorities having Jurisdiction.

6. Pneumatic Pressure Testing of Piping Systems [B,D,L,R]:

a. Provide written test procedures for Pneumatic tests for the Owners, and Architect-Engineer review. Review and approval shall be obtained prior to the start of any testing. The written procedure shall, at a minimum, contain the following items:

1) Fully describe the test circuit or system to be tested. Provide a colored piping drawing outlining the piping that will be tested in each circuit.

2) Identify preliminary testing and full test pressures for each piping test loop shown on the pressure test circuit drawings listed above.

3) Identify all valve locations and positions (opened or closed) for test purposes.

4) Examine systems and identify any in-line devices or equipment that must be isolated or removed from the circuit during the test due to over-pressurization concerns.

5) Describe the pressure test injection manifold location, configuration, and components including chart recorder location and connection.

6) Identify the test medium to be used.

7) Identify required safety precautions and devices that will be utilized for personnel and equipment protection, and system over pressurization protection.

8) unauthorized personnel. Only Owner and Contractor personnel directly involved with performance of the pressure testing shall be permitted within the test area.

9) Describe in detail the test filling procedures.

10) Define the methods of joint inspection that will be used

11) Describe the procedure for post test system depressurization, including vent locations, and protection of personnel and equipment from flying particles.

b. Leave joints, including welds, un-insulated and exposed for inspection during the system pressure

testing.

c. Isolate all equipment that shall not be subjected to test pressures. If a valve is to be used to isolate equipment, the valve shall be capable of sealing against test pressure without damage to valve or equipment, otherwise properly sized blinds shall be installed to isolate equipment. Flanged joints where blinds are inserted to isolate equipment shall be service tested after completion of the system test.

d. Provide temporary restraints for expansion. If temporary restraints are impractical, isolate expansion joints from the test circuit and service test at a later date, prior to operation.

e. Install a properly sized relief valve set at a pressure no more than one-third higher than test pressure, to protect against damage to the piping and equipment. Safety valves shall be capable of relieving the overpressure at a higher rate than is the injection manifold capable of pressurizing the system.

f. Use an ambient temperature testing medium.

g. Perform preliminary pneumatic testing at 5 PSI, swabbing each and every system joint, flange, valve bonnet/stem/body joints, welded support locations, in-line devices, etc. with a commercial leak detector solution, and observe joint for bubbles. In the event that preliminary testing demonstrates there are any leaks, determine the source(s) of leakage, repair or replace defective materials and workmanship, and retest the installation at 5 PSI re-swabbing all system joints. If no further leaks are found after repairs and re-examination, the test sequence may proceed.

h. Subject piping system to test pressures that is not less than 1.25 times the design pressure, or 150 psig which ever is higher. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test.

i. Once 70 percent of the maximum test pressure is reached, install an orifice at the pressure injection manifold that will prevent accidental, rapid over pressurization of the system during the remainder of the pressure injection sequence.

j. Check and verify that stress due to pressure at the bottom of vertical runs does not exceed either 90% of specified minimum yield strength or 1.7 times "SE" value in Appendix A of ASME B31.9, Code for Pressure Piping, "Building Services Piping."

k. After the maximum test pressure has been applied and held steady for a minimum of 10 minutes, remove the pressure injection source from the system, then examine all piping, joints, valve stems/packing/body joints, in-line devices, welded support members, and connections for leakage by swabbing each and every joint. Eliminate all leaks by tightening, repairing, or replacing components as appropriate **only after all test pressure has been released from the system!** Once leaks are repaired, and systems have been restored to test conditions, repeat the test, until there are no leaks.

l. Test shall only be considered successful if no leaks are found during the required soap testing of all joints, and the full test pressure has been maintained for a minimum of 20 minutes after removal of the pressure injection source.

m. Prepare a written report of testing noting all locations where repairs were made, and provide copies to the Owner, Owners Representative, the Architect-Engineer, and Authorities having Jurisdiction.

7. Post Pressure Test, Compressed Air Purging (Table Ref. *)

a. Unless otherwise indicated, purge piping by blowing out pipe with clean, dry, oil free compressed air through all piping, dirt pockets, and open ends of piping until all air shows no evidence of contamination.

b. Install the necessary piping, supports and anchors to divert the free discharge of air during purging, to eliminate any danger to personnel or equipment.

c. Utilize targets installed to blow against, where necessary, in order to prevent injury to personnel caused by the discharge of contaminants from the piping system during the purging process.

d. Test blow-down locations for cleanliness by blowing through a 100 micron filter until air shows no evidence of contamination or free water.

e. Where connected to existing piping, purge existing piping adjacent to point of connection, up to and including the nearest shutoff valve.

f. Do not discharge piping being purged into confined spaces unless adequate ventilation has been provided and is operational.

g. After acceptance of the blow down (purging), return all system components to their normal operating condition, reconnect system components removed or opened, replace caps on drain legs, close all vent/drain valves, remove test valve tags, etc.

I. FINAL INSPECTIONS

1. Perform the following final inspections before start-up, and provide a written report to the Owner, Owners Representative, and the Architect-Engineer verifying that all pre start-up testing and inspections have been completed, describe in detail any corrective measures that were required, and indicate that the system is now ready for start-up.

a. Remove burrs, dirt, and construction debris from the exterior of piping and equipment, and repair damaged finishes including chips, scratches, and abrasions.

b. Use Ameron “EZ” zinc-rich coating for touch-up of the damaged galvanized finish on the exterior of piping.

c. Verify that the specified testing of all the piping systems has been completed.

d. Verify that potable-water supply connections to equipment have correct type backflow preventer in water supply upstream of equipment/process connections.

e. Verify connection and operation of the cooling water supply to water-cooled equipment.

f. Check for piping connection leaks and repair as required.

g. Verify that the proper type and amounts of lubricating oils and greases have been installed in lubricated-type equipment.

h. Verify that all V belts have been installed with the proper tension.

i. Verify that compressor and pump inlet filters/strainers and piping are unobstructed and free flowing.

j. Verify that all pressure and temperature gauges have been installed properly, and contain the proper gauge scales for the system. (Pressure gauges are to be supplied with a maximum scale reading that is twice the normal system operating pressure,)

k. Verify that equipment vibration-control supports and flexible pipe connectors have been installed and adjusted properly.

l. Verify that all safety valves have been installed correctly and have been set to the correct discharge settings. Ensure settings are greater than system pressures, but are not greater than the rating of any system components.

m. Verify that the capacities and pressure ratings of all gas meters, regulators, valves, and specialties are correct.

n. Verify that all pressure regulators have the correct pressure settings for their inlets and outlets.

o. Verify proper seismic restraints have been installed.

p. Test the operation of equipment safety controls and devices.

q. Drain receiver tanks.

r. Verify rooms are adequately ventilated

2. General Piping System Start-up Procedures: Follow the manufacturer's written instructions for all system components, and the following description.

a. Energize circuits.

b. Calibrate automatic fill valves for required system pressure, and levels.

c. Verify that all air vents at high points of the system are installed and operating freely, both automatic and manual type vents.

d. Start and run equipment through complete sequence of operations.

e. Check for excessive system vibration and noise. Correct problems.

f. Check all piping supports, hangers, and insulation shields. Make all adjustments required to properly support piping, and locate insulation shields to properly protect insulation from damage or displacement of the shields due to pipe expansion and contraction.

g. Perform systems balancing as required per Division 15 Section “Testing and Balancing”

h. Check system pressures and verify that they are set per design and operational requirements.

i. For liquid systems other than Potable Water, provide a water analysis prepared by chemical treatment supplier to determine the type and level of chemical treatment required to prevent scale and corrosion within the systems. Perform initial treatment after completing system testing.

j. Manually operate safety valves.

k. Adjust operating controls, including pressure settings, and verify the operation of automatic bypass valves.

l. Set temperature controls so all cooling and heating coils are calling for full flow.

m. Verify and calibrate the operating temperatures of boilers, water heaters, chillers, and cooling towers based on design requirements.

n. Operate and adjust all system safety devices and controls.

o. Replace damaged and malfunctioning devices, controls, materials, or equipment that is discovered.

15110 - VALVES

15110.1 GENERAL

SUMMARY

A. Section Includes:

1. Provide valves with materials of construction and methods of fabrication, assembly, erection, testing and interim operation in compliance with the requirements specified herein and requirements of applicable codes and authorities having jurisdiction.

B. Description Of Systems:

1. Refer to Division 15 Section “Aboveground Piping Systems” for description of systems and associated valves.

C. Related Work Specified In Other Sections:

1. Division 15 - Basic Mechanical Materials and Methods
2. Division 15 - Aboveground Piping Systems
3. Division 13 - Instrumentation and Control Work
4. Division 16 - Electrical Work

QUALITY ASSURANCE

A. Refer to Division 15 Section “Basic Mechanical Materials and Methods.” for applicable requirements.

SUBMITTALS

A. Refer to Division 15 Section “Basic Mechanical Materials and Methods.” for applicable requirements.

B. Furnish submittals for items that are identified in this Section by a different typeface and a bracketed code (e.g., *Item [L]*). Refer to Division 1 General Requirements Section “Submittal Codes” for definitions of codes regarding types of submittals and the administrative requirements governing submittal procedure. Additional submittal requirements pertaining to this Section are specified herein under this Article.

C. Shop drawings submittals shall bear the Contract Documents identifying project name and number, and shall be sequentially item numbered.

D. Include valve design/body materials and equipment classification and identification, component pressure/temperature ratings, end connection details, seating materials, trim material and arrangements, actuator details with locking mechanisms, dimensions and required clearances, piping and equipment supports and restraints, special installation requirements, catalogue data, list indicating valves and applications, maintenance data and other data necessary to verify compliance with Contract Documents.

OPERATING AND MAINTENANCE PERSONNEL TRAINING

A. Refer to Division 15 Section “Basic Mechanical Materials and Methods.” for applicable requirements.

PROJECT CONDITIONS

A. Refer to Division 15 Section “Basic Mechanical Materials and Methods.” for applicable requirements.

GUARANTEE/WARRANTY

A. Refer to Division 15 Section “Basic Mechanical Materials and Methods.” for applicable requirements.

15110.2 PRODUCTS

VALVES: GENERAL REQUIREMENTS

A. Provide valves conforming to SDWA, ASME/ANSI/NSF, API, CGA, NFPA, UL, Owner's Underwriter's or MSS Standards, Class as applicable, to suit specified and indicated requirements, including applicable codes/standards, function, fluid materials compatibility and maximum pressure/temperature conditions to be potentially encountered.

B. Valved Drains: Line valves, in all fluids risers, shall have integral to body or line fitted, 1/2 inch ball valved drain on upper side of valve for valves 6 inch and larger and 1/2 inch ball valved drain for valves smaller than 6 inches. Where necessary to indicated function or to match line materials, provide cast steel or forged steel valves with integral tapped boss valved drains using Schedule 80 nipples. Ball valves shall be full port, system pressure/temperature and material rated.

C. Fit with chain operator (COP), manual valves sized 4 inch and larger, except dead-end location valves, in utility/equipment spaces and where indicated, which cannot be reached from operating level or position. Provide chain to within 4'-0" above operating level. Offset chains that fall in aisle-ways or over equipment to hang on hooks on nearest column or wall or otherwise secure for personnel safety. Provide operators as specified in other sections of these specifications.

D. Extension shafts: Provide, where indicated, extension shaft guided in not less than 2 places, to prevent damage to the valve stem, and leakages.

E. Asbestos packing and gasket material is NOT ALLOWED.

F. Where electrical continuity for electro-static charge dissipation is specified or required by applicable code, fit valves with anti-static grounding provisions to prevent static discharge between components.

H. Equip system valves with lockable handles or manual actuators for padlock application in compliance with OSHA, Owner's Lock-Out Standards and where specified or indicated.

I. Where a valve is used for balancing, fit valve operator with adjustable memory stop.

J. Provide valves where shown on the drawings and at all connections to equipment, for isolation, control, etc.

K. Valves shall be accessibly located and installed with ample clearance for operating wheels or wrenches and ease of padlocking. Valves shall have unrestricted openings equal to flow areas of the piping in which they are installed, unless otherwise specified or shown on the drawings.

L. Gate, ball and butterfly valves shall be generally used for normally closed or wide open service. Gate, ball and butterfly valves shall be lockable in the closed position by padlock. Globe and plug valves shall be generally used for throttling service, unless otherwise shown on drawings or specified herein.

M. Valves (with stuffing boxes) shall have liberally-sized stuffing boxes with packing glands, hexagon stuffing box nuts and well-proportioned semi-finished bodies. Stuffing boxes shall be packed with approved packing and made tight. Valves shall be constructed so that they may be packed under pressure. All packing and gasket materials shall be asbestos-free.

2.1 General Service Valves

A. General Requirements

1. See Article Valves: General Requirements.

B. Class 125, Threaded, Bronze Gate (GA-1), Globe (GL-1), Angle (AN-1) And Check (CK-1) Thru 2 Inches

1. Type 1 Series: Bronze body and trim, rising stem, union bonnet; minimum rating 125 PSI at 353 degF WSP, 200 PSI at 100 degF CWP.

2. Manufacturer:

	GA-1	**GL-1**	**AN-1**	**CK-1**
Crane		1	----	1707
Hammond	IB 617	IB 440	IB 463	IB 904
Milwaukee	1152	502	504	509
Powell	2700	650		578
Stockham	B-105	B-16	B-216	B-319

** Composition disc seat.*

*** Teflon disc seat.*

C. Class 125, Flanged, Iron Gate (GA-2), Globe (GL-2), Angle (AN-2), And Check (CK-2) 2-1/2 Inches And Larger

1. Type 2 Series: Cast iron body, bronze trim, rising stem, outside stem and yoke; minimum rating 125 PSI at 353 degF WSP, 200 PSI at 100 degF CWP.

2. Manufacturer:

	GA-2	**GL-2**	**AN-2**	**CK-2**
Crane	465-1/2	351	353	373
Hammond	IR 1140	IR 116		IR 1124
Milwaukee	F2885	F 2981		F 2974
Powell	1793	241		559
Stockham	G-623	G-512		G-931

D. Class 150, Threaded And Flanged, Bronze Gate (GA-3, 3A), Globe (GL-3,3A), Angle (AN-3,3A), And Check (CK-3,3A) Thru 3 Inches

1. Type 3, 3A Series: Bronze body and trim, rising stem, outside stem and yoke; horizontal swing; minimum rating 150 PSI at 366 degF WSP, 200 PSI at 100 degF CWP.

2. Manufacturer:

Threaded	**GA-3**	**GL-3**	**AN-3**	**CK-3**
Crane	431-UB	7TF***	17TF***	137**

Hammond	IB 629	IB 413T***	IB 454T***	IB 944
Milwaukee	1151	590**	595**	508
Powell	2714	150***	151***	560
Stockham	B-120	B-22T***	B-222T***	B-321
Flanged	**GA-3A**	**GL-3A**	**AN-3A**	**CK-3A**
Crane	429	----	----	----
Powell	1414G		----	
Stockham	----	B-40/49	----	B-342
* *Stainless steel disc and seat.* ** *Composition disc seat.* *** *Teflon Disc*				

E. Class 150, Flanged, Steel Gate (GA-3B), Globe (GL-3B), Angle (AN-3B) And Check (CK-3B) 2-1/2 Inches And Larger

1. Type 3B Series: Steel body, hard faced trim, rising stem, outside stem and yoke; flexible wedge on gate valves where available. Minimum rating 150 PSI at 366 degF WSP, 285 PSI at 100 degF CWP.
2. Manufacturer:

	GA-3B*	**GL-3B**	**AN-3B**	**CK-3B**
Crane	47-XU	143-XU		147-XU
MCC/Pacific	2150	163GB	173GB	184
Powell	1503N	1531	1533	1561A
Stockham	15-OFUS	15GPFUS	15APF	15SF-US
Velan	F0064C-02 TY	F0074C-02T Y		F0114C-02TY
* *GA-3BB. Same as GA-3B but with integral GL-8 bypass.*				

F. Class 150, Threaded, Socket Weld, And Flanged Stainless Steel Gate (GA-4, 4A, 4B), Globe (Gl-4, 4A, 4B), And Check (CK-4, 4A, 4B) Thru 2 Inches

1. Type 4, 4A, 4B Series: Minimum rating 150 PSI at 353 degF WSP, 275 PSI at 100 degF CWP. Type ASTM A351/A296 Grade CF8M stainless body with Type 316 stainless trim. Type CF8M or wrought 316 stainless disc. Rising stem, outside stem and yoke.
2. Manufacturer:

Threaded	**GA-4**	**GL-4**	**CK-4**
Crane (Aloyco)	122	310	370

Ladish	8273	7270	5270
Powell	2490	2474	2341
Socket Weld	**GA-4A**	**GL-4A**	**CK-4A**
Crane (Aloyco)	124	314	374
Ladish	8274	7271	5271
Powell	2490-SWE	2474-SWE	2341-SWE
Stockham	20-OSW-316	20-GPNSW-316	20-SS-W
Flanged	**GA-4B**	**GL-4B**	**CK-4B**
Crane (Aloyco)	127	317	377
Ladish	8275	7272	5272
Powell	2491	2475	2342
Stockham	15-02RF-316	15-GPRF-316	15-SBRF-316

G. Class 150, Flanged And Butt Weld, Stainless Steel Gate (GA-5, 5A), Globe (GL-5, 5A), And Check (CK-5, 5A) 2-1/2 Inches And Larger

1. Type 5, 5A Series: Minimum rating 150 PSI at 353 degF WSP, 275 PSI at 100 degF CWP. Type ASTM A351/A296 Grade CF8M stainless body with Type 316 stainless trim. Type 6F8M or wrought 316 stainless disc. Rising stem, outside stem and yoke.

2. Manufacturer:

Flanged	**GA-5**	**GL-5**	**CK-5**
Crane	61176-A	61376-G	61676-G
Powell	2456	2469	2342
Stockham	15-OZRF-316	15-GPRF-316	15-SBRF-316
Velan	F0064C-13SC	B0074-13SC	B0114C-13SC
Butt Weld	**GA-5A**	**GL-5A**	**CK-5A**
Crane	61174-A	61374-G	61674-G
Powell	2456-BWE	2475/2629-BWE	2342/2633-BWE
Velan	B0064C-13SX	B0074-13SX	B0114C-13SX

H. Class 300, Flanged, Steel Gate (GA-6), Globe (GL-6), Angle (AN-6) And Check (CK-6) Thru 2 Inches

1. Type 6 Series: Cast steel body and hard alloy trim; minimum rating 300 PSI at 800 degF WSP, 740 PSI at 100 degF CWP. Outside stem and yoke; flexible wedge on gate valves.
2. Manufacturer:

	GA-6	**GL-6**	**AN-6**	**CK-6**
Crane	33-XU	151-XU		159-XU
Powell	3003N	3031	3033	3061
Velan	F1064C-02TY	F1074C-02TY		F1114C-02TY

I. Class 300, Flanged, Steel Gate (GA-7), Globe (GL-7) Angle (AN-7), And Check (CK-7), 2-1/2 Inches And Larger

1. Type 7 Series: Cast steel body and hard alloy seat trim; minimum rating 300 PSI at 800 degF WSP, 740 PSI at 100 degF CWP. Outside stem and yoke; flexible wedge for gate valves.
2. Manufacturer:

	GA-7	**GL-7**	**AN-7**	**CK-7**
Crane	33-XU	151-XU		159-XU
Powell	3003N	3031	3033	3061
Stockham	30-OF-U	30-GPF-U	----	30-SF-U
Velan	F1064C-02TY	F1074C-02TY		F1114C-02TY

L. Type GL-12. Class 150 Flow Control, Bronze, Thru 2 Inches

1. Bronze threaded end globe body, silicon brass rising stem, hard alloy V-Port disc trim, micrometer dial and pointer; minimum rating 150 PSI at 406 degF WSP, 300 PSI at 100 degF CWP.
2. Manufacturer:
    a. Hancock product available from Yarway

2.2 Ball Valves

A. General Requirements

1. See Article Valves: General Requirements.

2. Valves shall be suitable for bi-directional service. Where specified and where required by applicable codes or authorities having jurisdiction, provide valves with: special cleaning; Firesafe construction per API 607; integral anti-static grounding per NFPA. Provide valve stem extension for valves which are insulated in Chilled Water Systems and where handle temperature could exceed OSHA 150 degF limits. Manual operators shall be safety oval type for valves thru 3 inches and enclosed gear handwheel type for valves 4 inches and larger, except where chain operators are additionally required. Submit samples of proposed safety oval handles and insulation stand-off handles. Thermoplastic valves 3 inches and smaller have solvent weld end connections to thermoplastic pipe, and minimum 1/8 inch steel ring reinforced flanged ends for larger sizes. Threaded thermoplastic valve end connections are permitted with Schedule 80 pipe only where demounting from pipe is normally required. Not all valve types listed below are used on this project.
3. Ball valve handles shall be equipped for padlock application in the closed position.

B. **Type BA-1**. Class 150, Threaded, 2-Piece All Bronze

1. Type BA-1: Minimum rating 150 PSI at 366 degF WSP, 600 PSI at 100 degF CWP; bronze 2-piece body and ball; reduced port; TFE seats and seals; brass or bronze trim; threaded end connections.
2. Manufacturer:

a. Smith (1/4 thru 2 inches) 0125-size.

b. PBV , Series 5324.

c. Apollo Valves 70-10X Standard Port (1/4 inch thru 4 inch)

d. Apollo Vales 77C-10X Full Port (1/4 inch thru 2 inch)

e. Milwaukee BA 100, (1/4" thru 3")

f. Hammond 85 Series (1/4" thru 3").

C. **Type BA-2.** Class 150, Threaded And Socket Joint, 3-Piece Bronze

1. Type BA-2: Minimum rating 150 PSI at 366 degF WSP, 300 PSI at 100 degF CWP; bronze 3-piece body and ball; full or reduced port as specified; 30 or 60 degree V-port where indicated; 3-way ported where indicated; TFE glass or Type 316 stainless reinforced seats, and TFE seals; bronze or Type 304 or 316 stainless trim; threaded and socket joint end connections, anti-static grounded for hydrocarbon systems and where specified.
2. Manufacturer:
    a. PBM "SP Series" (3/4 thru 4 inches)
    b. Worcester "Miser" 316 Type stainless ball; V-port source (1/4 thru 2 inches) Threaded. size-4-1-6-RT-SE (2-way) size-T-4-1-6-T-SE (3-way); Socket Joint. size 4-1-6-RT-TE.
    c. Apollo Valves. (1/4 inch thru 4 inch) Threaded 82-140 Series; Socket Joint 82-240 Series.
    d. Milwaukee BA 300/S, (1/4" thru 2").
    e. Hammond 86 Series (1/4" thru 2")

D. **Type BA-2A.** Class 150, Flanged, 3-Piece Bronze

1. Type BA-2A: Same as Type BA-2, except flanged ends and full port.
2. Manufacturer:
    a. PBM "SP Series," Full Port, (1 thru 4 inches). SP-B-size code-F-15-2.

E. **Type BA-2C.** Class 250, Threaded And Socket Joint, 3-Piece Bronze

1. Type BA-2C: Minimum rating 250 PSI at 405 degF WSP, 300 PSI at 100 degF CWP; bronze 3-piece body; full or reduced port; TFE glass or Type 316 stainless filled seats and TFE seals; Type 316 stainless ball and trim; threaded or socket joint end connections.
2. Manufacturer:
    a. PBM "SP Series", Full Port, (3/4 thru 4 inches) Threaded. SP-B-size code-S-2; Socket Joint. SS-B-size code-SJ-4.
    b. Worcester "Miser" (1/4 thru 2 inches) Threaded. size-4-1-6-PM-SE; Socket Joint. size-4-1-6-PM-TE.
    c. Apollo Valves - Threaded 82-14X (1/4 inch thru 4 inch); Solder Joint. 82-24X Series (3/8 inch thru 4 inch)
    d. Milwaukee/Hammond 30BSOF-02/03, (1/4" thru 2").

F. **Type BA-3.** Class 150, Threaded 2-Piece Ferrous

1. Type BA-3: Minimum rating 150 PSI at 366 degF WSP, 600 PSI at 100 degF CWP; ferrous 2-piece body;

reduced port; TFE seats and seals; Type 316 or 416 stainless ball and trim; threaded end connections.

2. Manufacturer:
    a. Neles/Jamesbury "Clincher Type 2000" (1/4 thru 2 inches). size-21-2236TT-0.
    b. Smith, (1/4 thru 2 inches). 0411T-size.
    c. Apollo Valves – 73A-14X Series (1/4 inch thru 2 inch)
    d. Milwaukee/Hammond 20CSOR-02/03, (1/4" thru 2").

G. **Type BA-4A.** Class 150, Threaded And Socket Weld, 3-Piece Body and Ball

1. Type BA-4A: Minimum rating 150 PSI at 366 degF WSP, 400 PSI at 100 degF CWP; ferrous 3-piece body and ball; full or reduced port; TFE glass or RPTFE filled seats and TFE seals; ferrous or Type 304 or 316 stainless trim; threaded and socket weld end connections.
2. Manufacturer:
    a. Neles/Jamesbury Series 3A and 3C (1/2 thru 2 inch) Threaded. size-3A 2236 MT3; Socket Weld. size-3C 2236 MT3.
    b. Pittsburg Brass "SP Series", Full Port (3/4 thru 4 inches) Threaded. SP-E-size code-S-2; Socket Weld. SP-E-size code-SW-2.
    c. Worcester "Miser" (1/4 thru 2 inches) Threaded. size-4-4-6-RT-SE; Socket Weld. size-4-4-6-RT-SW.
    d. Apollo Valves - Threaded 83R-10X or 83R-14X Series (1/4 thru 3 inch); Socket Weld 83R-20X or 83R-24X Series (1/2 thru 3 inch).
    e. Milwaukee/Hammond 30CCOF-02/03, (1/4" thru 2").

H. **Type BA-4C.** Class 150, Flanged, Ferrous

1. Type BA-4C: Minimum rating 150 PSI at 366 degF WSP, 275 PSI at 100 degF CWP; ferrous 1 or 2-piece body; full or reduced port; TFE glass or Type 316 stainless filled seats and TFE seals; Type 316 stainless ball and trim; flanged end connections.
2. Manufacturer:
    a. Neles/Jamesbury "Type 5150" (1/2 thru 4 inches). size-5150-31-22-36-MT; "Type 7150" (3 inch and larger) size-7150-31-2200 TT.
    b. PBM "AN Series", Full Port (1thru 6 inches). AN-E-size code-F-15-2.
    c. Worcester (1/2 thru 10 inches). size-51-4-6-R-T-150.
    d. Apollo Valves (1/2 thru 10 inches) 88A-140 Series.
    e. Milwaukee/Hammond F90C150-02/03, (1/2" thru 6").

I. **Type BA-4D.** Class 150, Flanged, Ferrous Body And Ball

1. Type BA-4D: Minimum rating 150 PSI at 366 degF WSP, 275 PSI at 100 degF CWP; ferrous 1 or 3-piece body and ball; reduced port; TFE glass filled or TFE seats and seals.
2. Manufacturer:
    a. Neles/Jamesbury "Type 5150" (1/2 thru 2 inches). size-5150-31-2200 TT; "Type 7150" (3 inch and larger) size-7150-31-2200 TT.
    b. Marpac Type ANSI 150 (1/2 thru 4 inches). size-4-CS-470-CS-T-T.
    c. Apollo Valves 88A-100 Series (1/2 thru 10 inch).

J. **Type BA-4E.** Class 300, Flanged, Ferrous

1. Type BA-4E: Minimum rating 300 PSI at 420 degF WSP, 740 PSI at 100 degF CWP; ferrous 1-piece body; reduced port; TFE glass filled seats and TFE seals; Type 316 stainless ball and trim; flanged end connections.
2. Manufacturer:
    a. Neles/Jamesbury * "Type 530S" (1/2 thru 2 inches). size-5305-31-2236 MT; "Type 7300" (3 inch and larger) size-7300-31-2236 MT (375 degF limit at 300 PSI).
    b. Worcester (1/2 thru 10 inches). size-52-4-6-P-T-300.
    c. Apollo Valves 88A-740 Series (1 1/2 thru 10 inches)

K. **Type BA-4FL.** Firesafe, Fusible Link, Threaded Socket Weld Butt Weld Or Flanged [L]:

1. Same as Type BA-4F, except fitted with FM Approved, spring-loaded operator which will automatically function to [**close**] [**open**] [**to limited position**] upon actuation of a thermal element, i.e. fusible link. Valve shall be manually operable by chain attached handle prior to and after thermal actuation. Operator shall be capable of providing break-away and end-torque to close next size larger valve under 1000 psig live pressure, but derated for FM Approved pressure size.
2. Manufacturer:
    a. Essex Fluid Controls (1/2 thru 2-inch) (125 PSI max)
    b. Neles/Jamesbury (1/2 thru 2 inch).
    c. PBM (1/2 thru 2 inch)

L. **Type BA-5.** Class 150, Threaded, 2-Piece Stainless Steel

1. Type BA-5: Minimum rating 150 PSI at 366 degF WSP, 600 PSI at 100 degF CWP; Type 316 stainless 2-piece body and ball; reduced port; TFE filled seats and TFE seals; Type 316 stainless trim; threaded end connections.
2. Manufacturer:
    a. Apollo Valves Series 76-100 (1/4 thru 3 inches)
    b. Neles/Jamesbury "Clincher Type 2000" (1/4 thru 2 inches). size-21-3600MT-1.

M. **Type BA-9.** CWP 150 PSI, Threaded, Socket Weld And Flanged, PVC Or CPVC

1. Type BA-9: Minimum rating 150 PSI at 73 degF CWP; Type 1, Grade 1 PVC or Type 4, Grade 1 CPVC; true union body; TFE seats and Viton seals.
2. Manufacturer:
    a. Asahi/American True Union. Threaded, Socket or Flanged (1/2 thru 6 inches).
    b. Chemtrol-Nibco True Union. Threaded, Socket or Flanged (1/2 thru 3 inches).
    c. Hayward True Union. Threaded, Socket or Flanged (1/2 thru 4 inches).
    d. Colonial Valves (1/2 thru 6 inch)

e. Spears.

2.3 Check Valves

A. General Requirements

1. See Article Valves: General Requirements. Not all valves listed below are used on this project.

B. **Type CK-15.** Class 125, Threaded And Flanged, Cast Iron, Non-Slam, Silent, Thru 24 Inches

1. Type CK-15: Minimum rating 150 PSI at 100 degF CWP; cast iron globe body and bronze and stainless steel trim, center-guided poppet-disc, plugged drain. FM approved where required.
2. Manufacturer:
    a. Apco Valve and Primer Corp. Flanged Fig 600 Series.
    b. Combination Pump and Valve (CPV) Threaded. No. 34 (1/2 thru 2 inches); Flanged. No. 20D (6 thru 24 inches), 125 PSI at 100 degF CWP.
    c. Mueller Steam Specialty Threaded. No. 203-BP (1/2 thru 2 inches); Flanged. No. 105-AP (2 thru 24 inches).
    d. Val-Matic Valve and Manufacturing Flanged. Fig. 1800 Series ANSI 125 (2-1/2 thru 42 inches).
    e. Milliken

*All threaded end valves are 300 PSI CWP pressure rated only.

C. **Type CK-15A.** Class 150, Cast-Steel, Flanged, Non-Slam Silent Thru 20 Inches

1. Type CK-15A: Minimum rating 285 PSI at 100 degF cast-steel globe body, full-ported, center-guided poppet-disc, stainless steel trim.
2. Manufacturer:
    a. Mueller Steam Specialty No. 105MDT. (2 thru 20 inches)

D. **Type CK-15F**, Foot Valve And Suction Strainer, Flanged, Thru 32 Inches

1. Type CK-15F*:* Minimum rating 100 PSI at 100 degF, Class 125 [**cast iron**] [**cast AISI Type**] [**304**] [**316**] [**stainless steel**] flanged globe body, AISI Type [**304 (316**] stainless steel trim, center-guided poppet disc with [**Buna-N**] [**neoprene**] [**Viton**] [**Teflon**] soft seat. Fit with perforated AISI Type [**304**] [**316**] stainless steel screen of sufficient strength to prevent collapse under full vacuum.
2. Manufacturer:
    a. APCO Series 400 (2-16 inches)

b. Flomatic Corp . Series 44/144 (2 thru 32 inches)

c. Mueller Steam Specialty

d. Val-Matic Valve and Mfg. Corp. Series 1900 (2-16 inches)

E. **Type CK-17A.** Class 150, Wafer, Stainless Steel, Non-Slam, Silent, Thru 8 Inches

1. Type CK-17A: Same as CK-17 except wafer body and 275 PSI at 100 degF CWP.
2. Manufacturer:
    a. Mueller "No. 101M-HT" (1 thru 8 inches).

F. **Type CK-18**. CWP 150 PSI, Wafer, Non-Slam, Split Disc Thru 48 Inches

1. Type CK-18: Minimum rating 150 PSI at 100 degF CWP; cast iron body, bronze or aluminum bronze discs, stainless steel trim, Buna-N seats and seals.
2. Manufacturer:
    a. APCO "9000 Series" (2 thru 42 inches). 9-0-size-A-R-1-F.
    b. TRW "Mission" (2 thru 5 inches). K-12-H-M-P; (6 thru 48 inches). G-12-H-M-P.
    c. Techno 5050 (2 thru 36 inch)

G. **Type CK-20**. CWP 125 PSI, Flanged Cast Iron, External Weight, Swing Disc Thru 36 Inches

1. Type CK-20: Minimum rating 125 PSI at [**100**] [**200**] degF CWP; cast iron body, stainless steel pin, [**bronze**] disc with Buna-N seat, [**external weight and lever**] [**external lever and spring**].
2. Manufacturer:
    a. APCO "Series S-6000" (3 thru 36 inches) (CK-2 Series.)

H. **Type CK-21**. CWP 150 PSI, Flanged Cast Iron, PFA Fully Lined, Solid Teflon Ball Thru 8 Inches

1. Type CK-21: Minimum rating 150 PSI at 100 degF CWP, PFA fully lined, solid Teflon ball.
2. Manufacturer:
    a. Peabody Dore (1 thru 8 inches).

I. **Type CK-21A**. CWP 150 PSI, Flanged Cast Iron, Polypropylene Fully Lined, Solid Teflon Ball Thru 8 Inches

1. Type CK-21A: Minimum rating 150 PSI at 100 degF CWP, PPL fully lined, solid Teflon ball.
2. Manufacturer:
    a. Peabody Dore (1 thru 8 inches).

J. **Type CK-22.** CWP 150 PSI, PVC, CPVC, PP, Or PVDF Body And Ball Thru 4 Inches

1. Type CK-22: Minimum rating 150 PSI at 70 degF CWP, body and ball material to match piping system; Viton or Teflon coated Viton seats and seals.

2. Manufacturer:
    a. Asahi/America, PVC, CPVC and PVDF; Threaded, Socket and Flanged (1/2 to 4 inches)
    b. Chemtrol Nibco True Union, PVC, CPVC, and PP; Threaded, Socket and Flanged (1/2 to 4 inches).
    c. Colonial Valve (1/2 thru 3 inch)
    d. Spears.

K. **Type CK-22A**. CWP 150 PSI, PVC Or PVDF Body And Swing Disc Thru 3 Inches
1. Type CK-22A: Minimum rating 150 PSI at 70 degF CWP, body and disc material to match piping system; Viton seats and seals.
2. Manufacturer:
    a. Asahi/America PVC, CPVC and PVDF; Flanged (3/4 thru 8 inches).

L. **Type CK-23.** CWP 150 PSI, PVC Body And Split Disc Thru 8 Inches
1. Type CK-23: Minimum rating 150 PSI at 70 degF CWP, PVC body and split disc Buna-N seats.
2. Manufacturer:
    a. Techno Corp Threaded, Socket and Flanged (1 thru 8 inches)

M. **Type CK-24**. Double Ball Check Assembly, Chemical Injection Valve
1. Type CK-24: Double ball check assembly for injection of sulfuric acid; Alloy 20 body and balls, Teflon seat.
2. Manufacturer:
    a. Milon Roy Co. (1/2 inches male IPS) Model No. 221-0264-003-1/4 BORE.

N. **Type CK-25**. Refrigeration And High Purity Gas Services, Solder Joint, Bronze
1. Type CK-25: Minimum rating 425 PSI at minus 40 degF, operating temperature to 300 degF; bronze body and trim, neoprene seal and Teflon seat.
2. Manufacturer:
    a. Henry Valve Co. “Type 205” (7/8 thru 3-1/8 inches).
    b. Mueller Brass Series A-137 (7/8 thru 2 inches); Series A-147 (2-5/8 thru 3-1/8 inches).

O. **Type CK-26**. CWP 150 PSI, Cast Iron Wafer Body And Disc, PFA Fully Lined Thru 8 Inches
1. Type CK-26: Minimum rating 150 PSI at 70 degF CWP, cast iron wafer body and disc PFA fully lined.
2. Manufacturer:
    a. Xomox (4 thru 8 inches) “Fig. 070”.

P. **Type CK-27**. CWP 150 PSI, Ductile Iron Flanged Body, PFA Lined And Teflon Ball Thru 3 Inches
1. Type CK-27: Minimum rating 150 PSI at 70 degF CWP, ductile iron flanged body, PFA lined; Teflon ball.
2. Manufacturer:
    a. Xomox (1 thru 3 inches) “Fig. 071”.

Q. **Type CK-28**. Flanged Body, Elastomer Sleeve, Pinch Check Assembly Thru 20 Inches

1. Type CK-28: Minimum rating [**50**] <**Insert**> [**100**] PSI at 70 degF CWP, cast [**iron**] [**aluminum**] body, [**EPDM**] [**Buna N**] elastomer normally closed sleeve, pinch check valve assembly designed for not less than [**50**] [**70**] [**100**] PSI back pressure.
2. Manufacturer:
    a. Red Valve [1 thru 20 inches] “Series 39”.

R. **Type CK-28A**. Flanged Body, Pure Gum Rubber Sleeve, Pinch Check Assembly Thru 20 Inches

1. Type CK-28A: Minimum rating [**50**] [<**Insert**>] [**100**] PSI at 70 degF CWP, cast [**iron**] [**or**] [**aluminum**] body, pure gum rubber normally closed sleeve, pinch check valve assembly designed for not less than [**50**] [**70**] [**100**] PSI back pressure.
2. Manufacturer:
    a. Red Valve (1 thru 20 inches) “Series 33”.

S. **Type CK-29**. CWP 175 PSI, Cast Iron Body, Buna-N Flapper Check Thru 24 Inches

[NOTE: FLOMATIC SAYS “NORMAL VELOCITY 2-3 FPS”.]

1. Type CK-29: Minimum rating 175 PSI at 150 degF CWP, cast iron body, solid Buna-N flapper.
2. Manufacturer:
    a. **<APCO** (2 thru 24 inches) “Series 100”.>
    b. Val-Matic (2 thru 24 inches) “Series 500”.
    c. Flomatic (2 thru 16 inches) “Series 78”.

T. **Type CK-29A**. CWP 175 PSI, Cast Iron Body Buna-N Flapper/Lining Check Thru 24 Inches

1. TYPE CK-29A: Same as TYPE CK-29 except internal wetted surfaces BUNA-N lined.
2. Manufacturer:
    a. APCO (2 thru 24 inches) “Series 100”.
    b. Val-Matic (2 thru 24 inches) “Series 500”.
    c. Flomatic (2 thru 16 inches) “Series 78”.

U. **Type CK-30**. Class 150 Flanged Cast Steel 2 Thru 10 Inch

1. Type CK-30*:* Minimum rating 285 PSI at 100 degF, Class 150 flanged cast steel body, TYPE 304 pulsation dampening, stable, center-guided, stainless steel disc/trim [**with**] [**BUNA-N**] [**Teflon**] [**soft seat**].
2. Manufacturer:
    a. Durabla PDC Series.

V. **Type CK-31**. Class 125, Cast Iron, Flanged, Rubber Flapper, Thru 24-Inch

1. Type CK-31*:* Minimum rating 200 PSI at 100 degF, piggable Class 125 flanged cast iron body, neoprene hinged and encapsulated metal disc bronze or stainless steel seat [**internally neoprene lined**] [**externally epoxy coated**].
2. Manufacturer:
    a. APCO Series 100 (2 thru 24 inches)

b. Flomatic CSC/78 (2 thru 16 inches)

W. **Type CK-32**. Class 125, Cast Iron, Threaded, Flanged, Ball Check, 1 Thru 14 Inch

1. Type CK-32: Cast iron body, ANSI B16.1 flanged, rated 150 PSI at 150 degF, non-clog, non-slam, piggable, phenolic or Buna N encapsulated metal ball. Electrostatically coat, spark-test, [**all**] [**wetted**] metallic parts for [**0-14 pH**] service.
2. Manufacturer:
   a. Empire Specialty Co. Inc., Div. GA Industries , Fig. 240
   b. Flygt.
   c. Flomatic Series 50 1-2 inch Threaded or Series 208; Series 408 Flanged

X. **Type CK-34**. [**Threaded**] [**Flanged**] Body, Springloaded Check Thru 2 Inches

1. Minimum rating [**ANSI**] [**API**] [**Class**] <**Insert**> PSI at 100 degF CWP, [**carbon**] [**stainless**] [**steel**] [**cast iron**] body, <**Insert**> inch orifice diameter, ANSI B16.104 leakage [**Class IV Teflon seat**] [**Class VI**] [**Buna N**] [**Viton GFLT/GF**] <**Insert**> seat, springloaded for [**maximum**] [**minimum**] [**1/8**] <**Insert**> [**14.7**] [**100**] PSI horizontal cracking pressure.
2. Manufacturer:
   a. Check-All Mfg
   b. Circle Seal Controls/Bifco.
   c. Kepner Products Company.

2.4 Special Service Valves

A. General Requirements

1. See Article Valves: General Requirements.

2.4.1 Back Pressure Control Valves (BPV)

A. **BPV**, Self Contained

1. BPV*:* Maintain constant upstream pressure with capability of pressure adjustment ± 25% of pressure set point at ± 50% of design flowrate.
   a. Valves shall be self-contained, direct-acting.
   b. Valves shall have ANSI B16.5 Class 150 WSP/285 WOG flanged connections.
   c. Body shall be indicated line size with reduced port trim.
   d. Trim shall be stainless steel with Stellite or equivalent Jordanite hard metal seat/disc.
   e. Maximum pressure drop for abnormal low temperature, high viscosity conditions may be 185 PSI.

f. Shut-off shall be Class IV (ANSI).

g. Pressure control range and minimum pressure differential of valves shall correspond to system pressures shown on the Drawings and as approved.

2. Manufacturer:

a. Jordan

b. Leslie

2.4.2 Pressure Regulating Valve - Water (PRV)

A. **PRV-Gas and Air**: Self-contained pressure regulator; ferrous body; stainless steel trim; globe or plug style body. Materials of construction shall be suitable for the media and service conditions. Provide valve with capability of pressure adjustment ± 25% of pressure setpoint at ± 50% of design flowrate.

1. Manufacturer:

a. Fisher Controls.

b. Masoneilan International.

c. Leslie.

2.4.3 Safety Relief (SRV), and Relief Valves (RV)

A. **TYPE SRV-(1) (,2) (,3):** For compressed [**air**] [**gas**] and [**steam**] <**Insert**> [**vapor**] service.

1. Valves shall conform to ASME Unfired Pressure Vessel Code Section VIII and capacities shall be certified by NBBPVI stamp.

2. Size for [**indicated**] [**scheduled**] [**required**] capacity and pressure, set-point for each application [**10%**] [**or 10 PSI**] greater than operating pressure, 10% pressure accumulation at maximum flow [**90% of theoretical capacity**].

3. Valves in sizes 2 inches and under shall have threaded or flanged connections and valves 2-1/2 inches and larger shall have integral to body or fitted flanged inlet and outlet connections.

4. Valve body and trim materials shall be bronze, cast iron, cast steel, wrought steel or stainless steel to match fluid piping system service corrosion conditions.

5. Manufacturer:

a. Consolidated Div. Dresser

b. Anderson Greenwood/Crosby

c. Farris/Teledyne

d. Kunkle/Lonergan

e. Apollo Valves

B. **Type RV-(1) (, 2) (, 3)**: For <**Insert**>

1. Liquid pressure relief valves shall conform to ASTM Unfired Pressure Vessel Code Section VIII and capacities shall be certified by NBBPVI stamp.
2. Valves shall be sized for indicated flow through or thermal relief capacity/service. [**Where two pumps may discharge into a protected header, valve capacity shall be equal to pump capacity.**] Capacity shall be based on 10% accumulation.
3. Indicated set points are subject to shop drawing revision upon coordination with pump shut-off head shop drawings.
4. Valves in sizes 2 inches and under shall have [**threaded or flanged**] connections and valves 2-1/2 inches and larger shall have integral to body or fitted flanged inlet and outlet connections.
5. Provide with packed external lifting gear and gasketed cover for back pressure service.
6. Valve body shall be [**bronze**] [**cast iron**] [**cast steel**] [**wrought steel**] [**stainless steel**] and trim shall be stainless steel [**as scheduled**].
7. Manufacturer:
    a. Consolidated Div. Dresser
    b. Anderson Greenwood/Crosby
    c. Farris/Teledyne
    d. Kunkel/Lonergan

15110.3 EXECUTION

A. Execute the Work in compliance with Division 15 Section "Basic Mechanical Material and Methods."

B. Refer to Division 15 Section "Aboveground Piping Systems" for additional requirements, and special requirements based on piping system fluid/product.

C. General Service Valve Locations

1. Locate shut-off valves to permit isolation of system mains, branches and risers, equipment and piping specialties, from the balance of each connected piping system, without loop or system shutdown. Locate system sectionalizing and equipment isolation valves to permit safe shutdown and convenient maintenance or drainage of equipment without moving equipment.

D. Delivery, Storage and Handling

1. Prepare valves for shipping as follows:
    a. Protect internal parts against rust and corrosion.
    b. Set globe and gate valves closed to prevent rattling.
    c. Set ball and plug valves open to minimize exposure of functional surfaces.
    d. Protect threads, flange faces, grooves, and weld ends.
    e. Set butterfly valves closed or slightly open.

f. Block check valves in either closed or open position.

2. Use the following precautions:

a. Maintain valve end protection.

b. Store indoors and maintain valve temperature higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

E. Use only nylon slings to handle large valve bodies. Rig to avoid damage to exposed parts. Do not use handwheels and/or stems as lifting or rigging points.

15120 - PIPING SPECIALTIES

15120.1 PRODUCTS

1.1 Piping Specialties

1.1.1 Backflow Preventer

A. *Backflow Preventer [D,P]:* Reduced-pressure backflow prevention device per AWWA C-506 or ASSE requirements, consisting of two tight-closing check valves, two shut-off valves, anti-syphon mechanism, and test ports. Wetted components; bronze or stainless steel selected for service.

1. Manufacturer:

a. Cla-Val “R.P. Series”.

b. Watts Regulator.

c. Hersey-Sparling.

d. Conbraco.

e. Febco.

1.1.2 Escutcheons

A. *Escutcheons [P]*: Nonferrous one-piece or split pattern type shall maintain a fixed position against a surface by internal spring tension or set screws.

1.1.3 Flexible Connectors

A. *TYPE FC-1 Spherical Elastomer Connector [D,P]:* Steel van-stone flanged expansion-vibration joints to absorb

movement of the pipe sections with no detrimental effect on joint. Provide control rod or cable assemblies to restrict joint movement under service pressure (positive or negative) application. Provide spherical steel washers at control rods. rubber washers are not acceptable. Provide joints for continuous duty working temperature of not less than 240 degF and pressures to 225 PSI. Factory tag joints with manufacturer's maximum recommended limits for elongation or compression or lateral displacement and do not remove prior to acceptance inspection.

1. Manufacturer:
    a. Metraflex Co. "Metra-Sphere/Cablesphere"
    b. Garlock EZF-200.
    c. General Rubber Corp. "Maxi-Sphere" Style 1010

B. *TYPE FC-2 Braided/Convoluted Metal Hose [D,P]:* AISI 304 or 316 Series stainless steel externally shielded with wire braid of same or similar alloy, with ANSI Class 150 flat faced flanges, rated for not less than 150 PSI at operating temperature with safety factor of 4 for all sizes.

2. Minimum live length shall be (per manufacturer's calculations) (as indicated) (for indicated applications).
3. Maximum permanent offset shall be 1inch or as scheduled.
4. Maximum offset shall be 1 inch ± greater than maximum permanent offset with zero allowance for misalignment.
5. (For Gasoline Service, hose shall be UL Listed.)
6. Manufacturer:
    a. Anaconda.
    b. Boa.
    c. Metraflex Hose and Braid.

C. *TYPE FC-3 Tie-rod Bellows Connectors [D,P]:* ANSI Class 150, 300 flanged welded assembly with multi-ply AISI 304/316L stainless steel bellows, and spherical metallic washers on spacer tie rods. Load carrying rubber grommets are not acceptable. Connectors shall be rated for indicated systems application as follows with a safety factor at working rating of not less than 4. Design 190 psig/127 psig working at 300 degF for all services operating at less than 125 psig and 300 degF. For other services. design 400 psig/275 psig working at 250 degF or design 365 psig/245 psig working at 450 degF. Adjust fix spacer tie-rod to maximum design limits. Factory tag each joint with manufacturer's maximum recommended limits for elongation/compression/lateral displacement and do not remove prior to acceptance inspection.

7. Manufacturer:
    a. Keflex, Flexible Bellows Connectors
    b. Badger Expansion Joint Co.
    c. Flexonics Model TCS-R/Mod
    d. Pathway
    e. Metroflex MPTR.

D. *TYPE FC-4 Tie-rod Bellows Connectors [D,P]:* Connector shall consist of molded Teflon bellows with reinforcing ring, ductile iron flanges with bolt holes conforming to ANSI Class 150, (neoprene) grommets, factory set limit bolts with (half-round) steel washers and elastic stop nuts. Molded/form bellows over

full flanges eliminating need for separate gaskets. Rate for application, with a safety factor at not less than 3, in sizes 10 inches and under, for minimum working pressure not be less than 115 PSI at 200 degF. Factory tag each connector with manufacturer's maximum recommended limits for elongation/compression/lateral displacement and do not remove prior to acceptance inspection.

8. Manufacturer:
    a. Resistoflex (R6904)
    b. Garlock Style (214)
    c. Metroflex T-1-J

E. *Type FC-5 Tie-rod Double Bellows Connectors [D,P]*: Provide tied-double bellows, double-flange joints designed for lateral deflection and thermal expansion/contraction within tied length.

9. Bellows shall be constructed of multiple-ply AISI Type 316 stainless steel per ANSI B31.1/ASME UPV Code.
10. Flanges shall be an integral part of the tie-rod plates and shall be fabricated from ANSI B31.1 or ASME UPV Code carbon steel plate. Flange thickness and drilling pattern for sizes under 24 inches shall be ANSI B-16.5 and MSS-SP44 for larger sizes.
11. Fit each joint with four tie-rods fabricated from carbon steel or stainless steel. Nuts shall be stainless steel, unless technically prohibited by strength requirements. Spherical washers shall be stainless steel and shall be bedded in never-setting butyl elastomer caulk.
12. Joints sized 24 inches and larger shall be pressure and temperature rated at 55 psig at 100 degF, shall have not less than 10 corrugations per section to provide not less than 1.5 inches of lateral movement with a lateral force of 3693 lbs. and shall be of a nominal 311/4 inch overall length. Match bolt circles to connecting valve and pipe flanges.
13. Joints shall be in chilled water service and subject to external corrosion due to moisture condensation/entrapment. Apply Type A Primer Paint, specified herein, to all carbon steel surfaces.
14. Provide a slip-joint stainless steel sheet metal cover for each joint, secured to one flange. Insulate each joint with 7" of cellular elastomer with a single rectangular bellows to permit movement without mechanical damage. Seal all fixed and moving joints, stay bolts, etc. with butyl sealant during assembly. Since absolute vapor barrier construction is not practical, provide "J" type water seal drip for condensation drainage to outside of insulation. Contractor may propose REMOVABLE/REUSEABLE insulation specified in Division 15 Section "Thermal Insulation." Submit proposed construction details for approval.
15. Manufacturer:
    a. Adsco Corraflex, "Universal"

F. *TYPE FC-6 Gimbal Joint [D,P]:* ANSI Class 300 flanged connector to permit angular rotation in any plane using two pairs of hinges affixed to common floating gimbal ring. Bellows of AISI TYPE 316L. Minimum rating of 350 psig at 300 degF with safety factor of 4 for indicated application.

16. Manufacturer:
    a. Adsco, Corruflex Gimbal
    b. Badger Expansion Joint Company, Gimbal

c. Pathway, Gimbal

1.1.4 Grooved Couplings & Fittings

A. *Grooved Couplings and Fittings [D,P]*: Roll grooves unless otherwise specified. Fabricate housing of ductile iron castings per ASTM A 536, Grade 65-45-12. For gasket per ASTM D 2000. Furnish gaskets per manufacturer's preferred/recommended standard for the service fluid and operating conditions. Furnish coupling bolts with track head design and hexagonal heavy nuts per ASTM A 183.

B. For use with grooved couplings, furnish long radius malleable iron pipe fittings castings per ASTM A 47, Grade 32510, or fabricated from Schedule 40 to 0.375 inch wall ASTM A 53, Grade B seamless steel pipe or fabricated from long radius seamless welding fittings per ASTM A 234 and ANSI B16.9 with wall thickness to match pipe. In galvanized piping system furnish galvanized fittings.

1. Manufacturer:

a. Flexible Couplings:

1) Anvil International "Gruvlok 7001"

2) Victaulic "Style 77"

b. Rigid Couplings:

1) Anvil International "Rigidlok 7401"

2) Victaulic "Zeroflex 07"

1.1.5 Pressure Indicating Gauges

A. *Bourdon tube type pressure gauges [D,P]*: With minimum 4-1/2-inch dial. Case shall be of drawn steel with friction fit stainless steel ring. Bourdon tube and socket material shall be as required for the service media. Pointer shall be precision needle type. Range shall be twice design pressure, except where otherwise indicated, and normal operation and accuracy shall be within 1% over the middle third of the range. Where not indicated otherwise, provide range such that process readout is nominally at mid-point of middle-third of range. Dial shall indicate in Kg/Cm^2 and PSI.

B. Furnish gauge complete with manufacturers standard needle type isolation valve and integral-to-stem snubber screw.

C. Provide compound gauges at pump suction and at vertical locations where pressure/vacuum occurs. Provide/retrofit glycerine filled type gauges at interior to building pumps, air compressors, and wherever pulsation occurs.

1. Manufacture:

a. Trerice.

b. Marsh Instruments.

c. U.S. Gauge.

d. Ashcroft.

e. Wika.

f. Weksler.

g. Palmer.

h. Tel-Tru

1.1.6 Strainers

1. *TYPE STR-Y, LINE Y-BODY [D,P]*:

   a. ANSI Class 125, 150, 250 300 pressure/temperature rating and body materials shall match fluid system in which installed, unless otherwise specified. Strainer screen/back-up to pipe area ratio shall be not less than 3:1 and pressure drop, 25% dirty, shall not exceed 2 PSI at fluid rated flow.

   b. Strainer screen perforated sheet back-up shall be AISI TYPE 304/316 stainless steel or Monel. Start-up screens. Liquids No. 20 mesh; gases/vapors No. 100 mesh. Revise to approved particle separation where mandated by fluid characteristics/ pressure drop.

   c. Cast bronze, iron, semi-steel carbon, steel, stainless steel body. screwed ends thru 2 inch, unless otherwise specified; flanged ends in sizes (1-1/2) (2-1/2) inches and larger with off-set blow-off connection. Fit with system rated ball blow-down valve with capped outlet, unless otherwise indicated, differential pressure gauge tapped connection parts.

   d. Manufacturer:

      a) Armstrong

      b) Leslie

      c) Mueller Steam Specialty

      d) Metroflex.

   e. Y-type constructed from PVC Type I Cell Classification 12454 or CPVC Type IV Cell Classification 23447. Pressure rated at 150 psi for water at 73 degF.

      1) Manufacturer:

         a) Spears.

         b) Hayward.

2. *TYPE STR-ST SIMPLEX, TYPE STR-DT DUPLEX BASKET [D,P]*:

   a. ANSI Class 125, 150, 250/300 pressure/temperature rating: wetted metallic and non-metallic materials shall be suitable for fluid contained in system in which installed. Strainer screen/back-up to pipe area ratio shall be not less than 3:1 and pressure drop, 25% dirty, shall not exceed 2 PSI at fluid rated flow.

b. Strainer screen back-up shall be AISI TYPE 304/316 stainless steel. Start-up screens. liquids No. 20 mesh; gases vapors No. 100 mesh. Revise to approved particle separation where mandated by fluid characteristics pressure drop.

B. Cast bronze iron semi-steel carbon steel stainless steel body. (Screwed ends in sizes thru 2 inches); flanged ends in sizes (1-1/2) (2-1/2) inches and larger. Body drain in bottom, fitted with ball blowdown valve with capped outlet, unless otherwise indicated. Bolted cover, for pressure temperature rating, fitted with rated pressure vent valve. Provide differential pressure gauge tapped connection ports.

C. (For <**Insert**> System:) Fabricated wrought (carbon) (AISI TYPE 304/316 stainless) steel, conforming to ASME UPVC Section VII, (without) (with) stamp, for 150 PSI at 200 degF service with Class 150 flanges. Fit with (bottom) (side) outlet drain, ball valve with capped outlet, unless otherwise indicated, differential pressure gauge tapped connection ports.

D. Duplex strainer shall be fitted with metal to metal multi-port,type single plug, diverter valve which permits cleaning of idle strainer while system operating under rated pressure/temperature. Butterfly switching valves with elastomeric seats and seals are not acceptable for other than water service.

E. Manufacture, cast metal type:

1) Andale
2) Elliot
3) Mueller Steam Specialty
4) S.P. Kinney
5) Kraissl Co.
6) Leslie
7) Metroflex

F. Manufacture, fabricated metal type:

8) Fluid Engineering, Series 124 Simplex/ 534 Duplex(thru 24 inch)
9) Mueller Steam Specialty
10) S.P. Kinney, Model FF (3 thru 30 inch)

1.1.7 Vacuum Breakers

A. Rate for the temperatures, pressures and service to be encountered. Provide with isolating valve on inlet side.

1. Manufacturer:
   a. Crane
   b. Johnson

c. Hoffman

1.1.8 Water Hammer Arrestors

A. *Water Hammer Arrestors [D]:* Commercially manufactured with AISI TYPE 18-8 stainless steel bellows arranged to absorb the energy of pressure waves generated by valve closure in a line in which liquid is flowing. Arrestors with inlets sized 1 inch and smaller, per Plumbing and Drainage Institute Standard PDI-WH201. Arrestors for larger system requirements, engineered for the service by the manufacturer.

1. Manufacturer:
    a. Metraflex “Surge Master”
    b. J. R. Smith
    c. Josam
    d. Souix Chief

1.2 Miscellaneous Materials

1.2.1 Access Panels

A. General: Furnish access panels to provide access to valves, dampers, control devices and other mechanical equipment items which are concealed by building construction. Furnish access panels suitable for the construction and compatible with the contiguous surface finish of the installed location. Furnish access panels required by applicable codes. In fire rated construction, furnish UL Listed panels for the fire rating of the construction. Chrome plate exposed access panels in toilet rooms.

1. Manufacturer:
    a. Birmingham Ornamental.
    b. Karp.
    c. Milcor.

2. TYPE ACS-P: Round, face of wall, chrome plated bronze or mirror finish, AISI 18-8 stainless steel, with vandal-proof screw for attachment to cleanout plug.
3. TYPE ACS-DC: Square or rectangular pattern brush chrome plated bronze frame with frame anchor lugs, frame flush with wall, secured or concealed hinge, satin finish AISI 18-8 stainless steel door, vandal-proof screws.
4. TYPE ACS-DS: Square or rectangular pattern 16 MS gage prime coated carbon steel door and frames, with concealed hinge. Doors shall be dust-tight and shall open to 160 degrees. Frames shall have anchor provisions and shall be face of surface type. Provide cam and cylinder lock with two keys.

5. TYPE ACS-FF: Square or rectangular pattern, heavy cast nickel bronze or nickel brass frame and cover, flush with floor. Cover shall be scoriated in concrete and tile finished floors and recessed for resilient flooring.
6. TYPE ACS-CT: Square or rectangular pattern, 16 MS gage prime coated carbon steel doors and frames, with concealed continuous hinge. Doors shall be dust-tight, shall have recess for acoustical ceiling tile and shall open to 160 degrees. Provide slotted screw driver latch.
7. TYPE ACS-SS: Same as ACS-DS except exposed to view surfaces No. 4 finish AISI 18-8 stainless steel and 14 gage door.

1.2.2 Bolting

A. General Requirements: Bolting shall be certified "made in USA" and furnished with visually identifiable manufacturing source/quality.

B. *General Service Bolts [P]:* Heavy hex head or stud per ASTM A 307, Grade B and hex nuts per ANSI B18.2.2. Square head bolts and nuts are not acceptable.

C. *High Strength Bolts [P]:* For all ANSI Class 150 or 300 flanged joints per ANSI B31.1 Table 108.52, except where Class 125 and special case Class 250 cast iron flanges occur. Heavy hex head or stud alloy steel per ASTM A 193, Grade B7 and semi-finished heavy hex nuts per ASTM A 194, Grade 2H. Square head bolts and nuts are not acceptable. Color code to be visually identifiable in field.

D. *Corrosion Resistant Bolts [P]:* Stainless steel, Type 304, semifinished regular hex head bolts, ASTM A 193, Grade B8, NC thread with stainless steel, Type 303, semifinished regular hex head nuts, ASTM A 194, Grade 8F, NC thread. Square head bolts and nuts are not acceptable. Certified made in USA, and visually identifiable in field.

E. *High Strength High Temperature, Bolting High Nicke [C,P]*: High nickel (26% Ni/15% Cr) nominal steel, working range to 800 degF, UNC-2A thread full thread studs, ASTM A 453, Grade B660 Class B with, UNC-2B thread, heavy hex head nuts, ASTM A 453, Grade B660 Class B NOTE: This material has a coefficient of expansion similar to that of austinitic stainless steel.

F. *High Strength High Temperature Bolting, Ferritic [C,P]*: Ferritic stainless steel, working range -0 to 900 degF, Type 410, UNC-2A thread full thread studs, ASTM A 193, Grade B6 with ferritic stainless steel, UNC-2B thread, heavy hex head nuts, ASTM A 194, Grade 6.

G. *High Strength High Temperature Bolting, Nimonic [C,P]*: Nimonic alloy steel, working range to 1500 degF, Alloy N07080, UNC-2A thread full thread studs, ASTM B 637 , Alloy N07080 (Nimonic 80A), with same alloy steel, UNC-2B thread, heavy hex head nuts. **WARNING:** No acceptable deviation. Contractor shall import/purchase this product from UK at the start of project to meet Project Schedules.

[DO NOT SPEC UNLESS AVAILABLITY AND ESTIMATED SPEC CRITERIA IS CONFIRMED WITH A SPS MANUFACTURE BOLTING DISTRIBUTOR/SUPPLIER. NOTICE VERY HIGH TENSILE GRADE. EASY TO BEND CLASS 150 AND 300 FLANGES.]

H. High Strength Alloy Bolting [C,P]: Alloy steel, working range to 600 degF, UNC-2A thread full thread studs, ASTM A 434, (Grade BB 90 ksi tensile) (Grade BC 110 ksi) (Grade BD 130 ksi), UNC-2B thread, heavy hex head nuts, ASTM A 434, (Grade BB 90 ksi tensile) (Grade BC 110 ksi) (Grade BD 130 ksi). NOTE: This material has a coefficient of expansion similar to that of austinitic stainless steel. (HJD 5/14/97)

1.2.3 Caulking Materials

A. *TYPE PTR, POLYSULFIDE Caulk [P]*: Two-part, non-sag polysulfide, with primer for unprimed surfaces

1. Manufacturer:
    a. Pecora Corp. “SYNTHACALK” GC-2 and primer.

B. *TYPE RTV, SILICON caulk [P]*: Room temperature vulcanizing, with product formulation recommended by manufacturer as suitable for service/application.

1. Manufacturer:
    a. Dow-Corning
    b. General Electric
    c. Union Carbide Chemical and Plastics
    d. Uniroyal

C. *TYPE UR, POLYURETHANE caulk [P]*: Single component, marine grade

1. Manufacturer:
    a. 3M “5200”

1.2.4 Flashing-Counterflashing

A. Sheet mill galvanized steel: Not less than 18 gage.

B. Sheet copper: Per ASTM B 370, not less than 16 ounces per square foot.

C. Sheet lead: Not less than 4 pounds per sq. ft. per FS QQ-L-201F, Grade B, C or D.

1.2.5 Grout

A. *TYPE NS Non-Shrink Grout [P]*: Premixed, nonshrink grout, consisting of aggregate base, portland cement and sand, with all necessary plasticizers, densifiers and other control ingredients;

1. Manufacturer:

a. Nonmetallic:

1) Euclid Chemical Co. “Euco N-S Grout”.

2) L & M Construction Chemicals “Crystex”.

3) Master Builders “Masterflow 713”

4) W. R. Meadows, Inc. “588 Grout”.

5) U. S. Grout Corp. “Five Star Grout”.

b. Metallic:

1) Euclid Chemical Co. “Firmix”.

2) L & M Construction Chemicals “Fero Grout”.

3) Master Builders “Embeco 153”.

4) Sonneborn “Ferralith G”.

B. *TYPE EP Chemical/Oil Resistant Epoxy Grout [P]*: Premixed, nonshrink grout, consisting of plastic resins base, with appropriate modifiers:

2. Manufacturer:

a. The Ceilcote Co. “648 Grout”.

b. L & M Construction Chemicals “Epo Grout”.

c. U.S. Grout Corp. “Five Star Epoxy Grout”.

1.2.6 Pipe Thread Compounds

A. *Thread Compound [P]*: For potable water service and similar applications utilize compounds acceptable to U.S. Department of Agriculture (USDA) or Food and Drug Administration (FDA). Compounds containing lead are prohibited.

B. Type GRAF Thread Compound [P]: Proprietary corrosion inhibited and conductive graphite compounds suitable for gasoline/solvent/alcohol/fuel oils/LPG and specified (including hydro-test and flushing) fluid systems, where electrical continuity for anti-static discharge is required.

1. Flow Control Div./Copper Industries/WKM Products. “Key Graphite Paste” (non-aqueous service only).

2. Union Carbide Chemicals & Plastics, Grafoil GTS (petroleum base).

C. *TYPE PBO-1 Thread Compound [P]*: Certified for oxygen service. Litharge (lead oxide) and glycerine.

D. *TYPE PBO-2 Thread Compound [P]*: UL approved for industrial services, Freon 11/12, chemicals, natural and LP gas, petroleum products. Lead oxide formula which will not wash out.

3. John Crane Plastic Lead No. 2.

E. *TYPE TFE Thread Compound [P]*: Use tetrafluoroethylene (Teflon) tape or sealant compound for other systems.

For FRP/PVC/CPVC joints, (use correct thickness tape.)

4. Manufacturer:
    1) Cadillac Plastic Tape .
    2) Cajon Co. “SWAK” Part No. MS-PTS-50 Anaerobic/TFE Sealant.
    3) Jomar Seal “Heavyweight” Sealant.
    4) Permacel Tape.
    5) Permatex.

1.2.7 Zinc Coatings

A. Inorganic zinc-rich coatings: Or corrosion inhibited proprietary compounds for GALVANIZED CARBON STEEL SYSTEMS to coat oil-free raw carbon steel surfaces, in lieu of subsequent painting.
    1. Manufacturer:
        a. Ameron "EZ"
        b. Carboline "Carbo-Zinc 12"
        c. ZRC

1.2.8 Sleeves Wall and Floor Fireproof

A. Refer to Division 15 Section “BASIC MECHANICAL MATERIALS AND METHODS.”

B. *Pre-fabricated [P]:* Fit insulated piping penetrating fire rated walls or floors with slip-fit Type 360 degree shield/jacket. Up to and through 2 hour rated barrier shall be 24 gage; 3 and 4 hour rated barrier shall be 16 gauge. Jacket shall be flush on both sides of wall and underside of floor and project 2 inches above floor. Insulation shall consist of 360 degree calcium silicate insert 1 inch longer than the shield/jacket for vapor barrier lines with the thickness matching adjacent insulation.
    1. Pipe Shields, Inc. Model WFBCS, DFBCS, QDFBCS as appropriate.
    2. Elcen “Iso-Shield” Type 3, 360 degree insert, fire-rated.

C. *Field Fabricated System [P]:* Consisting of sleeve, packing and calking on both ends:
    3. Standard weight black carbon steel pipe sleeve with anchor lugs where required
    4. Packing: Refractory fiber or ceramic fiber
        a. Manufacturer:
            1) Corborundum “Fiberfrax”.
            2) Eagle Picher “Epitherm 1200”.
            3) Babcock and Wilcox “Kaowool”.
            4) Manville “Cerafelt”.

5. Multi-part polyurethane calk
    a. Manufacturer:
        1) Pecora “Dynatrol II”.
        2) PRC Rubber Calk “210 and 270 Sealants”.
        3) Tremco “Dymeric”.
        4) Mameco “Vulkem 227”.
6. As an alternate to packing specified above, and subject to approval, a fire-rated surface silicone foam, not exceeding the foam fire rating, may be proposed.
    a. Manufacturer:
        1) Dow Corning “3-6548 RTV Foam”.
        2) Semco Div. Products Research and Chemical Corp. “PR-855”.
        3) Chase Technology Corp. “CTC PR-855”.
7. Intumescent Caulk
    a. Manufacturer:
        1) Johns-Manville.
        2) 3M.
        3) Nelson Electric.
        4) Trimco.

D. *Three-Hour Rated [P]*: Provide wall sleeve and modular floor and wall seal to assure protection against the penetration of flame, smoke, gases, and water for three hours.

8. Sleeve shall be manufactured from heavy wall welded or seamless steel pipe with full circle, continuously welded water stop plate, to assure positive water sealing on the O.D. of the sleeve and no thrust movement. Sleeve shall be finished with enriched red primer to assure metal surface protection.
    a. Manufacturer:
        1) Thunderline “Link-Seal, Wall Sleeves”.
9. Modular floor and wall seal shall be constructed of inorganic materials to provide protection against the penetration of flames, smoke, gases, water and temperatures in excess of 1900 degF for three hours. Sealing elements shall be fire resistant silicone rubber with steel pressure plates and shall meet ASTM Standard E-119-76.
    a. Manufacturer:
        1) Thunderline “Link-Seal, Pyro-Pac”.

1.2.9 Thermal Joining Filler Materials

A. *TYPE LF, Soft Solder [P]*: Tin-antimony “95-5”; ASTM B 32-83 Alloy Grade Sb5, “Lead-Free, 0.2% Pbmax”.

B. *TYPE BA, Brazing Alloy [P]*: AWS A5.8, Classification B Cup-5. Use of brazing alloys containing lead or cadmium is prohibited.

C. *Pig Lead [P]*: For lead and oakum joints. ASTM B 29.

D. *Welding Filler Metal [P]*: Furnish, store, apply materials per referenced codes and metallurgically compatible with materials being joined. See Contractor's Welding Procedures.

E. *Plastic Thermal Joining Filler [P]*: To match pipe composition.

F. *Consumable Insert and Chill Rings [P]*: Metallurgy compatible with piping materials being jointed per referenced codes.

1.2.10 Solution Type Leak Detector

A. Leak Detector Solution. Commercial type for pipe system testing
   1. Manufacturer:
      a. American Gas and Chemicals Inc . "Leak Tec".
      b. Cole-Parmer Inst. Co . Leak Detector.
      c. Guy Speaker Co. Inc . "Squirt 'n Bubbles".

1.2.11 Weather/Rain Cap Flapper

A. Counter balanced, stainless steel, clamp band type for sizes thru 4 inch IPS.
   1. Manufacturer:
      a. Gas Supply Inc. Anthes

1.3 Hot Tap/Line Stop Services

A. Description of Work
   1. Start/Stop steam and condensate service for piping relocation as indicated on the mechanical plans.

B. Service Sources
   1. *Team Industrial Services, Alvin Texas (419.841.0669)*

15120.2 EXECUTION

2.1 General

A. Execute the Work in compliance with Division 15 Section "Basic Mechanical Material and Methods." and all other applicable Division 15 Sections.

B. Refer to Division 15 Section "Aboveground Piping Systems" for additional requirements.

C. Grooved Couplings And Fittings

1. Install air vent valves at all pressurized liquid piping systems and equipment water box high points and where indicated.

2. Provide automatic air vent valves with isolation valves in condenser water box, water lines, except potable water lines, and drainage piping to points indicated or to points of disposal approved by the authorities having jurisdiction. Other vents shall be manual type installed in easily accessible locations.

D. Water Hammer Arresters

1. Prevent hammer in liquid lines; size and locate water hammer arresters per the manufacturer's published instructions. Submit shop drawings showing details of installation and location for approval.

E. Escutcheons

1. Provide escutcheons at building surface penetrations of piping into finished areas. Size the plates to fit around insulation and conceal openings in building construction.

2. Mount one-piece chrome-plated escutcheons on chrome plated pipe or tubing and one-piece or split pattern type elsewhere.

F. Mg Set Diesel Engine Exhaust Pipe Expansion Joint Insulators

1. Insulate expansion joint with 16 gage galvanized beaded edge expanded sheet metal guards 2 inches away from hot surface and clamped to adjacent pipe surface.

G. Expansion Joints And Flexible Connectors

1. Install piping supports, anchors and guides related to expansion joints and flexible connectors per manufacturer's instructions.

H. Flashing And Counterflashing

1. Provide flashing and counterflashing to maintain building weathertightness.

I. Pipe Pig Launch Retrieval

1. Provide pig launching retrieval system as indicated, complete with full-bore piggable main-line valve, miscellaneous bypass, vent and drain valves, pig launcher retrieval closure latches, pig passage signal devices, piping, etc.

2. Pigs shall be sized, selected for the project system by the manufacturer.

3. Prior to acceptance demonstrate system operation in Owner's presence.

4. T. D. Williamson Inc.

5. Girardo

J. Blow-Off Piping Acoustic Treatment

1. Provide Schedule 80 BCS-150 piping from surge/bypass valve to inlet flange of silencer and Schedule 40 BCS-150 piping downstream from silencer discharge flange to above roof terminus.
2. Acoustically treat surge/bypass valve body with lead wool loaded removable/replaceable insulation otherwise as specified in Division 15 Section "Thermal Insulation."
3. Acoustically treat all piping surfaces from air compressor to under roof, including silencer, as follows:
    a. Apply 1-inch layer of calcium silicate, secure to pipe on not greater than 9-inch centers. Wrap pipe with "one-lb." lead sheet in accordance with Lead Industries recommended procedures to ensure no noise leakage path.
    b. Secure lead sheet to pipe with stainless steel straps or wire on not more than 9-inch centers.
    c. Apply second layer of 1-inch calcium silicate insulation which is jacketed with plain aluminum jacketing not less than 16 mil thick.
    d. Secure jacket to assembly with stainless steel straps as specified or with proprietary couplings. In order to help sustain weight of vertically stacked assembly, the Contractor shall weld collars to pipe to provide support at required intervals.

2.2 Owner-Furnished Equipment Installation

A. Provide all supplementary materials and equipment necessary to a functioning system.

B. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for additional requirements.

2.3 Field Quality Control

A. General

1. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for additional requirements.

B. Testing Of Equipment

1. Test equipment per manufacturer's published instructions, and as specified for the system.

15300 - FIRE PROTECTION SYSTEMS

15300.1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the contract, including General, Supplementary, Special Conditions, Division 1, and General Mechanical Work sections, apply to work of this Section.

B. Provide all items, articles, materials, operations or methods listed, mentioned or scheduled on drawings and/or herein, including all labor, materials, equipment and incidentals necessary and required for their completion.

1.2 SUMMARY

A. Scope

1. Provide the fire protection system as shown or specified, complete with all accessories for a complete functioning system to meet the applicable code and Owner underwriter requirements.

B. Description of Aboveground Systems and Equipment

1. WET PIPE SYSTEM

a. Piping;

1) TYPE BCS-FP (STD), BLACK CARBON STEEL - FIRE PROTECTION.

2) TYPE BCS-FP (LW), BLACK CARBON STEEL - FIRE PROTECTION.

b. Valves: Special Service - Fire Protection Valves.

C. Related work specified in other sections:

1. Division 1 Section - Summary.
2. Division 2 Section - Water Service.
3. Division 2 Section - Water Distribution.
4. Division 3 Section - Cast-In-Place Concrete.
5. Division 7 Section – Through-Penetration Firestop Systems.
6. Division 9 Section - Painting.
7. Division 13 Section - Noise Control.
8. Division 13 Section - Vibration Control.
9. Division 13 Section - Fire Alarm Systems.
10. Division 15 Section – Basic Mechanical Material And Methods.
11. Division 15 Section - Thermal Insulation.
12. Division 16 Section - Electrical Work.

D. Related Work Performed Under Other Contracts

1.3 DEFINITIONS

A. AHJ: Federal, State, or Local Authority having jurisdiction responsible for approving equipment, materials, installation, or procedure.

B. AISI – American Iron and Steel Institute.

C. ANSI/HI: American National Standards Institute and Hydraulic Institute.

D. ANSI/ASME B31.1 - Power Piping.

E. ANSI/ASME SEC 9 - Welded and Brazing Qualifications.

F. ANSI/AWS D1.1 - Structural Welding Code.

G. ANSI/NFPA 12 - Carbon Dioxide Extinguishing Systems.

H. ANSI/NFPA 72 - Fire Alarm Code.

I. ANSI/NFPA 70 - National Electric Code.

J. ASME – American Society of Mechanical Engineers.

K. AWS – American Welding Society.

L. XL GAPS: XL Global Asset Protection Services.

M. GMGS: General Motors Global Security.

N. GMWFG - General Motors Worldwide Facilities Group.

O. FM - Factory Mutual.

P. IBC – International Building Code.

Q. IFC - International Fire Code.

R. ISO – International Standards Organization.

S. NFPA – National Fire Protection Association. Current version unless mandated by local authority having jurisdiction.

T. NEC – National Electrical Code.

U. UL – Underwriter's Laboratories.

V. Hose Connection: Valve with threaded outlet matching fire hose coupling thread for attaching fire hose.

W. Hose Station: Hose connection, fire hose rack, fire hose reel, hose holder, covers, nozzles, couplings, spanner wrenches and fire hose.

X. Working Plans: Documents, including drawings, calculations, and material specifications prepared according to NFPA 13 and NFPA 14 for obtaining approval from XL GLOBAL ASSET PROTECTION SERVICES (XL GAPS) and authorities having jurisdiction.

Y. Fishmouth Connection: Branch pipe end shaped to fit run pipe cross-section.

1.4 QUALITY ASSURANCE

A. Requirements Of Regulatory Agencies: Provide fire protection work per the mandatory code requirements, standards of NFPA, and the requirements of the XL GAPS, except where more stringent requirements are indicated, as modified and supplemented by the Contract Documents.

1. The NFPA requirements include the appendices and supplements.

2. The provisions and recommendations of the NFPA constitute mandatory minimum requirements for work specified herein. No payment will be made by Owner for extra charges for work added in order to comply with NFPA Standards and Owner's Underwriter requirements.

B. Installer Qualifications: An installer that has been accepted to the General Motors Fire Protection Blanket Contractors List as a Tier 1 service provider, is licensed prior to the bidding of this contract in the state which this contract will be performed, is licensed where required by authorities having jurisdiction, and who has designed and installed fire-protection piping similar to that indicated for this Project and obtained design approval and

inspection approval from XL GAPS and authorities having jurisdiction. The General Motors Fire Protection Blanket Contractors List is available upon request.

C. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer or NICET Level 3 or 4 Designer. Base calculations on results of fire-hydrant flow test that has been accepted by XL GAPS.

D. Manufacturer Qualifications: Firms whose equipment, specialties, and accessories are listed by product name and manufacturer in UL's "Fire Protection Equipment Directory" and FM's "Fire Protection Approval Guide" and that comply with other requirements indicated.

E. Contractor Qualifications: Fire protection system work shall be supervised and performed by personnel regularly engaged in the installation of fire protection systems per Underwriter's and NFPA Standards.

1. Where allowed, employ for welding, brazing, soldering and cutting work, "qualified" personnel, as defined by applicable code and certified by the National Weld Test Bureau, the Hartford Steam Boiler and Inspection Company, or other approved bureau or agency.

F. Standpipe and Sprinkler Components: Listing/approval stamp, label, or other marking by a testing agency acceptable to authorities having jurisdiction.

G. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.

H. NFPA Standards: Equipment, specialties, accessories, installation, and testing complying with the following:

1. NFPA 10, "Portable Fire Extinguishers."
2. NFPA 13, "Installation of Sprinkler Systems."

I. Owner's Standards: Comply with "General Motors Fire Prevention and Protection Manual."

J. Owner's Underwriters: The Owner has designated Swiss-Re Global Asset Protection Services (XL GAPS) to conduct a fire protection review of the working drawings of this project.

K. Hydraulic Design Criteria: Design sprinkler piping according to the following and obtain approval from XL GAPS, General Motors and authorities having jurisdiction:

1. Base design on hydraulic calculations. Conduct fire hydrant flow tests that are acceptable to XL GAPS to obtain data for hydraulic calculations.
2. Include hose stream allowance. Add two hose streams at their point of connection to the overhead sprinkler system, 50 gpm (3.15 L/s) each, and 400 gpm (25.2 L/s) at the base of the automatic sprinkler riser for systems with design densities of 0.30 gpm per sq.ft.(0.2 L/s per sq. m) and less, and 900 gpm (57 L/s) at the base of the automatic sprinkler riser for systems with a design density greater than 0.30 gpm per sq.ft. (0.2 L/s per sq. m).
3. The maximum base of riser pressure demand shall not exceed 90 psig (621 kPa). Provide additional hydraulic calculations to discharge flange of the fire pumps to verify that the hose and sprinkler systems can be met.
4. Include losses through water-service piping, valves, and backflow preventers.
5. Use ordinary temperature rated heads on all sprinkler systems, except in areas where the ambient temperature exceeds 110 deg F (43 deg C). Sprinkler ratings for areas exceeding 110 deg F (43 deg C) shall be ambient plus 50 deg F (28 deg C).
6. Hydraulic calculations shall begin at outlet connection of city water meter or connection into distribution system with pipe friction based on Williams and Hazen coefficients.
    a. Aboveground: Black carbon steel wet pipe and deluge systems, C=120.

7. Gridded branch lines shall be limited to two heads on the outside of the primary and secondary cross mains.

L. Piping, Components, and Installation: Capable of producing piping systems with 175-psig (1200-kPa) minimum working-pressure rating, unless otherwise indicated.

1.5 SUBMITTALS

A. Furnish submittals for items that are identified in this Section by a different typeface and a bracketed code (e.g., *Item [L]*). Refer to Division 1 Section "Submittal Codes" for definition of codes for types of submittals and the administrative requirements governing submittal procedure. Additional submittal requirements pertaining to this Section are specified herein under this Article.

B. Submittals shall bear the Contract Documents identifying project name and number, and shall be sequentially item numbered.

C. *Fire-Hydrant Flow Test Report [T]:* As specified in "Preparation" Article.

D. Working plans [D]:

1. Working plans shall be submitted for approval to the authority having jurisdiction, XL GAPS and General Motors before any equipment is installed or remodeled. Deviation from approved plans shall require permission of the authority having jurisdiction, GM and XL GAPS.
2. Working plans shall be drawn to an 1/8 inch minimum scale, on sheets of uniform size, with a plan of each floor, and shall show items from the following list that pertain to the design of the system.
3. Where the equipment is to be installed as an addition to an existing system, indicate enough of the existing system on the plans to make all conditions clear.
4. The working plan submittal shall include the manufacturer's installation instructions for any specially listed equipment, including descriptions, applications, and limitations for any sprinklers, services, piping, or fittings.
    a. GM division name, street address, city, and state.
    b. The bay/column location and building number where the installation is proposed.
    c. The scale used on all plans.
    d. Name and address of contractor.
    e. Full height cross section (scaled), or schematic diagram, including details of structural members and ceiling construction. Indicate the type of construction (obstructed or unobstructed) per the definitions in NFPA 13.
    f. Details of lights, HVAC ducts, and other non-structural obstructions to the proposed sprinklers.
    g. Locations of full height walls.
    h. Occupancy class of each room/area per GM definitions ("offices", "manufacturing and/or storage less than 10 ft.", or "storage 10 ft. or greater").
    i. Location and size of concealed spaces. Include construction and occupancy details.
    j. Any small enclosures/areas where sprinklers are omitted.
    k. Make, type, model, orifice size and K-factor of sprinklers, and manufacturers cut sheet(s).
    l. Temperature rating and location of all sprinklers.
    m. Total area protected by each system riser on each floor.

n. Pipe type and schedule of wall thickness.

o. Nominal pipe size and cutting lengths of pipe (or center-to-center dimensions). Where typical branch lines prevail, it shall be necessary to size only one typical line.

p. Location, size, and length of riser nipples.

q. Type of fittings and joints. Location of all welds and bends. The contractor shall specify on drawing any sections to be shop welded and the type of fittings or formations to be used.

r. Type, details and location of hangers, sleeves, braces, and methods of securing sprinklers.

s. Make, type, model, and size of all control valves, alarm valves, dry pipe valves, preaction valves, deluge valves, check valves, etc. Also include size of drain pipes, and test connections.

t. Size and location of standpipe risers, hose outlets, hand hose, monitor nozzles, and related equipment.

u. For hydraulically designed systems, provide hydraulic data nameplate information.

v. Show hydraulic reference points on the plan that correspond with comparable reference points on the detailed hydraulic calculation sheets.

w. Detailed Hydraulic Calculation Forms per NFPA 13. Also include the minimum rate of water application (density), the design area of water application, in-rack sprinkler demand, and the water required for hose streams both inside and outside calculated to the Base of Riser and back to the available water supplies. Elevations Above Finished Floor of sprinklers, junction points and supply or reference points should be included.

x. The location and proof of the hydraulically most remote area (using the rectangular area having a dimension parallel to the branch lines equal to or greater than 1.4 times the square root of the area of operation).

y. The setting for any pressure reducing valves.

E. *Field Test Reports and Certificates [C, T]:* Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13 and NFPA 14. Include "Contractor's Material and Test Certificate for Aboveground Piping" and "Contractor's Material and Test Certificate for Underground Piping."

F. *Maintenance Data and Hydraulic Placard [D]:* For each type of standpipe and sprinkler system to include in maintenance manuals specified in Division 1.

1.6 RECORD DOCUMENTS

A. Submit as-built drawings and progress prints per Division 1 Section.

1.7 OPERATION AND MAINTENANCE DATA

A. Furnish per Division 1 Section, operating and maintenance data, special tools, and spare parts list.

B. Install on the riser, permanent type hydraulic placards, nameplates and instruction plates per NFPA 13 requirements to identify the system and instruct in its use under emergency conditions.

C. Spares for each type of sprinkler head complete with cabinet and wrench per NFPA No. 13 are to be installed where indicated by the Plant Fire Chief.

1.8 PROJECT CONDITIONS

A. Hazardous Areas

1. Ground piping and equipment in hazardous areas as specified in the Division 16 Section.
2. Provide electrically operated equipment suitable for NEC 500 Class I, Division I, Group D Series.

1.9 NATIONAL ACCOUNTS

A. The following materials and equipment shall be purchased from Vallen Safety Corp. under the National Account Agreement, GM Contract No. TCB04953.

2916 Walden Ave., Suite 250

Depew, NY 14043

Phone and Fax No. 716-833-4205

B. Equipment to include the following:

1. Hose Cabinets
2. Hose Valve Cabinets
3. Fire Hose Racks
4. Fire Hose Reels
5. Fire Hose
6. Fire Hose Nozzles
7. Fire Hose Couplings

C. Fire Extinguishers

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of portable fire extinguishers that fail in the materials or workmanship within specified warranty period.

1. Failures include, but are not limited to the following:
   a. Failure of hydrostatic test according to NFPA 10.
   b. Faulty operation of valves or release levers.
   c. Warranty Period: Six year from the date of Substantial Completion.

15300.2 PRODUCTS

2.1 ABOVEGROUND PIPING MATERIALS

A. Type BCS-FP (STD.), Black Carbon Steel -Fire Protection

1. Pipe:	

8” and under	Schedule 40 black carbon steel; ASTM A 53, Type E
2. Pipe:	
10” and larger	Schedule 30 black carbon steel; ASTM A 53, Type E or S, Grade B.
3. Couplings:	
All sizes	Extra heavy screwed black carbon steel ASTM A-53.
4. Unions:	
1/8 thru 2”	300 PSI WSP female screwed malleable iron with ground joint and brass to iron seat.
5. Nipples:	
1/8 thru 2”	Schedule 80 black carbon steel, ASTM A 53.
6. Flanges:	
2-1/2” and up	175 PSI WOG minimum, cast iron screwed; ASTM A 126, Class B and ANSI B16.1, UL/FM Listed.
7. Fittings:	175 PSI WOG minimum, cast iron screwed; ASTM A 126, Class B and ANSI B16.4 or flanged; ANSI B16.1, UL/FM Listed.
8. Cut and roll grooved couplings and fittings:	
All sizes	UL/FM Listed, malleable iron, elastomer gasket. Anvil International Victaulic Grinnell Mechanical Products
9. Welding fittings:	
4” and up	Steel buttweld; ASTM A 234 and ANSI B16.9 to match pipe wall thickness.
10. Flanges:	
2-1/2” and up	150 PSI WSP steel; ANSI B16.5 and ASTM A 181, Grade 1 or 2 to match pipe wall thickness.

B. Type BCS-FP (LW), Black Carbon Steel - Fire Protection

1. Pipe:	
1 thru 2”	Wall thickness 0.109 inches (min.); ASTM A 135, Type E.
2-1/2 thru 4”	Wall thickness 0.120 inches (min.); ASTM A 135, Type E.
5 and 6”	Wall thickness 0.134 inches (min.); ASTM A 135, Type E.
8 and 10”	Wall thickness 0.188 inches (min.); ASTM A 135, Type E.

2. Roll grooved couplings and fittings:	
3. All sizes	UL/FM Listed, malleable iron, elastomer gasket.
	Victaulic Style 75, 07, 741, 750, 72, 920. Anvil International "Gruvlok" Figure 7000, 7010, 7012, 7045, 7046, 7047, 7048, 7049. Grinnell Mechanical Products Figure 700 Series (couplings), 200 and 300 Series (fittings)
4. Plain End Fittings:	
2" and smaller	UL/FM Listed Victaulic - FIT Anvil International Sock-It Fittings/ Couplings Allied Piping Products Branchlets Bonney Forge Weldolets Grinnell Mechanical Products Figure 900 Series
5. Flanges:	
All sizes	150 PSI WSP steel, ANSI B16.5 and ASTM A 181, Grade 1 or 2 to match pipe wall thickness.
6. Welding fittings:	
All sizes	Steel butt weld, ASTM A 234 and ANSI B15.9 to match pipe wall thickness.
7. Lightwall Pipe:	Not acceptable for sprinkler riser piping below bottom chord of truss and piping in pump rooms.

C. Type BCS-150, Black Carbon Steel System

1. Pipe:	
1/8 thru 3"	Schedule 40 black carbon steel; ASTM A 53.
4 thru 10"	Schedule 40 black carbon steel; ASTM A 53, Type E or S, Grade B.
12 thru 24"	0.375 inch wall, black carbon steel; ASTM A 53, Type E or S, Grade B.
2. Screwed couplings:	
1/8 thru 2"	Extra heavy tapered thread black carbon steel.
3. Screwed unions:	
1/8 thru 2"	300 PSI WSP female screwed malleable iron with ground joint and brass to iron seat.

4. Welded unions:	
1/8 thru 1-1/2”	2000 or 3000 PSI WOG, AAR, forged steel socket weld; ASTM A 105, Grade II and ANSI B16.11. (Clayton Mark)
5. Flanges:	
2-1/2” and up	150 PSI or 300 PSI WSP forged steel welding neck to match pipe wall thickness and valve flanges; ANSI B16.5.
6. Screwed fittings:	
1/8 thru 2”	150 PSI WSP banded malleable iron screwed; ASTM A 197 and ANSI B16.3.
7. Welding fittings:	Steel butt weld to match pipe wall thickness; ASTM A 234 and ANSI B16.9.
8. Socket fittings:	Forged steel; ASTM A 105, Grade II and ANSI B16.11, to match pipe wall thickness.

D. Type GCS-150, Galvanized Carbon Steel System

1. Pipe:	Schedule 40 galvanized carbon steel; ASTM A 53.
2. Fittings:	
1/8 thru 2”	Class 150 banded galvanized malleable iron screwed; ASTM A 197 and ANSI B16.3.
3. Fittings:	
2-1/2” and up	150 banded galvanized malleable iron screwed fittings; ASTM A 197 and ANSI B16.3.
4. Flanges:	Class 150 flat or raised face as required, forged steel, screwed, ANSI B16.5.
5. Cut grooved couplings and fittings:	
All sizes (Roll grooving not permitted)	UL/FM Listed, galvanized malleable iron, elastomer gasket. Victaulic Anvil International Grinnell Mechanical Products
6. Special requirements	Clean damaged galvanized surfaces oil-free with solvent and touch-up with a zinc rich coating or Type “A” primer.

E. Type CPR-BJ, Copper Brazed Joint System

1. Tubing:	Type L seamless copper tubing; ASTM B 88 hard drawn.
2. Brazing fittings:	150 PSI wrought copper socket joint; ANSI B16.22. Cup depths and tolerances per MIL F-1183.
3. Unions:	150 PSI wrought copper socket joint; ANSI B16.22. Cup depths and tolerances per MIL F-1183.

4. Flared fittings:	45 degree flared forged brass; ANSI B70.1. Imperial-Eastman Crawford Parker-Hannifin

2.2 PIPING SPECIALTIES

A. Altitude ValveMfrMdl

1. Diaphragm Type Globe Valve [D]: Hydraulically operated, pilot controlled, UL Listed, operable with pilot valve and hydro mercury control.
    a. Manufacturer:
        1) Cla-Val Co. "No. 206 Type III", or "201-01 with CDS-5 control".
        2) Hersey Products Inc.

B. Flexible Couplings

1. Flexible Couplings [D]: Factory assembled couplings consisting of gaskets, follower rings, minimum seven inch long middle ring and track head bolts. Coupling shall be capable of accepting minimum four degree deflection.
    a. Manufacturer:
        1) Dresser Industries "Style 38"

C. Sleeve Couplings

1. Sleeve Type Couplings [D]: FM Listed.
    a. Manufacturer:
        1) Dresser Industries "Style 40" Water Meter

D. Detector Check Valve

1. Detector Check Valve [D]: Provide UL Listed and/or FM approved, rubber faced checks to register or detect all flow (through a bypass meter) from leakage or illegal water connections in the sprinkler system.
    a. Manufacturer:
        1) Hersey Products Inc. "Model EDC III"
        2) Kennedy Valve, Div. of MCWANE Inc.

2.3 ABOVE GROUND VALVES

A. General

1. Refer to NFPA 13.
2. Use UL Listed or FM Approved valves.
3. For overhead, inaccessible, exposed valves, equip with chain wheel and chains of sufficient length to allow operation from the floor.
4. Valves shall be locked open with chains and locks. Locks to be keyed alike to match site requirements.
5. NOTE: VERIFY REQUIREMENT FOR LOCKS AND CHAINS. CHECK IBC

IF ADOPTED.

B. Description

1. *Ball valves [D]:* 2 inches and under.
    a. Manufacturer:
        1) Jamesbury A-11-TT-22
        2) Worcester 44
2. *Gate valves [D]:* 2 inches and under.
    a. Manufacturer:
        1) Crane 459
        2) Stockham B-133
        3) Kennedy Valve
        4) NIBCO T-104-0
3. *Globe valves [D]:* 2 inches and under.
    a. Manufacturer:
        1) Crane 7
        2) Stockham B-22
4. *Check valves [D]:* 2 inches and under.
    a. Manufacturer:
        1) Crane 34
        2) Stockham B-319
5. *Gate valves [D]:* 2-1/2 inches and larger.
    a. Manufacturer:
        1) Crane 467
        2) Stockham G-634
        3) Kennedy Valve
        4) NIBCO T-104-0
        5) Mueller A2079-6
6. *Check valves [D]:* Rubber faced checks 2-1/2 inches and larger.
    a. Manufacturer:
        1) Crane 375
        2) Stockham G-940
        3) Kennedy Valve 126A
        4) NIBCO F-908-W
        5) Mueller A2122-6
        6) Tyco Model CV-1F

7. *Butterfly valves [D]:* Tapped lug type, 175 PSI rating to 12 inches, cast or ductile iron body, standard disc, position indicator, stainless steel stem, standard bushing, enclosed gear operator with position indicator.
    a. Manufacturer:
        1) Kennedy Valve
        2) NIBCO LD3510-2 Lug
        3) Pratt Model K
        4) Stockham LD-72U
        5) Tyco BFV-N

2.4 SPRINKLER SYSTEM COMPONENTS

A. Sprinkler Types and Categories
    1. Office areas, density 0.10 GPM ft2, 3000 ft2 (278.7 m2) area of application, noncombustible obstructed and unobstructed construction, standard upright and standard pendent sprinkler K-5.6 (81.0), protection area 130 ft2 (12.1 m2), maximum spacing 15 ft. (4.6m), minimum spacing 8 ft. (2.4m), temperature rating 165F (74C).
    2. Office areas, only with smooth ceilings, density 0.10 GPM ft2, 3000 ft2 (278.7 m2) area of application, noncombustible obstructed and unobstructed construction, standard upright and standard pendent sprinkler K-5.6 (81.0), protection area 225 ft2 (20.9 m2), maximum spacing 15 ft. (4.6m), minimum spacing 8 ft. (2.4m), temperature rating 165F (74C).
    3. Office areas, only where extended coverage sprinklers are permissible by NFPA 13, density 0.10 GPM ft2, 3000 ft2 (278.7 m2) area of application, noncombustible obstructed and unobstructed construction, extended coverage standard pendent sprinkler K-11.4 (164.4), protection area 400 ft2 (37.2 m2), maximum spacing 20 ft. (6.1m), minimum spacing 8 ft. (2.4m), temperature rating 165F (74C).
    4. Densities 0.35 GPM ft2 and 0.60 GPM ft2, 4000 ft2 (371.6 m2) area of application, noncombustible obstructed and unobstructed construction, standard upright sprinkler K- 8.0 (115.3) or K-11.2, protection area 100 ft2 (8.4 m2), maximum spacing 12 ft. (3.7m), minimum spacing 8 ft. (2.4m), temperature rating 165F (74C).
    5. Density 0.60 GPM ft2, 4000 ft2, (371.6 M2) area of application, noncombustible obstructed and unobstructed construction, may use the following type sprinklers as options:
        a. K-11 standard application sprinklers, maximum spacing 12 ft. (3.6m), minimum spacing 8 ft. (2.4m), temperature rating 165F (74C).
        b. K- 17 standard application sprinklers, maximum spacing 12 ft. (3.6m), minimum spacing 8 ft. (2.4m), temperature rating 165F (74C).
        c. extended coverage upright sprinkler K- 17 EC (362.9), protection area 196 ft2 (18.2 m2), maximum spacing 14 ft. (4.3m), minimum spacing 10 ft. (3.0m), temperature rating 165F (74C). This is a special application sprinkler and prior consent from the owner and XL GAPS is required for use outside of it application.
        d. extended coverage upright sprinkler K- 25.2 EC (362.9), protection area 196 ft2 (18.2 m2), maximum spacing 14 ft. (4.3m), minimum spacing 10 ft. (3.0m), temperature rating 165F (74C). This is a special application sprinkler and prior consent from the owner and XL GAPS is required for use outside of it application.

B. Sprinkler Heads

1. Upright or Pendent Type [P]: In all unfinished areas; as required.
    a. Manufacturer:
        1) Star Sprinkler, Tyco Fire Products Model SG.
        2) Grinnell, Tyco Fire Products Model "A"
        3) Reliable Model F1.
        4) Viking Micromatic Model M
        5) Central, Tyco Fire Products Model GB Series.
2. Pendent type, chrome plated brass heads [P]: In finished areas below suspended ceilings. Furnish escutcheon plate with baked enamel finish to match ceiling.
    a. Manufacturer:
        1) Grinnell, Tyco Fire Products "Model F972".
        2) Viking Micromatic Model M/Model E-1 Escutcheon
        3) Star Sprinkler Tyco Fire Products, Model SG
        4) Reliable Model F1.
        5) Central, Tyco Fire Products Model GB Series.
3. Concealed type [P]: In sensitive areas and where indicated; provide with a closure over the entire assembly.
    a. Manufacturer:
        1) Grinnell, Tyco Fire Products "Model F976"
        2) Star Sprinkler, Tyco Fire Products QUASAR Model Q.
        3) Reliable Model G1
        4) Viking Model A1.
        5) Central, Tyco Fire Products Model AC.
4. Intermediate type [P]: With head baffles.
    a. Manufacturer:
        1) Grinnell, Tyco Fire Products "Model A"
        2) Viking Corp. "Model M/B-1"
        3) Star Sprinkler, Tyco Fire Products ,Model I-LD-2.
        4) Reliable Model E.
        5) Central, Tyco Fire Products Model Multi-Level Sprinkler A.
5. Sidewall heads [P]: Horizontal or vertical sidewall type.
    a. Manufacturer:
        1) Grinnell, Tyco Fire Products "Model F 950/Q46 or Model A/Q46"
        2) Viking Corp. "Model M"
        3) Star Sprinkler, Tyco Fire Products ,Model LD-2.
        4) Reliable Model G.

5) Central, Tyco Fire Products Model H Series.

6. Temperature rating of heads shall be ordinary temperature, 155 to 165 degF temperature ratings except shall be 50 degF above ambient for temperatures exceeding 100 degF.
7. Sprinkler head guards: Furnish where damage to sprinkler heads may occur, such as stairways, loading docks, aisles with lift truck operations, or within 8 feet of floor.

C. Pressure Gauges (Water) [D]:

1. Bronze Bourdon tube: 0 200 PSI range, 3 1/2 inch dial.
    a. Manufacturer:
        1) Ashcroft Duragauge Model 1005, XUL.
        2) Brecco Corp. Model W-101.
        3) US Gauge Div. Amtek Inc. P-1590.

D. Sprinkler System Control Valves

1. Wet pipe alarm check valve [D]: Flanged or grooved end inlet and outlet complete with standard accessories and trim including pressure gages, necessary intercomponent piping, fittings and valves.
    a. Manufacturer:
        1) Grinnell, Tyco Fire Products ,Model F200 (Flanged) or F2001 (Flange x Groove) or F20 (Groove x Groove).
        2) Star Sprinkler, Tyco Fire Products ,Model E 5900 Series.
        3) Viking Corp. Model H-2.
        4) Reliable Model E.
        5) Central, Tyco Fire Products Model F.
2. Dry pipe valve [D]: Complete with trim and air maintenance device.
    a. Manufacturer:
        1) Viking Corp. "Model E"
        2) Grinnell, Tyco Fire Products “Model F302”(Flanged) or F3021 (Flange x Groove)
        3) Grinnell, Tyco Fire Products Star Sprinkler, Tyco Fire Products, “Model A”.
        4) Reliable Model D.
        5) Central, Tyco Fire Products ,Model AF.
        6) Victaulic Series 705W.
3. Deluge valveMfrMdl [D]: Complete with trim, release panel and detectors.
    a. Manufacturer:
        1) Grinnell, Tyco Fire Products “Model F445 or F470”.
        2) Viking Corp Model E-1.
        3) Star Sprinkler, Tyco Fire Products Model G.
        4) Reliable Model BX.
4. Preaction valve [D]:

a. Manufacturer:
   1) Grinnell, Tyco Fire Products ,"Model A 4".
   2) Viking Corp. Model E-1.
   3) Star Sprinkler, Tyco Fire Products Model G
   4) Reliable Model BX.

E. Pressure Maintenance Device
   1. Pressure maintenance device [D]:
      a. Manufacturer:
         1) Viking Corp. "Model D-2".
         2) Grinnell, Tyco Fire Products "Model F-324".
         3) Star Sprinkler, Tyco Fire Products "Model A".
         4) Reliable Model A-2.
         5) Central, Tyco Fire Products ,Model D1.

F. Accelerator
   1. Accelerator [D]:
      a. Manufacturer:
         1) Viking Corp. "Model D-1".
         2) Grinnell, Tyco Fire Products ,"Model F311".
         3) Star Sprinkler, Tyco Fire Products "Model B-B".
         4) Reliable Model B.
         5) Central, Tyco Fire Products Model A.
   2. Retarding Chamber [D]:
      a. Manufacturer:
         1) Grinnell, Tyco Fire Products Model F211.
         2) Star Sprinkler, Tyco Fire Products Model D.
         3) Reliable Model E-1.
         4) Viking Model C.
         5) Central, Tyco Fire Products Model F.

2.5 ALARM DEVICES

A. *Flow Alarm, Vane type [D]:* With 2 DPDT contacts which will energize alarm circuit on deflection by flowing water that equals or exceeds the capacity of a single sprinkler head.
   1. Manufacturer:
      a. Tyco VSR
      b. Potter Electric Signal Co. Model VSR-F
      c. Reliable Model A

d. Viking Corp. Model VSR-F

B. *Low pressure alarm switch [D]:* Two sets of adjustable, DPDT contacts. One set shall close on pressure decrease, the second set shall close on further pressure decrease.

1. Manufacturer:

a. Tyco PS10-2A

b. Potter Electric Signal Co. Model PS10-2

c. United Electric Controls Co. Model 5835

d. Viking Corp. Model A-1

C. *Valve supervisory switch [D]:* Unit shall contain one or two single pole, double throw switches, mounting hardware, and accessories necessary to monitor unauthorized closing of water supply to automatic sprinkler system, by actuating a remote signaling device when the water supply valve is turned from the full open position.

1. Manufacturer:

a. Tyco OSY-SU or PVCS

b. Guardian Fire Equip. Co. Model No. 7247

c. Potter Electric Signal Co. Model OSYSU-A2

d. Potter Roemer Figure 6220

D. *Electric alarm gong [D]:* Assembly shall include an U.L. Listed gong with non-staining, weather resistant mounting. Wiring will be provided as part of Work under Division 16 Sections.

1. Manufacturer:

a. Guardian Fire Equip. Co. Model No. 7276

b. Potter Electric Signal Co. Model PSB

2.6 PORTABLE FIRE EXTINGUISHERS

A. Contractor furnished through "Section 1.9- NATIONAL ACCOUNTS" of this document.

Occupancy	Extinguisher Type	Extinguisher Rating	Coverage Sq. Ft.	Travel Distance Allowed Ft.
Office Areas	2 1/2 gallon pressurized water. 10 pound CO2 by copy machines. Fire Extinguisher Cabinet shall be designed for surface, semi-recessed, recessed or trimless mounting, with 22 gauge steel box, one piece 22 gauge tubular steel door with cam latch, double	2A	6000	75

	strength clear glass or solid metal door panel with identification decal, one piece 20 gauge steel frame with continuous steel hinge and brass pin, and white baked enamel finish.			
Computer Rooms	20 Pound Carbon Dioxide. 2 1/2 gallon pressurized water.	10 B:C 2A	NA 6000	75 75
Manufacturing, Body Shop, Press Shop, Assembly, Engine Plants, Storage.	20 Pound ABC Multi-Purpose Dry Chemical.	20A:120B:C	11,250	75
Paint Shops, Paint Spray Booths & Ovens, Heated Flash Zones, Tank Enclosure in Dipping and Coating Areas, Labs, Paint Mix, Paint Storage.	20 Pound ABC Multi Purpose Dry Chemical.	20A:120B:C	NA	50
Electrical Rooms, Sub Stations, Major Electrical Panels & Robotic Equipment.	20 Pound Carbon Dioxide.	10B:C	NA	50

2.7 ELECTRICAL WIRING

A. Electrical wiring: Install or reconnect load side wiring disconnected for shipment; for replacement or additional wiring required, provide as part of the Work of this Section per applicable requirements of Division 16 Sections.

2.8 SUPPORTING ELEMENTS

A. *Supporting elements [D]:* Provide UL/FM components per NFPA 13, ANSI B 31.1 and MSS SP-58 and SP-69 except that "C" clamps or any modifications thereof are unacceptable.

B. Furnish necessary piping and equipment supporting elements including; building structure attachments; supplementary steel; hanger rods, stanchions and fixtures; vertical pipe attachments; horizontal pipe attachments; anchors; guides.

C. All hanger rods shall connect to approved "I" beam or channel clamps, concrete inserts or expansion shields. Provide all concrete inserts and structural members required for the proper support of fire protection piping. "C" clamps with or without retainer straps may not be used on piping 3" and larger. Top beam clamps with retaining straps (as specified) may be used on pipe sizes up to and including 2-1/2" nominal diameter; install lock nut on hanger rod above retaining strap.

D. "C" clamps without retaining straps are not permitted. Retaining straps not required in office buildings. Office areas located within the plant require retaining straps.

Pipe Size	Manufacturer	Model No.
Clevis Hangers		
Up to & incl. 4" diameter	Anvil International	65
Up to & incl. 8" diameter	Anvil International	260
	B-Line	B3100
	M-Co.	400
	Witch	100
Adjustable Swivel Rings		
Up to & incl. 8" diameter	Anvil International	69
	B-Line	B317ONF
	M-Co.	100
	Witch	800
Beam Clamps		
Up to & incl. 8" diameter	Anvil International	218 with extension piece No. 157
	B-Line	B3054
Up to & incl. 12" diameter	Anvil International	134
	B-Line	B3050
Top C-Clamps with Retaining Straps		
Up to & incl. 2-1/2" diameter	Anvil International	92 or 93 with retaining strap
		equal to or

		greater than B-Line B3367. B3033 or B3034 with B3367.
Up to & incl. 2-1/2" diameter	M-Co.	300 or 310 with 301 retaining strap.
	Witch	192 with restraining strap.

1. Hangers for overhead piping shall comply with NFPA 13 Standard as to size, load capacity and spacing. Special supports and hangers shall be completely detailed and shall meet with the approval of the Underwriters and Owner's Representatives.
2. Suspension from roof deck or cellular floor deck will not be permitted.
3. Vertical piping supports within the column web shall consist of a strut with mechanical type fastening to the column flanges, and pipe clamp attached to the strut. Pipe clamps shall be U.L. labeled, FM approved. Minimum strut section modulus shall be equal to or greater than that listed in NFPA 13 for trapeze hangers.
    a. Pipe clamp shall be B-Line Systems, Inc. B2400 Series or equal.
    b. Strut column support shall be B-Line Systems, Inc. Model No. B613A or equal.

2.9 MISCELLANEOUS MATERIALS

A. Painting:
    1. Refer to Division 9 Section for requirements.
B. System Identification:
    1. Refer to Division 15 Section for requirements.
C. *Fireproof Wall and Floor Sleeves [P]*:
    1. Aboveground sleeves:
        a. Provide standard weight black carbon steel pipe sleeves where piping passes through roofs, floors and concrete or masonry walls. Location of sleeves shall be coordinated with other DIVISIONS for incorporation into the Work as construction progresses.
        b. Provide cast-in-place sleeves, fabricated from pipe with welded anchor lugs.
        c. Sleeves through steel decks shall be welded with a continuous weld to the deck.
        d. Where sleeves are placed in existing concrete or masonry, use pipe size core drills and secure sleeve watertight with EPOXY BONDING COMPOUND. Do not load sleeves without approval of Owner's Representative.
        e. Set sleeves flush with walls, under sides of suspended slabs and top surface of floors in

finished spaces. Set sleeves flush with walls and 2 inches above finished floor in manufacturing and equipment room spaces, unless otherwise indicated. Set sleeves a minimum of 9 inches and a maximum of 12 inches above finished roof.

f. Refer to Division 7 Section for requirements, packing and sealing of space between the piping and the inside of sleeve.

2. Below grade sleeves:

a. Provide below grade wall sleeve and modular floor and wall seal to assure protection against the penetration of flames, smoke, gases, and water for three hours.

b. Sleeve shall be manufactured from heavy wall welded or seamless steel pipe with full circle, continuously welded water stop plate, to assure positive water sealing on the O.D. of the sleeve and no thrust movement. Sleeve shall be finished with enriched red primer to assure metal surface protection.

1) Thunderline “Link-Seal” Wall Sleeves.

c. Modular floor and wall seal shall be constructed of inorganic materials to provide protection against the penetration of flames, smoke, gases, water and temperatures in excess of 1900 degF for three hours. Sealing elements shall be fire resistant silicone rubber with steel pressure plates and shall meet ASTM Standard E-119-76.

1) Thunderline “Link-Seal, Pyro-Pac”.

D. Escutcheons:

1. Nonferrous, chrome plated, except if fabricated from AISI 300 Series Stainless Steel, one-piece or split pattern type shall maintain fixed position against a surface by internal spring tension or set screws.

E. Flashing: Refer to Division 7 Section for requirements.

F. Epoxy Bonding Compound: Refer to Division 7 Section for requirements.

G. *Bituminous Coating [P]*: Refer to Division 7 Section for requirements.

H. Splash Blocks:

1. Precast concrete splash blocks.

15300.3 EXECUTION

3.1 ABOVEGROUND PIPING INSTALLATION

A. Fabrication, Assembly, Erection

1. Install piping per NFPA 13, Owner’s Underwriters and governmental authorities having jurisdiction.

2. Clean pipe, tubing, fittings, valves, equipment and accessories of extraneous foreign material and dry the components before installation into their respective systems. During construction, protect open ends of pipe, fittings and valves to prevent the admission of foreign matter. Place plugs in the ends of installed work at the end of the day and whenever work stops. Use commercially manufactured plugs. Fabricate pipe to measurements established on the project site; work pipe into place without springing

or forcing. Provide for absorbing movement without undue stress in any part of the system.

3. Install piping straight and true, with approved offsets to increase headroom and avoid obstructions. Provide specified drainage where piping offsets are required.
4. Use standard pipe fittings for changes in direction. No mitered joints or field fabricated pipe bends will be permitted. Short radius elbows may be used where specified or specifically authorized by the Owner's Representative. Copper tubing may be bent in the field with the use of approved tube bending equipment.
5. Make tee connections with screwed tee fittings, grooved or specified welded connections. Make welded branch connections with either welding tees or forged branch outlet fittings per ASTM A 234, ANSI B16.9 and ANSI B16.11. For forged branch outlets, furnish forged fittings flared for improved flow where attached to the run, reinforced against external strains and to full pipe-bursting strength requirements. "Fishmouth connections" are not acceptable.
6. Provide unions, grooved couplings, or bolted flanges to permit removal of equipment, valves and piping accessories from the piping system. Make final connections to equipment with unions or flanges located between equipment and valves.

B. Joints

1. Ream pipe ends. Make up screwed joints with joint compound. Apply joint compound to the male thread only; prevent compound from reaching the interior of the pipe. Provide leak-tight joints without stressing fittings.
2. Make up screwed joints with Teflon tape per manufacturer's instructions.
3. Hot work permit shall be approved by the site Security before any hot work is started. Perform field welding and cutting in approved areas per referenced codes and standards. Provide welded joints utilizing chill rings in black carbon steel piping systems sized 2-1/2 inch and larger, except where consumable insert rings, flanges and unions are specified or indicated. The Contractor may use socket or butt welded joints in lieu of screwed joints, sizes 2 inches and under.
4. Assemble flanged joints with fresh-stock gasket and hex head nuts, bolts or studs. Make clearance between flange faces such that the connections can be gasketed and bolted tight without strain on the piping system. Align flange faces parallel and bores concentric; center gaskets on the flange faces without projection into the bore.
5. Lubricate bolts with oil and graphite before assembly to insure uniform bolt stressing. Draw up and tighten bolts in staggered sequence to prevent unequal gasket compression and deformation of the flanges. Do not mate a flange with a raised face to a companion flange with a flat face; machine the raised face down to a smooth matching surface and use a standard ring gasket. After the piping system has been tested and is in service at its maximum temperature, check bolting torque to provide required gasket stress.
6. Cut copper tubing square for socket joints; remove burrs with approved cutting and reaming tools. Clean inside of fittings and outside surfaces of tubes in joint area with stainless steel wool before assembly of joint. Apply joint flux, filler material and heat source per manufacturer's instructions to provide proper capillary action to fill the socket space and to achieve 100% of shear-line strength. For valves in copper piping include screwed ends with end adaptors to suit mechanical connections, unless filler jointing is specified or indicated for a given application. Remake copper joints which fail pressure tests with new materials including pipe or tubing fittings and filler metal.
7. Cut copper tubing square for mechanical joints; remove burrs with approved cutting and reaming tools. Do not work-harden copper surfaces; in case of doubt, cut off tube ends or anneal ends by heating to a temperature and air cooling per manufacturer's instructions.

8. Silicone components are not allowed.

C. Joints Of Dissimilar Metals

1. At connections between piping systems, hangers and equipment of dissimilar metals, insulate, using dielectric insulating material, nonferrous piping against direct contact with the building steel by insulating the contact point of the hanger and pipe or the hanger and building steel. Test each point of dielectric insulation with an ohmmeter to insure proper isolation of dissimilar materials. Test shall be observed by the Owner's Representative.

D. Grooved Couplings And Fittings

1. Grooved pipe couplings and fittings shall be as specified and indicated. Select manufacturer's recommended gaskets for the piping contents.

3.2 SPRINKLER HEADS

A. Space heads per lighting, building equipment layout and NFPA 13. Because the sprinkler heads may be installed before the lighting, ducts, piping and equipment are installed, locate heads referring to Contract Drawings to prevent conflicts. Equipment location shall have priority over sprinkler head and piping location. No sprinkler pipe shall pass through air ducts.

B. Aesthetically locate sprinkler heads in finished administrative function spaces with respect to ceiling patterns, tile patterns, masonry bonds and similar construction lines. Locate sprinklers on center of tile or quarter point of ceiling tile.

C. Upon completion of installation and prior to any painting work, protect heads with rubber band secured plastic or paper bags. Removal of bags is specified as part of work of another Section.

3.3 BUILDING SURFACE PENETRATION SLEEVES AND CALKING

A. Sleeves are required where piping passes through roofs, floors and concrete or masonry walls. Provide sleeves required for this Work in cooperation with the work provided under other DIVISIONS for incorporation into the Work as construction progresses.

B. Provide cast-in-place sleeves, fabricated from pipe with welded anchor lugs.

C. Sleeves through steel decks shall be welded with a continuous weld to the deck.

D. Where sleeves are placed in existing concrete or masonry, use pipe size core drills and secure sleeves watertight with EPOXY BONDING COMPOUND. Do not load sleeves without approval of Owner's Representative.

E. Set sleeves flush with walls, under sides of suspended slabs and top surface of floors in finished spaces. Set sleeves flush with walls and 2 inches above finished floor in manufacturing and equipment room spaces, unless otherwise indicated. Set sleeves a minimum of 9 inches and a maximum of 12 inches above finished roof.

F. Pack space between bare or insulated pipe and the inside of sleeve with mineral wool or fibrous glass. Where vapor barrier is required, add 3/8 inch deep calking on both sides of packing.

G. Seal piping passing through aboveground sleeves weathertight with packing and calking. Calk expandable inserts exposed to weather.

H. With Owner's Representative's approval, silicone foam may be used in lieu of the foregoing for interior applications.

3.4 ESCUTCHEONS

A. Provide escutcheons at all surface penetrations of piping into finished areas. Where finished areas are separated by partitions through which the piping passes, provide escutcheons on both sides of the partition. Where suspended ceilings are installed, provide escutcheons at the underside only.

3.5 FLASHING AND COUNTERFLASHING

A. Provide flashing and counterflashing to maintain building weather tightness.

3.6 PAINTING

A. Refer to Division 9 Section.

3.7 SYSTEM IDENTIFICATION

A. Refer to Division 15 Section.

3.8 FIELD QUALITY CONTROL

A. General

1. Test equipment per the manufacturer's published instructions, NFPA and as specified for the system.

B. Piping Systems Testing

1. Test piping systems per NFPA 13, 14 and 24, applicable governing codes, such as State, local or insurance codes, and the requirements of Owner's insuring agency.
2. Provide the necessary equipment and materials and make necessary test connections required to properly execute tests. Tests shall be witnessed by Owner's Representative and authorized inspectors (or representatives) having jurisdiction, who shall be timely notified by the Contractor to insure their being present during the testing.
3. Perform tests before piping is painted or concealed. Immediately correct defects discovered during the tests and retest the systems to the complete satisfaction of the Owner's Representative and the inspectors (or representatives) authorized to approve the piping installation. Correct any piping system, or any portion thereof, which does not conform to the best current installation practices of the trade. Such corrections shall be at no additional cost to the Owner

3.9 FLUSHING AND DISINFECTING

A. Flushing and disinfecting shall be witnessed by Owner's Representative and authorized inspectors (or representatives) having jurisdiction, who shall be timely notified by the Contractor to insure their being present during the procedure.

B. Disinfect piping if required to comply with applicable codes.

C. Flush piping per NFPA 13 or 24 at a velocity of not less than 10 FPS.

D. Provide additional system controlled or uncontrolled openings necessary to achieve specified velocity.

E. If sufficiently high velocities cannot be practically obtained, "lance" piping prior to flushing with high pressure

water oroil-free compressed air jets.

F. Submit for approval proposed means of disposing of flushing water.

3.10 COMMISSIONING

A. Commissioning shall be witnessed by Owner's Representative and authorized inspectors (or representatives) having jurisdiction, who shall be timely notified by the Contractor to insure their being present during the procedure.

B. Verify that specialty valves, trim, fittings, controls, and accessories are installed and operate correctly.

C. Verify that air compressors and their accessories are installed and operate correctly.

D. Verify that specified tests of piping are complete.

E. Verify that damaged sprinklers and sprinklers with paint or coating not specified are replaced with new, correct type.

F. F. Verify that sprinklers are correct types, have correct finishes and temperature ratings, and have guards as required for each application.

G. Verify that potable-water supplies have correct types of backflow preventers.

H. Drain dry-pipe sprinkler piping.

I. Pressurize and check dry-pipe sprinkler piping air-pressure maintenance devices and air compressors.

J. Verify that hose connections and fire department connections have threads compatible with local fire department equipment.

K. Fill wet-pipe sprinkler piping with water.

L. Fill standpipes with water.

M. Verify that hose connections are correct type and size.

N. Verify that hose stations are correct type and size.

O. Energize circuits to electrical equipment and devices.

P. Start and run air compressors.

Q. Adjust operating controls and pressure settings.

R. Coordinate with fire alarm tests. Operate as required.

S. Coordinate with fire-pump tests. Operate as required.

3.11 DEMONSTRATION

A. Demonstrate equipment, specialties, and accessories. Review operating and maintenance information.

B. Schedule demonstration with Owner, XL GAPS, and authorities having jurisdiction with at least seven days' advance notice.

15400 - PLUMBING FIXTURES & EQUIPMENT

15400.1 GENERAL

1.1 Summary

A. Scope

1. Refer to Section Division 15 Section “Basic Mechanical Materials and Methods.”

2. Provide all plumbing as shown or specified, including components, accessories and trim for a complete installation.

3. DRAINAGE SPECIALTIES

a. Cleanouts and P-traps.

B. Related work specified in other sections:

1. Division 15 Section “Basic Mechanical Materials and Methods.”

1.2 Quality Assurance

A. Requirements Of Regulatory Agencies

1. Provide plumbing work per applicable State and Local codes.

1.3 Project Conditions

A. Field Measurements: Coordinate roughing-in and final fixture locations and verify that plumbing fixtures can be installed to comply with original design and referenced standards.

15400.2 PRODUCTS

2.1 Plumbing Fixtures and Trim

A. General

1. Provide fixtures with trim necessary for a complete assembly and functioning installation, including supplies, risers, stops, drains, escutcheons, couplings, gaskets, nuts, fasteners, seats and fittings.

2. Provide fixtures basically selected from a single manufacturing source and of like quality and material.

3. Provide combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

4. Provide rough-in per manufacturers published instructions.
5. For exposed to view trim, including surface penetration escutcheons, support escutcheons and fasteners, furnish chromium-plated or nickel-plated brass with polished, bright surfaces, normally referred to as “chrome-plated”.
6. All plumbing fixtures in barrier free environment shall be in compliance with ADA. Where lavatories are indicated with the symbol (HCP), furnish unit complete with thermostatic tempering valve in faucet supply piping, and cover hot water and drain piping with a molded closed cell vinyl insulation from lavatory to wall.
7. Vitreous china fixtures shall be color as selected by the ARCHITECT from the manufacturer’s standard color schedule, except where otherwise specifically noted.

B. Fixture Supports

1. Ferrous metal carriers: Support wall hung fixtures; furnish and select for the particular installation conditions. Securely bolt carriers to the supporting surface.
2. Enameled iron support: For fixtures specified with support surfaces not concealed by support escutcheons.
3. Concealed adjustable arm carriers: With steel pipe uprights and buttress foot block bases; to support lavatories. Conceal lavatory fixture support arms by means of secure, deep drawn, chrome plated escutcheons.
4. Carriers: With adjustable fittings, drain connections and buttress foot block bases; to support water closets.
5. Carriers: With mounting plates, steel pipe uprights and buttress foot block bases; to support urinals.
6. High extension type carriers: Furnish for water closets and urinals, for the handicapped.
7. Chair carriers: To support medical sinks except as otherwise specified.
8. Manufacturers:
   a. Josam.
   b. J. R. Smith.
   c. Wade.
   d. Zurn.

2.1.1 Sinks

A. **TYPE S-1** [C]:

1. 18 Gage, Stainless Steel, single bowl under-mount sink. Lustrous Highlighted Satin finish, 3-1/2" drain. L: 30-1/2"; W: 18-1/2"; H: 4-3/8". Provide compatible drain fitting as required.
   a. Elkay model ELUHAD281645PD with model LKPDAD18B drain fitting.

2.1.1.1 Sink Faucets

A. **TYPE SF-1** [C]: One-piece, metal construction, single lever handle and self-contained ceramic disc valve for volume and temperature control. 9" gooseneck 360 degree rotation swing spout with matching finish side spray feature.

1. Kohler model K-6333-CP

2.2 Floor Drains

A. Floor Drains (FD)

1. Floor drains shall conform to applicable portions of ANSI/ASME A112.6.3. Provide floor drains with: Traps, except where otherwise indicated; running traps below ground floor shall have extension cleanouts on house side; inside caulk outlets on ground floor; threaded or caulk outlets to match piping for suspended slabs; bottom outlets except where otherwise indicated or required; seepage pans and weepholes and clamping collars for slabs with membrane or metal pan waterproofing. BITUMINOUS COATING, factory or field applied to all surfaces before rusting occurs except grate. Provide hopper drains with grates.

2. Provide following types, where indicated. Series numbers given represent basic style only and do not necessarily include required modifications or sizes.

3. **TYPE FS-1** [C]: Floor Sink. Cast iron body, 12" square, 8" deep receptor with acid resistant coated interior and nickel bronze rim and hinged top grate with stainless steel 1/2" mesh lined aluminum sediment bucket. Provide sure-seal trap guard. Provide flashing clamp in membrane floors.

   a. Josam 49340A-NB

   b. Smith 3410

   c. Wade 9140-1

d. Zurn Z1920

4. **TYPE FD-1** [C]: Floor Drain. Cast iron body, adjustable 7 inch diameter, with funnel, polished nickel-bronze strainer, and sure-seal trap guard.

   a. Josam 30000-5C.

   b. Smith 2010-A".

   c. Wade W-1100-STD.

   d. Zurn Z-415-7"B.

2.3 Cleanouts (CO)

A. Raised head cleanout plugs: Provide cast brass, except as indicated.

B. Gasketed gas and liquid tight cleanouts: Provide where under pressure or required for space function.

C. Cleanouts and access: Provide in finished spaces as approved by the Architect-Engineer.

D. Seepage flange and weephole: Provide in cleanouts in slabs not on ground floor.

E. Inside caulk outlets: Provide on the ground floor.

F. Seepage flanges, weep holes and flashing clamp: Provide in cleanouts in floors with membrane or metal water proofing.

A. **TYPE CO-1 [C]:**

1. Round, polished cover of size to completely cover hole in wall. Fasten cover to plug with flat head countersunk screw.

   a. Josam 58600.

   b. Smith 4710.

   c. Wade W-8480-R.

   d. Zurn Z-1460-9.

B. **TYPE CO-2 [C]:**

1. Scoriated bronze alloy cover with cast iron body, threaded bronze plug; secure to plug with countersunk screw.

   a. Josam 56030.

   b. Smith 4045.

   c. Wade W-7010-S

   d. Zurn Z-1400

2.4 P-Trap

A. Extra heavy cast iron: For connection to type CISP piping.

2.5 Hub Outlet (HO)

A. Hub: End of TYPE CISP pipe.

2.6 Air Gap

A. Cast iron fitting [C]: With air gaps, threaded inlet and outlet, size as indicated.
   1. Josam Series 88900.
   2. Smith 3955 Series.
   3. Zurn Z-1025 Series.

B. Riser Sleeve
   1. Riser Sleeve [C]: Cast iron with anchor lugs and flashing clamp. Threaded each end for pipe sleeve extensions with flashing clamp ring, pressure ring, and bolts.
      a. Josam 46400.
      b. Smith 1760.
      c. Zurn Z-197.

2.7 Miscellaneous Materials

A. Escutcheons: Manufactured from nonferrous metals and chrome plated, except when AISI 300 Series stainless steel is provided.

B. Flashing: Lead for floor drains shall be fabricated from 4 pound, 36 inch square sheet lead.

C. Bituminous Coating [C,P]:
   1. Koppers “Bitumastic 50”.
   2. Porter Coatings Div. of Porter Paint Co. “Tarmastic 101”.

D. Calking: Silicone, white, Type RTV.
   1. Dow .
   2. General Electric .

2.8 Extension of Piping System

A. Piping fittings and valves: Chrome plated, polished surface red brass or bronze.

B. Piping [C]: Schedule 40 red brass per ASTM B 43.

C. Pipe fittings *[C]:* Threaded brass or bronze per ANSI B16.15.

D. Stop valves and check valves: Straight or angle, cast or bar stock body and trim brass, bronze or stainless steel, rated for system service conditions. Compression type service rated valves are acceptable for water service through 1/2 inch IPS. Other valves per Division 15 Section "Valves," except that body and trim finish may be "brushed" in lieu of "polished". Valve wheels shall be "four lever" type for compression type valves and round or "four lever" type for other valves.

15400.3 EXECUTION

3.1 Drainage Specialties Installation

A. Cleanouts

1. Provide cleanouts where indicated and as required by the applicable codes. Aesthetically locate cleanouts with respect to tile patterns, masonry bond and alignment. Coordinate installation with concrete and masonry work.
2. Connect underground system cleanouts by means of long sweep 1/4 bends or two 1/8 bends. Cleanouts in connection with threaded pipe, where indicated and accessible, shall be cast iron drainage, T-pattern, 90-degrees branch fittings with extra-heavy brass screw plugs of the same size as the pipe up to and including 4 inches.
3. Where cleanout plugs extend beyond the wall finish, furnish machine finished brass plates of sufficient depth to fit against the wall and cover the plug. Paint cleanout cover plates to match adjacent wall finish in lieu of being plated or polished.
4. Remove each threaded cleanout plug from the assembly and make free turning. Reassemble plugs with tetrafluorethylene tape applied to threads or lubricated with waterproof grease. Cleanout surfaces, which remain accessible after installation, shall be protected by plastic films during concrete placing operations.
5. Prior to acceptance of the system, demonstrate that cleanout plugs are easily removable and that cleanouts can be easily rodded with standard rodding tools in the space or clearance provided.

15800 - AIR DISTRIBUTION

15800.1 GENERAL

1.1 SUMMARY

A. Scope

1. Provide labor, materials and equipment to provide air distribution and exhaust systems, including accessories as necessary to provide properly functioning installations.

B. Description Of Systems

1. ABOVEGROUND SYSTEMS

a. Galvanized sheet metal ductwork, 2" WG, positive or negative, except as otherwise indicated on the Drawings, minimum Seal Class B, per SMACNA (HVAC Duct Construction Standards)(Round Industrial Duct Constructions Standards)(Rectangular Industrial Duct Constructions Standards).

b. Acoustically lined galvanized sheet metal ductwork, 2" WG positive or negative, except as otherwise indicated on the Drawings, minimum Seal Class B, per SMACNA (HVAC Duct Construction Standards) (Round Industrial Duct Constructions Standards)(Rectangular Industrial Duct Constructions Standards).

C. Related work specified in other sections:

1. Division 15 Section "Basic Mechanical Materials and Methods."
2. Division 15 Section "Thermal Insulation."
3. Division 15 Section "Heating Ventilation and Air Conditioning Equipment."
4. Division 15 Section "Testing and Balancing."
5. Division 13 Series Sections for Instrumentation and Control Work.

1.2 QUALITY ASSURANCE

A. Reference Standards

1. Standards of SMACNA:

a. HVAC Duct Construction Standards (DCS).

b. Fibrous Glass Duct Construction Standards (FGDCS).

c. Thermoplastic Duct (PVC) Construction Manual (TDCM).

d. Rectangular Industrial Duct Construction Standards.

e. Round Industrial Duct Construction Standards.

f. Manager's Guide for Welding.

g. Testing, Balancing and Adjusting of Environmental Systems.

2. NFPA 90A, Air Conditioning & Ventilating Systems.
3. NFPA 90B, Installation of Warm Air Heating and Air Conditioning Systems.
4. NFPA 91, Blower & Exhaust Systems.
5. NFPA 96, Vapor Removal From Commercial Cooking Equipment.
6. ACCA, Air Conditioning Contractor's Association.
7. ACPA, American Concrete Pipe Association.

8. ACGIH "Manual of Recommended Practice for Industrial Ventilation".
9. ADC, Air Diffusing Council.
10. ASHRAE Fundamentals Handbook.
11. AISI, American Iron and Steel Institute.
12. ANSI, American National Standards Institute.
13. API, American Petroleum Institute.
14. ASTM, American Society for Testing and Materials.
15. AWS, American Welding Society.
16. FS, Federal Specifications.
17. NBS, National Bureau of Standards.
18. Wherever the words "should", "recommended", "it is recommended", "preferred" or "must" appear in the text of the referenced standards, interpret them as the word "shall", to indicate mandatory conformance. Where the words "can" and "may" are similarly used in conjunction with an option which would result in superior quality or strength construction, interpret them as "shall".

1.3 SUBMITTALS

A. Furnish submittals for items that are identified in this Section by a different typeface and a bracketed code (*e.g., Item [L]*). Refer to Division 1 Section "Shop Drawings, Product Data and Samples" and Division 15 Section "Basic Mechanical Material and Methods" for definition of codes for types of submittals and the administrative requirements governing submittal procedure. Additional submittal requirements pertaining to this Section are specified herein under this Article.

B. Submit shop drawings of ductwork and plenums. Show details of joint construction, supports, reinforcement, access doors, fitting configuration and accessory installation for construction where these are field conditions or specified options.

C. Submit a schedule of proposed air diffusion devices, indicating type, location, air quantity, neck or jet velocity, pressure drop, throw and diffusion range. Identify air diffusion devices using Contract DRAWING DESIGNATIONS. Include sound data for supply air diffusion devices in terms of sound power level in octave bands 2 through 8, and NC Index for the capacity range of the device. Where no room attenuation is indicated, 8 dB shall be assumed. Where no noise criteria data is indicated, NC-40 shall be assumed.

D. Submit shop drawings for VARIABLE VOLUME BOXES which include sound ratings in terms of discharge sound power levels in each of the second through seventh octave bands for indicated inlet pressure range. Show a nominal space NC Index for at least three volume ratings, which include set point and maximum and minimum ratings.

E. Attenuation required shall be as specified. Submit for each attenuator application, as part of the shop drawings, certification that the sound reduction required will be obtained with the length of device proposed, and a graphic system noise spectrum indicating: Proposed fan sound power level; attenuation of ducting system as proposed to be installed and based on referenced ASHRAE Fundamentals Handbook for bends, branches and other duct system construction details; sound pressure level without sound trap; attenuation required; excess attenuation compared to specified NC curve.

F. Furnish data regarding loads and forces imposed on building structure by proposed work sufficiently in advance of the required work to permit analysis of structure for proposed loads and forces.

G. Submit for each exhaust stack, flue, chimney, or vent, suggested reinforcement of building structure, other support requirements, wire or structural steel guy configuration, stack support loads, guy loads on guy anchors, and stack

flashing and seal.

H. *Test report [R]:* Submit to certify testing and rating of air diffusion devices per Air Diffusion Council (ADC) Test Code 1062 R2.

I. *Test report [R]:* Submit test reports of each system as described under FIELD QUALITY CONTROL.

15800.2 PRODUCTS

2.1 DUCTWORK MATERIALS

A. Sheet Metal - Galvanized

Sheet Metal:	Mill galvanized steel of lock forming quality per ASTM A 653; Coating Designation G-90.
Sheet Metal:	Cold rolled copper per ASTM B 152.
Reinforcing and Supports:	Mill rolled galvanized structural steel shapes per ASTM A 36, mill galvanized per ASTM A 123, when material is not in contact with copper.
	Mill or warehouse rolled, Copper Development Association copper alloy No. 260 or 360 leaded, free machining, 1/2 hard, when material is in contact with copper.
Rivets:	Copper, button head, annealed.
Brazing:	Silicon bronze per AWS A5.6.
Gaskets:	Chloroprene elastomer 40-50 Durometer, 1/8 inch thick, full face, one piece vulcanized or dovetailed at joints.

B. Double-Walled Panels, Plenums And Duct

1. *Sandwich type panels [D]:* Construct from smooth or embossed mill finish aluminum facing sheets. Each panel shall contain an integral frame of extruded aluminum bonded to the facing sheets to provide a moisture tight seal at the panel perimeter. Panels shall be load bearing and capable of forming the plenum or duct without the installation of structural members. Join panels together with extruded aluminum mullions and fasten with closed end rivets. Make connections to the duct or plenum using a support mullion extrusion which is an integral part of the panel and not bolted to or through the panel. Gasket all joining mullions with a double vinyl gasket and a

double butyl gasket to provide a permanent, air tight seal. Design panel skins, core density, rib spacing and mullion spacing to eliminate panel pulsation and to produce a maximum deflection of 1/200 of any span at design pressure, positive or negative. The overall "U" factor of the panel shall not exceed 0.14 BTU/sq.ft./degF.

2. *Acoustic absorptive panels [D]:* Per NFPA 90A with perforated aluminum inner facing sheet with a core of mineral wool or fibrous glass. Core materials such as polyurethane or polystyrene are not acceptable. Solid transmission panels shall have a solid aluminum facing sheet with a core of mineral wool.
3. *Access doors and removable panels [D]:* Same construction as panels above. Use double seals around periphery to guarantee tight closure. Provide 12 x 12 inch viewing window in all doors. Provide windows located downstream of cooling coils of insulating glass type.
4. *Acoustic ducts and plenums [D]:* Assemble utilizing a panel system as manufactured by a recognized manufacturer of panel systems. The manufacturer shall have published literature available stating the coefficient of absorption and the sound transmission loss characteristics of the panel system per ATSM C 423 and the sound transmission loss properties per ASTM E 90 and E 413. Published acoustic properties technical data shall show the trade mark or name of the manufacturer, shall be made by a recognized independent testing laboratory and shall specify the coefficient of acoustic absorption and attenuation by octave band. Submit acoustic performance data in graphic and tabular form as part of the shop drawings. Panel absorption coefficients and sound transmission loss by discrete frequency for 2-1/2 inch thick panels shall be as follows:

Frequency (Hz)	125	250	500	1000	2000	4000
Transmission Loss (dB)	14	22	28	35	43	48
Absorption Coefficient	.3	.7	.95	.95	.95	.85

5. The duct and plenum systems, in addition to any indicated equipment, scheduled maximum system operating pressure and system test pressure, shall be capable of sustaining 35 lb. per sq. foot maintenance function loads without permanent deformation or damage.
    a. United McGill Corp.
    b. Semco Mfg. Co.

C. Sheet Metal - Galvanized Spiral

1. Duct and fittings: Galvanized sheet steel lock forming quality per ASTM A 527, Coating Designation G-90, factory fabricated, lock seam or welded design per SMACNA (HVAC Construction Standards)(Round Industrial Duct Constructions Standards)(Rectangular Industrial Duct Constructions Standards).
    a. United Sheet Metal Div., United McGill Corp.
    b. Semco Mfg. Co.

D. Brazing Materials

1. Silicon bronze: Per AWS A5.6 or A5.7.

E. Welding Materials

1. Welding materials: Refer to SMACNA "Manager's Guide for Welding" for applicable requirements.

F. Packing

1. Mineral fiber: Per FS HH-I-558, Form B, Class 8.

G. Caulk

1. Elastomer caulk: UL Listed and per NFPA 90A.

a. Benjamin Foster No. 30-02.

b. United Sheet Metal , “Duct Sealer”.

c. Miracle Adhesives Corp. “Miracle D615”.

H. Inorganic Zinc Rich Paint

1. Inorganic zinc rich paint [P]:

a. Carboline , “Carbo-Zinc”.

b. Tnemec.

c. Koppers.

I. Pressure-Sensitive Tape

1. *Pressure-sensitive tape [P]:*

a. Hardcast, Inc.

2.2 DUCTWORK SPECIALITIES

A. Flexible Connectors - For Indoor Use

1. *Fabric [P]:* UL Listed and conforming to NFPA 90A, 30 ounce, waterproof and non-combustible, air-tight, glass fabric double coated with fire-retardant polychloroprene. Minimum clear width, not including clamping section, shall be 6 inches.

a. Ventfabrics, Inc. , “Ventglas”.

B. Flexible Connector - For Corrosive Applications

C. Duct Acoustic Lining

1. Duct Acoustic Lining: Per SMACNA HVAC Duct Construction Standards, Flexible Type, minimum 1 inch thick except as otherwise indicated on Drawings, in sheet metal ductwork where indicated. Increase size of ductwork to maintain original inside design dimensions. Density of the insulation including surface coating or facing not less than 1.5 pounds per cubic foot nor greater than 2 pounds per cubic foot, conforming to U.L. Standard 181 Class 1, and shall be impregnated on the surface exposed to air stream per ASTM C 1071 and NFPA 90A. Air stream side of the liner shall withstand air velocities of 4000 FPM without delamination or erosion. Perforated metal inner wall, where required, shall be minimum 22 gage galvanized steel sheet.

	DENSITY, PCF
Owens-Corning “Aeroflex” (Flexible).	2
Manville “Linacoustic” (Flexible).	1-1/2
Certainteed Corp. “Ultralite” (flexible).	1-1/2 or 2
Knauf Duct Liner M (Flexible).	1-1/2

D. Acoustic Lining Accessories

1. *Adhesive [P]:*

a. Foster 85-11.

b. Insul-Coustic Div., Berma Products Corp .

c. Vimasco Corp .

2. *Sealants and edge sealing mastic [P]:*
    a. Foster 85-48 or 30-36.
    b. Insul-Coustic Div., Berma Products Corp .
    c. Vimasco Corp .
3. Mechanical fasteners: Per (HVAC Duct Construction Standards)(Round Industrial Duct Constructions Standards)(Rectangular Industrial Duct Constructions Standards).

E. Duct Probe Access
1. Duct probe access: Provide plugs with threaded or twist-on cap fittings.
2. Duct probe access fittings will be provided as part of the Work under another Contract.

F. Flexible Duct
1. Flexible duct connectors: Rated and tested under UL-181 Class 1 Material, and comply with NFPA 90A. Maximum length shall be 5 feet unless otherwise indicated.
2. Galvanized spring steel or aluminum spiral helix and glass cloth duct: Insulated with fibrous glass and vapor barrier jacketing to provide a C factor of 0.23. Working pressure 1-1/2” WG. Diameter as indicated.
    a. Owens-Corning “Fiberglas” INL-25.
    b. Flexmaster Type 5.
3. Factory fabricated assembly consisting of a three layer laminate of aluminum foil, fiberglass and polyester. It shall be mechanically locked without adhesives into a formed aluminum helix on the ducts outside surface. The duct material shall be factory wrapped in a thick blanket of fiberglass insulation with a C factor of .23 or less. The insulation shall be encased in a fire retardant polyethylene protective vapor barrier with a perm rating of not over .1 grains per square foot per hour, per inch of mercury. The flexible duct shall be U.L. listed 181 Class I air duct and comply with NFPA90A and 90B and have a flame spread of not over 25 and a smoke developed of not over 50. The flexible duct shall have a minimum pressure rating of 12" W.C. through a temperature range of -20 degrees F. to +250 degrees F.
    a. Flexmaster Type 3.
    b. Flexible Technologies Inc. , “Thermaflex” Type M-KH.
4. *Round duct type access section [P]:*
    a. United Sheet Metal Div., United McGill Corp. Type AR-W.

G. Access Doors
1. Duct access door: Construct per (HVAC Duct Construction Standards)(Round Industrial Duct Constructions Standards)(Rectangular Industrial Duct Constructions Standards), minimum size 10 x 15 inches unless otherwise precluded by duct dimensions. Insulated doors shall be double panel type with outer panel flush with duct insulation.
2. Commercial equivalent doors: May be used on approval of proposed product samples.
    a. Air Balance Inc .
    b. American Warming and Ventilating Inc .

H. Fire Dampers And Wall Sleeves (Collars)
1. *Parallel blade type fire dampers [P]:* Constructed and labeled per, UL 555 Class “B” rating. For link loads in excess of 20 pounds, furnish UL Listed quartzoid links. Fabricate operating element for housing external to air stream. Fabricate wall collars per UL 555.

a. Ruskin Mfg. Co. Model FD-35 Series.

b. Air Balance Inc .

2. *UL Labeled curtain type fire damper Constructed and labeled per, UL 555 [P]:* Store curtain out of air stream.

a. Air Balance, Inc . Type B.

b. Ruskin Mfg. Co. Model IBD-2 Style B.

I. Automatic (Power Operated) Dampers

1. Automatic dampers: Except where integral with packaged units furnished as specified in Division 13 Series Sections for installation as part of the Work of this Section.

J. Extractors

1. *Extractor (controllers) [P]:* Provide where indicated on low pressure branch take-offs and at registers.

2. Air extractors shall consist of fully adjustable, gang operated blades, with movement from fully closed to fully opened position and shall be same size as duct, as indicated on the drawings. Extractor shall be adjustable by control knob mounted in bottom of duct.

a. Titus Model AG-45 with operator No. 1.

b. Tuttle and Bailey , Model 990 VLC.

c. Agitair Model DF Scooptrol.

d. Anemostat DT.

K. Turning Vanes For Right Angle Elbows And Branch Tees

1. Turning vanes shall be provided in all right angle elbows and branch tees. Turning vanes shall be factory fabricated, true airfoil design with smoothly rounded entry nose and extended trailing edge, mounted on pre-punched sidepieces of the same make as the vanes proper. Spacing of vanes shall be as defined by sidepiece punching but in no case shall spacing exceed 2-1/2 inches. Single sheet-turning vanes and shop-fabricated turning vanes are prohibited.

2. Where right angle elbows have an outlet size dimension different from inlet size or a branch tee fitting has unequal outlets requiring the turning vane assembly to be installed in duct fitting at an angle other than 45 degrees, sidepieces of split rail design shall be provided to permit adjusting vanes to required airflow configuration.

a. Aero/Dyne Company H-E-P.

L. Short Radius Elbows (Rectangular Duct)

1. Wherever obstructions necessitate a throat radius which is less than duct width and air velocity exceeds 1000 FPM fabricate splitter vanes as smooth single elements per SMACNA HVAC DUCT CONSTRUCTION STANDARDS Fig. 2-6.

M. Air Balancing Station

1. *Air flow measuring and balancing station [D]:* Permanently installed same size and configuration as the duct in which it is installed, have a pressure drop not exceeding 0.5” WG, sound rating of NC-45 at the rated flow and shall be suitable for system. Station shall be manufacturer’s standard, galvanized steel with integral or separate opposed blade damper and external high and low pressure connections. Factory test the station and provide a suitable CFM chart. Provide an instrument kit consisting of a dry-type differential pressure indicator having the required range, two lengths of tubing of sufficient length to connect balancing station and indicator and means for adjusting opposed blade damper. Instrument kit shall become Owner’s property on completion of testing and balancing of the air systems.

a. Krueger “K” Station.

b. Titus B-35.

c. Cambridge Filter Corp. Type FMS.

d. Anemostat Type TAB.

e. Barber-Colman Model HQM Series.

N. Solvent Cement

1. Solvent cement: Virgin, unpigmented PVC resin per applicable requirements of ASTM D 2564.

O. Air Diffusion Devices

1. General Terminal air diffusion devices have been chosen in terms of specific air distribution requirements, spacing, and sound characteristics. Provide ADC certified manufacturer's standard devices. Refer to mechanical drawings for locations of air diffusion devices and grilles.

   a. Provide plaster frames for units installed in plaster ceilings.

   b. Provide gaskets for supply terminal air devices mounted in finished surfaces.

   c. Install wall mounted supply registers 6 inches below ceiling unless otherwise indicated.

   d. Provide aluminum air diffusion devices with anodized exposed-to-view surfaces. Provide steel air diffusion devices with specified finish. Where aluminum components are mixed with steel components, finish shall be as specified for steel air diffusion devices. Finish and color shall be as selected by the Architect-Engineer. Provide air diffusion device interior surfaces, including blank-offs, with black matte finish.

   e. Provide supply diffusers with damper and equalizing grid. Damper shall be extracting splitter type unless otherwise specified.

   f. Air volume and pattern adjustments shall be made from the face of the device.

2. *Diffusers [P]:* Provide the following: Refer to mechanical schedules. Not all items below are used on the project.

   a. Supply diffuser, square, perforated hinged face plate with equalizing grid, opposed blade damper, white baked enamel exterior surface finish, and black matte exposed to view interior surface finish for lay-in T-bar ceiling. Provide deflection as indicated.

      1) Anemostat Model PD Series.

      2) Titus Model PAS with Style 3 frame, 24 x 24 inch face, round neck.

      3) Tuttle and Bailey Model CT Series.

      4) Krueger Model 1100 Series.

      5) Price .

   b. Linear bar type, for ceiling sidewall sill installation of extruded aluminum construction, with anodized finish and fixed deflection.

      1) Anemostat Model AL-1 Series.

      2) Titus Model CT Series.

      3) Tuttle and Bailey Model 4000 Series.

      4) Krueger Model 1500 Series.

      5) Price .

   c. Ceiling mounted anodized aluminum supply T-bar or suspended ceiling type slot linear diffuser with integral volume control balancing damper and supply boot. Provide diffuser with 180 degree adjustable pattern controller in 24 inch increments.

1) Anemostat Model SLAD.
2) Titus Model TBD Series.
3) Tuttle and Bailey 6000.
4) Krueger Model TBS.
5) Price .

d. Adjustable blade design, square, steel or aluminum construction with baked off-white enamel finish, size and air pattern as indicated.
   1) Anemostat Model XIC Series.
   2) Krueger Model 180 Series.
   3) Titus Model 250 Series.
   4) Tuttle and Bailey Model A40 Series.
   5) Price .

e. Supply diffuser, square faced, round neck with four or more expanding flared members to radially diffuse discharge air in a fixed pattern.
   1) Type 1 - Surface mounted, prime painted.
   2) Type 2 - Metal pan, snap-in mounted, factory finished.
   3) Type 3 - “T” bar mounted, factory finished.
   4) Type 4 - Spline mounted, factory finished.
      a) Anemostat Model EA-1.
      b) Titus Model TMS.
      c) Krueger 1400 Series.
      d) Tuttle and Bailey Model DM
      e) Price .

f. Supply diffuser, square faced, round neck with four or more expanding flared members to radially diffuse discharge air. Pattern adjustment ranges from horizontal to vertical projection including intermediate points.
   1) Type 1 - Surface mounted, prime painted.
   2) Type 2 - Metal pan, snap-in mounted, factory finished.
   3) Type 3 - “T” bar mounted, factory finished.
   4) Type 4 - Spline mounted, factory finished.
      a) Anemostat Model EA-1.
      b) Titus Model TMSA.
      c) Krueger 1400-ADJ Series.
      d) Tuttle and Bailey Model DA
      e) Price .

g. Supply diffuser, square pattern and square neck with combination damper and equalizing grid and white baked enamel exterior surface finish.

1) Anemostat Model “D” Series.
2) Krueger Model S or SH.
3) Titus Model TDC.
4) Price .

h. Linear, 1/2 inch slot type, extruded aluminum construction.
1) Anemostat Model SLAD.
2) Titus Model ML-37.
3) Krueger Model 1900-50.
4) Price .

i. Round industrial type diffuser with combination damper and equalizing grid and flow pattern adjustment from full horizontal to full vertical accomplished by manual means without disassembling the diffuser. Phosphate treated steel finished with manufacturer’s standard off-white paint.
1) Titus Model XC-310.
2) Anemostat Model HU-4 with DE-2 radial deflector.
3) Krueger Model RA Series.
4) Price .

j. Industrial drum type rectangular device with gang operated louvers and opposed blade dampers, anodized extruded aluminum construction. Adjustable components shall retain fixed position. Fluttering vanes or failure to retain fixed drum position shall be sufficient cause to reject installed device.
1) Michigan Air Products Model AMAP.
2) Krueger Series DPL.
3) Titus Model DL.
4) Price .

k. Mushroom type diffuser, size as indicated, cast iron construction with manufacturer’s standard finish, anchors for casting in place and permanent locking tamperproof adjustment.
1) Aladdin Heating Corp .

l. Ceiling Diffuser (VAV Type) shall be thermally powered variable air volume cooling and heating type with relief air collar. Unit shall be of square configuration suitable for modular ceiling installation and have smooth appearance bottom panel. Diffuser shall contain a thermal thermostat-actuator and linkage mechanism that would control discharge air volume in response to changes in room temperature. Unit shall be able to control room temperature within 1-1/2 deg. F of its setting. Room temperature setting shall be field adustable over the range from 70 to 80 deg. F.
1) Progressive Air Products, Inc. "Dynafuser" Model VAV 2 STCHR.
2) Acutherm , "Therma-Fuser."

3. *Registers [P]:* Provide the following:
a. Supply air register with adjustable face bars parallel to long dimension and rear bars parallel to short dimension, adjustable by key or lever from face. Furnish with extruded vinyl gasket and opposed blade damper.

1) Anemostat Model S2H0.
2) Titus Model 272-RL5.
3) Krueger Model 880H-OBD.
4) Price .

b. Aluminum exhaust registers with fixed eggcrate face panel, and opposed blade dampers.
1) Anemostat Model GC5O.
2) Krueger Model EGC-5-OBD.
3) Titus Model 50F5.
4) Price .

c. Steel, exhaust register, fixed face bars and opposed blade dampers with baked, off-white enamel finish. For vertical installation (walls), provide unit with fixed horizontal face bars set at an angle of approximately 45 degrees down and parallel to long dimension.
1) Anemostat Model S3HOD.
2) Titus Series Model 23RL5.
3) Krueger Model S80H-OBD.
4) Price .

d. Return register, fixed face bars set straight and parallel to short dimension, steel construction with baked, off-white enamel finish.
1) Anemostat Model S3VOS.
2) Titus Model 13 RS5.
3) Krueger Model S80VZ-OBD.
4) Price .

e. Supply air register, prime coated, pressed steel with opposed blade dampers. Units constructed as double deflection type, with adjustable face bars parallel to long dimension, opposed blade dampers, adjustable by key or lever from face.
1) Anemostat Model S2HO.
2) Titus Model 272-RL5.
3) Krueger Model 880H-OBD.
4) Price.

f. Supply register, industrial type, extruded aluminum or primed steel with 3/4 inch minimum depth blades, core style as noted and 2 sets of louvers (front-vertical and individually adjusted, rear-horizontal and gang operated) with damper.
1) Anemostat 1GS2V.
2) Titus Model JFA-S.
3) Hart and Cooley AIG Series.
4) Krueger Model 6880-15-V-OBD-HD.

g. Heavy duty gym return or exhaust register, face bars straight and parallel to short dimension, integral opposed blade damper, zero degree deflection, steel construction, prime coated.

1) Anemostat HDOS or EHDOS.
2) Titus Model 30RS.
3) Krueger Model S480 VZ-OBD.
4) Price .

4. *Grilles [P]:* Provide the following:
   a. Square , steel perforated return and transfer grille with removable face, for lay-in in T-bar ceiling.
      1) Anemostat Model PDLR.
      2) Titus Model PAR.
      3) Krueger Model 1190-FR23.
      4) Price.
   b. Return air aluminum bar type grille (linear diffuser) with 0 degree deflection and 1/2 inch spacing.
      1) Anemostat Thinline Model TAL.
      2) Tuttle and Bailey Model 4000.
      3) Titus Model CT-580.
      4) Krueger Model E01600 Series.
      5) Price.
5. *Fixture Diffusers [P]:* Provide the following:
   a. Saddle type diffusers for supply and return service, sized to fit the lighting troffer fixtures provided as part of the Work under Division 16 Series Sections.
   b. Dual plenum saddle (troffer) type, fabricated of galvanized steel and fitted with top round inlet or side oval inlet equivalent to 6 inch round duct. Size to fit light fixture. Provide unit with 180 degree adjustable air pattern and volume damper.
      1) Supply Units (Insulated): Insulated with external 1/2 inch thick glass fiber with vapor barrier or internally lined with 1/2 inch thick glass fiber insulation complying with NFPA 90A.
         a) Anemostat Model LPRT.
         b) Krueger ADLT Model TE/SE.
         c) Price .
      2) Return Units (Not Insulated)
         a) Anemostat Model PRT.
         b) Krueger ADLT Model RTE/RSE.
         c) Price .
   c. Single plenum side saddle (troffer) type, fabricated of galvanized steel and fitted with side oval inlet equivalent to 6 inch round duct. Size to fit light fixtures.
      1) Supply Unit (Insulated): Insulate with external 1/2 inch thick glass fiber with vapor barrier or internally lined with 1/2 inch thick glass fiber insulation complying with NFPA 90A.
         a) Anemostat Model LPRT.
         b) Titus Model LTTI.

c) Krueger ADLT Model SE.

d) Price .

2) Return Unit (Not Insulated):

a) Anemostat Model PRT.

b) Titus Model LTT.

c) Krueger ADLT Model RSE.

P. Variable Volume Single Duct Terminal Box

1. PRESSURE-INDEPENDENT BOX (WITH AND WITHOUT REHEAT)

a. *Variable Volume Box [D]:* Pressure independent variable and constant air volume terminal boxes with casing, pneumatic, electronic or DDC controlled volume regulators, damper operator, sound attenuation thermal insulation and with or without heating coils as indicated. Provide a multi-port velocity pickup probe which averages the velocity distribution across the terminal box inlet to assure accurate flow sensing. Volume regulators shall be guaranteed to shut with less than 2% leakage 5 inches W.G. Total pressure drop across the terminal box shall not exceed 1 inch W.G.

b. Construct unit casing of mill galvanized steel, minimum 20 gage, with removable panels for access to interior parts. Insulate units internally with minimum 1 inch thick, dual density glass fiber thermal and acoustical insulation per NFPA 90A and UL 181 and designed to resist erosion at surface velocities to 4,000 fpm. Terminals shall be tested, certified and labeled under ARI Standard 880-94. (Alternate fiber free insulation for IAQ: Insulate units internally with 3/8 inch thick, 1.5 lb/cu.ft. density engineered polymer foam insulation with a minimum thermal conductivity of 0.25 BTU-in/hr-sq.ft. at 75 degF. Insulation shall have flame spread rating not exceeding 25, smoke developed less than 20 and no mold growth potential.)

c. Terminal box sound levels shall not exceed the noise criteria for the area served as outlined in the ASHRAE Guide and Data Book latest edition.

d. For options, which include electronic or DDC control, install electrical components in a NEMA 1 enclosure with an easily removable cover for access, service and calibration of components. Unit shall be UL listed and labeled. Provide the space sensors for field installation.

e. Provide units as scheduled.

f. Electric reheat shall be slip-in blast coil type, including built-in components, limit safety devices, and interconnecting wiring. Units shall be UL Listed, zero clearance construction, meeting NEC requirements, complete with mercury contactors, control circuit transformers, fuses, disconnect switch, integral junction boxes. Coils shall be exposed type.

g. Distance between coil and upstream inlet valve position shall assure uniform air velocities over face of coil. Provide access to inlet and outlet sides of coil.

h. Air volume and the reheat output shall be controlled by a single room thermostat designed to modulate the air volume to the scheduled minimum before reheat is applied. Controls per Division 13 Instrumentation and Control Series Sections.

i. Manufacture:

1) Titus Model ESV-3000 Series.

2) Tuttle & Bailey . ECON-O-FLO Model H Series.

3) Krueger Model LMHS.

4) Anemostat Model FA Series.

5) Environmental Technologies.

6) Price.

Q. Variable Air Volume Parallel Fan Powered Terminal Box for Underfloor Air Distribution Applications

1. PRESSURE INDEPENDENT BOX (WITH OR WITHOUT REHEAT)

a. *Constant Volume Box [D]:* Pressure independent variable air volume, parallel fan powered terminal boxes with casing, pneumatic, electronic or DDC controlled volume regulators, damper operator, sound attenuation thermal insulation and with or without heating coils as indicated. Provide a multi-port velocity pickup probe which averages the velocity distribution across the terminal box inlet to assure accurate flow sensing. Normally open volume regulators shall be guaranteed to shut with less than 2% leakage 5 inches W.G., and fully open upon loss of control air. Total pressure drop across the terminal box shall not exceed 1 inch W.G.

b. Construct unit casing of mill galvanized steel, minimum 20 gage, with removable panels for access to interior parts. Insulate units internally with minimum 1 inch thick, dual density glass fiber thermal and acoustical insulation per NFPA 90A and UL 181 and designed to resist erosion at surface velocities to 4,000 fpm. Terminals shall be tested, certified and labeled under ARI Standard 880-94. (Alternate fiber free insulation for IAQ: Insulate units internally with 3/8 inch thick, 1.5 lb/cu.ft. density engineered polymer foam insulation with a minimum thermal conductivity of 0.25 BTU-in/hr-sq.ft. at 75 degF. Insulation shall have flame spread rating not exceeding 25, smoke developed less than 20 and no mold growth potential.)

c. Terminal box sound levels shall not exceed the noise criteria for the area served as outlined in the ASHRAE Guide and Data Book latest edition.

d. Install electrical connections and control components in a NEMA 1 enclosure with an easily removable cover for access, service and calibration of components. Unit shall be UL listed and labeled. Provide the space sensors for field installation.

e. Mount fan assembly on rubber and shear vibration isolators and attach to an energy efficient, ECM type, single phase motor of a voltage scheduled on the drawings.

f. Provide a 1 inch thick, replaceable filter on the induced air inlet.

g. Distance between coil and upstream inlet valve position shall assure uniform air velocities over face of coil. Provide access to inlet and outlet sides of coil.

h. Air volume and the reheat output shall be controlled by a single room thermostat designed to modulate the air volume to the scheduled minimum before reheat is applied. Controls per Division 13 Instrumentation and Control Series Sections.

i. Manufacture:

1) Titus Model TQP Series.

2) Tuttle & Bailey.

3) Krueger Model

4) Anemostat Model

5) Price.

6) Trane.

2.3 MISCELLANEOUS

A. *Sandwich type panels [D]:* Double-walled insulated units. Construct from mill finish aluminum or galvanized steel facing sheets. Each panel shall contain an integral frame bonded to the facing sheets to provide a moisture-tight seal at

the panel perimeter. Panels shall be load bearing and capable of forming the wall without the installation of structural members. Join panels with mullions and fasten with closed end rivets. Gasket mullions and building surface junctions with a gasket to provide a permanent air-tight seal. Design panel skins, core density, rib spacing and mullion spacing to eliminate panel pulsation and produce a maximum deflection of 1/200 of any span at wind velocities up to 100 MPH. The overall "U" factor of the panel shall not exceed 0.14 BTU/sq.ft./degF.

1. Modulam Panels, Inc.
2. United McGill Corp.
3. Semco Mfg., Inc.

B. Bird screens: No. 2 mesh, 0.063 inch diameter galvanized wire bird screen with an open area of not less than 72%. Conceal sharp edges by adding metal edging consisting of rod, flat or angle iron, or 16 gage galvanized sheet metal turned over at least 3/4 inch on both sides.

C. Heat shrinkable bands: Polyethylene, with heat softening epoxy sealant for round slip fit duct joints.

D. Bituminous coating:

1. Koppers "Bitumastic 50".
2. Porter Coatings Div. of Porter Paint Co. "Tarmastic 101".
3. Dampney Co.

E. Epoxy Bonding Compound: Two-component system.

1. Copolymer Chemical, Inc. Detroit, MI , "Crete Tac".
2. H. B. Fuller Co., St. Paul, MN, "BC-013-14".
3. W. R. Grace Co., A. C. Horn Products, Chicago, IL , "Thiopoxy-63".

F. Chemical coatings:

1. Heresite-Salkaphen, Inc. "Heresite P-403".
2. Ceilcote No. 9314 with V-201 vinyl lacquer.

G. *Waterproofing [P]:* Materials for the system specified consist of: Primer-sealer; neoprene base coating with continuous roving glass fiber reinforcing if standard with the manufacture; neoprene wearing course with granules; Hypalon weathering and color coating; reinforcing materials, sealant and flashing compounds and sheet flashing, all compatible with the basic materials as required for a complete installation. Coating color shall be as selected by the Architect-Engineer from the manufacturer's standard colors.

1. Gaco Western "Gacoflex".

2.4 DUCT SUPPORTS

A. Refer to Article "DUCT AND EQUIPMENT SUPPORT SYSTEM".

15800.3 EXECUTION

3.1 DUCTWORK FABRICATION

A. Fabricate sheet metal construction per "REFERENCED STANDARDS", except as modified and supplemented by this

SPECIFICATION.

B. Ductwork located below bottom chord of manufacturing building trusses or joists shall be two gages heavier than that specified for the actual class of that ductwork, unless specified herein or shown on the drawings.

C. Fabricate ductwork to prevent failure under pressure or vacuum created by fast closure of ductwork devices. Provide leaktight automatic relief devices where indicated.

D. Fabricate necessary offsets and transformations to avoid interference with the building construction, piping, or equipment. Make easements (streamliners) for duct obstructions per SMACNA (HVAC Duct Construction Standards)(Round Industrial Duct Constructions Standards)(Rectangular Industrial Duct Constructions Standards).

E. Where ducts pass through fan room floors, or walls, finish wall openings with angle iron frames. The space around the ducts shall be packed and sealed with mineral wool insulation and mastic.

F. Where ducts pass through walls and floors, finish wall openings with metal trim strips, and curb floor openings where indicated. Use metal sleeves; wood frames are not permitted.

G. Duct dimensions on Drawings are interior dimensions. Dimensions shall be increased as necessary to compensate for liner thickness.

H. Where rectangular sheet metal ductwork is indicated, on approval by the Architect-Engineer, equivalent capacity round ductwork may be substituted.

I. Ducts exhausting shower rooms shall be aluminum sheet metal soldered watertight and pitched to the shower-bathroom registers.

J. Outside air intake ducts and housings shall be sheet metal, soldered watertight and provided with drains where indicated.

K. Outdoor ductwork shall be sheet metal and soldered watertight.

L. Evaporative condenser discharge ductwork shall be sheet metal, soldered watertight and pitched to evaporative condenser.

M. Dishwasher exhaust ductwork shall be watertight and pitched down to dishwasher. Weld and finish stainless steel ductwork. Solder aluminum ductwork.

N. Kitchen hood exhaust ductwork shall be welded construction except where flanged components (hood and fan) are provided. Provide cleanout doors on minimum 10’-0” centers.

O. Ductwork containing a humidifier shall be sheet metal and soldered watertight for a minimum distance two feet upstream of humidifier and 10 feet downstream of humidifier.

P. Repair galvanized surfaces damaged by method of duct fabrication by the application of zinc rich paint per manufacturer’s instructions.

Q. Enclose dampers located behind architectural intake or exhaust louvers in a sheet metal collar and seal to building construction.

R. Crossbreak or bead rectangular sheet metal ducts (including externally insulated ducts). Where sheet metal is not crossbroken or beaded, increase sheet metal gage by four gage numbers, i.e., 24-gage crossbroken equal to 20 gage not crossbroken.

S. Where ducts pass through fire-walls or floor dividing conditioned spaces from unconditioned spaces, provide a flanged duct-segment for installation during the time of wall construction, to provide a tight, hermetic seal.

3.1.1 Rectangular Ductwork

A. Rectangular Ductwork

1. Rectangular ducts, unless otherwise noted, shall be smooth inside and true to sizes as shown on plans and in accordance with the following:

   a. Classification

Static Pressure Construction Class:	2" W.G. maximum
Velocity Level:	2500 FPM maximum
Seal Classification:	Class C
Leakage Classification:	Class 24

Sheet Metal Minimum Thickness

Dimension of Longest Side	Gage
Up through 12"	26
13" through 30"	24
31" through 54"	22
55" through 84"	20
over 84"	18

   b. Classification

Dimension of Longest Side	Gage
Up through 24"	24
25" through 48"	22
49" through 72"	20
73" through 96"	18
over 96"	16

Sheet Metal Minimum Thickness

Dimension of Longest Side	Gage
Up through 18"	24
19" through 30"	22
31" through 60"	20
61" through 84"	18
over 84"	16

   c. Classification

Static Pressure Construction Class:	6" W.G. maximum
Velocity Level:	Over 2000 FPM

Seal Classification:	Class A
Leakage Classification:	Class 6

Sheet Metal Minimum Thickness

Dimension of Longest Side	Gage
Up through 48"	22
49" through 60"	20
61" through 72"	18
over 72"	16

d. Classification

Static Pressure Construction Class:	6" W.G. maximum
Velocity Level:	Over 2000 FPM
Seal Classification:	Class A
Leakage Classification:	Class 6

Sheet Metal Minimum Thickness

Dimension of Longest Side	Gage
Up through 48"	22
49" through 60"	20
61" through 72"	18
over 72"	16

e. Classification

Static Pressure Construction Class:	10" W.G. maximum
Velocity Level:	Over 2000 FPM
Seal Classification:	Class A
Leakage Classification:	Class 6

Sheet Metal Minimum Thickness

Dimension of Longest Side	Gage
Up through 30"	22
31" through 60"	18
over 60"	16

2. Rectangular Duct Reinforcement

   a. Contractor shall conform to the rectangular duct reinforcement tables of SMACNA's current edition of "HVAC DUCT CONSTRUCTION STANDARDS" for each static pressure class but within following guidelines:

      1) Button punch snaplock seams and drive slip joints are not approved.

      2) Reinforcement for rectangular ductwork shall be as follows:

         a) Longitudinal joints shall be Pittsburgh lock type and shall be sealed with Minnesota Mining & Manufacturing Company's EC-800 or as approved sealing compound.

         b) Transverse joints shall be 1-1/2" companion angles with mastic sealer caulking and neoprene gasket.

         c) All rectangular supply ducts up to 36" wide shall have transverse 1" x 1" x 1/8" angle iron stiffener on all sides on maximum of 36" centers. Ducts wider than 36" shall be provided with 1-1/2" x 1-1/2" x 1/8" angle iron stiffeners on all sides on maximum of 36" centers.

      3) Manufactured duct joint connectors may be submitted for approval, prior to installation instead of shop fabricated connectors. Acceptable duct joint manufactured product, when approved for use by Owner, shall be "Ductmate" by Ductmate Industries, Inc.; "Nexus Duct" by Exanno Products Limited; or as approved.

3.1.2 Round Ductwork

A. Round ductwork shall be fabricated as detailed on drawings and as specified herein. Sealing compound shall be same as used for rectangular ducts and tape shall be Mystik 5808 C, Duro-Dyne Corporation's or as approved, industrial tape, 2" wide for ducts up to 20" diameter and 3" wide for ducts over 20" diameter.

1. Classification

Static Pressure Construction Class:	2" W.G. maximum
Velocity Level:	2500 FPM maximum
Seal Classification:	Class C
Leakage Classification:	Class 12

Sheet Metal Minimum Thickness

Duct Diameter	Spiral Seam Gage	Longitudinal Seam Gage	Fittings Gage
Up through 8"	28	24	24
9" through 14"	26	24	24
15" through 26"	24	22	22
27" through 36"	22	20	20
37" through 50"	20	18	18
51" through 60"	18	16	16
over 60"	18	16	16

2. Classification

Static Pressure Construction Class:	10" W.G. maximum
Velocity Level:	Over 2000 FPM maximum
Seal Classification:	Class A
Leakage Classification:	Class 3

Sheet Metal Minimum Thickness

Duct Diameter	Spiral Seam Gage	Longitudinal Seam Gage	Fittings Gage
Up through 8"	26	24	24
9" through 14"	26	24	24
15" through 26"	24	22	22
27" through 36"	22	20	20
37" through 50"	20	20	20
51" through 60"	18	18	18
over 60"	18	16	16

3.2 DUCTWORK AND PLENUM FABRICATION

A. Turning Vanes For Right Angle Elbows And Branch Tees

1. Cut individual turning vanes exactly to required length. Cuts shall be neat and square. Turning vanes will not be accepted if they are cut short, are cut on a bias or exhibit jagged cuts.

B. Square Elbows

1. Provide double vane duct turns in accordance with SMACNA DCS Fig. 2-3 or commercial equivalent products as approved by the Architect-Engineer.

C. Outlets, Inlets And Supply Duct Branches

1. Install branches, inlets, and outlets in such manner that air turbulence is reduced to a minimum and air volume will be properly apportioned and as follows:
   a. Where a duct branch is to handle more than 25% of the air handled by the duct main, use a complete 90 degree increasing elbow with an inside radius of 0.75 times branch duct width. Fabricate the size of the leading end of the increasing elbow within the main duct in the same ratio to the main duct size as the ratio of the relative air quantities handled.
   b. Where a duct branch is to handle 25% or less of the air handled by the duct main, furnish a branch connection of 45 degrees, straight or radius tap-in with volume damper.
2. Where supply ducts have side outlets without branch ductwork, such as registers or grilles, provide turning vanes with manual adjustment.

D. Supply Duct Transitions

1. Where the shape of a duct changes, the angle of the side of the transition piece shall not exceed 15 degrees from

the straight run of duct connected thereto, unless otherwise indicated.

2. Where equipment is indicated in ductwork, the angle of the side of the transition piece from the straight run of duct connected thereto shall not exceed 15 degrees on the upstream side of the equipment and 22-1/2 degrees on the downstream side of the equipment, unless otherwise indicated.

E. Tee Connections

1. Construct tap-ins per SMACNA HVAC Duct Construction Standards Fig. 2-6, unless otherwise indicated.

F. Access Openings And Doors

1. Provide insulated access doors and panels in insulated ductwork. Fabricate access doors and panels in ductwork per SMACNA (HVAC Duct Construction Standards)(Round Industrial Duct Constructions Standards)(Rectangular Industrial Duct Constructions Standards) for the following locations:
   a. Upstream and downstream from coils.
   b. Adjacent to fire dampers at the fusible link.
   c. At controls or items requiring periodic inspection, adjustment, maintenance or cleaning.
   d. Where indicated.
2. Size access openings minimum 18 by 15 inches unless precluded by duct dimensions.
3. Make duct access provisions suitable for commercial practice duct cleaning methods utilizing vacuum devices. Space access openings with a frequency and at points, which will permit ready access to duct with no duct or insulation cutting. Where access through an air diffusion device or through access doors is not available at a specific point, provide 8 inch diameter 16 gage access plates at not more than 10 foot centers. Where duct is insulated and vapor sealed, provide mastic seals around circumference of access. When access plate is in place and insulated, provide external identification of location.

G. Round Duct Requirements

1. Provide duct, fittings, joints and reinforcement per SMACNA HVAC Duct Construction Standards for pressures up to 2” WG positive or negative. For pressures greater than 2” WG negative fabricate per SMACNA Round Industrial Duct Construction Standards. Round duct connections to main shall be:
   a. 45 degree lateral.
   b. Combination tee.
   c. 2-way “Y”.
   d. Conical tee.

3.3 DUCT AND EQUIPMENT SUPPORT SYSTEM

A. General

1. Select and provide duct and equipment support system per SMACNA (HVAC Duct Construction Standards)(Round Industrial Duct Constructions Standards)(Rectangular Industrial Duct Constructions Standards). After system start-up, replace or otherwise alleviate condition of any duct support element which vibrates.
2. Attach hot rolled carbon steel, prime coated hanger rods, angles, and straps to beam clamps, concrete inserts, and masonry anchors and fasteners per SMACNA (HVAC Duct Construction Standards)(Round Industrial Duct Constructions Standards)(Rectangular Industrial Duct Constructions Standards). Set inserts and anchors in conjunction with other Trades. Lugs welded to ducts are not acceptable as sole supports. Powder actuated fasteners into steel or concrete, welded studs, C-clamps, and friction clamps are not acceptable.
3. Do not hang ductwork or equipment from roof deck, piping, other ducts or equipment.

4. Provide not less than one set of two vertical support elements for each point of support and each length of duct. Install supports on sides of duct turns, branch fittings and transitions. Cross-brace hangers vertically and laterally to eliminate sway.
5. Support rectangular ducts in sizes to 36 inches by strap type hangers attached at not less than three places to not less than two duct surfaces in different planes or by trapeze hangers. Perforated strap hangers are not acceptable. Support rectangular ducting 36 inches and larger with trapeze hangers.
6. Use angle iron "V" construction supports or similarly rigid construction for vertical ducting which needs lateral support. Anchor downcomers to building to prevent swaying due to functional operation of any discharge grille directional device. Where no building element is convenient, multi-point cables, structural elements or angle iron may be used.
7. Where ducts are required to have insulation with a vapor sealed facing, support duct on trapeze hangers. Space hangers far enough out from the side of the duct to permit the duct insulation to be placed on the duct inside of the trapeze. Under no circumstances shall duct hangers penetrate the vapor sealed facing.
8. Where ductwork system contains heavy equipment, excluding air diffusion devices and single leaf dampers, hang such equipment independently of the ductwork with rods or angles sized to support the load.
9. Duct hangers in direct contact with galvanized duct surfaces shall be galvanized steel or black carbon steel painted with zinc rich paint.
10. Allowable loads on purlins or the top chord of jack trusses between panel points shall be such as to produce a moment no greater than the moment produced by a one kip concentrated load at midspan of the purlin or jack truss or by the uniform mechanical (utility) load specified on the Drawings. Loads shall not be supported from the top chord of roof or carrying trusses except at their panel points.
11. When the hanger load exceeds the above limits, provide reinforcing of purlin(s) or additional support beam(s). When an additional beam is used, install beam such that it frames into the roof purlin or jack truss top chord or bears on the roof truss top chord panel point.
12. Limit the location of supporting elements for ductwork and equipment when supported from roof to panel points of the bar joists and limit the allowable load on the bar joist such that the loads produce a moment no greater than the moment produced by one kip load at mid-span of bar joist or by a uniform (utility) load specified on the Drawings.
13. When the hanger load exceeds the above limits, provide reinforcing of the roof bar joists or additional structural support as required. When an additional member is used, support the added member at the panel points. Stabilize member by connection to adjacent roof bar joists.
14. Consider bar joists used for supporting fire protection sprinkler mains, electrical lighting fixtures, electrical power duct or cable tray as fully loaded. Supplemental reinforcing of these bar joists or auxiliary support steel shall be furnished and installed by the Contractor.
15. Building structure shall not be reinforced except as approved by the Architect-Engineer in writing.
16. Use approved cast-in-place inserts or built-in anchors for attachment to concrete structure. Size inserts and anchors for the total applied load with a safety factor per applicable codes but in no case less than 5. Coordinate installation of all imbedded items with the Work under other Sections. Installed imbedded items per manufacturer's instructions. Position anchorage and imbedded items as indicated and support against displacement during placing of concrete. Cutting or repositioning of concrete beam or girder to accommodate inserts will not be allowed. Provide removable closures in imbedded device openings to prevent entry of concrete.
17. Support piping and equipment from concrete building frame, not from roof or floor slabs unless otherwise indicated.
18. Use cast-in-place inserts in concrete beams and girders. Masonry and other drilled anchors will not be permitted. Use wedge type inserts on vertical surfaces only.

19. Attach duct supports to the side of concrete joists. Provide supplementary support steel as required. Cast-in-place or drilled anchors will not be permitted in the bottom of concrete joists.
20. Each insert shall be capable of supporting one kip unless otherwise indicated.
21. Where attachment by cast-in-place inserts is not possible, specified or approved masonry anchor devices may be used after submission of test criteria and receipt of written approval by the Architect-Engineer.
22. Allowable loads on precast prestressed concrete floor slabs shall not exceed recommendations of manufacturer. Ductwork and specialties shall be supported wherever possible by means of 14 gage galvanized hanger straps installed in grouted joints between adjacent concrete slabs. Holes, not requiring cutting of prestress strand, shall be core drilled in hollow sections of slabs only in accordance with the manufacturer's standard recommendations. No drilling or cutting of prestress strand portion of slabs will be permitted.

B. PVC Duct Supports

1. Use PVC Duct support members for PVC ductwork per applicable "DUCT AND EQUIPMENT SUPPORTS" specifications above.
2. Supports less than 3 inch in width and assembled to ducting, shall be isolated from direct contact with ducting with 1/8 inch thick elastomer whose width exceeds support width.

C. FRP Duct Supports

1. Use FRP Duct support members for FRP ductwork per applicable "DUCT AND EQUIPMENT SUPPORT" specifications above
2. Supports less than 3 inches in width and assembled to ducting, shall be isolated from direct contact with ducting with 1/8 inch thick elastomer whose width exceeds support width.

3.4 DUCTWORK SPECIALTIES

3.4.1 Acoustic Lining

A. Install duct liner per SMACNA HVAC Duct Construction Standards.

B. The smooth surface of the duct liner shall face the air stream. Duct liner shall be cut to assure overlapped and compressed longitudinal corner joints. Duct liner transverse joints shall be nearly butted and there shall be no interruptions or gaps. Duct liner shall be adhered to the sheet metal with 100% coverage of adhesive, and all exposed leading edges and all transverse joints coated with adhesive. Duct liner shall be additionally secured with mechanical fasteners, which shall compress the duct liner sufficiently to hold it firmly in place.

C. For velocities to 2,000 feet per minute, fasteners shall start within 3" of the upstream transverse edges of the duct liner and 3" from the longitudinal joints and shall be spaced at a maximum of 12" on centers around the perimeter of the duct, except that they may be a maximum of 12" from corner break. Elsewhere they shall be spaced at a maximum of 18" on centers except that they shall be placed not more than 6" from a longitudinal joint of the liner nor 12" from a corner break.

D. For velocities from 2,001 to 4000 feet per minute, fasteners shall start within 3" of the upstream traverse edges of the liner and 3" from the longitudinal joints and shall be spaced at a maximum of 6" on centers around the perimeter of the duct, except that they may be a maximum of 6" from a corner break. Elsewhere they shall be spaced at a maximum of 16" on centers except that they shall be placed not more than 6" from a longitudinal joint of the liner nor 12" from a corner break. In addition to the adhesive edge coating of transverse joints, any longitudinal joints shall be similarly coated with adhesive.

E. For velocities from 4,001 to 6,000 feet per minute, installation shall be the same as for 2,001 to 4,000 fpm, except that

metal nosing shall be installed to secure the duct liner at all upstream transverse edges.

3.4.2 Flexible Connections

A. Provide flexible connection between sheet metal work and vibrating equipment per SMACNA (HVAC Duct Construction Standards)(Round Industrial Duct Constructions Standards)(Rectangular Industrial Duct Constructions Standards). Flexible materials shall be installed loosely without tension at any point and shall be suitable for temperatures and pressures encountered.

B. Install flexible connections after system air moving devices (fans) are operative and vibration isolation mountings have been adjusted. When system fans are operating, connectors shall be free of wrinkles caused by misalignment or fan reaction; width of surface shall be curvilinear.

C. Furnish flexible connections where ducts cross building expansion joint lines.

D. Flexible connections shall be not less than 4 inches long and shall be installed with sufficient slack to prevent transmission of vibration. Circular connections shall be secured to fans and sheet metal with 12 gage, 1" wide metal bands. Rectangular connections shall be secured to fans and sheet metal with 1 by 1/8 inch flat bars fastened with screws or bolts at 8 inch intervals or slip joints similar to those specified for duct joints, the fabric shall be tightly crimped into the slip joint and complete joint shall be fastened with sheet metal screws at maximum 8 inch intervals. Metal for fastening collars shall be the same as specified for ductwork and bracing.

E. Flexible connections shall not be painted.

3.4.3 Duct Probe Access

A. Locate access fittings as required and directed under the Work of Division 15 Section “Testing and Banlancing.”

3.4.4 Air Diffusion Devices

A. Aesthetically locate air diffusion devices with respect to lighting, ceiling patterns and masonry bond, unless otherwise dimensioned or approved.

B. Install wall mounted supply registers as indicated.

C. Install devices per manufacturer’s published instructions.

3.4.5 Balancing Dampers

A. Provide balancing dampers at each duct main and branch.

3.4.6 Flexible Duct

A. Install as straight as possible. Maximum bends shall be 45 degrees. Inlet connections to terminal air units shall be 4 feet of straight run.

3.4.7 Sound Stopping

A. Provide effective sound stopping and adequate operating clearance to prevent structure contact where ducts penetrate

walls, floors, or ceiling into occupied spaces. “Occupied Spaces” include space above ceilings where no special acoustic treatment of ceiling is provided. Make penetrations finish compatible with surface being penetrated.

B. Provide sleeves or flanged duct segments and angle iron framing at time of wall construction.

C. Pack the space between a duct and the inside of a duct sleeve or a construction surface penetration solid with a mineral fiber wherever ducting passes and through equipment room walls, floors and ceilings connected to occupied spaces; other locations where sleeves of construction surface penetrations occur between occupied spaces.

D. Sound stopping and vapor barrier sealing of duct shafts and floor and wall openings, may be accomplished by packing with properly supported mineral fiber insulation and vinyl mastic or by foaming in place with self-extinguishing, silicone foam and cover with 11 gage sheet metal as specified for ductwork. Make vapor barrier of not less than 1/8 inch thickness of UL Listed vinyl mastic applied to visible and accessible surfaces.

3.4.8 Painting

A. Interiors of ducts or construction above ceilings shall not be visible through air diffusion devices. Where interior of duct would be visible, paint the viewed interior flat black as part of the Work under this Section.

B. Where construction above ceiling would be visible, provide sheet metal baffle with turned edges suspended from building construction. Size and position of baffle SHALL NOT restrict air distribution design. Paint baffle black as part of the Work under this Section. Where space above ceiling precludes use of baffle construction, paint visible building surfaces flat black as part of the Work under this Section.

3.5 ADJUSTING AND CLEANING

A. Adjust And Balance Air Distribution Systems

1. Air handling systems balancing and adjustment will be done as part of the Work under another Contract.
2. Air handling systems balancing and adjustment will be done as part of the Work under Division 15 Section “Testing and Balancing.”
3. Perform operational balancing and adjustment of air handling systems per referenced SMACNA Standards, the requirements of the Contract Documents in the presence of the Architect-Engineer.
    a. Work includes a complete mechanical air quantity and thermal survey to define system needs. Certain minimum balancing provisions are indicated. Provide additional balancing or adjusting provisions deemed necessary to effectuate compliance with the Contract Documents at no increase in Contract Sum.
    b. Provide independent laboratory certification of test apparatus component calibration data, dated after date of award of Contract. The Architect-Engineer reserves the right to require recalibration of test apparatus components per the frequency recommended by the component manufacturer, or when reasonable doubt of accuracy exists.
    c. Adjust items of the various systems for proper operation within design intent and operating characteristics as published by the equipment manufacturer. The Architect-Engineer may require the Contractor to provide the services of an authorized representative of the manufacturer in the event that the Contractor is unable to adjust any piece of equipment.
    d. Do not operate equipment for any purpose until properly lubricated and brought into specified service condition per manufacturer’s written instructions.
    e. Permanently mark, or fix by drilling and bolting or pinning of operators, system final adjustment positions, so as to be readily restorable if disturbed.

f. Test fire dampers by applying heat to fusible link to permit operation. Testing shall be done in the presence of the Architect-Engineer. Replace fusible links.

g. Systems acceptance is predicated upon successful completion of specified Work, receipt by the Architect-Engineer of certified data summarizing the performance of systems within design intent, and approval thereof. Following completion of any corrective work and approval of submitted data, provide six bound copies of testing, balancing and adjusting report. Data shall be arranged by system and identified apparatus and items, utilized referenced minimum standard forms where possible, and supplementing with reasonable facsimiles where necessary and single line systems systems diagrams indicating points of adjustment. Records shall be accompanied by two copies of referenced standards used as a basis of testing, balancing and adjusting work.

h. Systems final volume conditions shall be within the following limits:

1) Air handler delivery: Plus 5% minus 0% of design CFM at design temperature.

2) Terminal device delivery: Plus or minus 5% of design CFM at design temperature.

i. Balancing and adjustment apparatus and procedures shall be per the referenced SMACNA Manual.

j. Provide test report on systems tested, test apparatus data, air diffusion device data and include filter apparatus data which includes visual condition, inlet pressure and differential pressure for each filter installation.

k. After balance and adjustment operations have been completed, each system shall be tested as a whole to see that items perform as an integral part of the system and that space conditions are evenly controlled. Corrections and adjustments shall be made as necessary to produce the required space conditions.

l. Provide test report on each system which shall include:

1) Outdoor temperature.

2) Space by space temperature conditions (center of area at table top level).

3) Calculation for total BTU/hr. of cooling required.

4) Calculation for total BTU/hr. of heating required.

B. Ductwork Cleaning Provisions

1. Protect open ducting from construction dust and debris. Clean dirty assembled ducting by subjecting main and branch interior surfaces to air streams moving at velocities two times specified working velocities, at static pressures within maximum ratings. This may be accomplished by: Filter equipped portable blowers which remain the Contractor’s property, wheel mounted, compressed air operated, perimeter lances which direct the compressed air and which are pulled in the direction of normal air flow, other means approved by the Architect-Engineer. Compressed air used for cleaning ducting shall be water and oil free. After construction is complete, and prior to acceptance, remove construction dust and debris from exterior surfaces.

C. Terminal box Installation

1. Provide a minimum of 3 feet of straight rigid sheetmetal on the inlet of each terminal box to assure balance of air velocity across the sensing probe.

2. Locate terminal boxes to permit access to all controls and damper actuators for inspection, service and calibration without disconnecting any ductwork.

END OF SECTION

15950 - TESTING, ADJUSTING & BALANCING OF SYSTEMS

15950.1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Work includes a complete mechanical, fluid and thermal survey to produce design objectives. Provide any additional air handling systems and hydronic systems balancing or adjusting provisions deemed necessary to comply with the Contract Documents, at no increase in Contract Sum.
2. Work includes testing, adjusting, and balancing to complete the mechanical, fluid and thermal Work of this Section.

B. Description Definitions

1. The words “air handling systems” for the purposes of the WORK under this SECTION shall mean heating, ventilating, air conditioning systems as well as process systems provided as part of the WORK under Division 15 Sections.

C. Related Work Specified In Other Sections:

1. Division 15 Section “Aboveground Piping Systems.”
2. Division 15 Section “Air Distribution.”
3. Division 15 Section “Heating, Ventilation, and Air Conditioning Equipment.”
4. Division 16 Section “Environmental Systems Control.”

1.2 QUALITY ASSURANCE

A. Balancing Agency Qualifications

1. Perform operational testing, balancing, and adjusting of hydronic and air handling systems under the direction of an independent balancing agency.
2. Obtain the service of an agency that performs the type of balancing specified. Prior to commencing work under this Section, the testing agency shall have been approved by the Owner’s Representative. The agency shall be a member of the Associated Air Balance Council (AABC) and shall submit adequate documentation as to its competence. Affiliation with manufacturers, installing contractors, or engineering firms not normally engaged in or certified in air balancing work will preclude acceptance. The field representative of the balancing agency shall be a person certified by the State Chapters of the AABC where this work is performed. Perform Work per the standards of the AABC or SMACNA where applicable, the requirements of the Contract Documents and in the presence of the Owner’s Representative.

B. Performance Verification

1. The Owner may, as an option, engage the services of a qualified independent testing agency to verify that the fluid distribution systems provided under the Contract have been balanced by the Contractor to produce the end results required by the Contract Documents.
2. During normal course of construction, provide means integral to systems for balancing and testing including: Fluid control devices; pressure, temperature, flow, power and speed sensing points; means of access to Work being verified.

1.3 SUBMITTALS

A. Furnish submittals for items that are identified in this Section by a different typeface and a bracketed code (*e.g., Item [L]*). Refer to Division 1 Section "Submittals" for definition of codes for types of submittals and the administrative requirements governing submittal procedure. Additional submittal requirements pertaining to this Section are specified herein under this Article.

B. Prior to beginning Work, submit to Owner a report defining system additions required to permit testing, adjusting and balancing of systems.

C. *Submittals [T]:* Systems acceptance is predicated upon successful completion of specified Work, receipt by the Owner's Representative of certified data summarizing the performance of systems within design intent, and approval thereof. Following completion of any corrective work and approval of submitted data, provide bound copies of testing, balancing, and adjusting report. Arrange data by system and identify apparatus and items, utilizing referenced minimum standard forms where possible, and supplementing with reasonable facsimiles where necessary and single line systems diagrams indicating points of adjustment. Report shall be accompanied by two copies of referenced standards used as a basis of testing, balancing and adjusting Work.

D. Certificates: Provide independent laboratory certification of test apparatus calibration data, dated after date of award of Contract. The Owner's Representative reserves the right to require recalibration of any or all test apparatus components per the frequency recommended by the component manufacturer, or when reasonable doubt of accuracy exists.

E. Guarantee: The Contractor shall notify the AABC of the Contract award. Deliver the AABC "NATIONAL PROJECT CERTIFICATIONS GUARANTEE" to the Owner's Representative within 30 days of award.

15950.2 PRODUCTS

2.1 BALANCING, ADJUSTMENT AND ACCEPTANCE CRITERIA

2.1.1 Air Handling Systems

A. Systems volume limits:

1. Air handler delivery: Plus 10%, minus 0% of design CFM at design temperature.
2. Terminal device delivery: Plus or minus 10% of design CFM at design temperature.
3. Air handler delivery: Plus 5%, minus 0% of design CFM at design temperature.
4. Terminal device delivery: Plus or minus 5% of design CFM at design temperature.

2.2 TEST APPARATUS

A. Test apparatus: Consists of:

1. Pressure gages and fittings.
2. Dry bulb thermometer.
3. Wet bulb thermometer.
4. Pyrometer.

5. Balancing cock adjustment wrench.
6. Differential pressure gage, or manometer.

B. Pressure and flow taps and isolating valves: Provide in locations where permanent installation devices are not indicated or otherwise required.

C. Thermometer wells: Provide as necessary for balancing in locations where permanent installation thermometers are not indicated or otherwise required.

D. Test apparatus: Provide required by SMACNA, "Manual for the Balancing and Adjustment of Environmental Systems".

E. Test apparatus: Provide required by AABC, "National Standards for Field Measurements and Instrumentation", Volumes, I and II.

15950.3 EXECUTION

3.1 GENERAL

NOTE: SELECT FROM AND REWRITE THE FOLLOWING TO SUIT PROJECT NEEDS.

A. Perform tests for structural integrity and leakage prior to balancing, adjusting, insulation of surfaces, painting and concealment of the Work. Retest systems containing repaired defects to original criteria, except upon waiving of test by the Owner's Representative.

B. Perform hydronic systems structural and leakage testing per requirements specified under Division 15 Sections under PIPING SYSTEMS TESTING in each Section.

C. Perform air handling systems structural and leakage testing per requirements specified under Division 15 Section "Air Distribution" under Field Quality Control.

D. Test fire dampers by applying heat to fusible link to permit operation. Testing shall be done in the presence of the Owner's Representative. Fusible links shall be replaced as part of the Work under Division 15 Section "Air Distribution."

E. Adjust items of the various systems for proper operation within framework of design intent, and operating characteristics as published by the equipment manufacturer. The Owner's Representative may require the Contractor to provide the services of an authorized representative of the manufacturer in the event that the Contractor is unable to adjust any piece of equipment.

F. Do not operate equipment for any purpose until properly lubricated and brought into specified service condition.

G. Make system final adjustments and permanently mark and fix settings by drilling and bolting or pinning of operators, so as to be readily restorable if disturbed.

H. Where unusual measurement conditions occur, take data and do work in a manner previously agreed upon with the Owner's Representative.

3.2 AIR HANDLING SYSTEMS

A. General

1. After balance and adjustment operations have been completed, test the system as a whole to see that all items perform as an integral part of the system, and that space conditions are evenly controlled. Make corrections and

adjustments necessary to produce the required space conditions.

B. Balancing Procedure

1. Balance and adjust apparatus per the standards of AABC.
2. Balance and adjust apparatus per the standards of SMACNA.

C. Balancing Report

1. Provide balancing report on systems balanced, balancing test apparatus data, and air diffusion device flow coefficients, using current AABC standard forms for the following:
   a. Air handling apparatus data.
   b. Exhaust fan data.
   c. Air diffusion devices data.
   d. Duct traverse data for the main supply duct, main exhaust duct, outside air intake duct, and ducts indicated.
   e. Duct zone traverse data.
   f. Filter apparatus data which includes visual condition, inlet pressure and differential pressure for each filter installation.
   g. Coil data which includes visual condition, inlet pressure and differential for each coil installation.
   h. Pressure at inlet to each variable volume box.
   i. Air balancing station performance data and curves.

DIVISION 16
ELECTRICAL SYSTEMS

16010 - GENERAL REQUIREMENTS

16010.1 GENERAL

1.1 Summary

A. Description Of Systems

1. Lighting Systems. 480 volts, 3 phase, 3 wire, 60 hertz, ungrounded: 480/277 volts, 3 phase, 4 wire, 60 hertz, solidly grounded neutral and 120/208 volts, 3 phase, 4 wire, 60 hertz, solidly grounded neutral.
2. Small Power System. 120/208 volts, 3 phase, 4 wire, 60 hertz, solidly grounded neutral.

B. Related Work Specified In Other Sections:

1. Furnish all labor, materials, equipment, technical supervision, and incidental services required to complete, test and leave ready for operation the electrical systems as specified in the Dvision 16 Sections or as indicated.
2. Provide all power wiring, required for equipment specified under Article “Related Work Specified Under Other Sections” hereinafter.
3. Provide control wiring for all equipment/systems provided under these Division 16 Sections. In addition, within motor control centers and other Division 16 Sections electrical equipment/control panels, provide control devices and wiring as indicated.
4. Furnishing and mounting of all electric motors – Division 8, 11 and 15 Sections.
5. Furnishing and mounting of starters, disconnect switches, remote and integral controls on “packaged” or “packaged self-contained” building service equipment, and furnishing and installing all power and control wiring on “packaged” or “packaged self-contained” building service equipment, except for power service – Division 8 and Division 15 Sections, except as otherwise indicated.
6. Furnishing, installing and wiring of control devices not contained within starters, motor control centers or packaged self contained equipment – Division 13 Section, except as shown on the applicable Contract Drawings.

C. This Section includes general administrative and procedural requirements for electrical installations. The following administrative and procedural requirements are included in this Section to expand the requirements specified in Division 1 Sections.

1. Design requirements
2. Substitutions
3. Permits and fees.
4. Examination of Drawings and premises
5. Changes involving electrical work
6. Performance requirements
7. Submittals.
    a. Material list
    b. Shop drawings
    c. Coordination drawings
    d. Project record documents
    e. Operation and maintenance data
8. Safety lock-out procedures
9. Quality assurance
10. Delivery, storage and handling
11. Project/site conditions
12. Sequence and scheduling
13. Warranty
14. Maintenance

D. This Section includes basic requirements for materials and installations for electrical work, including but not limited to:

1. Concrete
2. Access doors
3. Sealing of openings
4. Sleeves
5. Expansion fittings
6. Nameplates and directories
7. Electrical demolition work
8. Temporary services
9. Cutting and patching
10. Damage to other work
11. Chases and recesses
12. Equipment foundations and supports
13. Structural and mechanical interferences
14. Coordination with other trades
15. Assembly of equipment
16. Equipment connections
17. Testing ducts and conduit for obstructions
18. Phasing
19. Field quality control
20. Cleaning
21. Painting

1.2 References

A. The electrical and physical properties of all materials, and the design, performance characteristics, and methods of construction of all items of equipment, shall be in accordance with the latest issue of the various, applicable Standard Specifications of the following recognized authorities:

1. ACI - American Concrete Institute
2. ANSI - American National Standards Institute
3. ASTM - American Society for Testing Materials
4. CSA - Canadian Standards Association
5. FCC - Federal Communication Commission
6. FM - Factory Mutual
7. ICEA - Insulated Cable Engineers Association
8. IEEE - Institute of Electrical and Electronics Engineers
9. GE GAP Services
10. NEC - National Electrical Code

11. NEMA - National Electrical Manufacturer's Association
12. NETA - InterNational Electrical Testing Association
13. NFPA - National Fire Protection Association
14. OSHA - Occupational Safety and Health Administration
15. UL - Underwriters' Laboratories, Inc.
16. Local codes

B. The electrical and physical properties of all materials, and the design, performance characteristics, and methods of construction of all items of equipment, shall be in accordance with the latest issue of the various, applicable General Motors Standards, Specifications, and Codes:

1. General Motors Corporation Electrical Installation Standard EI-1 for Buildings and Facilities
2. SAE HS-1738 " SAE Standard for Electrical Equipment for Automotive Industrial Machinery" – 2002 Edition
3. GM Electrical Equipment Specification No. 12E MOTOR CONTROLLERS Motor Control Centers and Combination Motor Starters 600 Volts and Below

C. Where there is a difference between the above standards and codes and this specification, the most stringent requirements shall apply. Clarifications of any differences between the standards, codes, drawings, and specifications will be made by the Architect-Engineer.

1.3 General Requirements

A. Furnish all labor, materials, equipment, technical supervision, and incidental services required to complete, test and leave ready for operation the electrical systems as specified in the Division 16 Sections and as indicated on Drawings.

1. The Electrical Drawings indicate the general design and extent of the electrical system. The Contract Drawings are schematic and diagrammatic and are not intended to indicate construction details and routing, unless specifically indicated. The Specifications establish minimum performance, product and installation requirements.
2. In addition to the specified and indicated performance and quality requirements, furnish products and perform installation work consistent with the design intent and necessary to the provision of complete operating electrical systems.

B. Substitutions: Base Bid must be in accordance with materials or products specified. Any exceptions to this must be approved in writing by the Architect-Engineer 10 days or more prior to bidding.

1. Voluntary alternates may be submitted for consideration, with listed addition or deduction to the Bid, but may not affect the awarding of the Contract.

C. Permits and Fees: Obtain all permits, licenses, inspections and test required. Upon completion of the Work, obtain and send certificates of inspections and approvals to the Architect-Engineer.

1. Pay all fees and expenses for permits, licenses, tests and inspections.

D. Examination of Drawings and Premises: Before submitting Bids, examine the architectural, mechanical and other trades' drawings and specifications.

1. Notify Architect-Engineer should any discrepancies occur between them and the electrical work.
2. No additional charges will be allowed because of failure to make this examination, or to include all materials and labor required for the Work.
3. Before submitting Bids, examine the premises to determine existing conditions for performing the Work. No additional charges will be allowed because of failure to make this examination or to include all materials and labor

to complete the Work.

4. The Architectural Drawings take precedence in all matters pertaining to the building structure, Mechanical drawings in all matters pertaining to Mechanical trades and Electrical drawings in all matters pertaining to Electrical trades installation. However, where there are conflicts or differences between the Drawings for the various trades, report such conflicts or differences to the Architect-Engineer who shall determine the course of action to be taken.

E. Performance Requirements: Perform all work in a first class and workmanlike manner, in accordance with the latest accepted standards and practices for the Trades involved and as specified.

F. All equipment of the same or similar systems shall be by the same manufacturer.

1.4 Submittals

A. The following is in addition to the requirements for submittals in Division 1, General Requirements.

B. Material List: Submit a complete list of all materials and equipment, and their manufacturers, for approval by the Architect-Engineer within 15 days after award of contract and prior to submittal of shop drawings.

C. Shop Drawings: Prepare layout shop drawings drawn to scale and submit 1 transparency copy and 2 prints of each to the Architect-Engineer for review, together with required number of additional copies as required by the General Conditions. Sepia transparencies of the Contract Documents will be furnished for this purpose. After the shop drawings are reviewed, the transparency copy will be stamped and returned for printing and distribution. Refer to Division 1 for submittals and quantities.

1. Layout shop drawings shall show building floor plans to scale and shall include lighting and power distribution systems, all details of electrical construction, routing of conduits, wiring, circuiting and related information necessary for the installation and future maintenance of the electrical wiring systems.

D. No apparatus or equipment shall be shipped from stock or fabricated until shop drawings for them have been reviewed by the Architect-Engineer. By the review of shop drawings, the Architect-Engineer does not assume responsibility for actual dimensions or for the fit of completed work in position, nor does such review relieve Electrical Contractor of full responsibility for the proper and correct execution of the work required.

E. Submit shop drawing with all pertinent data and with identification as specified or scheduled on the electrical Drawings.

F. Shop drawings shall be reviewed by the Electrical Contractor for completeness and accuracy prior to submitting to the Architect-Engineer for review. The shop drawings shall be dated and signed by the Contractor prior to submission.

G. Where the shop drawings consist of manufacturer's standard detail drawing or schedules and contain data for a variety of similar equipment, indicate the data pertinent to the equipment furnished for this project only. Standard detail drawings and schedules not clearly indicating which data is associated with this Project will be returned "Rejected".

H. Where accessories and/or options are specified and do not appear as part of manufacturer's standard detail drawings, state each accessory that is to be provided with the equipment on the standard detail drawings.

I. Partial submittals for equipment will not be permitted. Where partial submittals are transmitted to the Architect-Engineer, they will be returned "Rejected".

J. Lighting fixture submittals shall be submitted as 1 package including all fixtures intended to be used for this Project.

K. Submittal Preparation: Place a permanent label or title block on each submittal for identification. Indicate the name of the entity that prepared each submittal on the label or title block.

1. Provide a space approximately 4" x 5" on the label or beside the title block on shop drawings to record the Contractor's review and approval markings and the action taken.

2. Include the following information on the label for processing and recording action taken.
    a. Project Name
    b. Date
    c. Name and address of Architect-Engineer
    d. Name and address of Contractor
    e. Name and address of Subcontractor
    f. Name and address of Supplier
    g. Name of Manufacturer
    h. Number and title of appropriate Specification Section
    i. Drawing number, identification mark, fixture type, panelboard number, and detail references, or as noted on the electrical drawings.

L. Submit manufacturer's submittals on all major electrical systems and/or equipment and where specified in other sections.

M. Coordination Drawings: Prepare coordination Drawings to a ¼-inch equals – 1 – foot (1:50) scale or larger. Detail major elements, components, and systems of electrical equipment and materials in relation to each other and to other systems, installations, and building components. Indicate locations and space requirements for installation, access, and working clearance. Show where sequence and coordination of installation are important to the efficient flow of the Work. Coordinate drawing preparation with effort specified in other Specification Sections. Include the following:

1. Provisions for scheduling sequencing, moving, and positioning large equipment in the building during construction.

2. Floor plans, elevations, and details, including the following:
    a. Clearances to meet safety requirements and for servicing and maintaining equipment, including space for equipment disassembly required for periodic maintenance.
    b. Equipment support details.
    c. Exterior wall, roof, and foundation penetrations of cable and raceways; and their relation to other penetrations and installations.
    d. Fire-rated interior wall and floor penetrations by electrical installations.
    e. Sizes and locations of required concrete pads and bases.

3. Reflected ceiling plans to coordinate and integrate installing air outlets and inlets, light fixtures, alarm and communication system components, sprinklers, and other ceiling mounted items.

N. Project Record Documents: Revise layout shop drawings as required during construction to indicate the as-built condition.

1. At the completion of the Project, resubmit to the Owner's Representative the revised sepias and 1 set of prints for Owner's record.

2. Furnish and deliver to the Owner's Representative a manual of all shop drawings and product data upon substantial completion. The manual shall consist of a standard hard cardboard, vinyl covered, 3-ring binder, letterhead size, 8-1/2" x 11". Shop drawings shall be folded and punched. All items and pages shall be numbered with typewritten index inserted at front of manual.

3. Submit final project record documents as described in Division 1.

O. Operation and Maintenance Data: Retain operating instructions, service instructions, parts lists, etc., which are shipped with electrical equipment. On completion of the work, give these items to the Architect-Engineer, for the Owner's use.

If this information is not shipped with the equipment, obtain from the manufacturer.

1. Furnish 2 sets of bound operating instructions to the Architect-Engineer. Each set shall include:
   a. One copy of all shop drawings.
   b. Operating and maintenance instructions.
   c. As-built drawings.

P. Lockout Placards

1. Prepare and submit Black and White Lockout Placards [S]: Lockout placards shall be on equipment or system at "green tag" acceptance of safety buy-off process (power on).
2. Prepare and submit Full Color Lockout Placards [S]: Lockout placards shall be on equipment or system at "manilla tag" acceptance of safety buy-off process (final acceptance).
3. All placards shall be prepared with the GM g-Plac Excel® software tool.

1.5 Arc Flash Protection Labels

A. Provide an arc flash protection label from one of the following manufacturers for each piece of electrical equipment containing over 50 volts. Coordinate the labels with the Architect-Engineer that provided the Arc Flash Protection Study and with the WFG Lead Electrical Engineer.

1. Stranco, Inc.
2. Brady Corp.
3. Seton

1.6 Quality Assurance

A. Regulatory Requirements:

1. Ordinances and Codes: Perform all work in accordance with applicable Federal, State and local ordinances and regulations, the Rules and Regulations of the National Board of Fire Underwriters, the National Electrical Code, and the latest accepted practices of IEEE and NEMA.
   a. Notify the Architect-Engineer before submitting the proposal should any changes in Drawings or Specifications be required to conform to the above codes, rules or regulations. After entering into Contract, make all changes required to conform to above ordinances, rules and regulations without additional expense to the Owner.
   b. Barrier-Free Regulations: All materials and installations shall comply with the requirements of the State of Michigan Handicapped Barrier-Free Regulations and with the Americans With Disabilities Act (ADA).

1.7 Delivery, Storage and Handling

A. Storage and Protection: Provide adequate storage space for all electrical equipment, conduit and materials delivered to the job site under a weather protected enclosure. Location of the space will be designated by the Architect-Engineer's Field Representative. Equipment set in place in unprotected areas must be provided with temporary protection.

1. Be responsible for the care and protection of electrical equipment until it has been fully tested and accepted.
2. Protect materials with permanent factory finish from damage by covering.
3. Protect conduit openings with temporary plugs or caps.

1.8 Project Site Conditions

A. Field Measurements:

1. Drawings are not intended to be scaled for roughing-in or to serve as shop drawings. Take all field measurements required for fitting the installation to the building.

1.9 Sequencing and Scheduling

A. Sequence and schedule work so as to avoid interference with the work of other Trades. Be responsible for removing and relocating any work which in the opinion of the Owner's Representatives causes interference.

1.10 Warranty

A. Warranty: Provide a parts and labor warranty for all equipment and installation. Comply with requirements of the General Conditions. Length of warranty shall be as stated in GM1638.

1.11 Maintenance

A. Maintenance Materials: Retain all portable and detachable portions of the installation such as keys, tools, manuals, etc., until the completion of the work and then turn them over to the Owner and obtain itemized receipt. This receipt shall be attached to the "Final Application" for payment.

B. Retain operating instructions, service instructions, parts lists, etc., which are shipped with electrical equipment. On completion of the Work, give these items to the Architect-Engineer for the Owner's use. If this information is not shipped with the equipment, obtain from the manufacturer.

C. Furnish 2 sets of bound operating instructions to the Architect-Engineer. Each set shall include:

1. One copy of all shop drawings.
2. Operating and maintenance instructions and manuals.
3. As-built drawings.

16010.2 PRODUCTS

2.1 Concrete

A. Provide concrete work required for the electrical installation. Concrete work shall include envelopes for underground service conduits, ducts, housekeeping pads beneath equipment and bases for outdoor lighting equipment. Concrete work shall be in conformance with Division 3 Section "Cast-in-Place Concrete" or as indicated.

2.2 Access Doors

A. Furnish access doors as required to make accessible all controls, motors, electrical boxes and other equipment installed by Electrical trades or as required by Code.

1. Architectural trades will install access doors provided under this Section.
2. Access door size shall be minimum 12" x 12" in walls, 24" x 24" in ceilings.
3. Equip access doors with screwdriver operated cam lock.

B. In non-fire rated drywall, veneer plaster, masonry or ceramic tile walls, furnish Milcor Ltd. Partnership Type M, 3202

Series access doors as manufactured by the following:

1. Milcor Ltd. Partnership or approved equal.

C. In non-fire rated gypsum board or veneer plaster walls and ceilings, furnish the following:

1. Milcor Ltd. Partnership Type DW, 3203 Series or approved equal.

2.3 Sealing of Openings

A. Seal openings around electrical materials (Conduit, raceways, cable trays, panels, etc.) where floors, fire rated walls and smoke barriers are penetrated. (Fiberglass is not acceptable.) Fire and/or smoke barriers shall be UL Listed fire and smoke stop fittings and shall have fire rating equal to or greater than the penetrated barrier. Refer to Division 7 Section “Firestopping”.

2.4 Sleeves

A. Provide conduit sleeves where conduits pass through concrete floors, walls, beams and ceilings.

B. Sleeves shall be galvanized rigid steel conduit. Do not use aluminum conduit. Where specific sizes are not indicated on the Drawings, sleeves shall be sized to provide 1/2 inch clearance around the outside surface of the item for which they were installed. They shall be cut flush with wall surfaces, and shall extend 1 inch, or as directed through floor. Sleeves shall be packed with approved non-combustible packing material and sealed with sealant to prevent passage of air, liquid or fumes from 1 area to another. The filler and sealant materials used shall be rated at least equal in fire resistance to the construction material being penetrated. Floor sleeves shall be sealed between floor and sleeve with concrete grout. Refer to Division 7 Section “Firestopping”.

C. Provide PVC sleeves for ground wires.

2.5 Expansion Fittings

A. Provide expansion fittings in all conduit, cable trays, and busway runs that cross building expansion joints per manufacturers’ recommendations and GM EI-1, both in concrete slabs and where exposed.

2.6 Nameplates and Directories

A. Identify switchgear, unit substations, motor controls, panelboards, safety switches, etc., with manufacturers' nameplate, shop order, where applicable on composite assemblies, and designations used on the Drawings.

B. All identification shall comply with the requirements of Division 16 Section “Electrical Identification”.

16010.3 EXECUTION

3.1 Electrical Demolition Work

A. General: Perform electrical demolition work in a systematic manner. Use such methods as outlined below to complete Work indicated on the Drawings.

B. Obtain approval from the Owner prior to interrupting existing services. All service interruptions shall be at a time suitable to the Owner. Where the Owner approves service interruptions at times resulting in premium time work to this Contractor, this Contractor shall include the premium time in his Base Bid.

C. Remove the associated conduit, wire, junction boxes, supports, etc., of demolished equipment from the utilization equipment back to the source panel. Relabel the associated circuit breaker or fused switch as "spare", unless otherwise noted. Remove all associated wiring back to the "sources" noted below:

1. Power: Back to panel where circuit is dedicated to a single load, or from load to be removed back to first junction box where circuit continues on to other existing loads.
2. Telephone: Disconnected at board in communication room with cable removed.
3. Data system or other special wiring: Remove wiring back to communication room or other source.
4. Conduit in walls to remain: Abandon in place. Install blank coverplates.
5. Conduit accessible above ceilings and/or other location: Remove conduit.

D. Ring out circuits prior to deactivating feeders and branch circuits to insure maintaining electrical power in adjacent unrenovated area. Where removal of conduit and wire affects "downstream" circuits, refeed downstream circuits.

E. Conduit in floor slabs shall be cut 1/2 inch below the floor and patched.

F. Where applicable, existing in-place conduit may be reused for new work providing that the installation is in accordance with Division 16 Section "Raceways and Boxes".

G. Where equipment or fixtures are removed, properly blank-off outlets and cap conduits. After alterations are done, the entire installation shall present a "finished" look, as approved by the Architect-Engineer. The original function of the present electrical work to be modified shall not be changed unless required by the specific revisions to the system as specified or as indicated.

H. Materials salvaged from this work shall not be reused except where reuse is specifically indicated.

I. Existing fixtures and electrical equipment removed, not reused and not specifically indicated to be turned over to the Owner shall be legally and properly disposed of off Owner's property. The Owner may elect to dispose of hazardous waste.

J. Existing fixtures and electrical equipment specifically indicated to be turned over to the Owner shall be carefully disconnected, removed and turned over to the Owner in a storage area as directed by the Owner.

3.2 Temporary Services

A. Provide temporary lighting, power and telephone service as described in Division 1, General Requirements.

B. The existing building will be occupied during construction. Maintain electrical services and provide necessary temporary connections and their removal at no additional expense. The existing service shall not be removed until the new services have been installed and made operational so the transfer to service can be done with a minimum shutdown time. The Electrical Contractor shall be responsible for installing and maintaining a temporary service from the new transformers to the existing switchboard. Minimum temporary service capacity shall be <Insert> amperes. Correlate routing of temporary service so as not to interfere with the convenience of the Owner.

3.3 Cutting and Patching

A. Refer to Division 1 for requirements for cutting, patching and refinishing work necessary for the installation of Electrical Work.

B. Direct the miscellaneous cutting and patching of the existing building construction for the installation of the Electrical Work.

C. The cutting of holes through the existing building construction shall only be done by the use of abrasive saws and rotary coring machines. The use of hammer and drill points will not be permitted. The openings shall not be cut larger than necessary for the installation of the electrical work. Openings shall then be grouted in. Where existing piping, etc. is removed, the unused openings shall be grouted in.

D. The drilling or punching of structural members, such as holes through beams or columns, shall not be done without the specific permission of the Architect-Engineer.

E. Cutting of holes through floors and walls shall be done only at such locations as may be directed by the Architect-Engineer.

F. Cooperate with the other Contractors so that all cutting and repairing in any given area will be done simultaneously.

G. Electrical work which may interfere with changes in piping, ducts or other mechanical equipment, as well as conduits and outlets that may be uncovered by the cutting of new openings in present building, shall be removed at the direction of the Architect-Engineer.

3.4 Damage to Other Work

A. The Electrical Contractor shall be responsible for all damage to other Work caused by their Work or through the neglect of their workers.

1. All patching and repairing of any such damaged Work shall be performed by the trades which installed the Work, but the cost shall be paid by the Electrical Trades.

3.5 Chases and Recesses

A. Provide sizes and locations of chases and recesses affecting the electrical work for provision by general trades.

3.6 Excavation and Backfill

A. Furnish excavating and backfilling to install work specified in the Electrical Division. Refer to electrical drawings and Division 2 Section “Earthwork” for methods and materials.

3.7 Equipment Foundations and Supports

A. Furnish foundations and supports for electrical equipment and materials as required by codes, as listed hereinafter and shown or noted on the Drawings.

B. Provide necessary inserts, rod, structural steel frames, brackets, platforms, etc., for equipment suspended from ceilings or walls, such as conduits, transformers, panels, etc.

C. Inserts for equipment support shall be anchors for small work and steel expansion shields for large work. Wooden plugs will not be allowed. Do not use metal roof decking and cellular floors for supporting equipment. Lead products will not be allowed.

D. Where noted on the Drawings provide and install concrete bases 4" above finished floor, with leveling channels, where noted, for floor-mounted equipment such as unit substations, transformers, switchboards, distribution panels, motor control centers, etc. Coordinate the locations of leveling channels with the architectural trades.

3.8 Structural and Mechanical Interferences

A. Should construction conditions prevent the installation of switches, conduit, outlet boxes, junction boxes, conductors, lighting fixtures and/or other related equipment at locations shown on the drawings, minor deviations may be permitted and shall be as directed by the Architect-Engineer, and shall be made with no additional cost to Owner.

3.9 Coordination with other Trades

A. Install Work so as to avoid interferences with the Work of other trades. This contractor shall be responsible for

removing and relocating any work which, in the opinion of the Owner's Representative, causes interferences.

3.10 Assembly of Equipment

A. The Contract Drawings and Specifications may indicate items to be purchased and installed which are identified by a manufacturer's name, catalog number and/or brief description.

B. The catalog number may not designate all the accessory parts and appurtenances required for the particular use or function.

C. Arrange with the manufacturer for the purchase of all items required for the complete installation and efficient operation.

3.11 Equipment Connections

A. Connections to equipment, motors, elevator controllers, lighting fixtures, etc., shall be made in accordance with the shop drawings and rough-in measurements furnished by the manufacturers of the particular equipment furnished. Any and all additional connections not shown on the Drawings but called for by the equipment manufacturer's shop drawings or required for the successful operation of the particular equipment furnished shall be installed as part of this Contract at no additional charge to the Owner.

3.12 Testing Ducts and Conduit for Obstructions

A. Ducts and conduits which are installed underground or concealed in concrete floor slab, foundations, etc., shall be cleared of foreign material and obstructions after installation and before conductor or pullwires are drawn in, by wire brushing, swabbing and employing an iron or hardwood mandrel which is 1/4" smaller in diameter than the internal diameter of the duct or conduit. A polypropylene general purpose pulling rope shall be left in each empty conduit.

3.13 Phasing 600 Volts and Below

A. Identify general power and lighting feeder and branch circuits with a visual color code as established in existing facilities as an integral part of the outer jacket or as a printed color coding or phase identification the entire length of the installation, or for new facilities in accordance with the NEC, GM Electrical Installation Standard EI-1 and GM Electrical Equipment Specification # 11E

3.14 Painting

A. In general, no painting is required by Electrical Trades other than touch-up of factory-finished electrical equipment.

B. All factory finished electrical equipment shall be cleaned at completion of the job. Equipment showing rust or mars shall be thoroughly cleaned and sanded, prime coated and touched up with enamel of color to match original finish.

3.15 Field Quality Control

A. Tests and Inspection: When the systems are completed, operate equipment as directed by Architect-Engineer. Replace all faulty equipment. Make necessary adjustments before final acceptance.

1. Tests shall include but not be limited to panels, lighting fixtures, receptacles, fire alarm system, generator transfer, sound systems, emergency lighting, branch circuits, etc.
2. Test receptacles for polarity, opens, grounds, etc., using an approved receptacle tester, Hubbell #5200. Provide a letter to the Engineer stating that all equipment has been tested and adjusted properly.
3. Perform all tests required by State, City, County and/or other agencies having jurisdiction.
4. Provide all materials, equipment, etc., and labor required for tests.

5. Perform all acceptance testing as specified in Division 16 Section “Electrical Equipment Tests”.

B. Systems Placard Requirements and Lockout Procedures Demonstration

1. Provide Lockout Placards for Owner’s use in black and white format at “green tag” stage of safety buy-off and full color format at “manilla tag” stage of final safety buy-off.
2. Demonstrate to the Owner/Architect-Engineer and Owner’s operating personnel the complete and correct functioning of all Systems lock-out procedures and associated placards.

3.16 Cleaning

A. Keep premises free from accumulation of waste materials and rubbish. At completion of work remove all rubbish from and about the building and leave the electrical systems clean and ready for use.

B. Final clean-up shall include fixture lenses, switchboards, substations, transformers, motor control centers, distribution panels, lighting panels, etc., to remove shipping and/or construction dust and debris. Fixture reflectors and/or lenses with water marks or cleaning streaks will not be accepted.

END OF SECTION

16050 - BASIC MATERIALS AND METHODS

16050.1 GENERAL

1.1 Summary

A. Section Includes:

1. Supporting devices for electrical components.
2. Fire stopping materials.
3. Electrical demolition.
4. Cutting and patching for electrical construction.
5. Touchup painting.
6. Provide all items, articles, materials, operations or methods listed, mentioned or scheduled on drawings and/or herein, including all labor, materials, equipment and incidentals necessary and required for their completion.

B. Related Work Specified In Other Sections:

1. Division 7 Section “Firestopping”.
2. Division 16 Section “Electrical General Requirements”.
3. Division 16 Section “Electrical Identification”.

1.2 Quality Assurance

A. Requirements Of Regulatory Agencies

1. Work in Hazardous Areas: Per Article 500 of the National Electrical Code.

B. Electrical Components, Devices and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

1.3 Submittals

A. Furnish submittals for items that are identified in this Section by a different typeface and a bracketed code (*e.g., Item [L]*). Refer to Division 1 General Requirements for definition of codes for types of submittals and the administrative requirements governing submittal procedure. Additional submittal requirements pertaining to this Section are specified herein under this Article.

B. Include complete data on each item. Coordinate the items, as they relate to the work, prior to submittal.

1.4 Operation and Maintenance Manuals

A. Provide, per Division 1 General Requirements, Operation and Maintenance Manuals for systems and equipment.

1.5 Safety Lock-Out Procedures

A. Provide all safety lock-out procedures in the form of instructions and diagrams for electrical and pneumatic equipment installed as part of this project per the current Owner approved plant standard.

1.6 Electrical Standards

A. The electrical and physical properties of all materials, and the design, performance characteristics, and methods of construction of all items of equipment, shall be in accordance with the latest issue of the various, applicable General Motors Standards, Specifications, and Codes:

1. General Motors Corporation Electrical Installation Standard EI-1 for Buildings and Facilities

B. Where there is a difference between the above standards and codes and this specification, the most stringent requirements shall apply. Clarifications of any differences between the standards, codes, drawings, and specifications will be made by the Architect-Engineer.

16050.2 PRODUCTS

2.1 Supporting Devices

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Steel-Channel Support Systems (Strut)
2. Allied Tube and Conduit - Power-Strut
3. B-Line Systems, Inc.
4. Thomas & Betts, Superstrut Division
5. Unistrut Diversified Products
6. Hilti Incorporated

7. MonoSystems, Inc.

B. General

1. Support all conduit, boxes and other electrical equipment in accordance with the requirements of the NEC, this specification, and the Drawing.
2. Provide type and size of beam clamps, hanger rods, anchors and toggle bolts in accordance with the manufacturer's requirements, considering the application and maximum loading.
3. Provide beam clamps.
4. Do not drill, burn or weld the building steel, except with the specific written approval of the Structural Engineer of Record.
5. Do not stud weld, except with specific, written approval of the Owner's representative. If approval is given perform work using automatic stud welders in a manner recommended by the manufacturer, utilizing experienced workers.
6. Obtain written approval of the Structural Engineer of Record, Electrical Engineer of Record, WFG Lead Electrical Engineer, and the Owner's representative prior to utilizing explosive type fastening tools. If approval is given provide heat-treated studs and comply with written installation instructions from the Structural Engineer of Record.
7. Support equipment from beams rather than trusses. Where support from a truss is required, obtain written approval of the Structural Engineer of Record. Attachment to trusses shall be at or near the truss panel point.

C. Beam Clamps and Conduit Hangers

1. Provide beam clamps which clamp firmly onto both flanges of a beam. Provide a clamp designed to accept the size hanger rod required. Provide nuts with lock washers properly tightened with a wrench.
2. Bolt conduit hangers to beam clamps where structural steel beams are available.
3. Provide an anchor and lay-in type conduit hanger with positive bolt closure, when supporting conduit from concrete slabs.
4. Provide beam clamps, threaded steel hanger rod, or channel supports of the proper size and type for equipment supports secured to building steel. Provide the method of support in accordance with the details indicated on the Contract Drawings.
5. Provide threaded steel rod for hangers and supports with a minimum diameter of 3/8 inch (10 mm), except minimum diameter of 1/2 inch (13 mm) for busway and cable tray, or where indicated on the Drawings.
6. Provide self-colored oil-finished type threaded steel rod for indoor use, and hot-dipped galvanized threaded steel rod for outdoor use.

D. Anchors

1. Provide steel wedge type anchors of the proper size and load rating, per the manufacturer's instructions for conduit, material and equipment supported from or attached to concrete or masonry surfaces.

E. Toggle Bolts

1. Provide toggle type bolts to secure equipment supports to hollow tile or similar surfaces.

F. Miscellaneous Supports

1. Support equipment installed inside the web of building columns with expandable column inserts and off-set conduits to 1 side of insert to allow for future additions.
2. Where concrete, tile, brick or other masonry is found unsuitable for supporting required loads by means of expansive screw anchors, obtain written approval of the Structural Engineer of Record to drill holes entirely

through the wall or slab. Provide through-bolts with properly sized plates or washers. Countersink bolt heads and plates flush with the masonry.

3. Provide properly sized one-hole, galvanized, malleable iron pipe straps for conduits grouped on a common steel support.
4. Provide supports for exposed cables in the form of J-hooks, bridle rings and cable clips. Supports shall be galvanized steel and sized for the intended use.
5. Maximum spacing of conduit supports: 7 feet-6 inches (2.3 metres) for conduits 1 inch (25 mm) and smaller and 10 feet-0 inches (3.1 metres) for conduits greater than 1 inch (25 mm) in size.

G. Finish of Hardware

1. Provide galvanized or zinc-plated steel hardware, including bolts, nuts, washers, turnbuckles and clevises.

H. Channel and angle support systems, hangers, anchors, sleeves, brackets, fabricated items, and fasteners are designed to provide secure support from the building structure for electrical components.

1. Material: Steel, except as otherwise indicated, protected from corrosion with zinc coating or with treatment of equivalent corrosion resistance using approved alternative finish or inherent material characteristics.

I. Metal Items for Use Outdoors or in Damp Locations: Hot-dip galvanized steel, except as otherwise indicated.

J. Steel Channel Supports (Struts)

1. Roll formed from 12 gauge minimum mild strip steel, non-perforated type. Minimum size: 1-5/8 by 1-5/8 inches (41 by 41 mm).
2. Fittings and accessories mate and match with channels and are from the same manufacturer.

2.2 Fire Stopping Materials

A. Conduit Seal Bushings

1. Provide through-wall and through-floor seals that seal the hole in the wall or floor.
2. Manufacturers
   a. Cooper Industries, Inc. Crouse-Hines.
   b. Killark Electric Mfg. Co.
   c. O-Z Gedney

2.3 Touch Up Paint

A. For Equipment: Equipment manufacturer’s paint selected to match installed equipment finish.

B. Galvanized Surfaces: Zinc-rich paint recommended by item manufacturer.

16050.3 EXECUTION

3.1 Electrical Equipment Installation

A. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide the maximum possible headroom. Coordinate with the Owner.

B. Materials and Components: Install level, plumb, and parallel and perpendicular to other building systems and

components, unless otherwise indicated.

C. Equipment: Install to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.

D. Right of Way: Give to raceways and piping systems installed at a required slope.

3.2 Electrical Supporting Device Application

A. Damp Locations and Outdoors: Hot-dip galvanized materials or nonmetallic, U-channel system components.

B. Dry Locations: Steel materials.

C. Support Clamps for PVC Raceways, if non-metallic.

D. Selection of Supports: Comply with manufacturer's written instructions.

E. Strength of Supports: Adequate to carry present and future loads, times a safety factor of at least 4; minimum of 200-lb (90-kg) design load.

F. Spring steel clamps are allowed only for the following:

1. Supporting manufactured wiring systems.
2. In non-manufactured building subject to Owner’s representative’s approval, for supporting 1/2-inch and ¾-inch conduit.

3.3 Support Installation

A. Install support devices to securely and permanently fasten and support electrical components. Comply with Contract Drawing details.

B. Install individual and multiple raceway hangers and riser clamps to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assemblies and for securing hanger rods and conduits.

C. Support parallel runs of horizontal raceways together on trapeze- or bracket-type hangers.

D. Size supports for multiple raceway installations so capacity can be increased by a 25% minimum in the future.

E. Support individual horizontal raceways with separate, malleable-iron pipe hangers or clamps.

F. Arrange supports in vertical runs so the weight of raceways and enclosed conductors is carried entirely by raceway supports, with no weight load on raceway terminals.

G. Support horizontal and vertical exposed cables utilizing the support devices described in this Section.Provide attachment hardware for each type of support device as required.

H. Simultaneously install vertical conductor supports with conductors.

I. Separately support cast boxes that are threaded to raceways and used for fixture support. Support sheet-metal boxes directly from the building structure or by steel channel supports (struts). If struts are used, attach struts to raceways on opposite sides of the box and support the raceway with an approved fastener not more than 24 inches (610 mm) from the box.

J. Install metal channel racks for mounting cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices unless components are mounted directly to structural elements of adequate strength.

K. Install sleeves for cable and raceway penetrations of concrete slabs and walls unless core-drilled holes are used. Install sleeves for cable and raceway penetrations of masonry and fire-rated gypsum walls and of all other fire-rated floor and wall assemblies. Install sleeves during erection of concrete and masonry walls.

L. Securely fasten electrical items and their supports to the building structure, unless otherwise indicated. Perform

fastening according to the following unless other fastening methods are indicated:

1. Wood: Fasten with wood screws or screw-type nails.
2. Masonry: Toggle bolts on hollow masonry units and expansion bolts on solid masonry units.
3. New Concrete: Concrete inserts with machine screws and bolts.
4. Existing Concrete: Expansion bolts.
5. Do not fasten electrical items to metal siding. Support instead from the floor or structural steel.
6. Fasteners: Select so the load applied to each fastener does not exceed 25% of its proof-test load.

M. Provide identification in accordance with Section 16075 “Electrical Identification”.

3.4 Fire Stopping

A. Apply firestopping to cable and raceway penetrations of fire-rated floor and wall assemblies to achieve fire-resistance rating of the assembly.

3.5 Demolition

A. Protect existing electrical equipment and installations indicated to remain. If damaged or disturbed in the course of the Work, remove damaged portions and install new products of equal capacity, quality, and functionality.

B. Accessible Work: Remove exposed electrical equipment and installations, indicated to be demolished, in their entirety.

C. Abandoned Work: Cut and remove buried raceway and wiring, indicated to be abandoned in place, 2 inches (50 mm) below the surface of adjacent construction. Cap raceways and patch surface to match existing finish.

D. Remove demolished material from Project site.

E. Remove, store, clean, reinstall, reconnect, and make operational components indicated for relocation.

3.6 Cutting and Patching

A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces required to permit electrical installations. Perform cutting by skilled mechanics of trades involved.

B. Repair and refinish disturbed finish materials and other surfaces to match adjacent undisturbed surfaces. Install new fireproofing where existing firestopping has been disturbed. Repair and refinish materials and other surfaces by skilled mechanics of trades involved.

3.7 Field Quality Control

A. Inspect installed components for damage and faulty work, including the following:

1. Supporting devices for electrical components.
2. Electrical demolition.
3. Cutting and patching for electrical construction.
4. Touchup painting.

3.8 Refinishing and Touch Up Painting

A. Refinish and Touch up Paint

1. Clean damaged and disturbed areas and apply primer, intermediate, and finish coats to suit the degree of damage

at each location.

2. Follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats.
3. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
4. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.9 Cleaning and Protection

A. On completion of installation, including outlets, fittings, and devices, inspect exposed finish. Remove burrs, dirt, paint spots, and construction debris.

B. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

END OF SECTION

16060 - GROUNDING

16060.1 GENERAL

1.1 Related Documents

A. Provide all items, articles, materials, operations or methods listed, mentioned or scheduled on drawings and/or herein, including all labor, materials, equipment and incidentals necessary and required for their completion.

B. GM Electrical Installation Standard EI-1.

1.2 Summary

A. Description Of Systems

1. Provide grounding system as indicated or specified.
2. Grounding Conductors:
   a. In Conduit with Phase Conductors: [**Bare.**] [**Insulated.**]
3. Grounding Connections:
   a. To Non-Permanently Fixed Equipment. Lugs bolted to the equipment.

B. Related Work Specified In Other Sections:

1. Division 16 Section “Electrical Acceptance Testing”.
2. Division 16 Section “Wire and Cable (600V and Below)”.
3. Division 3 Section “Concrete Work”.

1.3 Quality Assurance

A. Requirements Of Regulatory Agencies

1. Ground electrical system neutrals and noncurrent carrying parts of electrical equipment per the requirements of the National Electrical Code, except where additional requirements are indicated or specified.

1.4 Submittals

A. Furnish submittals for items that are identified in this Section by a different typeface and a bracketed code (*e.g., Item [L]*). Refer to Division 1 General Requirements for definition of codes for types of submittals and the administrative requirements governing submittal procedure. Additional submittal requirements pertaining to this Section are specified herein under this Article.

B. Include complete data on each item. Coordinate the items, as they relate to the work, prior to submittal.

C. Shop drawings for ground detection devices applied to underground systems, reactors, and transformers.

D. Maintenance data for underground detection devices.

16060.2 PRODUCTS

2.1 Wire and Cable Grounding Conductors

A. Comply with Division 16 Section "Wire and Cable (600 Volts and Less)." Conform to NEC Table 8 in Chapter 9, except as otherwise indicated, for conductor properties, including stranding.

1. Material: Aluminum and copper. Use only copper wire for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.

2. Conductor Material: Copper, except aluminum bonding jumpers for use on aluminum cable trays.

B. Equipment Grounding Conductors: Insulated with green color insulation. Comply with the following;

1. Bare copper conductor.

2. Insulated or covered green or green with one or more yellow stripes striped bare or marked with green tape or labels at exposed ends.

C. Bare Grounding Conductors: stranded annealed copper.

D. Insulated Grounding Conductors: stranded annealed copper insulated with a heat and moisture resistant polyvinyl chloride compound and meeting UL Requirements for Type [**THWN**] [**or**] [**XHHW**], 75 degC, rated 600 volts, color-coded green. Conductor No. 10 AWG and smaller may be solid in lieu of stranded. Refer to Section 16120 for manufacturers.

E. Grounding Bus: Bare, annealed-copper bars of rectangular cross section.

F. Braided Bonding Jumpers: Copper tape, braided No 30 AWG bare copper wire, terminated with copper ferrules.

G. Bonding Straps: Soft copper 0.05 inch (1mm) thick and 2 inches (50 mm) wide, except as indicated

2.2 Grounding Connections

A. Exothermic Welding Connection Materials: Silicone-bronze alloy or zinc-plated steel bolts and nuts.

1. Erico Products Cadweld

B. Copper Compression Grounding:

1. Anderson
2. Burndy
3. Ilsco
4. Panduit
5. Penn Union
6. Thomas & Betts

C. Grounding Fittings for Bonding a Ground Conductor to Its Own Conduit:

1. Appleton Type GIB
2. Burndy NE
3. Penn Union BD
4. O-Z Type GB
5. Thomas & Betts Type TIG or 3800 Series

D. Other Grounding Connectors and Lugs: Compression type as specified in Section 16120.

16060.3 EXECUTION

3.1 Application

A. Equipment Grounding Conductors: Comply with NEC Article 250 for types, sizes, and quantities of equipment grounding conductors, except where specific types, larger sizes, or more conductors than required by NEC are indicated.

1. Install equipment grounding conductor with circuit conductors for the items below in addition to those required by Code:

a. Feeders and branch circuits.
b. Lighting circuits.
c. Receptacle circuits.
d. Single-phase motor or appliance branch circuits.
e. Three-phase motor or appliance branch circuits.
f. Flexible raceway runs.
g. Armored and metal-clad cable runs.

3.2 Installation

A. General: Ground electrical systems and equipment according to NEC requirements, except where Drawings or Specifications exceed NEC requirements.

B. Grounding Rods: Locate a minimum of 1-rod length from each other and at least the same distance from any other grounding electrode.

1. Drive until tops are 2 inches below finished floor or final grade, except as otherwise indicated.
2. Interconnect with grounding-electrode conductors. Use exothermic welds, or as otherwise indicated. Make these connections without damaging copper coating or exposing steel.

C. Grounding Conductors: Route along the shortest and straightest paths possible, except as otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

D. Underground Grounding Conductors: Use bare copper wire. Bury at least 24 inches below grade.

E. Medium Voltage Switchgear, Loadcenter Substation and Electrical Equipment Room Grounding Bus: Space minimum 1/2 inch (13 mm) from wall, support from wall or structure approximately 7 feet 6 inches (2.3 m) above finished floor unless specified or detailed otherwise.

F. Metal Water Service Pipe: Provide insulated copper grounding conductors, sized as indicated, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes by grounding-clamp connectors. Where a dielectric main water fitting is installed, connect grounding conductor to street side of fitting. Do not install a grounding jumper across dielectric fittings. Bond grounding-conductor to conduit end. Sprinkler mains shall not be used for grounding.

G. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with grounding-clamp connectors.

H. Bond interior metal piping systems and metal air ducts to equipment grounding conductors of associated pumps, fans, blowers, electric heaters, and air cleaners. Use braided-type bonding straps.

I. Building Frame Ground:

1. Ground the structural steel frame of the building by the use of ground rods or concrete encased electrodes.
2. Locate ground rods or concrete encased electrodes at intervals not exceeding 120 feet (30 m) on centers in a staggered arrangement.
3. Grounding Electrode Conductors: No. 4/0 AWG minimum bare stranded copper wire.
4. Ground electrodes for unit substation rooms and lighting transformers which have No. 4/0 AWG or larger grounding electrode conductors may be used to meet the building frame ground requirements.

J. Test Wells: One for each driven grounding electrode, except as otherwise indicated. Set top of well flush with finished grade or floor. Fill with 1-inch- (25-mm-) maximum-size crushed stone or gravel.

K. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NEC Article 250, using a bare copper conductor not smaller than No. 4 AWG. This conductor shall be located horizontally or vertically, and within the portion of concrete footing or foundation that is in direct contact with the earth for at least 20 feet (6 m). Where the length of concrete foundation is less than 20 feet (6 m) in length, coil excess conductor within base of concrete foundation. Route conductor on the outside of the steel cage and keep taught between connections. Bond grounding conductor to reinforcing steel with compression connectors UL listed and labeled for the application. Connections shall be made at top and bottom of cage, before any direction change, and at least every ten feet (3m) in vertical rises. Grounding conductor shall be of sufficient length to extend to building steel or other ground grid system as specified in contract documents.

L. Protect grounding conductors and bus in locations subject to mechanical damage with galvanized rigid metal conduit, steel guards, or other suitable shields. The conductor shall be permanently and effectively grounded to the conduit or enclosure at both ends, using approved fittings for the application.

M. Install grounding conductors that pass through floor slabs, building walls, etc., in a rigid PVC conduit sleeve, or other approved non-metallic material.

N. Soldered connections are not allowed on grounding circuits, except where grounding conductors are attached to lead cable sheaths or shielding tapes.

O. Do not install bare copper bar, cables or fittings used for grounding in cinder fill or soil containing corrosive materials.

P. Install cables with enough slack to prevent breaking stresses.

3.3 Connections

A. General: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.

1. Use electroplated or hot-tin-coated materials to assure 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.

B. Exothermic-Welded Connections: Use for connections to structural steel, ground rods, ground bar, and for underground connections. Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

C. Equipment Grounding-Wire Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.

D. Non-contact Metal Raceway Terminations: Where metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically noncontinuous conduits at both entrances and exits with grounding bushings and bare grounding conductors, except as otherwise indicated.

E. Equipment room perimeter ground bus sections shall be connected together by the exothermic welding process.Taps to grounding electrode conductors and equipment room ground buses shall be made by the exothermic welding process.

1. Exception: Where specifically approved by the Owner, stranded wire to stranded wire connections for taps to grounding electrode conductors may be made with UL approved compression deforming ground connectors, installed with the proper compression tool.

F. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. Where these requirements are not available, use those specified in UL 486A and UL 486B.

G. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by manufacturer of connectors. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.

H. Moisture Protection: Where insulated grounding conductors are connected to grounding rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

3.4 Field Quality Control

A. Tests: Subject the completed grounding system to a megger test at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wellseach ground rod to a

3-point null meter ground resistance test. Measure ground resistance not less than 2 full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests by the 2-point method according to IEEE 81.

B. Maximum grounding to resistance values are as follows:resistance to ground shall be 5 ohms.

1. Equipment Rated 500 kVA and Less: 10 ohms.
2. Equipment Rated 500 to 1000 kVA: 5 ohms.
3. Equipment Rated More than 1000 kVA: 3 ohms.

C. Excessive Ground Resistance: If higher resistance than 5 ohms is measured, drive additional ground rods until 5 ohms is achieved. Where resistance to ground exceeds specified values, notify Owner promptly and include recommendations to reduce ground resistance and to accomplish recommended work.

D. Report: Prepare test reports, certified by the testing organization, of ground resistance at each test location. Include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

3.5 Adjusting and Cleaning

A. Restore surface features, including vegetation, at areas disturbed by work of this Section. Reestablish original grades, except as otherwise indicated. Where sod has been removed, replace it as soon as possible after backfilling is completed. Restore areas disturbed by trenching, storing of dirt, cable laying, and other activities to their original condition. Include topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Division 2 Section "Landscaping." Maintain restored surfaces. Restore disturbed paving as indicated.

16075 - ELECTRICAL IDENTIFICATION

16075.1 GENERAL

1.1 Related Documents

A. Provide all items, articles, materials, operations or methods listed, mentioned or scheduled on drawings and/or herein, including all labor, materials, equipment and incidentals necessary and required for their completion.

B. GM Electrical Installation Standard EI-1

1.2 Summary

A. This Section includes identification of electrical materials, equipment, and installations.

1.3 Submittals

A. Furnish submittals for items that are identified in this Section by a different typeface and a bracketed code (*e.g., Item [L]*). Refer to Division 1 General Requirements for definition of codes for types of submittals and the administrative requirements governing submittal procedure. Additional submittal requirements pertaining to this Section are specified herein under this Article.

B. Schedule of identification nomenclature to be used for identification signs and labels.

C. Samples for each color, lettering style, and other graphic representation required for identification materials; samples of labels and signs.

1.4 Quality Assurance

A. Comply with NFPA 70, National Electrical Code.

B. Comply with UL 969, Marking and Labeling Systems.

1.5 Sequencing and Scheduling

A. Coordinate installing electrical identification after completion of finishing where identification is applied to field-finished surfaces.

B. Coordinate installing electrical identifying devices and markings prior to installing acoustical ceilings and similar finishes that conceal such items.

16075.2 PRODUCTS

2.1 Manufacturers

A. Manufacturers: Subject to compliance with requirements, provide products by 1 of the following:

1. Seton Identification Products.
2. Brady USA

2.2 Identification

A. *General [P]:*

1. Provide equipment identification in accordance with the following legend and Figure 1: (NOTE: All equipment listed herein may not be furnished or installed under this Contract. Provide identification only for equipment furnished or installed under this Contract).
    a. Substation primary switches, transformers and secondary breaker identification shall be furnished by the manufacturer in accordance with WFG's lead electrical engineer's requirements. Install these identifications.
    b. Provide identification for medium voltage raceway and cable in manholes, cable vaults, splices and terminations, etc. In manholes and cable vaults, utilize tie-wraps to attach identification on cables. Include the

feeder source for interlocked armor cable identification. Provide tags of the tie-wrap or snap-on type. Place tags wherever cable enters a substation room, where it enters a switchgear enclosure, and at each splice and tap location.

c. For 5E medium voltage cables provide fiberglass tags with minimum 1 inch high letters stating the voltage class on one line and cable identification number on a separate line. Tags for 15KV cables shall have a red background with white letters and 5KV tags shall have a yellow background with black letters. The material for tags shall be fiberglass reinforced polyester, rated for service temperatures -40 deg F (-40 deg C) to 193 deg F (90 deg C), and guaranteed not to chip, fade, rust, shatter, or peel for 15 years. Tags shall be located every 50 feet along the cable jacket and secured to the cable with UV resistant tie-wraps.W.H. Brady Co.

d. For cable tray identification, provide “Danger High Voltage” stick-on warning tags at 20-foot (6-meter) intervals along tray runs (alternate sides) for cable trays housing power cables.

e. For tap box identification, provide a phenolic engraved tag indicating the primary protective device and feeder number, and stick-on “Danger - High Voltage” warning tags.

f. Provide busway identification every 50 feet (15 meters) on alternating sides and at each termination, or as indicated on the Drawings, including:

   1) Protective device name

   2) Unique name of busway run

g. Provide bus plug identification, including:

   1) Device name

   2) Load name and location

h. Provide feeder disconnect switch identification, including:

   1) Device name

   2) Protective device name and location

   3) Load name and location

i. Provide motor control center and power panel identification, including

   1) Device name

   2) Protective device name and location

j. Provide starter and disconnect switch identification in motor control centers and power panels, including:

   1) Device name

   2) Protective device name and location

k. Provide combination starter, disconnect switch, lighting transformer combination starter, disconnect switch and control panel identification, including:

   1) Device name

   2) Protective device name and location

   3) Load name and location

l. Provide motor identification, including:

   1) Device name

   2) Protective device name and location

   3) Special characteristics such as explosion proof and special lubrication requirements

m. Clearly identify push button controls, selector switches, etc. as to function (e.g. start, stop). When not part of a motor control center or individual starter, provide control stations with nameplates, including:

1) Device name

2) Name and location of device controlled

n. Provide circuit breaker panelboard identification, including:

1) Device name

2) Protective device name and location

o. Identify interlock circuitry and separately supplied circuits as follows:

1) For control panel enclosures which contain interlock circuitry, provide a yellow warning tag on the outside of the control panel door adjacent to the main disconnect that states "ORANGE WIRING IS NOT DE-ENERGIZED BY MAIN DISCONNECT."

2) For terminal boxes containing interlock wiring, provide identification on the cover which reads "SEPARATELY ENERGIZED INTERLOCK WIRING INSIDE."

3) Where permitted by the Contract Documents, clearly identify devices connected to the line side of the main disconnect with yellow warning tags stating "CAUTION - 480 VOLT - SEPARATE SUPPLY - NOT DE-ENERGIZED BY THE MAIN DISCONNECT."

B. Letter Size and Color

1. Provide black characters on white background, unless otherwise specified by national, state or local codes.
2. Provide laminated phenolic engraving stock, a minimum of 0.062 inch (1.6 mm) thick.
   a. Exceptions:
      1) Warning tags described elsewhere in this Section which are yellow with black letters.
      2) Where environmental conditions require the use of other materials for tags.
3. Provide letter size as follows:

NORMAL VIEWING DISTANCE	STROKE WIDTH	LETTER HEIGHT
feet (meters)	**inch (mm)**	**inch (mm)**
Up to 3 (0.9)	0.031 (0.8)	0.218 (5.5)
3 to 6 (0.9 to 1.8)	0.062 (1.6)	0.437 (11.1)
6 to 30 (1.8 to 9.1)	0.312 (7.9)	2.312 (58.7)
Over 30 (9.1)	0.421(10.7)	3.000 (76.2)

E. Mounting

4. For tags and nameplates, provide metallic drive screws. Exception: for busway, provide hanging signs as indicated on the Drawings.
5. Provide ring type nameplates for push buttons and pilot lights.
6. For devices subject to periodic replacement or removal for repair (such as motors), mount tags and nameplates separate from and adjacent to the device.
7. Provide tags and nameplates for limit switches, pressure switches and similar devices, mounted separate from and

adjacent to the device.

2.3 Miscellaneous Identification Products

A. *Cable Ties [P]:* Fungus-inert, self-extinguishing, 1-piece, self-locking, Type 6/6 nylon cable ties with the following features:

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength: 50 lb (22.3 kg) minimum.
3. Temperature Range: Minus 40 to 185 deg F (Minus 4 to 85 deg C).
4. Color: As indicated where used for color coding.

2.4 Painting

A. If indicated in the Contract Documents, paint the electrical conduits, pull-boxes, starters, safety switches, supports, etc.

B. Where painting is required and painting specifications are not included in the Contract Documents, thoroughly clean and paint exposed conduits, supports, fittings, raceways, pull or junction boxes, etc., with 1 primer coat and 1 finish coat, the color to be selected by WFG's lead electrical engineer. For galvanized or bare metal surfaces, provide primer of the highest quality and specifically designed for the priming of the surface involved. Provide paint of fresh stock, delivered to the job site in sealed cans bearing the manufacturer's label and trade-mark, and apply in accordance with the manufacturer's requirements. Enclosures for lighting and power panels, safety switches, etc., which are factory finished need not be repainted; however, repair any chipping or marring in the field to the satisfaction of WFG's lead electrical engineer.

C. Require painting to be performed by competent and experienced painters. Where painting of electrical installations involves electrical hazard to painters, or where damage to electrical equipment may result, provide electrical supervision.

D. Paint: Alkyd-urethane enamel over primer as recommended by enamel manufacturer.

2.5 Phasing

A. Provide identification of each ungrounded conductor of a multiwire branch circuit by phase and system, as required by NEC Article 210.4 (D). Color coding shall match Plant Standards. Provide notice on panel as required by NEC Article 210.4 (D).

16075.3 EXECUTION

3.1 Installation

A. Self-Adhesive Identification Products: Clean surfaces of dust, loose material, and oily films before applying.

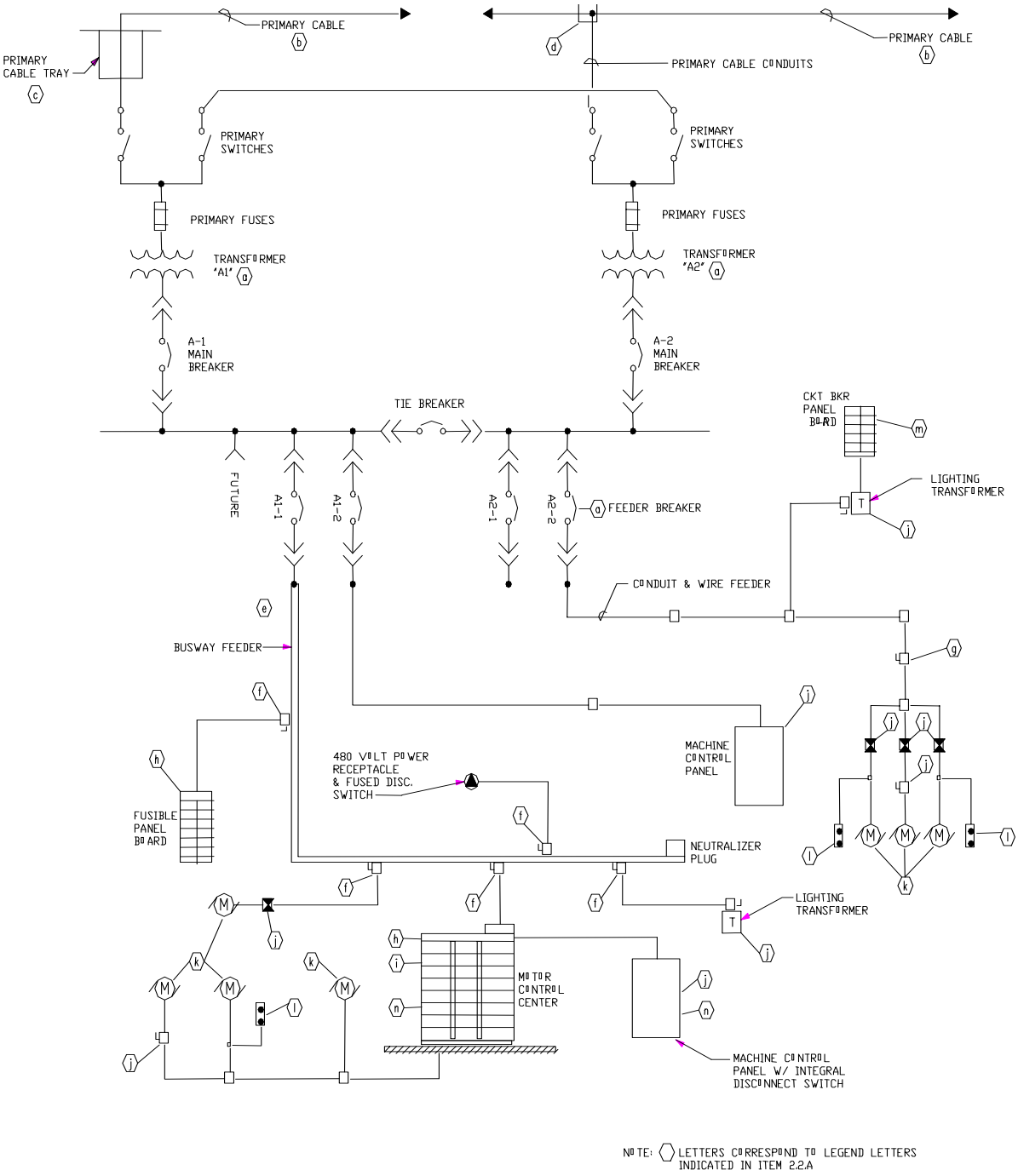

FIGURE 1

B. END OF SECTION

16080 - ELECTRICAL ACCEPTANCE TESTS

PART 1, 2 AND 3 COMBINED

SUMMARY

A. Description Of Systems

1. Furnish all labor, materials, test equipment, and technical supervision to perform and record the electrical tests as specified, and perform and record all electrical tests as required, including tests on high voltage wire and cable, 600 volt wire and cable, switchgear, unit substations, switchboards, distribution transformers, rotating equipment, busways, motor control centers, control devices, grounding, special service systems, relays, and transformer insulation liquids, unless otherwise specified.

2. Preliminary inspections and tests. Visual inspections of electrical equipment, wire checks of factory wiring and any other preliminary work required to prevent delays during performance of electrical acceptance tests.

B. Electrical acceptance tests. Those inspections and tests required to show that the workmanship, methods, inspections, and materials used in erection and installation of the electrical equipment conforms to accepted engineering practices, IEEE, ICEA. and NEMA Standards, the National Electrical Code, National Electric Testing Association (NETA) Specifications, manufacturers instructions, and 16000 Series Sections, and to determine that the equipment involved may be energized for operational tests.

C. Operating tests. Those tests performed on all electrical equipment installed under 16000 Series Sections, and under other Sections, to show that the electrical equipment will perform the functions for which it was designed.

D. Testing organization shall meet federal OSHA criteria for accreditation of testing laboratories, Title 29, Part 1910.7.

E. Related Work Specified In Other Sections:

F. Division 16 Section “Electrical General Requirements.”.

G. Operating tests on mechanical and electrical equipment installed under other Sections to prove capability of such equipment to perform as specified in the Section covering specific equipment.

H. Repair or replacement of equipment installed under other Sections and not meeting acceptance tests specified in this Section and therefore not acceptable.

I. Uncoupling of motors installed under other Sections where reverse rotation could damage equipment during acceptance tests for proper rotation.

RELATED DOCUMENTS

J. Provide all items, articles, materials, operations or methods listed, mentioned or scheduled on drawings and/or herein, including all labor, materials, equipment and incidentals necessary and required for their completion.

K. GM Electrical Installation Standard EI-1

FINAL ACCEPTANCE

L. Final acceptance of electrical equipment will not only depend on equipment integrity as determined by the electrical acceptance test, but will also depend on complete operational tests, whether performed under this or other Sections.

TEST REPORT SUBMITTALS

M. Test reports [T]: Submit, including complete data on actual readings taken and corrected values, to the Architect-Engineer for approval after each test period. Have all test reports signed by the authorized witnesses present at tests prior to submission. Do not energize any equipment or material for operating tests until test data has been approved. Refer to Division 1, General Requirements for requirements regarding submittals. Refer to Appendix “C” of GM Standard EI-1 for examples of acceptable test forms. Alternately, National Electrical Testing Association (NETA) test forms are also acceptable.

N. The test report shall include the following:

1. Summary of Project

2. Description of equipment tested

3. Description of test
4. Test results
5. Conclusions and recommendations
6. List of test equipment used and calibration date

RECORD DOCUMENTS

O. Submit, per Division 1, General Requirements, the final approved test reports to the Owner at the completion of the work under this Section.

ENVIRONMENTAL REQUIREMENTS

1. Humidity
   a. Do not perform megger or high potential tests during times of high relative humidity.
2. Weather
   a. Do not perform tests on outdoor equipment during inclement weather. Do not perform tests on direct burial bare ground conductors or on ground rods within a 48 hour period following rainfall.

SAFETY AND PRECAUTIONS

P. Prior to performing any testing, the testing personnel shall thoroughly familiarize themselves with the Plant's safety practices and procedures, as defined in the Purchasing Divisions contract documents, and perform testing in strict accordance with the plant's safety practices and procedures.

Q. Individuals responsible for performing the tests and inspections shall be capable of performing all procedures in a safe manner with complete knowledge of the hazards involved. The installer shall follow all recognized safety practices and procedures which include, but are not limited to the following:

R. All applicable provisions of the Occupational Safety and Health Act, particularly OSHA 29CFR 1910.

S. Accidental Prevention Manual for Industrial Operations, Latest Edition, National Safety Council.

T. National Electrical Testing Asssociation (NETA) Safety /Accident Prevention Program.

U. National Fire Protection Association NFPA 70E, Standard Electrical Safety Requirements for Employee Work Places.

V. National Electrical Safety Code – ANSI C2.

W. In all cases, approved work shall not proceed until the individual responsible for the test procedure has determined that is safe.

X. The installer shall have available sufficient protective barriers, warning signs, and related protective equipment to conduct specified test safely

Y. During cable tests, station a man at each point where cable has exposed connections.

SCHEDULING OF TESTS

Z. Perform all acceptance and operating tests in the presence of the Architect-Engineer.

1. Schedule sequence of tests so that equipment can be energized immediately after completion of the applicable tests and approval of test reports. Notify the Architect-Engineer of time of test at least 48 hours prior to testing.
2. Notify vendors and manufacturers of electrical equipment of the time of tests and extend reasonable cooperation

to them or their representatives to permit them to witness tests should they so request. Obtain list of manufacturers of Owner furnished equipment from the Architect-Engineer.

GENERAL TESTING REQUIREMENTS

AA. Preliminary Work

1. Perform preliminary inspections and tests immediately prior to performing acceptance tests. Fuses and protective devices, such as circuit breakers and cable limiters, shall be omitted from cable tests and tests involving cables.

BB. Megger Tests

1. Megger readings specified are the minimum readings desired at an ambient temperature of 60 degF (15.56 degC) and at a low relative humidity. Refer to Table 12-4 of GM Standard EI-1. When megger readings are taken at other than 60 degF, convert readings to equivalent values at 60 degF. As described in GM Standard EI-1, Section 12.2.3
2. When megger readings fall below the specified minimum values at 60 degF, devise some means of applying heat for the purpose of drying out the equipment subject to the approval of the Architect-Engineer. If drying is to be done by applying an electric potential to a piece of equipment, do not exceed the continuous voltage or current ratings of the equipment being dried, either directly or by induction.

CC. Phase Tests

1. All power distribution equipment, including but not limited to, switchgear, busway, panelboards, motor control centers, motor starters, disconnect switches, etc., shall have a phase arrangement of A-B-C, left to right, top to bottom and front to back.
2. The installer shall test electrical equipment and wiring to verify proper phase arrangement and prevent equipment damage and production and schedule delays. Primary cable and secondary power distribution cable shall be tested and documented before, during and after cable installations and modifications.

DD. On equipment connected to two power sources, such as tie breakers and automatic transfer switches, the installer shall perform cross voltage tests to ensure that phase A on one source corresponds to phase A on the other source, phase B to phase B and phase C to phase C.

16080.1 Tests on Wire and Cable in 480 Volt and Lower Service

A. General

1. Give each 480 volt power feeder and subfeeder cable a continuity test and a megger test. Verify phase identification for each power feeder and subfeeder cable. Verify identification of all lighting circuits and 120 volt circuits on panel directories and make operational checks on all lighting circuits and 120 volt circuits to prove that the circuits perform all functions for which they are designed. Check all power feeder and subfeeder cable connections for workmanship and conformance with standard practice by visual inspection.

B. Visual and Mechanical Inspections

1. Inspect cables for physical damage and proper connection.
2. Test mechanical connections of cable terminal lugs to manufacturer’s requirements with a calibrated torque wrench.
3. Verify cable color coding.

C. Connections

1. Isolate power cables to be megger tested by opening switches or breakers at each end of cable prior to testing where such disconnecting means exists. Where cables are direct connected without a disconnecting means, do not disconnect cables; test as connected after verifying that the connected equipment can safely withstand the applied test voltage.

D. Megger Tests

1. Use a 1000 volt megger for each megger test.
2. Apply megger tests between each conductor and ground with the other two conductors in the conduit or cable grounded to the same ground. Test each conductor in the same manner.
3. Minimum acceptable reading. For disconnected cables, 100 megohms; for connected cables, 1 megohm if conductor size is No. 14 or No. 12 AWG; 250,000 ohms for conductors No. 10 and larger.
4. Record all megger readings. Testing of cables having megger readings lower than average, even though meeting minimum requirements, shall be stopped and await further instructions from the Architect-Engineer.

E. Acceptance

1. Cable must pass all inspections and tests.

F. Records

1. Include the following information in test report on each 480 volt power cable:
   a. Complete cable identification and description of isolation means.
   b. Megger readings, including converted values.
   c. Approximate average cable temperature.

16080.2 Tests on Control Wiring

A. General

1. Give each single conductor and multi-conductor control wire or cable a continuity test and an insulation strength test. Verify identification of conductors.

B. Connections

1. Disconnect and fan out conductors to be tested.

C. Insulation Strength Tests

1. Subject each control wire to a 1000 volt, 60 hertz test.
2. Apply test between each conductor in a wire group and ground with all other conductors in the wire group grounded to the same ground. Use a test set having an accurate means of insuring 1000 volt test voltage and provide a series resistance to limit fault when a ground is found. Hold test voltage only long enough to read instruments. Test each conductor in the same manner.
3. In lieu of the above insulation strength test, megger each control wire as specified for 480 volt power conductors.

D. Acceptance

1. Wires must pass all tests.

E. Records

1. Include the following information in test report on each wire group.

a. Wire and group identification.

b. Type of test, insulation strength or megger.

c. When megger testing is selected, include information as specified for 480 volt power cables.

16080.3 Tests on Rotating Equipment

A. General

1. Inspect all motors installed under all other Sections for damage, moisture, alignment, proper lubrication, oil leaks, phase identification and cleanliness. Check for proper rotation. Coordinate uncoupling of motors where reverse rotation would damage equipment. Give each motor a megger test.

B. Visual and Mechanical Inspections

1. Inspect for physical damage.
2. Inspect for proper anchorage, mounting, grounding and connection.
3. Special tests, such as gap spacing and pedestal alignment, shall be performed in accordance with the manufacturer's requirements.

C. Connections

1. For three phase motors, include cable back to the open starter.
2. For single phase motors, disconnect motor from service.

D. Megger Tests

1. Apply megger tests on three phase motors between all phases tied together and ground, with motor at ambient temperature.
2. For single phase motors, apply megger test between phase and neutral conductor tied together and ground, with motor at ambient temperature.
3. Hold all megger tests for one minute or until the reading maintains a constant value for 15 seconds.
4. Minimum acceptable megger readings and megger voltage are listed below:

Equipment	Megger Volts	Minimum Megger Reading-Megohms
4000 volt, 3 phase induction motor	2500	100
2300 volt, 3 phase induction motor	2500	100
460 volt, 3 phase induction motor	1000	20
230 volt, 3 phase induction motor	500	20
200 volt, 3 phase induction motor	500	20
115 volt, 1 phase induction motor	500	5

E. Operating Tests

1. Run motor long enough to prove satisfactory performance including operating temperature, lubrication, vibration.

F. Acceptance

1. Motor must pass all inspections and tests.

G. Records

1. Make complete and accurate records of all tests and inspections. Include the following in each test report:
   a. Megger readings, including converted values.
   b. Ambient temperature at time of test.

16080.4 Tests on Control Devices

A. General

1. Perform operating tests on all control, alarm or indicating devices installed under Division 16000 Series Sections.

B. Connections

1. Include motors and protective control devices in test circuitry where operation of motors will not damage attached equipment.
2. Where equipment could be damaged by energizing motors, disconnect motor leads at the load side of starters.
3. Jumper or disconnect, as applicable, control devices installed under all other Sections as necessary to permit testing those devices and circuitry installed under 16000 Series Sections.
4. Coordinate these connections and tests with the trade responsible for the installation of motors.

C. Acceptance

1. Control devices and circuitry must pass all tests to prove that all design functions are satisfactorily performed, including manual and automatic operation and interlocking.

D. Records

1. Make complete records of all tests.

16080.5 Tests on Grounding Systems

A. General

1. Inspect ground conductors and connections for conformance with design specifications and for satisfactory workmanship. Test resistance to earth of each ground rod and each ground grid.

B. Visual and Mechanical Inspection

1. Inspect ground system to ensure compliance with the Contract requirement.

C. Connections

1. Maintain each ground rod isolated from the associated ground grid for tests on individual rods for resistance to earth.
2. Include associated ground rods and interconnecting wiring in tests on each grid system for resistance to earth.

D. Tests On Individual Ground Rods

1. Test each ground rod for resistance to earth by a standard method. Use a Biddle ground tester or the method of using two auxiliary ground rods as described in IEEE Standard No. 118, paragraph 5.5.2. The IEEE method requires the use of AC test current. Place auxiliary test rods sufficiently far away from the rod under test so that

the regions in which their resistance is localized do not overlap. Calculate ground resistance from the readings taken. Maximum acceptable resistance to earth. 25 ohms.

2. If the resistance is found to be higher than 25 ohms, drive additional rods with a minimum separation of 10 feet and connect in parallel with the rod under test until 25 ohms or less is obtained, or increase the length of the rod under test until 25 ohms maximum is obtained.

E. Tests On Each Ground Grid

1. Test each isolated ground grid as specified for individual ground rods, except the maximum acceptable resistance to earth is five ohms. In tests on total ground systems, the maximum acceptable resistance to earth is two ohms.

F. Acceptance

1. Grounding materials and connections must pass all inspections and must meet all specified maximum and minimum values.

G. Records

1. Make complete records of all tests. Include resistance values obtained, calculations of same, and methods of test and calculation.

16120 - WIRE AND CABLE (600 VOLT & LESS INCL MANUFACTURED WIRING SYSTEMS)

16120.1 GENERAL

1.1 SUMMARY

A. This section includes wire, cable, connectors for splices, lugs for terminations, interlocked armor cable fittings, terminators, wire labels, insulating tape, insulation for waterproof splices and taps, accessories, electronic cable, optical fiber cable, and optical fiber cables and connectors.

B. Provide all items, articles, materials, operations or methods listed, mentioned or scheduled on drawings and/or herein, including all labor, materials, equipment and incidentals necessary and required for their completion.

C. Description Of Systems

1. Provide wire and cable systems as required, and all material and equipment, including wire, cable, connectors and lugs, fittings, and wire and cable identification, as indicated or specified.

2. Provide the following types of control and signal transmission media:

a. Twisted-pair cable.

D. Related Work Specified In Other Sections:

1. Division 16 Section “Basic Electrical Materials and Methods”.

2. Division 16 Section “Electrical Acceptance Tests”.

1.2 RELATED DOCUMENTS

A. GM Electrical Installation Standard EI-1 .

B. GM Electrical Equipment Specification 11E, Interlocked Armor Cable, 600 Volt.

1.3 SUBMITTALS

A. Furnish submittals for items that are identified in this Section by a different typeface and a bracketed code (*e.g., Item [L]*). Refer to Division 1 General Requirements for definition of codes for types of submittals and the administrative requirements governing submittal procedure. Additional submittal requirements pertaining to this Section are specified herein under this Article.

B. Submit product data for each type and size of wire, cable, and connector. Identify material, construction data, insulation thickness, and jacket thickness. Submit color coding schemes for branch circuit wiring. Submit cable identifications.

C. Submit test data for wire and cable as specified under the paragraph “Source Quality Control”. Do not install wire and cable for which test data has been requested until test data is approved.

D. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

1.4 QUALITY ASSURANCE

A. Requirements Of Regulatory Agencies

1. Wire and Cable. Listed by Underwriters’ Laboratories as meeting National Electrical Code requirements and be so labeled.

B. Source Quality Control

1. Furnish wire and cable on which standard factory tests established by ASTM, ANSI, ICEA and NEMA have been performed.

C. Comply with NFPA 70.

1.5 PRODUCT STORAGE AND HANDLING

A. Wire And Cable Delivery

1. Deliver all wire and cable to the site on reels or in coils, plainly marked for complete identification, including the wire or cable size, the number of conductors, type of wire or cable, length, weight, thickness and character of the insulation and the name of the manufacturer. Furnish 600 volt wires and cables on coils and reels carrying original date and perforated inspection labels of the Underwriters’ Laboratories showing the number of feet and type of wire contained.

16120.2 PRODUCTS

2.1 WIRE AND CABLE SYSTEMS

A. Wire And Cable

1. General Requirements. Furnish wire and cable per standard specifications established for such material and construction by ASTM, ANSI, ICEA and NEMA, where applicable. Furnish copper conductors unless otherwise specified, not less than No. 12 AWG, except control conductors which may be No. 14 AWG. Furnish conductor

sizes as indicated. Furnish stranded conductors for sizes No. 10 AWG and smaller, and stranded conductors for sizes No. 8 AWG and larger.

a. American Insulated Wire Corp.

b. General Cable Co. BICC Cable.

c. The Okonite Co.

d. Pirelli Cable Corp.

e. Service Wire Co.

f. Southwire

g. AETNA Insulated Wire Inc.

2. *Wire for Final Connection in Conduit [U]*; to Incandescent Fixtures, HID Fixtures with Remote Ballasts, and

1) Remote Ballasts. No. 14 AWG Stranded copper, NEC Type SF-2 rated 200 degC, 600 volts.

3. *Wire for Use in Fluorescent Fixture Wiring Channels [U]*: Stranded copper, NEC Type THHN, or THWN, rated

a. 90 degC, 600 volts.

4. Wire for Exposed Cord Connection to Fluorescent Fixtures [U]: Three conductor stranded copper, NEC Type SO

a. rated 60 degC, 600 volts.

5. *Wire for Exposed Cord Connection [U]*; to Integrally Ballasted HID Fixtures. Three conductor portable cord Type

a. SO consisting of 3 stranded annealed copper conductors individually insulated with not less than 30 mils of heat and

b. moisture resistant ethylene propylene rubber compound rated 90 degC, 600 volts, cabled round with fillers and binder

c. tape covered with an overall neoprene jacket not less than 60 mils thick, UL listed.

6. *Wire for General Interior and Exterior Use [U]*: Single conductor, annealed copper, NEC Type XHHW or

a. THHN/THWN rated 90 degC in dry locations and 75 degC in wet locations, 600 volts, or NEC Type RHW rated 75

b. degC, 600 volts.

7. *Wire for Use in High Temperature Areas; as Indicated [U]*: Single conductor annealed copper, NEC Type FEP or

a. PFA rated 200 degC, 600 volts.

8. *Control Circuit Wiring [U]*:

a. Provide THHN/THWN insulation, 19 strand copper wire with thermoplastic insulation.

b. Provide minimum No. 14 AWG for raceways.

c. Provide SO or STD minimum No. 14 AWG for multi-conductor control circuit wiring.

d. Provide individual conductors of MTW/THHN/THWN construction and a jacket similar to STD Construction, with a minimum No. 16 AWG for multi-conductor control cables.

B. Connectors For Splicing Copper Conductors

1. Connectors for Straight Splicing Conductors; Up To and Including No. 8 AWG. Insulated solderless compression type.

a. Burndy “Hylink”

b. Thomas & Betts “Sta-Kon”

c. ILSCO “ILSCONS”

2. Connectors for Pigtail Splicing Conductors; Up To and Including No. 8 AWG. Solderless type; with a metallic insert connector within a plastic insulating cover having a temperature rating of 105 degC, 600 volts.

a. Buchanan

b. Ideal

c. Scotchlok

d. Thomas & Betts Corp. “Freespring” .

e. ILSCO “CPM”

3. Connectors for Straight Splicing Conductors; No. 6 AWG and Larger. Solderless compression 2-way type.

a. Burndy Type YS-L

b. Thomas & Betts 54500 Series

c. ILSCO “CT”

4. Connectors for 3-Way Splicing Conductors; No. 6 AWG and Larger. Solderless compression type.

a. Burndy YS-T

b. Thomas & Betts 54700 Series

c. ILSCO “ULT”

C. Lugs For Terminating Copper Conductors

1. Lugs for Terminating Power Conductors Up To and Including No. 8 AWG: Solderless type, manufacturer’s standard, unless otherwise specified.

2. Lugs for Terminating Power Conductors No. 6 AWG and Larger: Solderless compression type, 1 hole for No. 6 AWG through No. 4/0 AWG inclusive, and 2 hole for larger sizes.

a. Burndy Type YA-L

b. Thomas & Betts Series 54000

c. Anderson Products

d. ILSCO “CRA”

3. Lugs for Terminating Control and Switchboard Wiring: Solderless compression type with tinned ring tongue.

a. Burndy “Hylug”

b. Thomas & Betts “Sta-Kon”

c. Anderson Products

4. *Terminators [U]*: Armor grounding type, non-watertight for indoor use and watertight for outdoor use.

a. Thomas & Betts

b. Anderson Products

c. Burndy Corp.

d. 3M Company.

D. Wire Labels

1. Wire Labels for Identification of Conductors; Per Division 16 Section “Electrical Identification”.

E. Insulating Tape

1. General Use Tape:
   a. Okonite Type CLF Catalog Series 602-20
   b. Scotch 33 Plus
2. High Temperature Area Tape:
   a. Scotch 27

F. Insulation For Waterproof Splices And Taps

1. Insulation for Inline Splices: Heat shrinkable tubing with internal sealant or molded compound splice kit, suitable for submersion in water as used in manholes and handholes for installations of 1000 volts or less.
   a. Raychem WCSM.
   b. 3M 82A Series.
2. Insulation for Taps: Heat shrinkable sleeve with internal sealant or molded compound splice kits, suitable for submersion in water, in manholes and handholes for installations of 1000 volts or less.
   a. Raychem CTE (plastic type cable) .
   b. 3M 85 Series.

G. Miscellaneous

1. Lubricating Compound:
   a. American Polywater Corp.
   b. Ideal 77 Yellow or Wire Lube
2. Aluminum Joint Compound:
   a. Burndy “Penetrox A”
   b. Ilsco “DE-OX”
   c. Thomas & Betts No. 21059
3. Cable ties:
   a. Thomas & Betts DelTEC Black .

16120.3 EXECUTION

3.1 INSTALLATION

A. General

1. Install wiring in raceway systems, as indicated and as specified, except where exposed wiring is indicated or specified. Install wiring only in completed raceway systems and when systems are protected from the weather. Install conductors continuous, without splices, between equipment, where possible. Where splices are required, make up splices in boxes; do not use fittings for same.

2. Install phase and neutral conductors of each branch or feeder circuit in a single conduit except where paralleling circuits are indicated. Install paralleling circuits of identical makeup and length as the paralleled circuit, and terminate conductors at the same location, mechanically and electrically, at both ends, to ensure equal division of the total current between conductors.
3. Continuously lubricate all non-armored cables size #8 AWG and larger at the pull-in point of conduit systems with an approved compound compatible with conductor insulation or jacket.
4. Install conductors in such a manner that the bending radius of any wire or cable is not less than the minimum recommended by ICEA and/or the manufacturer. Do not exceed manufacturer's recommended values for maximum pulling tension applied to any wire or cable.
5. Connect all power wiring to equipment such that phasing shall be A-B-C-N left to right, top to bottom and front to back, where possible, and permanently identify phasing on the structure or housing adjacent to bus. Phase identification A-B-C is equivalent to transformer phase identification X1-X2-X3 and H1-H2-H3.
6. Connect phase wiring to all 3 phase receptacles to insure the same phase rotation in all receptacles with interchangeable plugs.

B. Voltage Drop

1. Limit the voltage drop to a total of 5% to the farthest device for feeder and branch circuit conductors. Limit the voltage drop in the feeder circuit not to exceed 2%. Refer to tables below for minimum lighting branch circuit wire sizes based on 3% voltage drop in the branch circuit.

MINIMUM WIRE SIZE FOR LIGHTING BRANCH CIRCUIT WIRING

120-VOLT, SINGLE PHASE, BRANCH CIRCUITS

Panel to Nearest Outlet (in feet)	**No. Wire Size (AWG) for Circuit Wattages**				
	1000 W	**1200 W**	**1400 W**	**1600 W**	**1800 W**
30	12	12	12	12	12
40	12	12	12	12	12
50	12	12	12	12	12
60	12	12	12	12	12
70	12	12	12	12	12
80	12	12	12	10	10
90	12	12	12	10	10
110	12	12	10	10	10
120	12	10	10	10	8

Note: The wire sizes shown are based on 3 current carrying conductors in 1 conduit. For installation where more than 3 such wires are permitted, multiply the watts shown in the above table by the de-rating factor in NFPA 70 for the number of current carrying conductors contemplated.

MINIMUM WIRE SIZE FOR LIGHTING BRANCH CIRCUIT WIRING

208-VOLT, 3 PHASE, 4 WIRE, GROUNDED WYE BRANCH CIRCUITS

Panel to Nearest Outlet (in feet)	No. Wire Size (AWG) for Circuit Wattages*									
	1 kW	2 kW	3 kW	4 kW	5 kW	6 kW	7 kW	8 kW	9 kW	10 kW
45	12	12	12	12	12	10	10	10	8	8
50	12	12	12	12	12	10	10	10	8	8
60	12	12	12	12	12	10	10	10	8	8
75	12	12	12	12	12	10	10	10	8	8
100	12	12	12	12	12	10	10	8	8	8
150	12	12	12	10	10	8	8	8	6	6
200	12	12	10	8	8	8	6	6	6	
250	12	10	10	8	6	6	6	6		
300	12	10	8	6	6	6				
400	12	8	8							
500	10	8	6							

**This chart may be used only if load is equally distributed on all phases, and 3-pole breakers and/or 3-pole switches are utilized to feed the 3 phase circuit.*

Note: The wire sizes shown are based on 3 current carrying conductors in 1 conduit. For installation where more than 3 such wires are permitted, multiply the watts shown in the above table by the de-rating factor in NFPA 70 for the number of current carrying conductors contemplated.

MINIMUM WIRE SIZE FOR LIGHTING BRANCH CIRCUIT WIRING

480-VOLT, 3 PHASE, GROUNDED WIRE, GROUNDED WYE* BRANCH CIRCUITS

Panel to Nearest Outlet (in feet)	No. Wire Size (AWG) for Circuit Wiring**						
	5000 W	7500 W	10000 W	12500 W	15000 W	17500 W	20000 W
100	12	12	12	12	10	10	8
150	12	12	12	12	10	10	8
200	12	12	12	12	10	10	8
250	12	12	12	10	10	8	8
300	12	12	10	10	8	8	8
400	12	10	10	8	8	6	6
500	12	10	8	8	6	6	6

**This chart may also be used for 480-volt, 3 phase, 4-wire, grounded Wye.*

***In both 3-wire and 4-wire system, this chart may be used only if load is equally distributed on all phases, and 3-pole breakers and/or 3-pole switches are utilized to feed the 3 phase circuits.*

Note: The wire sizes shown are based on 3 current carrying conductors in 1 conduit. For installation where more than 3 such wires are permitted, multiply the watts shown in the above table by the de-rating factor in NFPA 70 for the number of current carrying conductors contemplated.

MINIMUM WIRE SIZE FOR LIGHTING BRANCH CIRCUIT WIRING

277-VOLT, SINGLE PHASE, BRANCH CIRCUITS

Panel to Nearest Outlet (in feet)	No. Wire Size (AWG) for Circuit Wattages								
	2.8k W	3 kW	3.2 kW	3.4 kW	3.6 kW	3.8 kW	4 kW	4.2 kW	4.4 kW
150	12	12	12	12	12	12	12	12	12
160	12	12	12	12	12	12	12	12	10
170	12	12	12	12	12	12	10	10	10
180	12	12	12	12	12	10	10	10	10
190	12	12	12	12	10	10	10	10	10
200	12	12	12	10	10	10	10	10	10
210	12	12	10	10	10	10	10	10	10
220	12	12	10	10	10	10	10	10	10
230	12	10	10	10	10	10	10	10	10
240	10	10	10	10	10	10	10	10	10
250	10	10	10	10	10	10	10	10	8

Note: The wire sizes shown are based on 3 current carrying conductors in 1 conduit. For installations where more than 3 such wires are permitted, multiply the wattages shown in the above table by the editing factor in NFPA 70 for the number of current carrying conductors contemplated.

C. Color Coding And Conductor Identification

1. See Division 16 Section “Electrical Identification”.
2. Provide single conductor cables having black insulation for power feeders and subfeeders. Do not color-code these circuits. Identify individual feeder and subfeeder conductors as to phase connection A, B, C by means of wire labels at each splice and termination.
3. Identify individual phase conductors of branch power and lighting circuits as to phase and system voltage by means of color coding. Develop a unique color scheme for each different voltage system maintaining conformance with Section 210.5 of the NEC. Match existing schemes where such exist. Submit color schemes for approval of the Owner’s Representative prior to implementation. Provide conductor color coding by means of colored insulating materials or by means of colored wire labels attached to individual conductors in all outlet, pull or junction boxes and at all terminations.
4. Identify each control circuit wire at each termination by means of wire labels. Provide identification as indicated. Mark the white marking strip of all control terminal blocks with the same identification as the connecting wire in

permanent black ink.

D. In Underground Duct Systems

1. Brush and swab the duct line before pulling cable. When installing cables of large sizes, use flexible cable feeders of an appropriate size to lead the cable from the reel into the duct mouth. In manholes and handholes, install power cables exposed on cable racks and control and special system wiring in rigid steel conduit systems. In passing cables through manholes and handholes, take care to avoid crossovers so that each cable is accessible when placed on racks, and where feasible, install each cable in the duct in the same relative position throughout the underground system, unless otherwise required or indicated. Install cables so that spare ducts are accessible for use in the future.

E. Splices And Terminations

1. Splice and terminate conductors with connectors and lugs as specified for the specific size and type of conductor. Do not splice armored cable except where cable lengths are limited by reel capacity. Do not splice direct burial cable underground. Indent all compression type connectors and lugs with tools as recommended by the connector or lug manufacturer.
2. Thoroughly clean wire ends before connectors or lugs are applied.
3. Whenever copper lugs are terminated on aluminum bus, use a Belleville washer and 2 tin plated washers, 1 on each side in combination with aluminum joint compound on all contacting surfaces. Tighten and or torque bolts until Belleville washer is flat. Provide new Belleville washer after original use.
4. Insulate all bare surfaces of conductors with a minimum of 4 layers (half lap in 2 directions) of electrical insulating tape. On larger splices and terminals, build up connection with electrical insulating putty before applying tape, to eliminate both sharp edges and voids.
5. Terminate all armored cables at equipment with an approved type of armored cable terminator and terminate cable ground conductors on equipment ground bus. Where splices are required in armored cables, use approved splicing sleeves. Locate splicing sleeve outside of and adjacent to the tray, not in the tray.
6. All splices and taps in manholes and handholes shall be waterproof, suitable for submersion in water. Splices and taps shall be made using split bolt or compression type connectors and insulating materials, as specified in Part 2 of this Section. Splices and taps in manholes and handholes shall be avoided whenever possible.

NOTE:EDIT TO SUIT PROJECT REQUIREMENTS.

F. Terminations

1. Provide wire and cable terminations made with UL-listed 1-piece, compression deforming type, solderless high conductivity copper or copper alloy terminal lugs as follows:
   a. Provide terminal lugs with hole sizes and spacing in accordance with NEMA Standards.
   b. Provide terminal lugs attached to wire and cable in accordance with the manufacturer’s requirements and utilizing the proper tools.
   c. Provide terminal lugs for use on wire sizes number 3/0 and smaller, as single hole, single compression type. Exception: Wire and cable No. 6 AWG and smaller may be terminated on mechanical type connections or terminal strips integral with the utilization equipment or device. Provide the mechanical connector and terminal strip of UL-listed copper, either the tubular type with a pressure plate or the screw type with a wire clamp. In neither case, shall the screw directly compress the conductors.
   d. Provide terminal lugs for use on wire sizes number 4/0 and larger of the two-hole, long barrel, double compression type.
   e. Maintain proper phase arrangement on all electrical equipment throughout the installation.

G. Splices and Taps

1. General
    a. There shall be no splices from the power source to the load without written approval from the WFG lead Electrical Engineer.
    b. If written approval is obtained, provide splices and taps made with solderless, copper, compression deforming type connectors bearing the UL label on the part or delivery carton.
    c. Provide splices and taps made with approved tools and materials, and in accordance with the manufacturer's requirements. Tighten and secure the joints. No splice shall be made with conductor ends from which strands are missing or which are mutilated.

H. Cable Identification
    1. See Division 16 Section "Electrical Identification".
    2. Identify cable groups and conduit at entering and leaving locations in manholes and handholes by means of 1/8 inch thick lead die-stamped tags with punched ears. Fasten tags around the cable group or conduit with No. 12 AWG copper wire.
    3. Identify cables in cable tray at intervals of 40 feet, at each side of walls, and at terminations and splices by means of 1-1/2 inch strip aluminum with 3/16 inch raised letters.
    4. Designate source and load, or feeder or cable identification on tags. Submit identification for the approval of the Owner's Representative.

I. Acceptance Testing
    1. Perform the Visual, Mechanical, and Electrical acceptance tests specified in Division 16 Section "Electrical Acceptance Tests".

INSTALLATION – CONTROL AND SIGNAL TRANSMISSION MEDIA

J. Install cable as indicated, according to manufacturer's written instructions.

K. Install transmission media without damaging conductors, shield, or jacket.
    1. Do not bend cable, in handling or installation, to smaller radii than minimum recommended by manufacturer.

L. Pull cables without exceeding cable manufacturer's recommended pulling tensions.
    1. Pull cables simultaneously if more than one is being installed in same raceway.
    2. Use pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation.
    3. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage media or raceway.

M. Install exposed cables parallel and perpendicular to surfaces or exposed structural members, and follow surface contours where possible.

N. Support cables according to Division 16 Section "Basic Electrical Materials and Methods."

O. Use splice and tap connectors compatible with cable material.
    1. Make no splices except at indicated splice points.

P. Seal around cables penetrating fire-rated elements according to Division 7 Section "Firestopping."

Q. Bond shields and drain conductors to ground at only one point in each circuit.

R. Connect components to wiring system and to ground as indicated and instructed by manufacturer.

S. 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.

T. Identify cables according to Division 16 Section "Electrical Identification."

U. Copper Cable Testing Procedures: Inspect for physical damage and test cable for continuity and shorts. Use time-domain reflectometer with strip-chart recording capability and anomaly resolution to within 12 inches (300 mm) in runs up to 1000 feet (300 m) in length. Test cable segments for faulty connectors, splices, terminations, and the integrity of the cable and its component parts.

V. Optical Fiber Cable Testing Procedures: Perform each visual and mechanical inspection and field test, including optional procedures, stated in NETA ATS, Section 7.25. Certify compliance with test parameters and manufacturer's written instructions.

W. Replace malfunctioning cables at Project site, where possible, and retest to demonstrate compliance.

16130 - RACEWAYS AND BOXES

16130.1 GENERAL

1.1 RELATED DOCUMENTS

A. Provide all items, articles, materials, operations or methods listed, mentioned or scheduled on drawings and/or herein, including all labor, materials, equipment and incidentals necessary and required for their completion.

B. General Motors Standard EI-1.

1.2 SUMMARY

A. Section Includes

1. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

B. Related Work Specified in Other Sections:

1. Division 7 Section “Firestopping”.
2. Division 16 Section “Electrical General Requirements”.
3. Division 16 Section “Underfloor Raceways”.
4. Division 16 Section “Electrical Identification”.

1.3 QUALITY ASSURANCE

A. Requirements Of Regulatory Agencies

1. Work in Hazardous Areas: Per Article 500 of the National Electrical Code.

1.4 SUBMITTALS

A. Furnish submittals for items that are identified in this Section by a different typeface and a bracketed code (e.g., Item [L]). Refer to Division 1 General Requirements for definition of codes for types of submittals and the administrative

requirements governing submittal procedure. Additional submittal requirements pertaining to this Section are specified herein under this Article.

B. Include complete data on each item. Coordinate the items, as they relate to the work, prior to submittal.

1.5 OPERATION AND MAINTENANCE MANUAL

A. Provide, per Division 1 General Requirements for systems and equipment.

16130.2 PRODUCTS

2.1 MATERIALS

A. Conduit

1. Electrical Metallic Tubing: Zinc-coated steel per ANSI C80.3 “Specification for Electrical Metallic Tubing, Zinc-Coated”.
   a. Allied Tube and Conduit Corp .
   b. Condux International, Inc.
   c. Steelduct Conduit Products.
   d. Wheatland Tube and Conduit Corp.
   e. LTV Steel Tubular Products
2. Flexible Metal Conduit: Per ANSI/UL 1, “Flexible Steel Conduit”.
   a. Anamet, Inc.
   b. Condux International, Inc.
   c. Electri-Flex Corp.
3. Liquid-Tight Flexible Steel Conduit: Per ANSI/UL 360, “Steel Conduits, Liquid-Tight Flexible”, with a PVC jacket.
   a. Anamet, Inc. “Sealtite Type UA only”
   b. Electri-Flex Corp .
   c. Thomas & Betts

B. Conduit Fittings

1. Couplings and Connectors for EMT: Zinc-plated steel, compression or set screw type.
   a. Appleton
   b. Midwest Electric Product/Crouse-Hinds Company
   c. Raco
   d. Thomas & Betts
2. Conduit Unions; On Continuous Run:

a. Appleton

b. O-Z/Gedney

c. Raco

3. Fittings for Flexible Steel Conduit: Malleable iron or steel, zinc plated, securing the conduit by clamping action around the periphery of the conduit. Do not furnish fittings that anchor the conduit by means of set screws.

a. Appleton

b. Steel City

c. Thomas & Betts

4. Fittings for Liquid-Tight Flexible Steel Conduit: Designed to maintain the liquid-tight feature of the installation.

a. Appleton ST Series

b. Ideal Industries 75 Series

c. Thomas & Betts 5000 Series

5. Locknuts; for rigid steel or intermediate metal conduit terminated in threadless openings; gasketed sealing locknuts.

a. Appleton BLS Series

b. Crouse-Hinds SL Series

c. Raco 150SL Series

C. Outlet Boxes

1. Sheet Steel Boxes: Galvanized stock not less than No. 14 gage, with knockout openings, single or multiple gang, with extensions, adapters, plaster rings, tile covers, fixture studs and cover plates. Furnish accessories with same gage and finish as specified for boxes, except where special finishes are specified for covers and device plates in Section 16121. Provide sizes per NEC requirements for wiring space, except where minimum sizes are specified under Article “Installation”.

a. Appleton

b. Raco, Inc.

c. Steel City

2. Cast or Malleable Iron Boxes: Galvanized, single or multiple gang, with taper threaded hubs, adapters and cover plates. Furnish cast metal, galvanized accessories, except where special device plates are specified in Section 16121. Furnish gaskets when located in areas requiring gaskets as specified in Article “Installation”. Provide sizes per NEC requirements for wiring space, except where minimum sizes are specified under Article “Installation”

a. Appleton

b. Crouse-Hinds

c. Pyle-National

d. O-Z/Gedney

3. Cast Aluminum or Aluminum Alloy Boxes: Single or multiple gang, with taper threaded hubs, adapters and cover plates. Furnish cast aluminum or aluminum alloy accessories, except where special device plates are specified in Section 16121. Furnish gaskets when located in areas requiring gaskets as specified in Article “Installation”. Provide sizes per NEC requirements for wiring space, except where minimum sizes are specified under Article “Installation”.

a. Appleton

b. Crouse-Hinds

c. Pyle-National

d. O-Z/Gedney

D. Pull And Junction Boxes

1. Boxes Less than 5 Inches by 5 Inches. Conform to paragraph “Outlet Boxes”.

2. Sheet Metal Boxes: Code gage, full seam welded with bent-in flanges seam welded at corner joints, screw fastened cover of same gage as box. Fasten cover with brass or stainless steel machine screws. Galvanize box and cover after fabrication. Provide sizes conforming to NEC requirements for wiring space, except where boxes of larger size are indicated. Furnish gaskets when located in areas requiring gaskets as specified in Article “Installation”.

3. Cast or Malleable Iron Boxes: Code gage, with threaded hubs or conduit bosses for field drilling and tapping, screw fastened cover of same gage as box. Fasten cover with brass or stainless steel machine screws. Galvanize box and cover after fabrication. Provide sizes conforming to NEC requirements for wiring space, except where boxes of larger size are indicated. Furnish gaskets when located in areas requiring gaskets as specified in ARTICLE “INSTALLATION”.

   a. Appleton

   b. Crouse-Hinds

   c. O-Z/Gedney

4. Cast Aluminum or Aluminum Alloy Boxes: Code gage, with threaded hubs or conduit bosses for field drilling and tapping, screw fastened cover of same gage as box. Fasten cover with stainless steel machine screws. Provide sizes per NEC requirements for wiring space, except where boxes of larger size are indicated. Furnish gaskets when located in areas requiring gaskets as specified in ARTICLE “INSTALLATION”.

   a. Appleton

   b. Crouse-Hinds

   c. O-Z/Gedney

E. Metal Wireways

1. *Wireways [U]*: Rigidly supported and accessible.

2. Oil-tight and gasketed, equivalent to NEMA 12 construction for all applications, except NEMA 1 construction is acceptable for indoor exposed locations in an office building.

3. Minimum metal thickness: 14 gauge.

4. Provide hinged covers shaped to overlap the sides and be held closed by captive screws or other suitable fasteners exterior to the wireways. For sections mounted horizontally, provide the covers on top. Provide covers which are capable of opening at least 90 degrees.

5. Wireways with knockouts are not acceptable. Provide only such openings as are required for wiring the equipment.

6. Provide fittings and accessories, including couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for a complete system.

7. Select features, unless otherwise indicated, as required to provide a complete wiring system and to comply with NFPA 70.

a. Hoffman

b. Keystone

c. Square D

F. Surface Raceways

G. Enclosures and Cabinets

1. Hinge-Cover Enclosures: Steel, finished inside and out with manufacturer's standard enamel finish; NEMA 250, Type 12, unless otherwise indicated in the contract documents, with continuous hinge cover and flush latch.

a. Crouse-Hinds

b. Hoffman Engineering Company

c. O-Z/Gedney

d. Thomas and Betts Corporation

H. Cabinets: NEMA 250, Type 12, unless otherwise indicated in the contract documents, galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel finish. Hinged door in front cover with flush latch and concealed hinge. Key latch to match panelboards, if applicable. Include metal barriers to separate wiring of different systems and voltage, and include accessory feet where required for freestanding equipment.

e. Crouse-Hinds

f. Hoffman Engineering Company

g. O-Z/Gedney

h. Thomas and Betts Corporation

16130.3 EXECUTION

3.1 INSTALLATION

A. Conduit Systems:

1. Provide the types of conduit to be installed in the various locations indicated in the following table, unless specifically called for otherwise on the drawings or elsewhere in the specifications.

Indoor exposed locations in plants below 14 feet from finished floor, and all other areas not listed below:	Rigid steel **Exception 1:** Electrical metallic tubing for non-manufacturing equipment where continuously protected by the building structure (e.g., columns, side wall girts, block walls, and other permanent building structures) **Exception 2:** Electrical metallic tubing for 120 volt receptacle and lighting circuits

Indoor exposed locations in plants above 14 feet from finished floor	Electrical metallic tubing
Indoor exposed locations in offices, including areas above suspended ceilings	Electrical metallic tubing
Outdoor exposed locations:	Rigid steel **Exception:** PVC coated rigid steel conduit in constantly wet areas (cooling towers).
Concealed in masonry walls:	Electrical metallic tubing.
Concealed in concrete slabs or under slabs on grade:	Schedule 40 PVC with rigid steel stub-ups.
Direct buried in earth:	Schedule 40 PVC with Schedule 80 PVC under and near roadways and railroads. Use PVC coated rigid steel conduit at bends greater than 15 degrees.
At motors, transformers, and vibrating equipment	Liquidtight flexible metal conduit. (Maximum length 3 feet).
Recessed lighting fixtures:	Flexible steel conduit. (Maximum length 6 feet.)
Conduit sleeves:	Schedule 80 PVC.

2. Install rigid steel conduit in general in all applications, except as otherwise specified or indicated. Use aluminum conduit, where indicated in exposed dry locations only. Do not use aluminum conduit in concrete. Use electrical metallic tubing, unless noted otherwise, in lieu of rigid steel conduit in concealed dry locations in office and similar finished areas. Do not use EMT in concrete floors in contact with earth, underground, or in utility or factory areas.
3. Install flexible conduit for service to individual recessed fixtures, 1/2 inch minimum size, and for final connection to distribution transformers and other equipment subject to vibration or movement. Use liquidtight type of flexible conduit in damp or wet locations and for final connections to all motors.
4. Install conduit systems as indicated, as required by the NEC, and as specified. Install conduit sizes as indicated. Where conduit sizes are not indicated, install sizes per NEC requirements, except do not use conduit sizes smaller than 3/4 inch unless otherwise specified. Use 1/2 inch fixture stems unless otherwise indicated.
5. Install conduit concealed in office and similar finished areas, and exposed in all other areas unless otherwise indicated or specified. Do not run conduit in or under concrete floors in contact with earth in factory areas unless specifically indicated.
6. Use PVC jacketed rigid conduit in corrosive areas as indicated.
7. Install exposed conduit runs level and plumb parallel or perpendicular to walls, structural members, or intersections of vertical planes and ceilings. Keep conduit at least 6 inches away from parallel runs of high temperature surfaces, such as steam or hot water pipes and do not run conduit directly under cold water lines.
8. Encase conduit laid in earth below floor slabs, or in earth external to foundation walls and within 5 feet of same, with a 3 inch minimum concrete envelope around the conduit.
9. Install hazard warning tape directly above conduit or duct bank and located 12 inches below finished grade. Where conduit is installed below finished floor slab, warning tape shall be placed within the top 4 inches below the slab.

10. Group conduit for common support, where indicated and elsewhere as directed by the Architect-Engineer.
11. Do not install crushed or deformed conduits and avoid trapped runs in damp or wet locations. Take care to prevent the entrance of water and the lodging of concrete, plaster, dirt or trash in conduit, boxes, fittings and equipment during the course of construction. Free conduit of obstructions or replace the conduits. Where conduit joints occur in concrete slabs, or in damp or wet locations, make joints watertight by applying an approved compound on the entire thread area before assembling. Draw up all conduit joints as tightly as possible. Cap exposed empty conduits which do not terminate in outlets, panels, cabinets, etc. with standard galvanized malleable iron pipe caps. Plug empty conduits which terminate flush with floors or walls with flush coupling and galvanized malleable plug. Coat the threads of pipe caps and plugs with anti-corrosive joint compound.
12. Install conduit sleeves for all exposed conduits and cables passing through walls, ceilings or floors, and fill the void between sleeve and conduit with rubber calking flush with the end of the sleeve to seal the opening; where fire rating is required, use fire-barrier calking.
13. Terminate conduit stubbed up through concrete floors for connections to free standing equipment with a coupling flush with finish floor (except for conduit entering hazardous areas or entering non-hazardous areas from hazardous areas), and extend rigid conduit to equipment, except that where required, use flexible conduit from a point 6 inches above the floor.
14. Make changes in direction of runs with symmetrical bends, fittings or pull boxes. Do not use bends around outside corners; use fittings for same. Install elbows, bends and offsets having a minimum radius of curvature of 24 inches for 2 inch and 2-1/2 inch conduit, and 36 inches for 3 inch and larger conduit. Except where conduit runs are shown in exact detail, install pull points at not greater than 200 foot intervals in straight runs. Where bends are included between pull points, reduce this maximum permissible 200 foot separation between pull points by 50 feet for each 90 degree bend and 25 feet for each 45 degree bend. Figure deductions for all other angle bends on a similar basis. When bends are made in the field, make bends with an approved hickey or conduit bending machine. Make bends in 1-1/4 inch and larger conduits with standard conduit ells where possible.
15. Provide conduit nipples with 2 independent sets of threads. Do not use running threads on any part of the conduit system. Where conditions require joining 2 fixed conduits into a continuous run, use a conduit union, in place of running threads and coupling.
16. Install expansion fittings in exposed conduit runs of lengths greater than 200 feet, at each crossing of building expansion joints, and elsewhere as indicated.
17. Install expansion fittings in straight runs of aluminum conduit at intervals not greater than 80 feet.
18. Coat conduit threads in PVC jacketed rigid steel conduit with joint compound.
19. Install double locknuts and bushings on all rigid conduit terminations into threadless openings. Increase length of conduit threads at terminations sufficiently to permit the bushing to be fully seated against the end of the conduit. Use a threaded hub with watertight seal or a gasketed sealing locknut on all NEMA 12 applications and for all distribution boxes. Threads shall be per manufacturer’s recommendation.
20. Use 1 hole malleable iron galvanized pipe straps for support of single conduits, or clevis type hangers. Support groups of conduit on trapeze hangers. Use threaded rod or pipe for hanger support. Do not use perforated strap or wire for conduit or hanger support. Use beam clamps of malleable iron or wrought steel with hook rods to grip the beam flange for conduit or hanger support; do not use C-clamp type fittings unless otherwise indicated on Drawings. Support exposed conduit at least every 8 feet if smaller than 2 inch, and every 10 feet if 2 inch and larger unless otherwise noted.
21. Install nylon pull wire in empty conduits.

B. Outlet And Switch Boxes

1. Outlet Boxes for Use with Rigid Steel Conduit in Nonhazardous Areas. Sheet steel for flush or concealed work in dry locations; cast or malleable iron in exposed, or damp or wet locations. Do not use sheet steel outlet boxes in

utility or factory areas.

2. Outlet Boxes for Use with Aluminum Conduit. Sheet steel for flush or concealed work in dry non-concrete locations and cast aluminum or aluminum alloy in exposed locations.
3. Outlet Boxes for Use with Electrical Metallic Tubing. Sheet steel for flush or concealed work; cast or malleable iron for exposed locations.
4. Outlet Boxes for Use in Hazardous Areas. Approved for use in such areas.
5. Flush Mounted Boxes. For single outlets, use boxes not less than 4 inches square and 2-1/8 inches deep. For multiple outlets, use gang type boxes not less than 2-1/4 inches deep. Furnish plaster rings not less than 1-1/4 inches deep. In masonry walls use masonry boxes. For ceiling outlets in concrete slabs, use boxes not less than 3 inches deep.
6. Gaskets. Provide cover gaskets for boxes in damp or wet locations and in factory areas.
7. Install boxes in the wiring or raceway systems as required for pulling of wires, making connections, and mounting of devices and fixtures.
8. Install extension rings, adapters, raised covers and plaster rings on flush mounted boxes as required. Equip flush mounted boxes in masonry block or tile walls with tile covers.
9. Install separate concealed boxes for semi-flush or recessed fixtures when required by the fixture terminal operating temperature. Make boxes readily accessible on removal of the fixture or provide ceiling access panels as approved by the Architect-Engineer.
10. Locate outlets in offices and other finished areas with due regard for the finish and interior architectural treatment so that outlets are centered with respect to panels, joints or moldings, and so that plaster rings, frames and tile covers are properly located with respect to the finished surface.
11. Install outlets for wall switches controlling lighting on the latch side of door where possible.
12. Support boxes independent of conduit and secure rigidly in place. Install boxes used for fixture support such that they are capable of carrying 100 pounds.
13. In concrete, anchor boxes securely to reinforcing steel and to forms to prevent shifting when concrete is placed.
14. Above suspended ceilings, support boxes independent of the ceiling; fasten boxes to the ceiling support system by bar hanger or similar support.

C. Pull and Junction Boxes

1. Pull and Junction Boxes for use with Rigid Steel or Aluminum Conduit or Electrical Metallic Tubing in Non-Hazardous Areas. Sheet steel for exposed or flush work in dry locations; sheet steel with cover gaskets for work in dry locations of utility and factory areas; cast or malleable iron with cover gasket in damp or wet locations.
2. Pull and Junction Boxes for use with Rigid Steel conduit in concrete. Cast iron with reinforced cover and sealing gasket flush mounted in light traffic areas.
3. Pull and Junction Boxes in Hazardous Areas. Explosion proof suitable for use in such areas.

D. Floor Boxes

1. Install floor boxes with brass fittings and accessories in laboratory and medical areas, and with aluminum fittings and accessories in office areas.
2. Install floor box such that the cover is flush with floor covering or finish floor as applicable to the area in which the floor box is installed. Install plugs in unused conduit entrances. Install above floor fittings and accessories for services indicated. Install flush plugs in covers where outlets are not installed under this Contract.

E. Wireways

1. Install wireways at locations indicated. Where wireways are located on surfaces, do not install wireway in contact with such surfaces; support wireways with not less than 1/4 inch separation from the surface.
2. Provide supports at a maximum of 5 foot intervals.
3. Where pendent supports are indicated or required, provide 1/2 inch diameter threaded rods with beam clamps as specified for conduit supports. Provide lateral bracing at intervals not greater than 10 feet.

F. Equipment Identifications

1. Provide identification labels for electrical equipment as indicated in Division 16 Section “Electrical Identification”.

16140 - WIRING DEVICES

16140.1 GENERAL

1.1 RELATED DOCUMENTS

A. Provide all items, articles, materials, operations or methods listed, mentioned or scheduled on drawings and/or herein, including all labor, materials, equipment and incidentals necessary and required for their completion.

B. GM Electrical Installation Standard EI-1.

1.2 SUMMARY

A. Description Of Systems

1. Provide lighting control and receptacle services as required, and all materials and equipment, including switches, receptacles, device plates, multi-outlet assemblies, photoelectric controllers, time switches, lighting contactors and low voltage control systems, as indicated or specified.

B. Related Work Specified In Other Sections:

1. Division 16 Section “Basic Materials and Methods”.
2. Division 16 Section “Underfloor Raceways”.

1.3 SUBMITTALS

A. Furnish submittals for items that are identified in this Section by a different typeface and a bracketed code (e.g., *Item [L]*). Refer to Division 1 General Requirements for definition of codes for types of submittals and the administrative requirements governing submittal procedure. Additional submittal requirements pertaining to this Section are specified herein under this Article.

B. Submit complete data on each item. Coordinate the items, as they relate to the work, prior to submittal.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70.

B. Comply with NEMA WD-1 and WD-6.

C. Comply with NFPA 70.

D. Comply with UL 20 and 498.

1.5 COORDINATION

A. Receptacles for Owner furnished equipment: Match plug configurations.

1. Cord and plug sets: Match equipment requirements.

1.6 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and are identified with labels describing contents.

1. Telephone/power service poles: One for each 10, but not less than 1.
2. TVSS receptacles: one for each 8 installed, but not less than 2.

16140.2 PRODUCTS

2.1 WALL SWITCHES

WALL SWITCHES

A. Switch for Controlling Lighting Directly on AC Systems in General: Toggle-operated, brown or ivory specification grade, composition base, heavy duty, flush, quiet type, with provision for back and side wiring, and rated 20 amperes, 120/277 volts AC.

1. Manufacturers
   a. Arrow-Hart 1990 Series
   b. Bryant 4900 Series
   c. Eagle Electric 1201 Series
   d. General Electric GE5950 Series
   e. Hubbell 1220 Series
   f. Leviton 1221 Series

g. Pass & Seymour 20AC Series

B. Key-Operated Switch for Controlling Lighting Directly on AC Systems: Identical to toggle-operated switches specified above except for key operation. Furnish 4 keys to the Owner.

C. Switch for Controlling Lighting Directly on AC Systems; Located in Posts of Movable Metal Partitions. Toggle-operated, brown or ivory interchangeable type, composition base, flush type, rated 20 amperes, 120/277 volts AC.

1. Manufacturers

a. Arrow-Hart QT-91

b. General Electric GE7651-1

c. Pass & Seymour ACD201

2.2 CONVENIENCE RECEPTACLE

A. 20 Ampere Duplex Convenience Receptacle; for 120 Volt, Single Phase Service. Straight blade, 2 pole, 3 wire, NEMA configuration 5-20R, rated 20 amperes, 125 volts, NEMA performance standard, specification grade, for back and side wiring, brown or ivory in color.

1. Manufacturers

a. Arrow-Hart 5362

b. Bryant 5362

c. Eagle Electric 5362

d. General Electric GE 4108-1

e. Hubbell 5362

f. Leviton 5362

g. Pass & Seymour 5362

B. 20 Ampere Duplex Ground Fault Circuit Interrupter (GFCI) Convenience Receptacle [U]; for 120 Volt, Single Phase

Service. Straight blade, 2 pole, 3 wire grounding, NEMA configuration 5-20R, rated Class A, 20 amperes, 120 volts, 60

hertz, NEMA Standard WD1-4.02, heavy duty, wired to provide protection as indicated on the Drawings.

1. Manufacturers

a. Bryant GFR53FT

b. Eagle Electric 647 Series

c. Hubbell GF-5362 Series

d. Leviton 6899 Series

e. Pass & Seymour 2091F-S

f. Slater SIR-20-F Series

2.3 DEVICE PLATES

A. Device Plates in Offices and Other Finished Areas: Stainless steel No. 302 finish.

B. Device Plates in Laboratory Areas: Same as paragraph A above.

C. Device Plates in Factory, Utility and Similar Areas: Zinc or cadmium plated steel.

D. Device Plates in Wet or Moist Areas and Outdoors: Weatherproof type. Provide UL listed rain tight NEMA 3R cover on outdoor receptacle enclosures in wet locations. Assembly shall be clearly marked "Suitable For Wet Locations While In Use".

1. Manufacturers
   a. Eagle Electric 4900 Series
   b. RACO-BELL (Hubbell).
   c. Leviton 5900 Series
   d. Taymac Corp. of Tempe, Arizona.

E. Screws. Provide screws having a finish matching the plate.

2.4 MULTI-OUTLET ASSEMBLIES

A. *Multi-Outlet System of Receptacles [U]:* Consisting of receptacles and wiring installed in an all steel wireway system suitable for the use indicated. Locate and space receptacles and furnish lengths of wireway system as indicated. Provide necessary fittings such as couplings, clips, ends and covers. Furnish standard gray finish raceway system components. Provide receptacles as indicated and specified.

1. Manufacturers
   a. Walker Division, Butler Mfg. Co. "Walkermold"
   b. Wiremold

16140.3 EXECUTION

3.1 INSTALLATION

A. Mount equipment at locations indicated.

B. Install receptacles and switches in outlet boxes as specified in Section 16050 unless otherwise specified in this Section. Mount receptacles and switches at uniform heights above the floor for various areas as indicated.

C. Install plates on flush mounted outlets with all 4 edges in continuous contact with finished wall surfaces without the use of plaster mats or similar devices. Do not use plaster or similar fillings. Install plates vertically, unless otherwise noted, with an alignment tolerance of 1/l6 inch.

D. Identify wiring and control devices as per Division 16 Section "Electrical Identification".

E. Test wiring devices for proper polarity and ground continuity. Operate each device at least 6 times.

F. Test GFCI operation with both local and remote fault simulation according to manufacturer's written instructions.

G. Replace damaged or defective components.

3.2 CLEANING

A. Internally clean devices, device outlet boxes, and enclosures. Replace stained or improperly painted wall plates or devices.

16410 - DISCONNECT SWITCHES & CIRCUIT BREAKERS

16410.1 GENERAL

1.1 SUMMARY

A. Section includes disconnect switches rated 600 volts and below. Applications include, but are not limited to the following:

1. Main disconnect switches used in control enclosures.
2. Safety switches.

B. Related Work Specified In Other Sections:

1. Division 16 Section "Electrical Identification".
2. Division 16 Section "Wire and Cable" for lugs.
3. Division 16 Section "Motor Control".
4. Division 16 Section "Panelboards".

1.2 RELATED DOCUMENTS

A. GM Electrical Installation Standard EI-1.

B. GM Specification No. 12E, Motor Control.

C. GM Specification No. 12E-ASD, Adjustable Speed Drives.

D. GM Specification No. 12E-SS, Soft Starters.

E. GM Specification No. 13E, Busway.

F. SAE Standard for Electrical Equipment for Automotive Industrial Machinery, SAE HS-1738, 2002 Edition.

1.3 SUBMITTALS

A. Furnish submittals for items that are identified in this Section by a different typeface and a bracketed code (e.g., Item [L]). Refer to Division 1 General Requirements for definition of codes for types of submittals and the administrative requirements governing submittal procedure. Additional submittal requirements pertaining to this Section are

specified herein under this Article.

B. Product Data for switches and accessories specified in this Section. Include the following:
   1. Descriptive data
   2. Ratings.
   3. Certification that switches meet special switch testing requirements specified.

C. Wiring diagrams detailing wiring for power and control systems and differentiating between manufacturer-installed and field-installed wiring.

D. Qualification data for firms and persons who conduct testing.

E. Field test reports indicating and interpreting test results.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent testing agency shall meet OSHA criteria for accreditation of testing laboratories, Title 29, Part 1907, or shall be a full member company of the InterNational Electrical Testing Association (INETA).

B. Source Limitations: Obtain disconnect switches from one source and by a single manufacturer.

C. Comply with NFPA 70 for components and installation.

D. Comply with NEMA Standard KS-1.

E. Comply with UL Standard 98, Enclosed and Dead-front Switches.

F. Listing and Labeling: Provide disconnect switches specified in this Section that are listed and labeled.
   1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
   2. Comply with NFPA – National Electrical Code.
   3. Comply with IEEE C2 – National Electrical Safety Code.

16410.2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide disconnect switches and circuit breakers by 1 of the following:
   1. Fusible Switches:
      a. General Electric Co., Electrical Distribution and Control Division
      b. Siemens Energy & Automation, Inc.
      c. Square D Co
      d. Rockwell Automation

2.2 DISCONNECT SWITCHES

A. Switches shall be rated 600 volt ac and shall be three-pole, horsepower rated, quick-make, quick-break, heavy duty, industrial type with visible blades and no exposed live parts in the open position.

B. All fusible horsepower rated disconnect switches shall conform to the requirements listed in NEMA Standard KS-1 for heavy-duty (Type HD) enclosed switches and UL Standard 98 for enclosed switches.

C. Enclosure: Disconnect switches shall be fusible switches in NEMA 12 enclosure without knockouts, unless otherwise specified or required to meet environmental conditions of installed location.

1. Office areas: NEMA 1.

D. All current carrying parts of the switch shall be high conductivity copper, and all electrical connections shall be metal to metal only. No insulation material shall be used in the pressure system of a joint.

E. The design and construction of the operating mechanism shall be such as to insure ample strength and rigidity. Screws and nuts serving to attach operating parts to crossbars or other movable members shall be staked, upset or otherwise locked in position to prevent any possibility of loosening from vibration and mechanical shock. Mechanical stops shall be provided so as to remove undue strain from switch parts.

F. All fusible devices shall be furnished with UL approved rejection type fuse clips. The fuse clip current carrying parts shall be copper alloy. These clips shall be of such design that they shall accept the specified Class J or Class RK fuses. In addition, after a switch is installed, it shall not be possible to modify Class R or Class J type fuse clips with the use of ordinary hand tools in such a way as to permit the insertion of unapproved fuses. Clips that are designed to accept only 1 manufacturer's fuse shall not be acceptable.

G. The disconnect means shall be interlocked mechanically with the enclosure door. A suitable device operated by a screwdriver or other common hand tool shall be provided so that the interlocks may be bypassed and the enclosure door opened without disconnecting the power. Interlocking shall be reactivated automatically when the enclosure door is closed.

H. Mechanical interlocking shall be provided between the disconnecting means and its associated door to accomplish the following:

1. Prevent closing of the disconnecting means while the enclosure door is open, unless an interlock is operated.
2. Prevent closing of the disconnecting means until the door is in the fully closed position and the door hardware fully engaged.

I. The operating handle of the disconnecting means shall be of the flange-mounted type and be accessible.

J. The operating handle of the disconnecting means shall be such that it can only be padlocked in the off position. Provisions shall be made for a minimum of 3 locks having shackles 5/16 inch in diameter or smaller. The design shall be such that the switch cannot be closed when locked open by a single padlock.

K. The operating handle shall plainly indicate at all times whether the disconnecting means is in the open or closed position. The operating arm shall be in the down position for "off" indication.

L. The mechanical linkage between the disconnecting means and its operating handle shall be such that the operating handle is in control of the disconnect at all times. Door mounted disconnect handles shall not be acceptable.

M. In the event that one or more of the switch contacts are welded or otherwise stuck in the closed position, the bus plug design shall be such that:

1. The operating handle cannot be left at or near the off position when normal operating force is removed.
2. It shall not be possible to padlock the operating handle of the switch in the off position when normal force is applied.

N. Refer to ‘Busway Tests and Performance Data” in 13E for associated test.

O. All switches shall be rated and labeled as follows:
   1. Non-Fusible Switches
      a. Voltage
      b. Current
      c. Horsepower rated per NEMA Standards
   2. Fusible Switches
      a. Voltage
      b. Current
      c. Horsepower rated per NEMA Standards
      d. Withstand rated per UL (with rejection type RK fuses)

16410.3 EXECUTION

3.1 INSTALLATION

A. Install disconnect switches in locations as indicated, according to manufacturer's written instructions.

B. Install disconnect switches level and plumb.
   1. Disconnect switches shall be mounted so that the center of the grip of the operating handle, when in the highest position, is 5 feet 6 inches above the finished floor. Where special circumstances require other mounting heights, this dimension shall not be less than 36 inches or more than 78 inches above the finished floor. This 36 inch minimum mounting height is not applicable to motor control center and fusible panelboard installations.
   2. Disconnect switches shall be located in readily accessible location protected against damage from plant traffic.

C. Where remote control or indication devices are required, install wiring between disconnect switches, control devices, and indication devices.

D. Connect disconnect switches and components to wiring system and to ground as indicated and instructed by manufacturer.
   1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A .

E. Identify each disconnect switch according to requirements specified in Division 16 Section "Electrical Identification."

3.2 SPECIAL SWITCH TESTING REQUIREMENTS FOR MANUFACTURERS

A. The requirement of this standard are all-inclusive. All tests required by UL shall have written certification of compliance with these requirements signed by the engineering manager of the equipment manufacturer. Upon request of the purchasing Division, such certification shall be submitted including copies of data for test demonstrating conformance performed on equipment of identical construction and design.

B. The test circuit used for the performance of the special testing required in this section shall conform to that described for the "Withstand Tests" and "Closing Tests" in UL 98, Enclosed Switches. A schematic diagram of the actual test circuit used shall be included as a part of the certification.

C. For purposes of this testing, a source shall be used having a minimum of 100,000 amps RMS symmetrical, 600 volts, 60 hertz, at a maximum of 20% power factor available at the line side of the switch.

D. The switch shall be subjected to an I-peak and I2t of no less than the values listed in the table below. Refer also to UL 98, Enclosed and Dead-front Switches, and UL 198E, Class R Fuses.

Switch Ampere Rating	$I^2t \times 10^3$	Ipeak x 10^3
30	50	11
60	200	21
100	500	25
200	1,600	40
400	5,000	60
600	10,000	80

E. Fuses shall be mounted inside the device (unless non-fusible) but if a larger ampere rating fuse is required, the fuse may be installed outside the switch enclosure and on the load side of the disconnect. An appropriate copper dummy fuse shall be installed in the fuse clips having a cross-sectional area no smaller than the largest fuse intended for use with that switch. If the fuse is a size which is of the blade-type construction, the cross-section area of the dummy fuse shall as a minimum be equal to that of the actual size fuse blade.

F. Under the conditions described above, the switch shall be considered to have passed the test requirements if the following conditions are met:

1. There shall be no breakage of the switch base to the extent that the integrity of the mounting of live parts is impaired.
2. Neither end of a bar or tube used as a "Dummy Fuse" shall be completely ejected from the fuse clip and the line end of these bars or tubes shall not bridge from a fuse clip to dead metal.
3. The door shall be prevented from opening by its latch, without bolt or lock installed therein. (Deformation of the case alone is not considered to constitute failure.)
4. The switch shall be capable of being opened and reclosed manually with the operating handle at the conclusion of the test.

3.3 FIELD QUALITY CONTROL

A. Testing: After installing disconnect switches and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

1. Procedures: Perform each visual and mechanical inspection.

B. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units and retest.

3.4 CLEANING

A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish including chips, scratches, and abrasions.

END OF SECTION

16420 - MOTOR CONTROL

16420.1 GENERAL

1.1 SUMMARY

A. Description Of System

1. Provide motor control as required, and all material and equipment, including motor control centers, adjustable frequency controllers, motor starters, control devices, safety switches, fuses, terminal cabinets, and individually mounted shunt capacitors, as indicated or specified.
2. Provide all items, articles, materials, operations or methods listed, mentioned or scheduled on drawings and/or herein, including all labor, materials, equipment and incidentals necessary and required for their completion.

1.2 SUBMITTALS

A. Furnish submittals for items that are identified in this Section by a different typeface and a bracketed code (*e.g., Item [L]*). Refer to Division 1 General Requirements for definition of codes for types of submittals and the administrative requirements governing submittal procedure. Additional submittal requirements pertaining to this Section are specified herein under this Article.

B. Include complete data on each item. Coordinate the items as they relate to the work prior to submittal. See GM Standard Specifications referenced above for submittal requirements.

C. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 16 Section “Electrical Identification”.
2. Division 16 Section “Fuses”.
3. Division 16 Section “Grounding”.

16420.2 PRODUCTS

2.1 SINGLE PHASE MANUAL MOTOR STARTERS FRACTIONAL HORSEPOWER TYPE

A. *Single-Speed Starters for 115 Volt Motors [U]:* Per NEMA Standard ICS and consisting of a toggle-operated, or key-operated as indicated, single pole, quick-make, quick-break type starter, 1 thermal overload element, and pilot lights in cover as indicated all mounted in a NEMA 1, NEMA 12 surface mounting enclosure, or with a stainless steel plate for flush mounting in an outlet box, as indicated. Provide means for padlocking the toggle operator in the “off”

position. Provide a total of 4 keys for operation of key-operated starters.

B. Manufacturers:

1. Allen-Bradley Bulletin 600.
2. General Electric CR101.
3. Square D Class 2510.

2.2 CONTROL DEVICES

A. Provide control devices as indicated on the Drawings and as specified in GM Specification 12E.

B. Manufacturers

1. Allen-Bradley Bulletin 800T.
2. General Electric CR104P.
3. Square D Class 9001, Type K.

16420.3 EXECUTION

3.1 INSTALLATION

A. Motors: Motors 1/4 horsepower and larger are 460 volts, 3 phase, 60 hertz, and motors less than 1/4 horsepower are 115 volts, single phase, 60 hertz, unless other requirements are indicated. In all cases where the capacity or rating of equipment being furnished under this Section is based on the rating of equipment being furnished under other Sections, confirm such ratings before purchasing the equipment.

B. Control Equipment: Install equipment at locations indicated. Install motor starters, safety switches and control devices at uniform heights in general throughout the building with operating means at convenient heights above the floor and as indicated. Do not locate the operating means for individually mounted equipment at a height greater than 66 inches above the floor.

C. Capacitors: Install capacitors for all motors rated 10 horsepower and greater, unless otherwise indicated. Locate capacitors in motor control centers, except where capacitors are indicated to be individually mounted. Locate individually mounted shunt capacitors adjacent to motor starters. Connect capacitors ahead of the overload relay.

D. Fuses: Install fuses, of required ampere rating, in all fusible equipment installed under 16000 Series Sections. Verify all fuse ratings based on actual motor horsepower provided and manufacturer’s requirements for equipment protection.

E. Fingersafe electrical equipment

1. All electrical equipment that operates between 50-600 volts and located downstream of the bus plug must now be provided fingersafe, eg. IP2X. This includes all equipment supplied per this specification section.
2. Where equipment may be specified that does not meet this requirement, state each contradiction at time of bid for clarification by the WFG Lead Electrical Engineer. Lexan covers not listed for the purpose will not be accepted.

16440 - PANELBOARDS

16440.1 GENERAL

1.1 Summary

A. Description Of Systems

1. This Section includes fusible panelboards, circuit breaker panelboards, and mini-load centers.
2. Provide distribution systems as required, and install all materials and equipment, including panelboards, circuit breakers, mini-load centers, and other equipment, as indicated or specified. Provide equipment supports and identification as specified. Provide touch-up painting as specified.
3. Provide all items, articles, materials, operations or methods listed, mentioned or scheduled on drawings and/or herein, including all labor, materials, equipment and incidentals necessary and required for their completion.

1.2 Related Documents

A. GM Electrical Installation Standard EI-1.

B. Related Work Specified in Other Sections

1. Division 16 Section “Grounding”
2. Division 16 Section “Electrical Identification”
3. Division 16 Section “Electrical Acceptance Tests”
4. Division 16 Section “Wire and Cable (600 Volts and Less)”
5. Division 16 Section "Disconnect Switches and Circuit Breakers".

1.3 Submittals

A. Furnish submittals for items that are identified in this Section by a different typeface and a bracketed code (*e.g., Item [L]*). Refer to Division 1 General Requirements for definition of codes for types of submittals and the administrative requirements governing submittal procedure. Additional submittal requirements pertaining to this Section may be specified herein under this Article.

B. Include complete data on each item. Coordinate the items as they relate to the work, prior to submittal. Include the following:

1. Panelboards and Mini-Load Centers
   a. Product data giving details for each type of panelboard or mini-load center specified. Include dimensioned plans, sections, and elevations. Indicate minimum clearances.
   b. Identify enclosure type. Show divider in wireway for column-type panels.
   c. Detail doors, hinges, latches, and locks.
   d. Show bus configuration, material, sizes, and current ratings.
   e. Show connector and lug details for field wiring.

f. Short-circuit current ratings of panelboards and mini-load centers.

g. Current ratings, short circuit interrupting ratings, and factory settings of individual protective devices.

h. Indicate whether circuit breakers are bolt-on or plug-in type.

i. Provide complete wiring diagrams.

j. Provide panelboard schedules for installation in panelboards. Submit final versions after load balancing.

k. For fusible panelboards, provide manufacturer testing reports for disconnect switches in accordance with GM Electrical Installation Standard EI-1, Section 3.2.2.

l. Provide maintenance data to be included in maintenance manuals.

m. Provide field acceptance test reports as specified.

1.4 Quality Assurance

A. Testing personnel qualifications: Provide personnel for testing as specified in Part 3 who are certified by the InterNational Electrical Testing Association (INETA), or other nationally recognized certification organization.

B. National standards: Comply with the following, as a minimum:

1. NFPA 70, National Electrical Code (NEC)
2. NEMA standards:
   a. AB 1, Molded Case Circuit Breakers
   b. KS 1, Enclosed Switches
   c. PB 1, Panelboards
3. UL standards:
   a. UL 50, Electrical Cabinets and Boxes
   b. UL 67, Electric Panelboards
   c. UL 98, Enclosed and Dead-front Switches
   d. UL 489, Molded Case Circuit Breakers and Circuit Breaker Enclosures

C. General Motors Standards

1. General Motors Electrical Installation Standard EI-1 for Buildings and Facilities

1.5 Extra Materials

A. Keys: Provide 6 spare keys of each type for panelboard door locks. Locks shall be keyed alike and shall match the Owner's existing locks.

B. Extra locking devices for panelboard branch circuit breakers: Provide ten per panelboard.

C. Touch-up paint: One half-pint container per panelboard or mini-load center.

16440.2 PRODUCTS

2.1 MATERIALS

A. Circuit Breaker Panelboards

1. *Circuit Breaker Type General Description [B,D,P]:* Dead front safety type, per NEMA Standard PB 1 and UL 67, with main lugs or main circuit breaker as indicated, and branch circuit breakers, all in a flush or surface mounted steel cabinet as indicated.
   a. General Electric A Series
   b. Square D "I-Line"
   c. Siemens Energy & Automation, Inc. , I-T-E Division "CDP6"
2. Ratings:
   a. Bus ampere rating shall be 100 ampere or 225 ampere, as indicated on the drawings.
   b. Circuit breaker panelboards rated 277 volts and above shall be fully rated for a minimum of 65,000 RMS symmetrical amperes at 480 volts. Main and branch circuit breakers shall have an interrupting rating of 65,000 RMS symmetrical amperes at 480 volts. Exception: if the power source to the panelboard is a transformer rated no larger than 45 KVA, the panelboard and circuit breakers may be rated 14,000 RMS symmetrical amperes at 480 volts. Circuit breakers shall be the bolt-on type in either case.
   c. Circuit breaker panelboards rated 240 volts and below shall be fully rated for the available short circuit current, but in no case less than 10,000 RMS symmetrical amperes. Circuit breakers shall be the plug-in type.
   d. Circuit breaker panelboards used on DC systems shall be UL listed for the application. Circuit breakers shall have a DC rating.
3. Circuit Breakers: Provide in quantities, voltage rating, ampere rating, and number of poles as indicated. Circuit breakers shall be removable and interchangeable industrial type, quick-make, quick-break, with trip-free operating handle, position indication, and common trip from thermal magnetic trip device. Circuit breakers shall be ambient-compensated, thermal magnetic type automatic overload trip and identified with a circuit number in accordance with standard practice. Half size or tandem circuit breakers shall not be permitted. Branch circuit breakers used for switching shall be rated and marked SWD (Switching Duty) in accordance with UL and NEC requirements. Multi-pole circuit breakers shall be installed to serve loads which are connected phase-to-phase. Circuit breakers feeding locally switched areas, receptacle circuits, and night light circuits shall be provided with snap-on type locking devices.
4. Enclosures:
   a. NEMA 12 without knockouts in plant areas and NEMA 1 in office areas, as indicated.
   b. Surface mounted or flush mounted, as indicated.
   c. Standard width or narrow column type, as indicated. Column type shall have metal raceway interconnecting with a junction box located at the truss elevation. The junction box shall be provided with neutral terminals, captive hardware, and a hinged cover. Provide a divided raceway on column type panels having space for more than 27 branch circuit breakers.
   d. Cabinets, standard metal raceways, trim, and doors shall be constructed of code gauge sheet steel. Trim shall be complete with concealed full length piano hinges, door with concealed flush hinges, flush catch with keyed lock, and a large size directory frame on the inside of the door with a plexiglas cover. All locks shall be keyed alike and shall match the Owner's keying system
5. Busses: Provide bus bars of 98 percent conductivity copper, sized to result in a maximum current density of 1,000

amperes per square inch, and silver or tin plated at connections. Provide an equipment ground bus connected to the system ground. Provide an oversized neutral bus. Provide an isolated ground bus if required.

6. Spaces: When future circuit breakers designated as “space” are noted, equip the panelboard with bus and minimum hardware ready to receive future circuit breakers. Furnish a blank removable spacer plate to cover the “space” until future use.
7. Lugs for Mains: Compression type. Refer to Division 16 Section “Wire and Cable (600 Volts and Less)”.

B. Circuit Breaker Panelboards for Low-Voltage Control of Lighting Systems.

1. Mini-Load Center General Description [B,D,P]: Dead front safety type, per NEMA Standard PB 1 and UL 67, with main circuit breaker and controllable or standard circuit breakers configured in a master or slave column mounted panelboard as indicated.Manufacturer:
   a. Square D "Powerlink NF2000G3 Series".
2. Ratings:
   a. Bus ampere rating shall be 100 ampere or as indicated on the drawings.
   b. Panelboards shall be fully rated for a minimum of 65,000 RMS symmetrical amperes at 480 volts. Main and branch circuit breakers shall have an interrupting rating of 65,000 RMS symmetrical amperes at 480 volts. Circuit breakers shall be powerlink controllable or standard circuit breakers as indicated on the drawings and shall be the bolt on type.Primary main breakers shall be UL series rated for use on a circuit with 100,000 RMS symmetrical amperes available at 480 volts, when protected by an umbrella Class RK-5, 200-ampere fuse. Shop drawings shall include published data from the manufacturer verifying this rating.
3. Circuit Breakers:
   a. Controllable (remote operated) circuit breakers shall be Square D powerlink breakers with quantity, voltage rating, ampere rating, and number of poles as indicated.
   b. Standard breakers shall be switch rated and marked SWD (Switching Duty) in accordance with UL and NEC requirements. Provide quantity, voltage rating, ampere rating and number of poles as indicated.
   c. Circuit breakers shall be removable and interchangeable industrial type, quick-make, quick-break, with trip-free operating handle, position indication and common trip from thermal magnetic trip device. Circuit breakers shall be ambient compensated, thermal magnetic type with automatic overload trip and identified with a circuit number in accordance with standard practice.
4. Enclosures:
   a. NEMA 12 without knockouts.
   b. Narrow column mounted type.
   c. Cabinets, standard metal raceways, trim, and doors shall be constructed of code gauge sheet steel. Trim shall be complete with concealed full length piano hinges, door with concealed flush hinges, flush catch with keyed lock, and directory frame on the inside of the door with a Plexiglas cover. All locks shall be keyed alike and shall match the Owner’s keying system.
5. Busses: Provide bus bars of 98 percent conductivity copper, sized to result in a maximum current density of 1,000 amperes per square inch, and silver or tin plated at connections. Provide an equipment ground bus connected to the system ground.
6. Spaces: When future circuit breakers designated as “space” are noted, equip the panelboard with bus and minimum hardware ready to receive future circuit breakers. Furnish a blank removable spacer plate to cover the “space” until future use.
7. Lugs for Mains: Compression type. Refer to Division 16 Section “Wire and Cable (600 Volts and Less)”.

8. Master Panelboard:
    a. Panelboard shall include Square D NF 2000 Powerlink lighting and control system with Square D Powerlink remote operated circuit breakers and standard breakers as indicated.
    b. Panelboard shall include a Ethernet Gateway with RJ-45 port for connection to Ethernet to control lighting circuits by Energy Management System.
    c. Lighting and control system shall include a NF 2000 controller capable of controlling powerlink remote operated circuit breakers on the master panel and powerlink remote operated circuit breakers on up to eight slave panels via a communication loop cable as indicated on the drawings. Master panel shall also include a powerlink 120V power supply.
9. Slave Panelboard:
    a. Panelboard shall include Square D powerlink lighting and control system for a slave panel with Square D powerlink remote operated circuit breakers and standard breakers as indicated.
    b. Panel shall include a slave address selector and slave bus connector harness for remote operation of the powerlink circuit breakers from the master panel controller via the communication loop cable.

16440.3 EXECUTION

3.1 Installation

A. General
    1. Fully assemble panelboards.
    2. Mount panelboards at uniform heights throughout the building as indicated, and such that the distance from the floor to the center of the top switch or circuit breaker does not exceed 78 inches. Install handle-locking devices on all breakers for night lighting, emergency lighting, drinking fountains, and similar circuits which should remain on.

B. Equipment Supports
    1. Mount all electrical equipment securely to walls or columns, and provide all necessary struts, spacers, brackets, structural pieces, inserts, anchors and bolts for this purpose. Comply with GM Standard EI-1, the GM Standard Details, and the contract documents. Anchor fusible panelboards securely to floors and to supporting steel where such supports are indicated or required.

C. Installation Requirements
    1. Install mini-load centers in spaces which are adequately ventilated.
    2. Install all equipment such that sufficient working clearances are maintained per the NEC requirements.
    3. After balancing loads, provide typewritten circuit directory card in panelboard directory card holder. Provide accurate identification of all circuits.
    4. Provide at least 10 percent spare switches or circuit breakers in each panelboard. Provide more spares where indicated.
    5. Install filler plates in all unused spaces.
    6. For flush mounted panelboards, provide a minimum of four 1-1/2 inch empty conduits up into the ceiling space for future wiring from panelboard to loads. In addition, where mounted above a raised floor or supported slab, also provide a minimum of four 1-1/2 inch empty conduits down into the raised floor space or below the

supported slab for future wiring from panelboard to loads.

7. In plant areas, provide one duplex receptacle below each column-mounted panelboard connected to a branch circuit breaker.

D. Grounding

1. Provide grounding of all equipment per NEC requirements and per the requirements of Division 16 section "Grounding". Also comply with the requirements of GM Standard EI-1.
2. Provide isolated grounding where required.
3. Provide ground fault protection where required.
4. Provide ground fault circuit interrupting circuit breakers where required.

E. Tap Setting

1. Adjust tap settings of mini-load centers to provide the proper secondary voltage when normally loaded.

F. Touch-Up Painting

1. On all equipment installed, touch-up paint all manufacturer's standard finished equipment surfaces damaged during construction to "as new" condition with original manufacturer's finish paint.

G. Equipment Identification

1. Provide equipment identification per Division 16 Section "Electrical Identification".
2. Provide nameplates identifying the name of the panelboard as indicated in the contract documents or per the Owner's designation. Also identify voltages and the source from which the panelboard is fed.

3.2 Electrical Testing

A. Perform electrical testing of all equipment per Division 16 Section "Electrical Acceptance Tests".

END OF SECTION

16510 - LIGHTING SYSTEMS (INCL ALL ASSOCIATED EQUIPMENT)

16510.1 GENERAL

1.1 Summary

A. Description of System:

1. Provide lighting systems as required, and all materials and equipment, including luminaires, accessories and associated systems and equipment, as indicated or specified.

B. Related Work Specified In Other Sections:

1. Temporary Lighting – Division 1, 1638 General Requirement .

2. Ceiling Materials – Division 9 Series.
3. Painting and Paint Materials – Division 9 Series.
4. Wire and Cable (600 Volts and Less) – Division 16 Series.
5. Wiring and Control Devices – Division 16 Series.

1.2 Related Documents

1. GM Electrical Specification No. 8E-BAL "Electronic Ballasts for 32 Watt T-8 Fluorescent Lamps".
2. GM Electrical Equipment Specification No. 8E-HID1 "Indoor Industrial HID High-Bay and Low-Bay Luminaires".

1.3 Quality Assurance

A. Requirements of Regulatory Agencies

1. Furnish luminaires and other equipment, including all modifications thereto and component electrical parts, listed by Underwriters' Laboratories as meeting National Electrical Code requirements, National Appliance Energy Conservation Act of 1987; Amendments of 1988 (Public Law 100.357 dated June 28, 1988) requirements for energy efficient ballast, Energy Policy Act of 1992 requirements for lamp efficiency standards, also bearing the UL and energy efficient labels where such service is available for equipment specified.
2. All luminaires using metal halide lamps shall be enclosed and UL 1572 / CSA 250 labeled.

B. Source Quality Control

1. Fluorescent Lenses. Prismatic lenses on recessed fluorescent luminaires shall be acrylic and shall not be less than 0.125 inches in nominal thickness.

1.4 Submittals

A. Furnish submittals for items that are identified in this Section by a different typeface and a bracketed code (e.g., Item [L]). Refer to Division 1 General Requirements for definition of codes for types of submittals and the administrative requirements governing submittal procedure. Additional submittal requirements pertaining to this Section are specified herein under this Article.

B. Submit product data for each type of luminaire, equipment, and accessory with sufficient detailed information to allow the Architect-Engineer to accurately evaluate the products, including but not limited to the following:

1. Identify each item by luminaire specification type number and arranged in order of luminaire designation.
2. Manufacturer catalog number, ballast type, driver and emitter type (for SSL) and manufacturer.
3. Materials, dimensions, and weights of luminaires and poles.
4. Certified results of independent laboratory tests for luminaires and lamps/SSL emitters and drivers for electrical ratings, photometric data, lumen maintenance and life testing.
5. UL label information.
6. For luminaires to be used in hazardous locations, state the N.E.C. class, division, group and temperature identification number for which the luminaire is approved.
7. Shop drawings detailing dimensions, weights, and method of field assembly. components, features, and accessories for nonstandard luminaires.
8. Wiring diagrams detailing wiring for control system showing both factory-installed and field-installed wiring for specific system of this Project, and differentiating between factory-installed and field-installed wiring.

9. Battery and charger data for emergency lighting units.
10. Air, thermal, and sound performance data for air-handling luminaires.
11. Exterior luminaires and standards, submit effective projected area (EPA) and weights of luminaires, support assemblies, and standards.
12. Maintenance data for fixtures to include in the operation and maintenance manual specified in Division 1.

C. Samples for Verification: For lighting units or luminaires designated for sample submission in the Luminaire Unit Schedule.

1. Lamps: Specified units installed.
2. SSL Emitters: Specified units installed.
3. Ballast: 120V model of specified ballast type.
4. SSL Drivers: 120V model of specified driver/PSU type
5. Power connection: straight blade 120V 15A plug and cord.
6. Finishes: For each finished metal used in support components.

16510.2 PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the products specified in the Luminaire Schedule in this Section, or as indicated on the Drawings.

2.2 MATERIALS

NOTE: EDIT AND SELECT TO SUIT PROJECT REQUIREMENTS. DO NOT PROVIDE T12 34W ENERGY SAVING LAMPS WITH DIMMING SYSTEMS.

2.2.1 Ballasts

A. *Fluorescent Electronic [U]:* Unless otherwise indicated in lighting luminaire specification or schedule, ballasts shall be high-frequency, full light-output-type and shall comply with GM Document "Electrical Equipment Specification No. 8E-BAL." All ballasts for each luminaire type shall be of the same type and shall be the product of one manufacturer.

1. The following manufacturers are approved for low temperature electronic ballast for use on 800 ma rapid start, T-8 lamps. No substitutions permitted.
   a. Advance "Discrete"
   b. Universal Lighting Technologies "Triad"

B. *Fluorescent Dimming Electronic [U]:*

1. Shall meet all applicable requirements listed under this section "FLUORESCENT ELECTRONIC".
2. Shall be approved for use with the dimming system or controller as specified in Section 16510 and on the contract documents.

3. Shall provide a low end (5%) (20%) light output with consistent power output for various length lamps and quantities of lamps.
4. Shall provide dimming to the specified level without flicker or squirrel-tailing and also provide a "soft-start" at the level set on the dimmer control.
5. Electronic dimming ballast approved manufacturers shall be approved for use by the dimming system manufacturers specified in this Section.
    a. Advance
    b. Lutron
    c. Universal Lighting Technologies

C. *Solid State Lighting (SSL) Drivers [U]:*

1. Power Supply Units (PSUs), including drivers, must meet the following requirements.
    a. Shall have a minimum efficiency of 90%
    b. Driver input voltage shall be capable of 120-277V (±10%). For 480V power system applications a 480-277V auto-transformer shall be utilized.
    c. Power supplies shall be UL Class I or Class II.
    d. Operating frequency shall be 50/60 Hz.
    e. Drivers shall have a power factor (PF) ≥ 0.90.
    f. Drivers shall have a Total Harmonic Distortion (THD) ≤ 20%.
    g. Comply with FCC47 CFR part 15 non-consumer RFI/EMI standards.
    h. Reduction of Hazardous Substances (RoHS) compliant.
    i. Ensure compatibility/functionality between driver and control system (e.g. 0-10V, ELV, DMX). See Specification Section 16XXX and contract drawings.
    j. Conform to NEMA Standard SSL-1-2010.
    k. Conform to ANSI C62.41.2-2002 – IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000W and less) AC Power Circuits.
    l. Drivers in exterior applications shall be IP66 or IP67 rated.
    m. The following manufacturers are approved for SSL drivers No substitutions permitted.
        1) Dialight
        2) Inventronics
        3) KMW Inc.
        4) Lithonia Accudrive
        5) One Beta
        6) Philips Advance
        7) Philips Xitanium
        8) Thomas Research Products

2.2.2 Lamps

A. Incandescent: 130 volts extended service, 2500 hours rated life, inside frosted, except where otherwise indicated or

specified in the luminaire specification or schedule. Provide sizes as indicated or specified in the luminaire specification or schedule.

1. General Electric
2. North American Philips
3. Osram Sylvania

B. *Linear Fluorescent [U]:* 4100K, minimum CRI of 85, and minimum rated life of 24,000 hours at 3 hours per start on an instant start system, unless otherwise indicated or specified in the luminaire specification or schedule.

1. General Electric SPX Series
2. North American Philips Advantage Series
3. Osram Sylvania XP Series

C. Solid State Lighting (SSL) Emitters

1. SSL Emitters shall conform to ANSI/NEMA/ANSLG C78.377-2008 – American National Standard for the Chromaticity of Solid State Lighting Products.
   a. CRI minimum of 80 for interior office, CRI minimum of 70 for interior industrial and a CRI minimum of 65 for exterior applications.
   b. CCT nominal 4000K for office applications, 5000K for manufacturing area general lighting, and exterior lighting.
   c. Approved emitter manufacturers:
      1) Citizen
      2) Cree
      3) Luxeon
      4) Nichia
      5) Philips
      6) RAB
      7) Samsung

2.2.3 Interior Luminaire Requirements

A. Interior Luminaire General Requirement

1. Comply with UL 1598 /CSA 250.
   a. Luminaires shall be silicone-free except within sealed LED assemblies for Solid State Lighting (SSL) luminaires.
   b. Metal parts shall be free from burrs, sharp corners, and edges.
   c. Sheet metal components shall be made of steel, except as indicated, with baked enamel finish. Form and support to prevent warping and sagging.
   d. Doors, frames and other internal access shall be smooth operating, free from light leakage under operating conditions, and arranged to permit relamping without use of tools. Arrange doors, frames, lenses, diffusers, and other pieces to prevent accidental falling during relamping and when secured in operating position.
   e. Reflecting surfaces shall have the following minimum reflectance, except as otherwise indicated:
      1) Specular Reflectors 94 percent.

2) White surfaces: 90 percent.

3) Semi-Specular surfaces: 83 percent.

4) Diffusing Specular Surfaces: 75 percent.

f. Lenses, diffusers, covers, and globes shall be 100 percent percent virgin acrylic except as otherwise indicated.

1) Plastic: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

2) Lens Thickness: 0.125 inch (3 mm) minimum; except where greater thickness is indicated.

g. Parabolic louvers shall be semi-specular, 4" deep, where applicable. Review with owner.

h. Fixture Support Components: Comply with Division 16 Section "Basic Materials and Methods"

i. Pendant mounted luminaires shall be factory furnished with couterweights, offset top fittings, or similar means, such that the luminaires, powerhooks, and stem hang level and plumb when installed on ball joint type swivel hangers.

j. Connect luminaires to stems , power hooks, etc. with metal parts only. Plastic retaining nuts are not permitted.

k. Provide luminaires with an integral junction box or wiring compartment with a removable cover for easy access to field wiring terminations. On luminaires furnished with a cord and plug, connect with a removable connectors in an integral junction box for ease of cord replacement in the field.

l. Adjust luminaires with adjustable socket positions to give lighting distribution pattern called for by the drawings and / or specification, or as directed by the Architect-Engineer.

m. Provide luminaires specified herein for use in wet or hazardous locations UL listing and labeling for each specific area. Fusing and other accessories specified herein are not intended to affect the UL listing or label. Immediately bring to the attention of the Architect-Engineer and note prominently on the shop drawings. Any accessories which result in loss of UL listing or UL labeling for a specific application.

n. Provide lamp sockets for high intensity discharge and incandescent lamps of nickel plated, copper alloy with porcelain base as manufactured by the following, or as approved.

1) Arrow-Hart Inc.

2) Hubbell Inc.

3) Pass & Seymour

o. Interior High Intensity Discharge Luminaires General Requirements

p. Conform to UL 1598/CSA-S22.2, No. 250.-.

q. Enclose metal halide luminaires and provide vertically mounted lamps.

r. Provide powerhooks for high intensity discharge luminaires with GM Series pendant or feed-thru type. Furnish powerhook complete with box, hook, receptacle and plug, loop, fuses, etc., as required. Provide UL listed powerhooks in accordance with the following, or as approved.

s. Provide safety chains on each industrial high intensity discharge luminaire to prevent it from falling. Secure the reflector to the ballast enclosure with a removable chain, where these components can be disassembled. Secure any glass or metal reflector closure to the reflector. Safety chain shall be zinc plated, galvanized, or stainless steel safety chain and hardware. Provide the chain with a minimum 350 lb. working load. Attach it with Klein or equal swivel snap hooks with at least the same load capacity and the chain. Provide the chain and connections to withstand a minimum 6 inch free fall of the equipment it protects with a minimum safety factor of two. Provide a safety factor of two for safety chains and connections which allow a free fall in access of 6 inches. Provide an actual installed slack of 4 inches maximum or as shown on the drawings.

B. Fluorescent Luminaires Requirements

1. Provide fluorescent luminaires installed in rows in continuous rows with no less than one (1) support per luminaire and supports located not more than 12 inches from the end of luminaire. Support pendant or surface mounted luminaires in areas with ceilings independently of the ceiling.
2. Provide three-lamp fluorescent lighting luminaires with one single-lamp wired to the center lamp and 2-lamp ballast wired to outer lamps, unless otherwise specified or shown on the Drawings.
3. Provide four lamp fluorescent luminaires with the outer lamps wired to one ballast and the inner lamps wired to the other ballast, unless otherwise specified or shown on the Drawings.
4. Test the 800 MA fluorescent luminaires for operation in a 48 degree C ambient temperature without exceeding a 90 degree C ballast case temperature.
5. Provide industrial fluorescent reflectors with captive latches for easy removal and replacement. Make provisions at the attachment devices to prevent spawling or other damage to the finish while in the handling process.
6. Provide lamp holders and sockets as follows:
   a. Construct fluorescent lamp holders with non-porcelain white insulating bodies.
   b. Provide high output fluorescent lamp holders in industrial luminaires of the snap-in, spring-loaded, recessed, double contact type. Provide high output fluorescent lamp holders in strip lights, troffers, and enclosed and gasketed luminaires of the spring-loaded, recessed, double contact, tombstone type.
   c. Provide rapid start fluorescent lampholders of the snap-in, rotating locking, knife-edge contact, bi-pin type.
   d. Provide dimming system fluorescent lamp holders of the circuit interrupting type.
   e. Provide fluorescent lamp holders as manufactured by the following, or as approved.
      1) Bryant Division of Westinghouse Electric Corp.
      2) General Electric Co. Catalog Series ALF
      3) Leviton
      4) Kulka Electric Corp.
7. Fluorescent luminaires shall be as manufactured by the following, or as approved.
   a. Office lighting
      1) Acuity Lithonia
      2) Cooper Metalux
      3) Hubbell Columbia
      4) Philips Day-Brite
   b. Industrial Fluorescent
      1) Day-Brite "IF" Series
      2) Hubbell "C" Series
      3) Lithonia "AF" Series

C. Solid State Lighting Interior Luminaires Requirements

1. Conform to UL1598 for US. Where luminaires are to be installed in Canada they shall be CSA listed.
2. Conform to LM-79-08 (IES Approved Method for the Electrical and Photometric Measurements of Solid-Sate Lighting Products), LM-80-08 (IES Approved Method for Measuring Lumen Maintenance of LED Light Sources)

and TM-21 (IES Long Term Lumen Maintenance) testing standard. Independent Testing Lab reports shall be made available upon request. TM-21 report shall be in Microsoft Excel file format.

3. Minimum luminous efficacy shall be 85 LPW for office lighting and 80 LPW for highbay lighting.
4. Lumen output for office lighting luminaires shall be 2250 lumens minimum for 2'x 2' troffers and 4500 lumens minimum for 2'x 4' troffers. Lumen output for other interior lighting applications shall be as required for the minimum maintained lighting level for the application.
5. Internal components shall be single tool field accessible for service or repair.
6. Industrial Highbay luminaires shall be suitable for surface, stem or aircraft cable suspension mounting.
7. Luminaire shall use modular connectors for the electrical/data connections for emitter array(s) and driver(s).
8. Maximum weight shall be 35lbs for highbays and 2' x 4' troffers, and 20lbs for 2' x 2' troffers.
9. Distribution
    a. Office lighting luminaires shall be recessed type and exhibit direct distributions appropriate for office lighting environments.
    b. Standard and hazardous location Highbay luminaires shall be provided with maximum 3% uplight component) and be suitable for 18' AFF minimum mounting height.
10. Expected Useful Life (Light Output) and Depreciation
    a. The projected life of the luminaire in terms of hours of operation shall be based on the TM-21 method to project lumen maintenance using the LM-80 test data for the associated solid state light source. TM-21 projected life shall be based on the last 5,000 hours of collected LM-80 data for up to 10,000 hours of test data. For greater than 10,000 hours of LM-80 test data utilize the last ½ of the collected data.
    b. Office type luminaires shall provide a minimum of 40,000 hours rated life at L90 in-situ at 25°C luminaire ambient temperature.
    c. Highbay luminaires shall provide a minimum of 100,000 hours at L70 in-situ at 50°C luminaire ambient temperature.
11. Electrical Systems characteristics
    a. Under voltage protection shall be provided via internal automatic shut off.
    b. Integral short circuit protection shall be provided.
    c. 480 volt interior applications shall utilize an auto-transformer within the luminaire housing or as an attachment to the housing exterior. Sample submittal is required for approval where mounted on the exterior of the luminaire housing.
12. Mechanical requirements
    a. Heat sink shall be passive convection and/or conduction with no oscillating parts, fans, or other active cooling devices. Where luminaire contains liquids, a MSDS (Material Safety Data Sheet) shall be submitted for approval.
    b. Designed ambient operating temperature shall be 25C for interior office and 50C minimum for highbay lighting.
    c. Emitter assembly shall be sealed.
    d. No silicone material (e.g., sealant, gasketing, etc.) is permitted where exposed to atmosphere. Silicone shall be permitted within sealed LED assemblies.
13. Optical Requirements

a. Direct view of LED emitters shall not be permitted for office applications.

14. Warranty
    a. Luminaire manufacturer shall provide a minimum 5 year warranty including all components within the luminaire assembly including, but not limited to, drivers and power supplies, LED dies, encapsulate and phosphors, electrical and electronic components.
    b. Parts, shipping costs, and related labor to repair defective luminaires shall be provided by luminaire manufacturer at no charge to GM. Owner responsible for luminaire removal and installation.
    c. Luminaire failure rate above 20% within the within warranty period will constitute a recall in which 100% of the luminaires shall be replaced at the manufacturers cost, including all materials and installation labor.
    d. 15% or greater individual emitter or other component failure within the emitter assembly will be considered defective and the manufacturer shall supply corrected components and associated labor to replace them.
    e. Replacement components (or upgrades) for installed luminaires shall be available for 10 years minimum.
    f. Warranty shall begin 90 days after receipt of product at project site. The supplier shall provide the site Owner with appropriate signed warranty certificates. The site Owner must receive certifications prior to final payment.
15. Approved highbay luminaires:
    a. Acuity ‘IBL High Bay’ Series
    b. AGL ‘SW-MZ’ Series
    c. ALLED 'HB’ Series
    d. Albeo ‘H’ -Series
    e. Dialight ‘Durosite LED’ Series
    f. Digital Lumens ‘IL Intelligent High Bay’ Series
    g. KMW Giga Tera ‘Luna’ Series
    h. Lusio ‘Essentials 4-module’ Series
16. Approved highbay hazardous area luminaires:
    a. Dialight ‘Safesite’ Series
17. Approved 2’ x 2’ and 2’x 4’ office luminaires:
    a. Cooper '2AC Accord' Series
    b. Cooper '2ALN Arcline' Series
    c. Lithonia 'VTLED' Series
    d. Lithonia 'GTLED' Series

2.2.4 Exit Lights

A. Conform to UL 924 and the following:
    1. Provide LED type exit lights which utilize an integral diffusing material for smooth, even letter illumination. Provide test provisions to simulate supply voltage failure. Provide exit signs as follows, or as approved.
        a. Cooper Lighting / Sure-Lites ’CAX-LED’
        b. Hubbell Lighting, Inc. ‘C’ Series

c. Lightalarms Electronics Corp. 'Galaxy' Series, Catalog Series 'XLED'

d. Lithonia Lighting Catalog Series 'LES' or 'LES ELN'.

2.2.5 Emergency Battery Lighting Units

A. *Maintenance Free Lead-Calcium [P]:* UL Listed, consisting of finished metal cabinet containing a 6 volt wet cell lead-calcium battery sized to operate all connected lights 90 minutes minimum, automatic solid state dual rate charging equipment, automatic transfer means, low voltage battery dropout, time delay, brownout protection, battery status indication including voltmeter and test switch, provision for conduit connection and with top mounted halogen lamps rated 12 watts minimum. Provide number of lamps as indicated. Batteries shall be warranted for ten years. Furnish units with provisions for extending wiring to remote lamps. Provide remote lamps similar to top mounted units, with chrome finish enclosure and adjustable bayonet mount unless otherwise specified in the incandescent luminaire specifications or schedule. Provide suitable finished metal shelf or bracket where required.

1. Exide
2. Lithonia
3. Hubbell

B. *Pure Lead [P]:* UL Listed, consisting of a finished metal cabinet containing 6 volt sealed pure lead battery, sized to operate all connected lights 90 minutes minimum, automatic solid state dual rate charging equipment, automatic transfer means, charger status indication, battery test switch, provision for conduit connection and with top mounted tungsten halogen lamps rated 12 watts minimum. Provide number of lamps as indicated. Batteries shall be warranted for ten years. Furnish units with provisions for extending wiring to remote lamps. Provide remote lamps similar to top mounted units. Provide suitable finished metal shelf or bracket where required.

1. Dual Lite
2. Exide
3. Lithonia
4. Hubbell

C. *Self-Contained Emergency Lighting Unit [P]:* Unit shall conform to UL 924 and provide automatic emergency lighting for minimum of 90 minutes upon failure of normal electrical power. Emergency power source shall be fully rechargeable maintenance-free pure lead battery. Charger shall be the three-stage type with constant current, equalize and float voltage modes. Circuitry shall include 15 minute time delay, low voltage disconnect and brown out protection circuits. Custom designed integrated circuitry shall be self-diagnostic in design and constantly monitor charger performance and battery voltage. A visual indication of any failure shall be displayed by light-emitting diodes on the units' panel face and precisely indicate the area and type of malfunction. A manual test switch shall be provided to allow five minute diagnostic/discharge testing at any time. A transformer shall allow operation from 120 or 277 VAC, 60 Hz source.

1. Dual Lite Spectron Series
2. Lithonia Emergency System

2.2.6 Manual Slide Dimmers for Outlet Box Mounting

A. *Incandescent [P]:* Solid state, full range dimmer for 120 volt load as indicated, equipped with RFI filter and integral "on-off" switch.

1. Lutron "NOVA" Series

2. Prescolite "Design Line"

B. *Fluorescent [P]:* Solid state, full range dimmer for 120 volt load as indicated, equipped with RFI filter and integral "on-off" switch.

1. Lutron "Nova" Series
2. Prescolite

2.2.7 Light Track

A. *Light Track [P]:* One or two circuit, 2 or 3 wire, recessed or surface mounted as indicated, satin anodized aluminum track, rated 20 amperes per circuit, 125 or 125/250 volts, for support and service of luminaires as specified in the luminaire specifications or schedule, with matte white exposed surfaces and accessories.

1. Lightolier "Lytespan"
2. Lithonia "Track"
3. Marco "Trak"
4. Prescolite "Lite-Trac"

16510.3 EXECUTION

3.1 INSTALLATION

A. Supports

1. Provide supports for all luminaires as detailed, as specified or as otherwise required by the luminaire specified. Support single units from luminaire studs in outlet boxes. For continuous row fluorescent type, provide a support for each end plus at least one for each channel section, or as required. Swivel mount all stems. Provide concrete inserts at points of luminaire support in unfinished areas where a concrete slab serves as the ceiling. In finished areas, provide supports independent of the acoustic tile or plaster; support luminaires from the ceiling support system, or from the concrete floor or roof steel above the ceiling.
2. Provide supports for recessed luminaires as recommended by the luminaire manufacturer or as specified. Furnish plaster frames for all recessed luminaires mounted in plaster ceilings. Coordinate luminaire mounting with type of ceilings specified. Verify ceiling support systems and coordinate luminaire installation. Coordinate the work of installing the combination light and air handling or heat transfer luminaires with the work specified in other Sections of the Specifications. Fasten "lay-in" luminaires to the ceiling grid.
3. For industrial luminaires suspended from ceiling outlet boxes, provide 1/2 inch rigid combination conduit stems, luminaire stud, and self-aligning hangers. In other locations, except as otherwise detailed or required, provide ceiling or wall outlet boxes with 3/8 inch, no-bolt luminaire studs. Provide special hangers for support of any luminaire which weighs more than 50 pounds.
4. For chain hung industrial luminaires, provide a six foot three conductor cord with twist lock plug and six foot chains.

B. Splices and Connections

1. All cable splices in pole bases shall be bolted connector and sealed watertight.

C. Manufactured flexible modular wiring system

1. Provide, install and connect a manufactured flexible modular wiring system consisting of components required for a complete and functional installation. The system shall be designed for parallel wiring so that failure of one luminaire, etc., will not affect the operation of the remaining luminaires.
2. Provide connectors to the luminaire manufacturers for the luminaires to be used with the flexible wiring system. Installation of connector in modular wiring system shall be coordinated with installation of air handling boots for supply and heat-removal of all the luminaires intended for the above mentioned purpose at this time or future use.
3. Provide the Owner with six sets of parts listed and instruction manuals for the flexible wiring system.
4. Secure all modular wiring systems to building structural steel purlins (a maximum of six feet) with suitable clamps to eliminate sagging. Provide additional clamps and cable strain relieve at “tee” connectors to prevent disconnecting of fittings due to vibration.
5. When so requested, furnish a complete set of drawings indicating how the flexible system will be installed, also the manufacturer shall provide the services of a trained factory representative to assist and instruct the electrical contractor in the proper installation of the components of the system.

D. Mounting Height for Exit Lights

1. Finished areas:

E. Ceiling heights 10’-0” above finished floor or less Exit light shall be surface mounted from the ceiling

F. Ceiling heights greater than 10’-0” above finished floor Exit light shall be mounted from the walls or columns at 8’-0” above finished floor

1. Factory areas:

G. High Bays near walls or columns Exit lights shall be mounted on walls or columns within 6’-0” (lateral) from egress aisle at 15’-0’ above finished floor.

H. High Bays not in vicinity of walls or columns Exit lights shall be surface or pendant mounted from bottom cord of truss, bar joists or process equipment supports at 15’-0’ above finished floor. Maximum length of pendant on pendant mounted luminaires shall not exceed 10’-0”.

END OF SECTION

16610 - FIRE ALARM SYSTEM

16610.1 GENERAL

1.1 Description

A. General

1. Furnish all labor, material and accessories necessary to furnish and install a complete fire alarm system. The equipment and complete installation shall be in compliance with local and national codes, and the authorities having jurisdiction and comply with the requirements of GM Standard EI-1, as applicable.
2. The fire alarm system shall also comply with GM security Quality Assurance National Technical Support Group’s publication, “Proprietary supervising Station Fire Alarm System Specification” and GM Document “GL-7A-R”

ADA Visual Alarms for Emergency Warning Systems, as applicable.

3. Match existing fire alarm devices.

1.2 System Description

A. The work includes installation and necessary wiring. The installation shall include all hardware for a completely operable system per these specifications.

B. The system shall utilize distributed processing techniques, be totally solid state except for transponder relay associated outputs, microprocessor based and use digital transmission techniques.

C. The system shall be UL listed for fire alarm. All equipment shall be UL listed for the purpose intended and labeled under product category code UOJZ as an integrated control unit system.

1.3 Related Works Specified In Other Sections

A. Division 15 Fire Protection Sections

B. Division 16 Section “Basic Electrical Materials and Methods”.

C. Division 16 Section “Electrical Identification”.

D. Division 16 Section “Wire and Cable (600 volts and less)”.

E. Division 16 Section “Wiring and Control Devices”.

1.4 Quality Control

A. Source Quality Control

1. Furnish equipment and materials listed in the current, latest issue having a date prior to issue date of Specifications, of Equipment Publications and Underwriters’ Laboratories, Inc., bearing the UL Label and wherever standards have been established by NFPA, IEEE, ASTM, ANSI, ICEA and NEMA for equipment referenced to such standards in this document. Furnish equipment and materials conforming to the requirements of the National Electrical Code and the requirements of the Contract Documents.

B. Field Quality Control

1. Install equipment and material in compliance with the regulations of Local, State and Governmental laws governing electrical installations, the latest edition of the National Electrical Code and the requirements of the Contract Documents.

C. Quality Assurance

1. All tradesmen shall review the specifications herein with particular attention paid to the related sections. CLOSE COORDINATION IS ESSENTIAL TO THIS PROJECT!

2. Completely review all functions and layout of fire alarm and control unit components prior to permitting installation.

3. Bench test all components prior to installation.

4. Provide factory-trained personnel to conduct final site inspection, testing, start-up and programming.

1.5 Equipment Supplier Qualifications

A. The supplier of the system shall maintain permanent service facilities in the area of the installation. The facilities shall

include a permanent source of factory trained service technicians on 24 hour call experienced in servicing this type of equipment and shall provide warranty and routine maintenance service to afford the Owner maximum coverage. He shall also provide a central source of support to guarantee immediate answers to the Owner's problems resulting from malfunctioning and/or misunderstanding of the operation of the equipment.

1.6 Equipment Installer Qualifications

A. The installation of the system shall be performed by fully qualified personnel having had experience on the installation of this type of system and able to certify that they have had no less than 5 years of continuous experience in this area and have made installations similar to this and of this size or larger.

B. Contractor shall install the system under the supervision of the manufacturer and test the system in the presence of the Owner's Representative. Contractor shall submit all test reports to the Owner's Representative.

1.7 Wiring

A. All wiring shall be in accordance with the manufacturers recommendation. All wiring must be installed in conduit or approved raceway. Wiring used shall have **N.E.C. Type FPLR designation for general and riser use of indoor use, FPLP for plenum areas and OFNR for fiber optic cables. Cables used in underground ducts shall be rated for use in flooded applications.** Wiring shall be run continuous from terminal to terminal without splices to both the map net and transponders. Where wire lengths are limited by reel length or where taps are required, provide NEMA 12 enclosure with terminal blocks mounted at floor level and accessible without the use of ladders or other special equipment.

1.8 Submittals

A. Unit Prices

1. Submit unit prices for furnishing and installing each component specified in this Section. Each unit price includes all charges for General and Supplementary Conditions, incidental expenses, supervision, materials, labor, testing as required, applicable taxes, insurance, and overhead.

B. Shop Drawings And Product Data

1. Furnish submittals for items that are identified in this Section by a different type face and a bracketed code. Additional submittal requirements pertaining to this Section are specified herein under this Article. The type of submittals are defined as follows:

   a. B - Bill of Materials: A detailed description of an assembly or components, including quantity.

   b. C - Certificate: A notarized form or letter attesting to the quality of workmanship or product as measured by standards, codes or criteria specified in the Specifications.

   c. D - Shop Drawings: Drawings, diagrams, schedules, illustrations or similar data specifically prepared for Work on this Project by the Contractor, subcontractor, distributor, or manufacturer to illustrate a product or a particular portion of the Work.

   d. E – Extra Stock: Additional stack of specified material/products to be turned over to the Owner upon completion of project.

   e. G - Guarantee: Written statement guaranteeing the product or a particular portion of the Work to be and remain free from defects in materials or workmanship for a definite period of time from date of acceptance of the Work.

   f. L - Letter of Compliance: Written statement confirming that the product or a particular portion of the Work

conforms to the requirements of the Contract Documents.

g. P - Product Data: Brochures, pictures, illustrations, diagrams, color charts or similar printed data of a manufactured product that is incorporated into the Work.

h. Q - Qualifications: Notarized statements attesting to the quality of workmanship, firm or individual as measured by standards, codes or criteria specified in the Specifications.

i. R - Record: Data substantiating the performance of a product, or a particular portion of the Work, and which does not require prior review and approval by the Owner's Representative, but is required for record purposes only. Performance data and other data may be required.

j. S - Samples: Physical examples of sufficient size to clearly illustrate functional characteristic of the product or assembly, or to show color, texture or pattern, as appropriate.

k. T - Test Report: Report, from a qualified testing agency, of actual tests conducted on products, assemblies or particular completed portions of the Work, measured against standards, codes or criteria specified in the Specifications. Each report shall state the values obtained for comparison with the stated standard, code or criteria specified in the Specifications.

l. List of Units provided, with unit identifications per Drawings, unit descriptions, ratings, types and catalog numbers are required for review purposes.

2. *Shop Drawings [D,P]:* Submit customized wiring diagrams, component product data and installation and operating instructions. Wiring diagrams shall show color coding of connections and mounting dimensions of equipment.

3. *Guarantee [G]:* The entire system and its operation shall be warranted for a period of 2 years from date of Owner's acceptance.

4. Submit shop drawings for approval and include complete data on each item. Coordinate the items, as they relate to the Work, prior to submittal. Shop drawings shall be approved at least 30 days prior to commencement of work and shall include:

   a. System plans and riser diagrams: including sizing and routing of all conduits and wire, location of all equipment and devices, junction and pull boxes, and device address.

   b. Data catalog cuts or brochures on all equipment.

   c. Installation hardware and requirements.

   d. Wire and cable.

   e. Complete wiring and connection diagrams of all equipment.

5. Furnish 1 electronic copy of Final, as Constructed, Shop Drawings and Product Data on CD ROM.

C. Maintenance Data And Operating Instructions

1. Furnish to the Owner 3 sets of instruction manuals and 1 set of manuals on electronic media (CD ROM) covering complete operating, service and repair instructions for the equipment furnished and complete illustrated parts breakdown with manufacturer's name, nomenclature and part number for each component part and assembly, include current unit prices for parts and supplies along with the location of the nearest source of supply and service.

2. During system commissioning and at such time acceptable performance of the system hardware and software has been established, the system supplier shall provide on-site operator instruction to the Owner's operating personnel. Operator instruction during normal working hours will be performed by competent representatives familiar with the system software, hardware and accessories.

NOTE: EDIT NUMBER OF HOURS IF EXCESSIVE OR INSUFFICIENT.

3. At a time mutually agreed upon, the system supplier shall give 80 hours of instruction to the Owner's designated personnel on the maintenance and trouble shooting of all equipment within the system and describe its intended use with respect to the programmed functions specified. Maintenance and trouble shooting orientation of the system shall include the overall operational program. Equipment functions, commands, advisories and appropriate operator intervention required in responding to the system operation. An Owner's manual prepared for this project shall be used in addition to the instruction.
4. Additional instruction time as deemed necessary by the Owner shall be made available by the system supplier on a negotiated basis with the Owner.

D. *Guarantee [G]:*

1. The manufacturer shall warrant, in writing, all equipment and wiring to be free from all inherent mechanical and electrical defects in material and workmanship for a period of 2 years commencing at the time of system turnover to the Owner.
2. If the system fails to completely perform in accordance with the Contract Documents, the Contractor shall take all necessary action to repair or replace parts and wiring modification, at no additional cost to the Owner, to restore the system to perform in accordance with the Contract Documents.

E. Engineering Field Service

1. The Supplier shall furnish engineering field service as required.

F. Maintenance Contract

1. *Maintenance and Service Contract [G]:* shall be submitted with service rates covering all labor and materials necessary to maintain the system. The contract shall include a differentiation between and definitions of "emergency" and "non-emergency" service with applicable rates for each.

G. Spare Parts List

1. *Bill of Material [B]:* The supplier shall enclose a complete parts list of the equipment installed with vendor's names, address, telephone number, part numbers, prices and lead time.

1.9 The Owner Shall Supply The Following Items

A. Drawing of the existing building and equipment associated with the project, as required, for system design, if available.

1.10 Standards

A. Standards

1. All applicable regulations and laws shall apply to any installations. The standards indicated below are referenced as minimum requirements for installation and operation of the Fire Alarm System, unless otherwise noted, and not intended to be inclusive of all requirements. Requirements of appropriate authorities having jurisdiction shall supplement these specifications and indicated standards, and shall take precedence in case of conflict.
2. All materials and equipment shall comply with the latest revision of the applicable standard(s) in every case where such a standard has been established for the particular type of material in question.
    a. Federal Communication Commission (FCC)
    b. National Fire Protection Association (NFPA)
    c. National Electric Code (NEC)
    d. National Building Officials Code Administrator (BOCA)
    e. Underwriter's Laboratories (UL)

f. Institute of Electrical and Electronic Engineers (IEEE)

g. American National Standards Institute (ANSI)

h. General Motors Electrical Standards for Building and Facilities

i. General Motors Basic Electrical Installation Standards EI-1 for Industrial Equipment

j. General Motors Fire Prevention and Protection Manual

k. Uniform Building Code, by the International Congress of Building Officials (ICBO)

l. Industrial Risk Insurers (IRI)

m. Factory Mutual (FM)

n. Americans with Disabilities Act (ADA)

o. Occupational Safety and Health Act (OSHA)

p. International Fire Code.

q. International Building Code.

3. Clarification of differences between standards, codes, Drawings, and/or Specifications will be made by the purchaser's representative.

B. Performance

1. As indicated in NFPA Standard 72, system circuits shall comply, as a minimum, with the performance levels indicated:

a. Match Existing

C. Approval Drawings And Specifications

1. Approval Drawings and Specifications: The Contractor shall provide detailed installation Drawings indicating equipment and device locations with detailed routing locations for necessary conduit, cable and wiring. Installation Drawings shall include connection details for all wiring and cable terminations.

2. All Drawings and Specifications shall be developed through computer based media. Electronic Drawings shall be prepared in a format which can be used directly (without conversation) by General Motor's standard CAD software, "AutoCAD", for Windows, operating under MSDOS. Drawings, electronic file and layering requirements to be satisfied are described within the latest edition of the General Motors Facilities Graphics Standards Manual. Drawings and Specifications shall be maintained on CD ROM disk in a self extracting format.

3. The Contractor shall, upon completion of the work, furnish to the Owner, 2 complete sets of 'As Installed" Drawings in the 24 in. x 36 in. size. The Contractor shall also furnish the Owner with 1 complete set of the same Drawings on CD ROM disk as drawn with the latest version of AutoCAD 2000 brand software.

a. The following items shall be included in the Drawings and Specifications:

1) Names, addresses and phone numbers of Manufacturer's Rep, Engineer and Manufacturer's Service Center.

2) Detailed system operation.

3) System block diagram.

4) System riser diagram with E.O.L. resistors marked.

5) Device, appliance, control unit and terminal panel mounting details.

6) Device, appliance, control unit and terminal panel wiring details.

7) Device, appliance, control unit and terminal panel location details.

8) Complete Bill of Materials for the Project.
9) Device list with address and instructions for addressing points.
10) Complete set of battery calculations for system.
11) All power requirements, descriptions and sequences.
12) All wire and symbol legends.
13) All manufacturer's notes and recommendations.
14) Capacity of the system is installed and total system capability.

D. Coordination of Work

1. Installation of the new system shall be scheduled and performed in such manner as to prevent disruption or interference with the purchaser's business or other activities.
2. Installation of the new system shall be scheduled in such manner that the least amount of necessary disruption of Security monitoring is permitted at any given time. The purchaser's representative shall be notified, in advance, of any disruption in service in monitoring or occupant notification capabilities and the duration of such disruptions.

E. Testing and Acceptance

1. All system equipment and required functionality shall be tested after installation in the presence of the Owner and authority having jurisdiction.
2. The system installation shall meet all requirements of the Owner, required standards and approving authorities prior to acceptance.
3. All system components, devices and appliances shall be tested after installation to ensure that:
   a. All required systems and devices are connected.
   b. All connected systems and devices respond and report actual alarm conditions.
   c. All connected systems, devices and appliances respond and report trouble conditions, including circuit conditions.
   d. All alarm monitoring and processing equipment and control units perform under loss of primary power conditions.
   e. All required notification appliance control units and appliances perform under loss of primary power conditions.
   f. All notifications appliances perform in the appropriate manner with minimum required signal levels.
   g. All timed, automatic or interactive system functions perform as required.
   h. For final acceptance, the system must operate for thirty (30) consecutive days without malfunction of any kind, including any function not performed as a part of routine system administration.

16610.2 PRODUCTS

2.1 MANUFACTURERS AND MATERIALS

A. Manufacturer: Contact Lorie Peters of GM Global Security for manufacturer information for current project and region (313) 665-6684.

B. *Audible Signaling Devices [D,P]:* Audible signaling devices for the office and locker areas shall have a die cast housing and a high efficiency compression driver. They shall be moisture, corrosion, vibration and vermin resistant. They shall have multi-tap power selection and be flush mounted. Initial tap shall be 1 watts. Provide combination Audio/Visual units where shown on the Drawings.

C. *Visual Signaling Devices [D,P]:*

1. Visual Signaling Devices shall have a xenon type flasher. In office areas the visual signaling device shall be in a common enclosure with the audible signaling device. Strobe lights shall meet ADA standards and comply with GM Guideline No. “GL-7A-R”.

2.1.1 Network Display Unit

A. *Network Display Unit [D,P]*: <**Insert Device Location Here**>

1. Network Display Unit shall contain the following features:
   a. 80 column by 2 line back-lighted LCD readout of point status.
   b. Point and/or point lists.
   c. Multiple NDUs shall be capable of being installed as needed to vector point information by type, location, or other qualifier.
   d. Historical event logs shall maintain separate 600 Alarm and 600 Trouble events.
   e. RS232 ports shall be provided:
      1) Interface to serial printer to record network information as programmed at the NDU.
      2) Interface to PC to display network information as programmed at the NDU.
      3) Interface to wireless notification message paging.
      4) Interface for interrogating the status of any other node on the network.
      5) Third party systems interface.
2. Recording of Events: Print a record all alarm, supervisory, and trouble events on the system printer. Printouts are by zone, device, and function. When the NETWORK DISPLAY UNIT receives a signal, the alarm, supervisory, and trouble conditions are printed. The printout includes the type of signal (alarm, supervisory, or trouble) the zone identification, date, and the time of the occurrence. The printout differentiates alarm signals from all other printed indications. When the system is reset, this event is also printed, including the same information for device, location, date, and time. A command initiates the printout of a list of existing alarm, supervisory, and trouble conditions in the system.
   a. Permissible Signal Time Elapse: The maximum permissible elapsed time between the actuation of any fire alarm or fire-detection system alarm-initiating device and its indication at the NETWORK DISPLAY UNIT is 2 seconds.
   b. Independent System Monitoring: Supervise each independent smoke- or heat-detection system, duct detector, and elevator smoke-detection system for both normal operation and trouble.
   c. Circuit Supervision: Indicate circuit faults by both a zone and a trouble signal at the NETWORK DISPLAY UNIT. Provide a distinctive indicating audible tone and LED-indicating light. The maximum permissible elapsed time between the occurrence of the trouble condition and its indication at the NETWORK DISPLAY UNIT is 200 seconds.
3. **The Network Display Unit enclosure shall be fire alarm red.**

2.1.2 Voice Communication Module

A. *Voice Communication Module [D,P]*: In Network Display Unit: Provide a voice communication module and zone switches to make 1 way voice pages.

1. Provide an integral message player equipped with changeable test and evacuation messages.
2. Provide switches for the following:
    a. Manual audio evacuation (all areas)
    b. Selective manual audio evacuation
    c. Manual audio evacuation Engine Plant
    d. Talk to Engine Plant
    e. Talk to all speaker/all call
    f. Severe weather warning
    g. All clear

2.1.3 Occupant Notification System

1. Occupant notification systems shall be provided for coverage at the signal levels required by applicable standard or code. Occupant notification systems shall be capable of producing distinct visual and/or audible signals in selected zones with selection of signal type. In large facilities with multiple buildings, the facility occupant notification system should be divided into multiple separate notification systems controlled by the Fire Alarm System.
2. The occupant notification system components shall be activated and supervised for system integrity at the Security Office through the Fire Alarm System control units. Notification systems shall be installed with all required primary and secondary power requirements at each location. The notification system shall be capable of signal tones, control patterns and zones as defined for the following minimum types of events.
    a. Evacuation
    b. Take Cover
    c. All Clear
3. All occupant notification systems shall utilize the following standard audible signaling sounds and patterns.
    a. Evacuation: A 3 pulse temporal pattern using a horn or approved tone. The pattern shall be .5 to 1 second “on” phase followed by a .5 to 1 second “off” phase for 3 successive “on” periods followed by an “off” phase lasting 1.5 to 2 seconds. This sequence shall be repeated continuously for not less than 3 minutes.
    b. Take Cover: A wail, continuous horn or approved tone generated for a period of 3 minutes.
    c. All Clear: A continuous horn or tone for not less than 5 seconds.
4. Acceptable alternatives may be approved on a per application basis for Take Cover and All Clear notifications. Evacuation signals are a required standard as defined in the National Fire Alarm Code.
5. Appropriate live or recorded voice annunciation may be used in addition to the above signals.
6. Occupant notification system shall not be used for non-emergency purposes, such as paging.

2.1.4 Color Graphics

A. *Color Graphics PC [D,P]*: <**Insert Device Location Here**>

1. The Color Graphics PC: Shall operate by receiving system events and displaying specified graphic representative of the building(s), and/or conditions of zone(s).
    a. The CRT screen shall be "Touch Screen and/or Mouse" driven and serve as the interactive interface between the operator and the [network] system.
    b. From the "Touch Screen or Mouse" the operator shall be able to perform the following tasks:
        1) Silence signals.
        2) Acknowledge all alarm and return to normal conditions.
        3) Reset system.
        4) Display list menus.
        5) Select the individual message screens.
        6) Perform manual operation of system(s) control points.
        7) Request the "HELP" menu.
        8) Connect (Set Host) to other nodes.
        9) Perform graphic editing function.
        10) Set the system time and date.
2. The unit shall be equipped with at least 7 levels of password-protected access.
3. Color Graphic Unit Operating Modes:
    a. When no alarms or troubles are present, the CRT shall display a graphics screen menu used to access other graphic screens. The title of the screen shall be displayed at the top of the screen. Each screen shall also display current time and date, system status, and present operator name and access level.
    b. Upon activation of any alarm and on request by the operator, the CRT shall display the floor plan of the floor in alarm with all devices shown. The device in alarm shall flash until acknowledged. The device in alarm shall then become steady until cleared. During the alarm mode, the status block on any screen will flash to indicate an alarm condition, and when touched, will display the graphics screen with the alarm point. The node number, system point number, and the custom label will also be displayed below the status block.
    c. If a second alarm is registered prior to the first being cleared, the second shall be identified by flashing, pending alarm indication. Touching the pending alarm area will transfer the display to the second alarm point graphic screen. All subsequent alarms shall be displayed as indicted above.
    d. Supervisory service and trouble conditions shall operate similar to the manner described above, except that alarm conditions have priority over system/device trouble indications.
    e. The Color Graphics Unit shall give a constant off-line visual display and sound an audible tone every 10 seconds to indicate an off-line condition.
    f. Capacity to annunciate 50,000 network point and/or point lists.
    g. Historical event logs shall maintain up to 500,000 system events. For example; Alarm, Priority 2, Supervisory Service, Trouble, Operator Notes, and Log-in Log-out events. A trouble signal shall activate upon transferring to the last available log.

h. Built-in diagnostics shall provide graphical views of the network topology and status. Network communication breaks or inactive nodes shall be clearly indicated as a guide in returning the system to normal.

i. Individual point access shall display “real-time” analog sensor point information. For example; current smoke sensor obscuration or heat sensor temperature levels.

j. The operator shall be able to selectively view system points. For example; All points, or select only Alarm, Supervisory, Trouble or Control Points.

k. The operator shall be able to interrogate the status of any other node on the network.

4. The Color Graphics Unit shall have the following editing functions:

   a. Message Editor – System shall have the capability of on-site adding, changing, deleting or assigning of message screens.

   b. List Editor – System shall have the capability of on-site editing of customer user lists.

   c. Capacity to create and edit up to 25,000 Graphic Screens.

   d. Graphics Editor – System shall have the capability on on-site editing of graphics screens, editor shall have the capability of changing background graphics and adding or deleting point symbols.

5. Color Graphics Unit shall consist of:

   a. XEON or 2.4 GHZ Pentium Personal Computer with detachable keyboard, or better.

   b. Hard Drive: 120 Gigabyte capacity.

   c. 3-1/2 inch 1.44 Megabyte Floppy Drive.

   d. 21-inch high-resolution color monitor.

   e. Pre-programmed functions.

   f. Capability to communicate as a network node.

   g. Real-Time Write-to-File compatibility.

   h. Modem compatibility.

   i. 128 Mb Video Card.

   j. Read/Write 12/8X minimum CD ROM.

   k. DVD/CD ROM

   l. Touchscreen hardware.

   m. Pre-programmed functions.

   n. Capability for field editing of graphics representations.

   o. Capability to communicate as a network node.

   p. Real-Time Write-to-File compatibility.

   q. Modem compatibility.

   r. Graphics package shall be “AutoCAD 2000” compatible.

6. The Color Graphics System shall conform t the following standards:

   a. EIA RS-232-C – Interface between Data Terminal Equipment and Data Communication Equipment Employing Serial Binary Data Interchange.

b. ANSI X 3.4–1977 – Code for Information Interchange (ASCII).

c. ANSI X 4.14-1977 – American National Standard Keyboard Arrangements Accommodating the Character Sets of ASCII and ASCSOCR.

d. UL Listed as a Primary Operator Work Station.

2.1.5 Printer

A. *Printer [D,P]*: <**Insert Device Location Here**>

1. The security console in The Security Office shall include a wide carriage printer to provide a hard copy record of system events.
2. The printer shall utilize a DOT MATRIX mechanism.
3. The printer shall be equipped to utilize up to 10” cut sheet fan fold paper.
4. The print speed shall be at least 180 CPS.
5. The printer shall print in the following colors: red, green, blue and black

2.1.6 Time Control Center Panel

A. *Time Control Center Panel [D,P]*: <**Insert Device Location Here**>

1. The time control center panel shall provide break and dismal tones over fire alarm speakers. The panel shall be programmed to match GM break and dismissal times.

2.1.7 Uninterruptible Power Supply (UPS)

A. Uninterruptible Power Supply (UPS): A UPS system shall be provided to maintain service to supervising station FAS equipment (Network Display Unit, Color Graphics CPU and Printer) in the event of a failure of normal electrical service.

2.1.8 Transponders: Fire Alarm Control Panel

A. *Transponders [D,P]*: *Fire Alarm Control Panel [D,P]*:

1. [**Transponders**][**Fire Alarm Control Panel**] construction shall be modular with solid state, microprocessor based electronics. It shall display only those primary controls and displays essential to operation during a fire alarm condition. Keyboards or keypads shall not be required to operate the system during fire alarm conditions.
   a. A local audible device shall sound during alarm, Trouble or Supervisory conditions. This audible device shall sound differently during each condition to distinguish 1 condition from another without having to view the panel. This audible device shall also sound during each keypress to provide an audible feedback to ensure that the key has been pressed properly.
2. The following primary controls shall be visible through a front access panel:
   a. Eighty character liquid crystal display
   b. Green “power on” LED
   c. Alarm Acknowledge Key

d. Supervisory Acknowledge Key
e. Trouble Acknowledge Key
f. Alarm Silence Key
g. System Reset Key

3. The transponder [fire alarm control panel] shall provide the following:
   a. Setting of time and date
   b. LED testing
   c. Alarm, trouble, and abnormal condition listing
   d. Enabling an disabling of each monitor point separately
   e. activation and deactivation of each control point separately
   f. Changing operator access levels
   g. Walk Test enable
   h. Running diagnostic functions
   i. Displaying software revision level
   j. Displaying card status
   k. Point listing
4. For maintenance purposes the following lists shall be available from the point lists menu.
   a. All points list by address
   b. Monitor point list
   c. Signal/speaker list
   d. Feedback point list
   e. Pseudo point list
   f. LED/switch status list
   g. Scrolling through menu options or lists shall be accomplished in a self-directing manner in which prompting messages shall direct the user. These controls shall be located behind an access door.
5. Primary Keys, LED's and LCD Display
   a. The Control Panel shall have a 2 line x 40 character liquid crystal display which shall be backlit for enhanced readability. So as to conserve battery standby power, it shall not be lit during an AC power failure unless an alarm condition occurs or there is keypad activity.
   b. The display shall support both upper and lowercase letters. Lowercase letters shall be used for softkey titles and prompting the user. Uppercase letters shall be used for System Status Information. A cursor shall be visible when entering information.
6. System Front Panel Operation And Capabilities
   a. Under normal condition the front panel shall display a "System is Normal" message and the current time and date.
   b. Should an abnormal condition be detected, the appropriate LED (Alarm, Supervisory or Trouble) shall flash. The panel audible signal shall pulse for alarm conditions and sound steady for trouble and supervisory conditions.

c. The LCD shall display the following information relative to the abnormal condition of a point in the system.

1) 40 character custom location label

2) Type of device (i.e., smoke, pull station, waterflow)

3) Point status (i.e., alarm, trouble)

d. Alarm Silencing

1) Should the "Alarm Silence" button be pressed, all alarm signals shall cease operation.

2) Signals shall not be silenced during alarm silence inhibit mode.

e. System Reset

1) The SYSTEM RESET button shall be used to return the system to its normal state after an alarm condition has been remedied. The LCD display shall step the user through the reset process with simple English Language messages. Messages, "SYSTEM RESET IN PROGRESS," will first be displayed followed by the message, 'SYSTEM RESET COMPLETED," and finally, "SYSTEM IS NORMAL," should all alarm conditions be cleared.

2) Should an alarm condition continue to exist the message, "SYSTEM RESET IN PROGRESS," will be followed by the message, "SYSTEM RESET ABORTED," and the system will remain in an abnormal state. System control relays shall not reset. The Sonalert and the Alarm LED will be on The display will indicate the total number of alarms and troubles present in t he system along with a prompt to use the ACK keys to review the points. These points will not require acknowledgment if they were previously acknowledged.

3) Should the Alarm Silence Inhibit function be active, the SYSTEM RESET key press will be ignored. The message, "SYSTEM RESET INHIBITED," will be displayed for a short time to indicate the action was not taken. As feedback to the operator, the message "SYSTEM RESET NO LONGER INHIBITED" will be displayed when the inhibit function times out.

f. History Logging

1) The system shall be capable of logging and storing 300 events in an alarm log and 300 events in a trouble log. These events shall be stored in a battery protected random access memory. Each recorded event shall include the time and date of the event's occurrence. The following Historical Alarm log events shall be stored:

a) Alarms

b) Alarm Acknowledgment

c) Alarm Silence

d) System Reset

e) Alarm Historical log cleared

2) The following Historical Trouble log events shall be stored:

a) Trouble conditions

b) Supervisory alarms

c) Trouble acknowledgment

d) Supervisory acknowledgment

e) Alarm Verification tallies

f) Walk Test results

g) Trouble Historical log cleared

g. System Trouble Reminder

1) Should a trouble condition be present within the system and the audible trouble signal silenced, the trouble signal shall resound at preprogrammed time intervals to act as a reminder that the fire alarm system is not 100% operational. Both the time interval and the trouble reminder signal shall be programmable to suit the Owner's application.

h. Access Levels

1) There shall be 4 access levels with level 4 being the highest level. Level 1 actions shall not require a passcode. Passcodes shall consist of up to 10 digits. Changes to passcodes shall only be made by authorized personnel.

2) In order to maintain security when entering a passcode, the digits entered will not be displayed but a cursor will move along filling the positions with an X to indicate that the digit has been accepted. all key presses will be acknowledged by a local audible sound.

3) When a correct passcode is entered, the message "ACCESS GRANTED" shall be displayed. The new access level shall be in effect until the operator manually logs out or the keypad has been inactive for 10 minutes.

4) Should an invalid code be inputted, the operator shall be notified with the message, "ERROR . INCORRECT PASSCODE," and shall be allowed up to 3 chances to enter a valid code. After 3 unsuccessful tries, the message, "ACCESS DENIED," shall be displayed. The level shall not be altered, and the operator shall no longer be in the menu option.

5) Access to a level will only allow the operator to perform all actions within that level plus all actions of lower levels, not higher levels.

6) The following keys/switches shall have access levels associated with them.

a) Alarm Silence

b) System Reset

c) Set Time/Date

d) Manual Control

e) On/Off/Auto Control

f) Disable/Enable

g) Clear Historical Alarm Log

h) Clear Historical Trouble Log

i) Walk Test

j) Change Alarm Verification

i. Transponder Enclosures: Provide cabinets of sufficient size to accommodate the aforementioned equipment. Cabinet shall be equipped with locks and transparent door panel providing freedom from tampering yet allowing full view of the various lights and controls. [**Transponders**][**Fire Alarm Control Panel**] **shall be provided in NEMA 12 enclosures in plant areas and painted fire alarm red**.

7. Addressable Loop

a. Communication with addressable devices. The system must provide communication with initiating

and control devices individually. All of these devices will be individually annunciated at the control panel. Annunciation shall include the following conditions for each point:

1) Alarm
2) Trouble
3) Open
4) Short
5) Device missing/failed

b. All addressable devices shall have the capability of being disabled or enabled individually.

c. Up to 127 addressable devices may be multidroped from a single pair of wires. Systems that require factory reprogramming to add or delete devices are unacceptable.

d. Format: The communication format must be a completely digital poll/response protocol to allow t-tapping of the circuit wiring. A high degree of communication reliability must be obtained by using parity data bit error checking routines for address codes and check sum routines for the data transmission portion of the protocol. Systems that do not utilize full digital transmission protocol are not acceptable.

e. Identification of Addressable Devices: Each addressable device must be uniquely identified by an address code entered on each device at time of installation. The system must verify that proper type device is in place and matches the desired software configuration.

2.1.9 FSK Modem

A. *FSK Modem [D,P]*: (if required)

1. The modem shall employ FSK modulation in full duplex over 4 wire leased lines and half duplex over 2 wires. The modem shall have 6 diagnostic LED's which indicate receive data (RCV), transmit data (XMT), carrier on (CO), clear to send (CTS), request to send (RTS's), and data set ready (DSR).
2. A remote programming unit shall be supplied and consist of Pentium III 800 MHZ lap top computer, with 56K V.90US internal modem, 60 Gigabyte Hard Drive, 256 MEG memory, 12X DVD/CD ROM drive, NIC card, EtherNet Card, USB ports, 64 Bit AGP video card, mouse, power supply, and carrying case. All software for operating, back-up and trouble shooting shall be pre-loaded.

2.1.10 Addressable Pull Station and Watch Tour Station

A. *Addressable Pull Station and Watch Tour Station [D,P]*: Provide addressable pull stations with a separate key operated watch tour station connected to an addressable monitor module. The system shall contain electronics that communicate the station's status (alarm, normal) to the CPU over 2 wires, which also provide power to the pull station. The address will be set on the station and at the addressable monitor module. They will be manufactured from high impact red Lexan type of plastic. Lettering will be raised and painted white. Station will mechanically latch upon operation and remain so until manually reset by opening with a key common to all system locks. Pull stations shall be single action.

2.1.11 Detector Bases

A. *Detector Bases [D,P]*: Detector bases shall contain electronics that communicate the detector status (normal, alarm, trouble) to the transponder over 2 wires. The same 2 wires shall also provide power to the base and detector. A

trouble signal will be transmitted to the transponder and CPU if a detector is removed from the base. The following detector heads shall be provided.

1. Ionization - Type Smoke Detector: Multiple chamber type operating on the ionization principle and actuated by the presence of invisible products of combustion.
2. Photoelectric-Type Smoke Detectors: An infrared detector light with matching silicon cell receiver and actuated by the presence of visible products of combustion.

2.1.12 Other Detectors

A. Other Detectors

1. *Thermal Detector [D,P]*: Combination fixed-temperature and rate-of-rise unit with mounting plate arranged for outlet box mounting; 135-deg F fixed-temperature setting except as indicated.

2. *Addressable Thermal Sensor [D,P]*: Rate-compensated/fixed-temperature type with plug-in base and alarm indication lamp. Detectors have a communication transmitter and receiver with unique identification and capability for status-reporting to the FACU.

3. *Flame Detector [D,P]*: Ultraviolet/Infrared type with solid-state amplifier-switching circuit set for 3-second delay unless otherwise indicated.

4. *Addressable Flame Detector [D,P]*: Ultraviolet/Infrared type with solid-state amplifier-switching circuit set for 3-second delay unless otherwise indicated. Detectors have a communication transmitter and receiver with unique identification and capability for status-reporting to the FACU.

2.1.13 Photoelectric Smoke Duct Detector

A. *Photoelectric Smoke Duct Detectors [D,P]*: Smoke duct detectors shall be 4 wire, 24 V DC. They shall have an air tight rugged constructed housing with a see-through face plate. They shall have an auxiliary relay rated 10 amps and sampling and exhaust tubes. Where duct detectors are not accessible, a remote alarm indicator shall be supplied. **.** Detectors shall be furnished, installed and wired by this Contractor.

2.1.14 Addressable Module

A. *Addressable Module [D,P]*: Addressable modules shall be used for monitoring of waterflow, valve tamper, CO2 Control Panels and non-addressable detectors.

1. An addressable interface module shall be provided for interfacing normally open direct contact devices to an addressable signaling line circuit.
2. Addressable modules will be capable of mounting in a standard electric outlet box. Addressable modules will include cover plates to allow surface for flush mounting. Addressable modules will receive their 24VDC power from a separate 2 wire pair running from an appropriate power supply (If required).
3. There shall be 2 types of devices:
    a. Type 1: Addressable Monitor Modules
    b. Type 2: Addressable Control Modules
4. For Type 1 above:
    a. For conventional 2-wire smoke detector and/or contact device monitoring with Style B or Style A (NFPA-72A initiating device circuit) wiring supervision.

b. This type of addressable device module will provide power to and monitor the status of a zone consisting of N/O contact devices as specified elsewhere. The supervision of the initiating device circuit wiring will be Style B. These addressable monitor modules will communicate the zone's status (normal, alarm, trouble) to the control panel.

5. For Type 2 above:

   a. For non-supervised control: This type of addressable device will provide double pole double throw relay switching for loads up to 120VAC. It will contain easily replaceable 2 amp fuse, on each common leg of the relay.

6. The addressable control module shall be supervised and uniquely identified by the control panel. Device identification shall be transmitted to the control panel for processing according to the program instructions. Should the addressable control module become non-operational, tampered with, or removed, a discrete trouble signal, unique to the device, shall be transmitted to, and annunciated at, the control panel.

7. The above modules shall be capable of being programmed for its "address" location on the addressable device signaling line circuit. The above modules shall be compatible with addressable manual stations and addressable detectors on the same addressable circuit.

8. All devices will be supervised for trouble conditions. The system control panel will be capable of indicating the type of trouble condition (open, short, device missing/failed). Should a device fail, it will not hinder the operation of other system devices. Should a problem occur on a particular wire run, it will not affect other wire runs.

2.1.15 Audible Signaling Devices - Offices and Locker Rooms

A. *Audible Signaling Devices [D,P]*: Audible signaling devices for the office and locker areas shall have a die cast housing and a high efficiency compression driver. They shall be moisture, corrosion, vibration and vermin resistant. They shall have multi-tap power selection and be flush mounted. Initial tap shall be <**Insert**> watts. Provide combination Audio/Visual units where shown on the Drawings.

2.1.16 Audible Signaling Devices - Plants

A. *Audible Signaling Devices [D,P]*: Audible signaling devices for plant area shall be Atlas/Soundolier AP-15 TUC (Red) speakers. They shall be double re-entrant. They shall be all metal construction with built-in high efficiency compression driver. It shall be constructed to be water, humidity and vermin proof, and all components shall be enameled or plated to assure protection against corrosion. The speaker shall have a variable 6-position impedance switch providing a quick method of changing transformer taps for varying the wattage output. Initial tap shall be set at mid range <**Insert**> <**Insert**> watts). It shall have an omni-purpose mounting bracket. **Speakers shall be Fire Alarm Red**.

1. Contractor shall set the tap for each speaker in the field.

2.1.17 Visual Signaling Devices

A. *Visual Signaling Devices [D,P]*:

1. Visual Signaling Devices shall have a xenon type flasher. In office areas the visual signaling device shall be in a common enclosure with the audible signaling device. Strobe lights shall meet ADA standards and comply with GM Guideline No. "GL-7A-R".

2.1.18 Device Location Indicating Lights

A. *Device Location Indicating Lights [D,P]*:

1. Description: A system-voltage-indicating light denotes the location of each sprinkler water flow switch and valve tamper switch. A red-laminated, phenolic resin identification plate at the indicating light bears, in engraved white letters, the room numbers of protected spaces downstream from the water-flow switch, or the room number where the valve is located.

2.1.19 Magnetic Door Holders

A. *Magnetic Door Holders [D,P]*:

1. Description: Units are equipped for wall or floor mounting as indicated and are complete with matching door plate. Electromagnet operates from a [120-V a.c.] [24-V d.c.] source, and develops a 25 lbs. hold force.
2. Material and Finish: Match door hardware.

2.1.20 Photoelectronic Beam Smoke Detectors

A. *Photoelectric Beam Smoke Detectors [D,P]*: Photoelectric beam detectors shall be Underwriters' Laboratories (UL) Listed #268. The detector shall be microprocessor based, have automatic gain control and temperature compensation. The separate transmitter/receiver shall be capable of long-range coverage of up to 350 ft., (106M), and have 6 sensitivity settings. The detector shall include a normal status indicator (Green flashing LED), an alarm indicator (Red, LED) and a trouble indicator (Amber LED). The detector shall obtain its operating power from a UL Listed fire alarm panel. The operating voltage shall be 24VDC (Normal). The detector shall have front bore sighting for ease of installation.

1. Remote Indicator/Test Unit: The Remote Indicator/Test Unit, to be used in conjunction with the Beam Smoke Detector. This unit will indicate the status of the detector, (Normal, Alarm or Trouble), provide test points to check the detector calibration voltage, and can be used to test (via the key switch), the alarm function of the detector.

2.1.21 Annunciator

A. *Annunciator [D,P]*: Annunciator shall be LCD Type with Control Switches, Semi-flush or Surface Mounted.

2.1.22 Remote CRT and Key Board

A. *Remote CRT and Key Board [D,P]*: Remote CRT and Key Board [D,P]

1. The Remote CRT and Key Board shall be compatible with the Fire Alarm Control Panel. The monitor shall be 14 inches with 25 line, Non Glare Display.

16610.3 EXECUTION

3.1 INSTALLATION

A. General

1. Furnish and install in accordance with manufacturer's instructions, all wiring, conduit and outlet boxes required for the erection and operation of a complete system. All wiring shall meet all the requirements of national, state and local electrical codes.
2. Wiring shall be run for all lengths less than 1000 feet without splices. Where wire runs are of lengths greater than 1000 feet, cable pulling tension calculations shall be submitted to the Owner's Representative prior to installation. Where splicing is necessary, splicing shall be only in junction boxes at floor level on terminals. All wires shall be appropriately labeled and connected to an appropriate Terminal Box.
3. Final connections between the equipment shall be made under direct supervision of a representative of the manufacturer.
4. Contractor shall submit installation schedule to the Owner's Representative 30 days prior to commencement of work to provide for coordination of system interruption.

3.2 CABLE INSTALLATION

A. All circuits shall be protected to avoid interruption of service due to short-circuiting or other conditions, which might adversely affect the connected devices. Each individual signaling circuit shall be classified as a circuit pair.

B. All cabling in racks, cabinets and junction boxes shall be neatly strapped, dressed and adequately supported. Cable installation shall conform to good engineering practices and to the standards of the most current National Electrical Code.

C. Cables shall be terminated with the proper connector required for the associated operation of the equipment to which it is connected. Screw terminal blocks shall be furnished for all cables which interface with racks, cabinets, consoles or equipment modules. Wire shall be interfaced with screw terminal blocks with an installation tool specifically recommended by the manufacturer of the lug. Evidence of the installation of cable and wires without the appropriate connectors, shall be sufficient cause for rejection of the work and reinstallation of the cables or wires.

D. Where cables or wires require soldering, the soldering shall be done using rosin core solder and controlled temperature soldering equipment. Evidence of solder joints not made with rosin core solder or with non-temperature controlled tools shall be sufficient cause for rejection of the work and resoldering of all connections.

E. Every cable or wire shall be labeled or coded at each end. Each terminal of each field terminal strip shall be permanently labeled or coded to show the zone, instrument of item served.

F. All cables within a rack, console or junction box shall be grouped according to the signals being carried to reduce signal contamination.

G. Cables shall be run in continuous lengths except for terminations. No splices shall be permitted in any conduit run, terminal cabinets or control enclosures.

H. Install transmission media without damaging conductors, shield, or jacket.

1. Do not bend cable, in handling or installation, to smaller radii than minimum recommended by manufacturer.

I. Pull cables without exceeding cable manufacturer's recommended pulling tensions.

1. Pull cables simultaneously if more than 1 is being installed in same raceway.
2. Use pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation.
3. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage media or raceway.

J. Install exposed cables parallel and perpendicular to surfaces or exposed structural members, and follow surface contours where possible.

K. Support cables according to Division 16 Section “Basic Electrical Materials and Methods”.

L. Use splice and tap connectors compatible with cable material.

1. Make no splices except at indicated splice points.

M. Seal around cables penetrating fire-rated elements according to Division 16 Section “Basic Electrical Materials and Methods”.

N. Bond shields and drain conductors to ground at only 1 point in each circuit.

O. Connect components to wiring system and to ground as indicated and instructed by manufacturer.

P. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 FIELD QUALITY CONTROL

A. Copper Cable Testing Procedures: Inspect for physical damage and test cable for continuity and shorts. Use time-domain reflectometer with strip-chart recording capability and anomaly resolution to within 12 inches (300 mm) in runs up to 1000 feet (300 m) in length. Test cable segments for faulty connectors, splices, terminations, and the integrity of the cable and its component parts.

B. Optical Fiber Cable Testing Procedures: Perform each visual and mechanical inspection and field test, including optional procedures, stated in NETA ATS, Section 7.25. Certify compliance with test parameters and manufacturer's written instructions.

C. Replace malfunctioning cables at Project site, where possible, and retest to demonstrate compliance.

3.4 INSTALLATION AND TESTING

A. Every device shall be physically tested, and the results recorded. The system shall demonstrate a minimum of 30 days trouble free operation before acceptance by the Owner. A report shall be given to the Owner’s Representative record at the office of the architect. Each indicating and signaling circuit shall be tested to verify monitoring of electrical supervision for opens, shorts and grounds. Provide training to the Owner’s personnel in the system operation. At the conclusion of testing and the completion of training, present the system to the Owner for final acceptance. Turn over to the Owner’s Representative all keys, 3 copies of system literature, including training manuals, testing reports, system riser diagrams and a complete set of accurate as built plans. An electronic copy of all information including Drawings and product data shall be provided to the Plant’s Electrical Engineer on CD ROM.

B. Adjust the sound level of each horn and speaker to produce a sound level 15 dB over the expected ambient sound level in each area under normal plant operating conditions. After completion of testing of the fire alarm signalling system, readjust the sound level of the horns and speakers as required to meet this criterion. For bidding purposes, assume that 50 percent of the horns and speakers will require readjustment after testing.

C. Upon completion of the installation the Contractor shall provide as built drawings of all wiring diagrams, conduit layouts, device locations and addresses, and locations of all equipment associated with the system.

1. The following summary of system features shall be duplicated, completed and returned to the purchaser. Attach pages for additional information

3.5 ON-SITE ASSISTANCE

PART 1 Occupancy Adjustments: When requested within 1 year of date of Substantial Completion, provide on-site assistance in adjusting sound levels, controls, and sensitivities to suit actual occupied conditions. Provide a separate price for up to 3 requested adjustment visits to the Site for this purpose.

END OF SECTION

16740 - VOICE AND DATA SYSTEMS

16740.1 GENERAL

1.1 SUMMARY

A. Scope

1. Provide all labor, material and accessories necessary to furnish and install raceway systems for voice and data telecommunications systems wiring.

B. Related work specified in other sections:

1. Division 16 Section “Basic Electrical Materials and Methods”.
2. Division 16 Section “Electrical Identification”.
3. Division 16 Section “Wiring and Control Devices”.

1.2 QUALITY CONTROL

A. Source Quality Control

1. Furnish all materials conforming to the requirements of the National Electrical Code and the requirements of the Contract Documents.

B. Field Quality Control

1. Install material in compliance with the regulations of Local, State and Governmental laws governing electrical installations, the latest edition of the National Electrical Code and the requirements of the Contract Documents.

C. Quality Assurance

1. All tradesmen shall review the specifications herein with particular attention paid to the related sections. CLOSE COORDINATION IS ESSENTIAL TO THIS PROJECT!

1.3 MATERIAL INSTALLER QUALIFICATIONS

A. The installation of the material shall be performed by fully qualified personnel having had experience on the installation of this type of material and able to certify that they have had no less than 5 years of continuous experience in this area and have made installations similar to this and of this size or larger.

1.4 SUBMITTALS

A. Unit Prices

1. Submit unit prices for furnishing and installing each component specified in this Section. Each unit price includes all charges for General and Supplementary Conditions, incidental expenses, supervision, materials, labor, testing as required, applicable taxes, insurance, and overhead.

B. Shop Drawings And Product Data

1. Furnish submittals for items that are identified in this Section by a different type face and a bracketed code. Additional submittal requirements pertaining to this Section are specified herein under this Article. The type of submittals are defined as follows:
    a. B - Bill of Materials: A detailed description of an assembly or components, including quantity.
    b. C - Certificate: A notarized form or letter attesting to the quality of workmanship or product as measured by standards, codes or criteria specified in the Specifications.
    c. D - Shop Drawings: Drawings, diagrams, schedules, illustrations or similar data specifically prepared for Work on this Project by the Contractor, subcontractor, distributor, or manufacturer to illustrate a product or a particular portion of the Work.
    d. E – Extra Stock: Additional stack of specified material/products to be turned over to the Owner upon completion of project.
    e. G - Guarantee: Written statement guaranteeing the product or a particular portion of the Work to be and remain free from defects in materials or workmanship for a definite period of time from date of acceptance of the Work.
    f. L - Letter of Compliance: Written statement confirming that the product or a particular portion of the Work conforms to the requirements of the Contract Documents.
    g. P - Product Data: Brochures, pictures, illustrations, diagrams, color charts or similar printed data of a manufactured product that is incorporated into the Work.
    h. Q - Qualifications: Notarized statements attesting to the quality of workmanship, firm or individual as measured by standards, codes or criteria specified in the Specifications.
    i. R - Record: Data substantiating the performance of a product, or a particular portion of the Work, and which does not require prior review and approval by the Owner’s Representative, but is required for record purposes only. Performance data and other data may be required.
    j. S - Samples: Physical examples of sufficient size to clearly illustrate functional characteristic of the product or assembly, or to show color, texture or pattern, as appropriate.
    k. T - Test Report: Report, from a qualified testing agency, of actual tests conducted on products, assemblies or particular completed portions of the Work, measured against standards, codes or criteria specified in the Specifications. Each report shall state the values obtained for comparison with the stated standard, code or criteria specified in the Specifications.
    l. List of Units provided, with unit identifications per Drawings, unit descriptions, ratings, types and catalog numbers are required for review purposes.
2. *Shop Drawings [D,P]:* Submit component product data.
3. *Guarantee [G]:* The material shall be warranted for a period of 2 years from date of Owner’s acceptance.
4. Submit shop drawings for approval and include complete data on each item. Coordinate the items, as they relate to the Work, prior to submittal. Shop drawings shall be approved at least 30 days prior to commencement of work and shall include:

a. Riser diagrams: including sizing and routing of all conduits, cable trays, junction and pull boxes.

b. Data catalog cuts or brochures on all material.

5. Furnish 1 electronic copy of Final, as Constructed, Shop Drawings and Product Data on CD ROM.

16740.2 PRODUCTS

2.1 MATERIALS

A. *Telephone Cabinets [P]:* Code gauge steel, flush or surface as indicated, with hinged door with flush lock keyed same as panelboards, galvanized steel box sized as indicated, with plywood backing.

16740.3 EXECUTION

3.1 INSTALLATION

A. Provide conduit and other raceway system components as indicated and as specified in Division 16 Sections “Basic Electrical Materials and Methods” and “Underfloor Raceways”.

B. Provide transition assemblies for undercarpet cable systems as specified in Division 16 Section “Underfloor Raceways”.

C. Provide equipment identification as specification in Division 16 Section “Electrical Identification”.

APPENDICES