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SECTION 23 05 10_COMMON REQUIREMENTS FOR HVAC SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Pre-fabricated Pipe and Duct Supports
 2. Flashing.
 3. Equipment curbs.
 4. Sleeves.
 5. Firestopping relating to HVAC work.
 6. Flashing relating to HVAC work
 7. Equipment bases and supports.
 8. Flexible pipe connectors.
 9. Expansion joints.
 10. Expansion compensators.
 11. Pipe alignment guides.
 12. Swivel joints.
 13. Pipe anchors
 14. Inertia bases.
 15. Vibration isolators.

1.2 REFERENCES

- B. HVAC Insulation, Section 23 07 00
- C. Mechanical Identification, Section 23 05 53
- D. Steam and Condensate Heating Piping 23 22 13
- E. Hydronic Piping Systems 23 21 12.23
- F. DX Refrigeration Based Split Systems, Section 23 81 00

1.2 DESIGN REQUIREMENTS

- A. It is the responsibility of the consulting engineer or design build contractor to properly design and expansion loops into HVAC piping systems.

- B. The University of Delaware has a preference for hard piped expansion joints. Consult the University of Delaware Energy and Engineering Department if hard piped expansion joints cannot be used.
- C. It is the responsibility of the consulting engineer or design build contractor to properly design the supports for all piping and duct mounted exterior of the building. If manufactured support systems are used, consult with support system manufacturer when designing the support system.
- D. It is not standard to use roof curbs or to penetrate roofing systems in order to support duct, pipe or equipment. The consulting engineer or design build contractor shall design supporting systems that do not require roof penetrations. Consult the University of Delaware Energy and Engineering Department if roof penetrations cannot be avoided.
- E. Do not use wood dunnage or sleepers to support pipe, duct or equipment.

1.3 SUBMITTALS

- A. Shop Drawings: Contractor shall supply for approval a shop drawing to scale of the following:
 - 1. Shop Drawings: Indicate layout of piping systems, including flexible connectors, expansion joints, expansion compensators, loops, offsets and swing joints.
 - 2. Pipe, Duct and Equipment Support Systems for Mounting on Roofs and Outdoor Pads.
 - 3. Shop Drawings: Indicate inertia bases and locate vibration isolators, with static and dynamic load on each. Indicate assembly, materials, thickness, dimensional data, pressure losses, acoustical performance, layout, and connection details for sound attenuation products fabricated for this project.
- B. Product Data :
 - 1. Submit manufacturers catalog information including capacity, component sizes, rough-in requirements, and service sizes for the following:
 - a. All elements of equipment, pipe and duct support systems.
 - b. Fire Proofing and Stopping.
 - c. Flashing Materials.
- C. Flexible Pipe Connectors and Expansion Joints: Indicate maximum temperature and pressure rating, maximum expansion compensation face-to-face length, live length, hose wall thickness, hose convolutions per foot and per assembly,

fundamental frequency of assembly, braid structure, and total number of wires in braid.

1. Manufacturer's Installation Instructions: Submit special procedures.
2. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
3. Manufacturer's Field Reports: Indicate results of inspection by manufacturer's representative.

D. Inertia Bases and Vibration Isolators: Submit schedule of vibration isolator type with location and load on each. Submit catalog information indicating, materials, dimensional data, pressure losses, and acoustical performance for standard sound attenuation products.

1. Design Data: Submit calculations indicating maximum room sound levels are not exceeded.
2. Test Reports: Indicate dynamic insertion loss and noise generation values of silencers. And acoustic housings meet or exceed specified sound transmission loss values.
3. Manufacturer's Installation Instructions: Submit special procedures and setting dimensions. Indicate installation requirements maintaining integrity of sound isolation.
4. Manufacturer's Certificate: Certify isolators meet or exceed specified requirements.
5. Manufacturer's Field Reports: Indicate sound isolation installation is complete and in accordance with instructions.

1.4 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of flexible pipe connectors, expansion joints, anchors, and guides.
- B. Operation and Maintenance Data: Submit adjustment instructions.

1.5 DEFINITIONS

- A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.6 SYSTEM DESCRIPTION

- A. Firestopping Materials: UL 263 and UL 1479, to achieve fire ratings of adjacent construction
- B. Surface Burning: UL 723 with maximum flame spread / smoke developed rating of 25/450.
- C. Firestop interruptions to fire rated assemblies, materials, and components.

1.7 PERFORMANCE REQUIREMENTS

- A. Firestopping: Conform to all local codes and FM or UL for fire resistance ratings and surface burning characteristics.
- B. Firestopping: Provide certificate of compliance from authority having jurisdiction indicating approval of materials used.

1.8 QUALITY ASSURANCE

- A. Verify field measurements prior to fabrication on any equipment covered by this standard.
- B. Through Penetration Firestopping of Fire Rated Assemblies: UL 1479 with 0.10 inch water gage minimum positive pressure differential to achieve fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.
 - 1. Wall Penetrations: Fire F-Ratings as indicated on Drawings, but not less than 1-hour.
 - 2. Floor and Roof Penetrations: Fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.
 - a. Floor Penetrations Within Wall Cavities: T-Rating is not required.
- C. Through Penetration Firestopping of Non-Fire Rated Floor and Roof Assemblies: Materials to resist free passage of flame and products of combustion.
 - 1. Noncombustible Penetrating Items: Noncombustible materials for penetrating items connecting maximum of three stories.
 - 2. Penetrating Items: Materials approved by authorities having jurisdiction for penetrating items connecting maximum of two stories.
- D. Fire Resistant Joints in Fire Rated Floor, Roof, and Wall Assemblies UL 2079 to achieve fire resistant rating as indicated on Drawings for assembly in which joint is installed.

- E. Fire Resistant Joints Between Floor Slabs and Exterior Walls: ASTM E119 with 0.10 inch water gage minimum positive pressure differential to achieve fire resistant rating as indicated on Drawings for floor assembly.
- F. Surface Burning Characteristics: 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.
- G. Perform Work in accordance with AWS D1.1 for welding hanger and support attachments to building structure.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials and equipment on site in original factory packaging, labeled with manufacturer's identification.
- B. Protect from weather and construction traffic, dirt, water, chemical, and damage, by storing in original packaging.
- C. Accept expansion joints on site in factory packing with shipping bars and positioning devices intact. Inspect for damage.
- D. Protect equipment from exposure by leaving factory coverings, pipe end protection, and packaging in place until installation.

1.10 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply firestopping materials when temperature of substrate material and ambient air is below 60 degrees F.
- B. Maintain this minimum temperature before, during, and for minimum 3 days after installation of firestopping materials.
- C. Provide ventilation in areas to receive solvent cured materials.

1.11 EXTRA MATERIALS

- A. Supply two 12 ounce containers of packing lubricant and cartridge style grease gun for each expansion joint.

1.12 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

PART 2 PRODUCTS

2.1 EQUIPMENT, PIPE AND DUCT SUPPORT SYSTEMS FOR ROOF

- A. All equipment, pipe and duct located on the roof shall be supported by dunnage fabricated from structural members. All structural members shall be painted with a coat of primer and a finish coat of enamel paint.
- B. All equipment, pipe and duct roof supports must be a minimum of 18" high.
- C. All equipment supports must have an integral service platform of a minimum 3'-0" wide on all accessible sides of the equipment.

2.2 EQUIPMENT, PIPE AND DUCT SUPPORT SYSTEMS FOR OUTDOOR LOCATIONS AT GRADE (Consult with Manufacturer in the Design of the Support System)

- A. Manufacturers:
 - 1. Erico Caddy Pyramid Support Systems.
 - 2. Portable Pipe Systems Support Systems.
- B. Prefabricated system specifically designed for installation without roof penetrations, flashing or damage to roof materials.
- C. Pipe/Duct supports shall consist of 12 gage stainless steel roll formed 3-sided perforated channel with 9/16" holes at 1-7/8" centers on three sides.
- D. Base shall be molded high density/high impact polypropylene with UV inhibitors and anti-oxidants.
- E. Accessories: Clamps, bolts, nuts, washers and other devices as required to complete the system shall be stainless steel.
- F. Pipe/Duct supports system shall be attached to the roof membrane with an epoxy adhesive.
- G. Pipe/Duct supports system shall be specifically designed for weight and dimensions of system supported as well as the seismic, snow and wind classifications for the geographic area the system is located.
- H. All equipment supports must have an integral service platform of a minimum 3'-0" wide on all accessible sides of the equipment.

2.3 PIPE HANGERS AND SUPPORTS

- A. Hydronic Piping:
 - 1. Refer to Standard 23 21 12.23 Hydronic Piping Systems for specific requirements.
- B. Steam and Steam Condensate Piping:
 - 1. Refer to Standard 23 21 13 Steam and Condensate Piping Systems for specific requirements.
- C. Refrigerant Piping:
 - 1. Refer to Standard 23 81 00 DX Refrigeration Based Split Systems for specific requirements.
- D. Hanger Rods: Mild steel threaded both ends, threaded on one end, or continuous threaded.

2.4 INSERTS

- A. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.5 SLEEVES

- A. Sleeves for Pipes Through Non-fire Rated Floors: 18 gage thick galvanized steel.
- B. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage thick galvanized steel.
- C. Sleeves for Round Ductwork: Galvanized steel.
- D. Sleeves for Rectangular Ductwork: Galvanized steel.
- E. Sealant: Acrylic.

2.6 MECHANICAL SLEEVE SEALS

- A. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.7 FORMED STEEL CHANNEL

- A. Product Description: Galvanized 12 gage thick steel. With holes 1-1/2 inches on center.

2.8 FIRESTOPPING

- A. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.
 - 1. Silicone Elastomeric Firestopping: Single component silicone elastomeric compound and compatible silicone sealant.
 - 2. Foam Firestopping Compounds: Single component foam compound.
 - 3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
 - 4. Fiber Stuffing and Sealant Firestopping: Composite of mineral fiber stuffing insulation with silicone elastomer for smoke stopping.
 - 5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
 - 6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
 - 7. Firestop Pillows: Formed mineral fiber pillows.
- B. Color: As selected from manufacturer's full range of colors.

2.9 FIRESTOPPING ACCESSORIES

- A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.
- B. Dam Material: Permanent:
 - 1. Alumina silicate fire board.
- C. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.
- D. General:
 - 1. Furnish UL listed products [or products tested by independent testing laboratory].
 - 2. Select products with rating not less than rating of wall or floor being penetrated.
- E. Non-Rated Surfaces:

1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where piping is exposed.
2. For exterior wall openings below grade, furnish mechanical sealing device to continuously fill annular space between piping and cored opening or water-stop type wall sleeve.

2.10 FLEXIBLE PIPE CONNECTORS (Consult with University of Delaware Energy and Engineering Group before Specifying/Designing/Using flexible pipe connectors)

A. Steel Piping:

1. Inner Hose: Stainless Steel.
2. Exterior Sleeve: Double braided stainless steel.
3. Pressure Rating: 125 psig WSP and 450 degrees F.
4. Joint: Flanged/ or Threaded with Union or as specified for pipe joints
5. Size: As indicated on drawings.
6. Maximum offset: 3/4 inch on each side of installed center line.

B. Copper Piping:

1. Inner Hose: Bronze.
2. Exterior Sleeve: Braided bronze.
3. Pressure Rating: 125 psig WSP and 450 degrees F.
4. Joint: Flanged/ or Threaded with Union or as specified for pipe joints
5. Size: As indicated on drawings.
6. Maximum offset: 3/4 inch on each side of installed center line.

2.10 EXPANSION JOINTS (Consult with University of Delaware Energy and Engineering Group before Specifying/Designing/Using prefabricated expansion joints)

C. Stainless Steel Bellows Type:

1. Pressure Rating: 125 psig WSP and 400 degrees F
2. Maximum Compression: 3 inch.
3. Maximum Extension: 1/4 inch.
4. Joint: Flanged or Threaded or as specified for pipe joints
5. Size: As indicated on drawings.
6. Application: Steel piping 2-1/2 inch and smaller.

D. External Ring Controlled Stainless Steel Bellows Type:

1. Pressure Rating: 125 psig
2. Maximum Compression: 1-1/4 inch.
3. Maximum Extension: 3/8 inch.
4. Maximum Offset: 5/16 inch.
5. Joint: Flanged.
6. Size: As indicated on drawings.
7. Accessories: Internal flow liner.

8. Application: Steel piping 4 inch and larger.
- E. Flexible Compensators:
1. Body: Teflon.
 2. Working Pressure: 150 psi.
 3. Maximum Temperature: 400 degrees.
 4. Maximum Compression: 1 inch.
 5. Maximum Elongation: 7/8 inch.
 6. Maximum Offset: 7/8 inch.
 7. Maximum Angular Movement: 30degrees.
 8. Joint: flanges or unions as specified.
 9. Size: Use pipe sized units.
 10. Accessories: Control rods.
 11. Application: Steel piping 2 inch and larger.

2.11 PIPE EXPANSION ACCESSORIES

- A. Pipe Alignment Guides: Two piece welded steel with enamel paint, bolted, with spider to fit standard pipe, frame with four mounting holes, clearance for minimum 1 inch thick insulation, minimum 3 inch travel.
- B. Swivel Joints: Fabricated steel or Bronze body, double ball bearing race, field lubricated, with Buna-N o-ring seals.

2.12 INERTIA BASES (Consult with University of Delaware Energy and Engineering Group before Specifying/Designing/Using inertia bases)

- A. Manufacturers:
1. Amber Booth.
 2. BRD
 3. Mason Industries
- B. Structural Bases:
1. Design: Sufficiently rigid to prevent misalignment or undue stress on machine, and to transmit design loads to isolators and snubbers.
 2. Construction: Welded structural steel with gusset brackets, supporting equipment and motor with motor slide rails.
- C. Concrete Inertia Bases:
1. Mass: Minimum of 1.5 times weight of isolated equipment.
 2. Construction: Structured steel channel perimeter frame, with gusset brackets and anchor bolts, adequately reinforced, concrete filled.
 3. Connecting Point: Reinforced to connect isolators and snubbers to base.
 4. Concrete: Reinforced 3,000 psi concrete.

2.13 VIBRATION ISOLATORS (Consult with University of Delaware Energy and Engineering Group before Specifying/Designing/Using vibration isolators)

A. Manufacturers:

1. Amber Booth.
2. BRD
3. Mason Industries

B. Open Spring Isolators:

1. Spring Isolators:
 - a. For Exterior and Humid Areas: Furnish hot dipped galvanized housings and neoprene coated springs.
 - b. Code: Color code springs for load carrying capacity.
2. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
3. Spring Mounts: Furnish with leveling devices, minimum 0.25 inch thick neoprene sound pads, and zinc chromate plated hardware.
4. Sound Pads: Size for minimum deflection of 0.05 inch; meet requirements for neoprene pad isolators.

C. Restrained Spring Isolators:

1. Spring Isolators:
 - a. For Exterior and Humid Areas: Furnish hot dipped galvanized housings and neoprene coated springs.
 - b. Code: Color code springs for load carrying capacity.
2. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
3. Spring Mounts: Furnish with leveling devices, minimum 0.25 inch thick neoprene sound pads, and zinc chromate plated hardware.
4. Sound Pads: Size for minimum deflection of 0.05 inch; meet requirements for neoprene pad isolators.
5. Restraint: Furnish mounting frame and limit stops.

D. Closed Spring Isolators:

1. Spring Isolators:
 - a. For Exterior and Humid Areas: Furnish hot dipped galvanized housings and neoprene coated springs.
 - b. Code: Color code springs for load carrying capacity.
2. Type: Closed spring mount with top and bottom housing separated with neoprene rubber stabilizers.
3. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.

4. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators, and neoprene side stabilizers with minimum 0.25 inch clearance.
- E. Restrained Closed Spring Isolators:
 1. Spring Isolators:
 - a. For Exterior and Humid Areas: Furnish hot dipped galvanized housings and neoprene coated springs.
 - b. Code: Color code springs for load carrying capacity.
 2. Type: Closed spring mount with top and bottom housing separated with neoprene rubber stabilizers.
 3. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
 4. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators, and neoprene side stabilizers with minimum 0.25 inch clearance and limit stops.
- F. Spring Hanger:
 1. Spring Isolators:
 - a. For Exterior and Humid Areas: Furnish hot dipped galvanized housings and neoprene coated springs.
 - b. Code: Color code springs for load carrying capacity.
 2. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
 3. Housings: Incorporate [neoprene isolation pad meeting requirements for neoprene pad isolators] [rubber hanger with threaded insert].
 4. Misalignment: Capable of 20 degree hanger rod misalignment.
- G. Neoprene Pad Isolators:
 1. Rubber or neoprene-waffle pads.
 - a. 30 durometer.
 - b. Minimum 1/2 inch thick.
 - c. Maximum loading 40 psi.
 - d. Height of ribs: not to exceed 0.7 times width.
 2. Configuration: Single layer. 1/2 inch thick waffle pads bonded each side of 1/4 inch thick steel plate.
- H. Rubber Mount or Hanger: Molded rubber designed for 0.5 inches deflection with threaded insert.
- I. Glass Fiber Pads: Neoprene jacketed pre-compressed molded glass fiber.
- J. Seismic Snubbers:

1. Type: Non-directional and double acting unit consisting of interlocking steel members restrained by neoprene elements.
2. Neoprene Elements: Replaceable, minimum of 0.75 inch thick.
3. Capacity: 4 times load assigned to mount groupings at 0.4 inch deflection.
4. Attachment Points and Fasteners: Capable of withstanding 3 times rated load capacity of seismic snubber.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify openings are ready to receive sleeves.
- B. Verify openings are ready to receive firestopping.

3.2 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.
- B. Remove incompatible materials affecting bond.
- C. Install backing and damming materials to arrest liquid material leakage.]
- D. Obtain permission from Architect/Engineer before using powder-actuated anchors.
- E. Obtain permission from Architect/Engineer before drilling or cutting structural members.

3.3 INSTALLATION - INSERTS

- A. Install inserts for placement in concrete forms.
- B. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 inches and larger.
- D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
- E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut [above] [flush with top of] [recessed into and grouted flush with] slab.

3.4 INSTALLATION - PIPE HANGERS AND SUPPORTS

- A. Install in accordance with ASME B31.1/ASME B31.5/ASME 31.9.
- B. Support horizontal piping as scheduled.
- C. Install hangers with minimum 1/2 inch space between finished covering and adjacent work.
- D. Place hangers within 12 inches of each horizontal elbow.
- E. Use hangers with 1-1/2 inch minimum vertical adjustment.
- F. Support vertical piping at every floor.
- G. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.
- H. Support riser piping independently of connected horizontal piping.
- I. Provide copper plated hangers and supports for copper piping.
- J. Design hangers for pipe movement without disengagement of supported pipe.
- K. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
- L. Provide clearance in hangers and from structure and other equipment for installation of insulation. Refer to Section 22 07 00.

3.5 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

- A. Provide housekeeping pads of concrete, minimum 6" thick and extending 6 inches beyond supported equipment.
- B. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.
- C. Construct supports of steel members/formed steel channel/steel pipe and fitting. Brace and fasten with flanges bolted to structure. (Equipment supports fabricated from wood are not allowed at University of Delaware facilities)
- D. Provide rigid anchors for pipes after vibration isolation components are installed. Refer to Section 21 05 48.

3.6 INSTALLATION - FLASHING

- A. Provide flexible flashing and metal Counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.
- B. Provide curbs for roof installations 14 inches minimum high above roofing surface. Flash and counter-flash with sheet metal; seal watertight. Attach Counterflashing to equipment and lap base flashing on roof curbs. Flatten and solder joints.
- C. Adjust storm collars tight to pipe with bolts; caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

3.7 INSTALLATION - SLEEVES

- A. Exterior watertight entries: Seal with mechanical sleeve seals.
- B. Set sleeves in position in forms. Provide reinforcing around sleeves.
- C. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- D. Extend sleeves through floors 1 inch above finished floor level. Caulk sleeves.
- E. Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with stuffing or firestopping insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- F. Install chrome plated steel escutcheons at finished surfaces.

3.8 INSTALLATION - FIRESTOPPING

- A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, and other items, requiring firestopping.
- B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.
- C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating, to uniform density and texture.
- D. Remove dam material after firestopping material has cured.
- E. Non-Rated Surfaces:

1. Exterior wall openings below grade: Assemble rubber links of mechanical sealing device to size of piping and tighten in place, in accordance with manufacturer's instructions.
2. Interior partitions: Seal pipe penetrations at all interior partitions. Apply sealant to both sides of penetration to completely fill annular space between sleeve and conduit.

3.9 INSTALLATION – FLEXIBLE CONNECTIONS AND EXPANSION JOINTS

- A. Install flexible pipe connectors on pipes connected to equipment supported by vibration isolation. Provide line size flexible connectors.
- B. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end. Install in horizontal plane unless indicated otherwise.
- C. Rigidly anchor pipe to building structure. Provide pipe guides to direct movement only along axis of pipe. Erect piping so strain and weight is not on cast connections or apparatus.
- D. Provide support and anchors for controlling expansion and contraction of piping. Provide loops, pipe offsets, and swing joints, or expansion joints as indicated on Drawings.
- E. Provide expansion loops as indicated on Drawings.

3.10 INSTALLATION – VIBRATION AND SEISMIC CONTROLS

- A. Install isolation for motor driven equipment.
- B. Bases:
 1. Set steel bases for 1 inch clearance between housekeeping pad and base.
 2. Set concrete inertia bases for 2 inch clearance between housekeeping pad and base.
- C. Adjust equipment level.
- D. Install spring hangers without binding.
- E. On closed spring isolators, adjust so side stabilizers are clear under normal operating conditions.
- F. Prior to making piping connections to equipment with operating weights substantially different from installed weights, block up equipment with temporary shims to final height. When full load is applied, adjust isolators to load to allow shim removal.

- G. Provide pairs of horizontal limit springs on fans with more than 4 inch static pressure, and on hanger supported, horizontally mounted axial fans.
- H. Provide resiliently mounted equipment, piping, and ductwork with seismic snubbers. Provide each inertia base with minimum of four seismic snubbers located close to isolators. Snub equipment designated for post disaster use to 0.05 inch maximum clearance. Provide other snubbers with clearance between 0.15 inch and 0.25 inch.
- I. Support piping connections to isolated equipment resiliently as follows:
 - 1. Up to 4 inch Diameter: First three points of support.
 - 2. 5 to 8 inch Diameter: First four points of support.
 - 3. 10 inch Diameter and Over: First six points of support.
 - 4. Select three hangers closest to vibration source for minimum 1.0 inch static deflection or static deflection of isolated equipment. Select remaining isolators for minimum 1.0 inch static deflection or 1/2 static deflection of isolated equipment.

3.11 FIELD QUALITY CONTROL - FIRESTOPPING

- A. Inspect installed firestopping for compliance with specifications and submitted schedule.

3.12 FIELD QUALITY CONTROL – VIBRATION ISOLATION

- A. Inspect isolated equipment after installation and submit report. Include static deflections.

3.13 CLEANING

- A. Clean adjacent surfaces of firestopping materials.

3.14 PROTECTION OF FINISHED WORK

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

3.15 MANUFACTURER'S FIELD SERVICES - FLEXIBLE CONNECTIONS AND EXPANSION JOINTS

- A. Furnish inspection services by flexible pipe manufacturer's representative for final installation and certify installation is in accordance with manufacturer's recommendations and connectors are performing satisfactorily.

END OF SECTION