SECTION 23 05 16
EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING

PART 1 – GENERAL

1.01 WORK INCLUDED

A. The work of this Section shall include, but is not limited to, the following:

1. Expansion loops and flexible expansion loops
2. Expansion compensators
3. Pipe alignment guides and anchors
4. Expansion joints

1.02 RELATED DOCUMENTS

A. Section 23 05 01 – HVAC General Provisions

B. Section 23 05 29 – Hangers and Supports for HVAC

C. Section 23 05 48 – Vibration and Seismic Controls for HVAC

D. Section 23 21 13 – Hydronic Piping

1.03 REFERENCE STANDARDS

Published specifications standards, tests or recommended methods of trade, industry or governmental organizations apply to work in this Section where cited below:

A. AGA – American Gas Association

B. ANSI – American National Standards Institute: NFPA 54/ANSI Z223.1 National Fuel Gas Code

C. ASME – American Society of Mechanical Engineers

1. Standard for Boiler and Pressure Vessel Code – Sections I through XII
2. ASME B18.10: Track Bolts and Nuts
3. ASME B31.9: Building Services Piping

D. ASTM – American Society for Testing and Materials

1. ASTM A53/A53M: Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
2. ASTM A183: Standard Specification for Carbon Steel Track Bolts and Nuts
3. ASTM B650-95: Standard Specification for Electrodeposited Engineering Chromium Coatings on Ferrous Substrates
4. ASTM F844-07a: Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use
5. ASTM F1120-87: Standard Specification for Circular Metallic Bellows Type Expansion Joints for Piping Applications
6. ASTM F1123-87: Standard Specification for Non-Metallic Expansion Joints

E. AWWA – American Water Works Association

1. AWWA C153/A21.53: American National Standard for Ductile-Iron Compact Fittings for Water Service
2. AWWA C210: Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines
3. AWWA C213: Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines

F. NFPA – National Fire Protection Association: NFPA 99 Health Care Facilities Code

G. UL – Underwriters Laboratories Inc.

1.04 QUALITY ASSURANCE

A. Flexible expansion joints shall be AGA certified for use on gas piping.

B. Flexible expansion joints for medical gas piping shall comply with NFPA 99.

1.05 SUBMITTALS

A. Product Data: For each type of expansion fitting indicated.

B. Shop Drawings: Signed and sealed by a qualified professional engineer.

1. Design Calculations: For thermal expansion of piping systems and selection and design of expansion fittings and loops.
2. Anchor Details: Detail fabrication of each indicated. Show dimensions and methods of assembly.
3. Alignment Guide Details: Detail field assembly and anchorage.

C. Schedule: Indicate manufacturer's number, size, location, and features for each expansion fitting and loop.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Flexible Expansion Loops: MetraFlex, Hyspan

B. Expansion Compensator: MetraFlex Model HP, Flexonics Model H or HP, Hyspan Series 8540 up to 4-inch pipe size

C. Pipe Alignment Guides: Pipe Shields Series E2000 for insulated pipes; B-Line, Grinnell, Hyspan Series 9500 or MetraFlex for uninsulated pipes

D. Expansion Joints:

1. Rubber: Flexicraft, Garlock, MetraFlex, Proco
2. Flexible Hose: Flexicraft, MetraFlex
3. Slip: Adsco Type RJ, Advanced Thermal Systems Type TP2, Hyspan 6500 series, Yarway
4. Grooved End: Victaulic Company

5. Flexible Ball: Advanced Thermal, Hyspan
6. Metal-Bellows: Adsco, Anamet, Badger, Hyspan, MetraFlex, Proco

2.02 PERFORMANCE REQUIREMENTS

A. Expansion compensator shall be capable of elongating and compressing to absorb 200 percent of maximum piping expansion between anchors.

B. Pipe alignment guides shall be selected for both upward and downward motion.

2.03 FLEXIBLE EXPANSION LOOPS

A. Provide flexible expansion loops of size and material noted on the Drawings.

B. Flexible loops shall be designed to not impart thrust loads on the anchors. The loop shall consist of two flexible sections of hose and braid, two (2) 90-degree elbows, and a 180-degree return. Loops shall be installed in a neutral, pre-compressed, or pre-extended condition as required for application.

C. Loops installed hanging down shall have a drain plug. Loops installed straight up may be fitted with an automatic air release valve that purges air from the high point of the loop. Loops installed in any position other than hanging down must have the 180-degree return supported.

D. Joints for copper piping and fittings with solder-joint end connections:

1. 2-inch and smaller: Bronze hoses and single-braid bronze sheaths with 340 psig at 450 degrees F minimum pressure ratings.
2. 2½ to 4-inch: Stainless-steel hoses and single-braid, stainless-steel sheaths with 225 psig at 450 degrees F minimum pressure ratings.

E. Joints for steel piping and carbon-steel fittings:

1. End connections shall be threaded up to 2-inch and flanged for all other sizes.
2. Joints, up to 2-inch: Stainless-steel hoses and single-braid, stainless-steel sheaths with 325 psig at 600 degrees F minimum pressure ratings.
3. Joints, 2½ to 6-inch: Stainless steel hoses and single-braid, stainless steel sheaths with 145 psig at 600 degrees F minimum pressure ratings.
4. Joints up to 2-inch: Stainless steel hoses and single-braid, stainless steel sheaths with 90 psig at 600 degrees F minimum pressure ratings.
5. Joints for 2½ to 6-inch: Stainless steel hoses and double-braid, stainless steel sheaths with 200 psig at 600 degrees F minimum pressure ratings.
6. Joints for 8-inch and larger: Stainless steel hoses and double-braid, stainless steel sheaths with 120 psig at 600 degrees F minimum pressure ratings.
7. For water systems in approved applications, use adequate numbers of Victaulic Style 77 flexible couplings in header piping to accommodate thermal growth and contraction, and for the elimination of expansion loops. (In accordance with Victaulic instructions and as approved by the engineer.) Where expansion loops are required, use Victaulic Style 77 couplings on the loops.

2.04 FLEXIBLE EXPANSION JOINT

A. Buried Flexible Expansion Joints:

1. Flexible expansion joints shall be installed in the locations indicated on the Drawings and shall be manufactured of ductile iron conforming to the material properties of ANSI/AWWA C153/A21.53.

2. Provide double ball joint design with each flexible expansion joint shall be pressure tested against its own restraint to a minimum of 350 psi.
3. Each flexible expansion joint shall consist of an expansion joint designed and cast as an integral part of a ball and socket type flexible joint, having a minimum per ball deflection of: 20 degrees, 3 inches-expansion and total expansion range of not less than 6 inches.
4. All internal surfaces parts shall be lined with a minimum of 15 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C213 and shall be holiday tested with a 1,500 volt spark test conforming to said specification. All external surfaces shall be coated with a catalyzed coal tar epoxy conforming to the material requirements of AWWA C210.
5. Install with polyethylene wrap over all joints.
6. Provide restrained mechanical joint or flange ends as required to mate rigidly to piping at both ends. Consult with factory authorized manufacturer representative for guidelines for installations and pipe connection and support accessories required for complete and effective installation.
7. Provide thrust restraint devices to complete installation including thrust restraint products to adequately transfer loading to expansion joint.

2.05 EXPANSION COMPENSATORS

A. Constructed of two-ply stainless steel bellows with carbon steel shrouds, carbon steel threaded or flanged end fittings or copper solder joint fittings. Compensators shall be rated 175 psig minimum, with internal guides, anti-torque device, and removable end clip for positioning.

B. Provide internal guides for the full length of the bellows travel, and positive internal anti-torque device shall prevent twist or torque during installation. Units shall be rated at 150 psi at not less than 400 degrees F.

C. Provide threaded end connections for 2-inch and smaller, grooved or flanged connections for all other sizes.

D. Joints for copper piping shall be two-ply, phosphor-bronze bellows and brass shroud. Joints for steel piping shall be two-ply, stainless steel bellows and carbon-steel shroud.

2.06 EXPANSION JOINTS

A. Bellows Type:

1. Flanged, packless, self-equalizing type constructed of Type 304 stainless steel bellows and carbon steel fittings. Construct control rings of cast steel or nickel iron. Include limit stops and tie rods to prevent over traversing and to constrain pressure thrust forces on the joints. Units shall be rated at 150 psi at 400 degrees F.
2. Include an external sheet metal shroud on all joints that will be insulated. Shroud shall be removable for field inspection of the joint.
3. Include an internal sleeve of Type 304 stainless steel with sufficient clearance between the bellows and the sleeve to permit full rated rotational and lateral

movement. Inside diameter of sleeve is not to be less than that of the adjoining pipe.

4. 175 psig minimum pressure rating, with end fittings and external tie rods for limiting maximum travel.
5. Joints for copper piping shall be single- and two-ply, phosphor bronze bellows and brass shroud.
6. Joints for stainless-steel waterway shall be single-ply stainless-steel bellows, stainless-steel pipe end connections, and steel shroud.
7. Joints for steel piping shall be single- and two-ply, stainless-steel bellows and carbon-steel shroud.

B. Slip Type:

1. Provide integral internal and external guides designed for the injection of self-lubricating packing under full line pressure.
2. Provide double end with integral anchor base expansion joints, suitable for use with 150 psig steam of sizes and traverse noted on plans.
3. Traverse chamber and stuffing box shall be ASTM A53, Grade B, seamless steel pipe and concentric reducer of same or greater wall thickness as connected piping system.
4. Slip shall be ASTM A53, Grade B, Type S, black steel pipe. Use Schedule 80 material for sizes through 16-inch and Schedule 60 for sizes 18-inch through 24-inch, but not lighter weight material than used on the connected piping system. Slip shall be ground, polished, and plated with not less than 1 mil of hard chrome applied over 1 mil of crack-free hard chrome, in accordance with ASTM B650.
5. End connections shall be beveled to match connected piping for field welding.
6. Outward limit stops shall be T-303 stainless steel pins welded to slip to prevent disengagement of the slip in the event of anchor failure.
7. Packing/packing cylinder: Injectable packing shall be self-lubricating, asbestos free, flake graphite/Teflon packing suitable for 150 psig at not less than 600 degrees F, injectable under full line pressure, backed by self-lubricating, asbestos free reinforced graphite braided ring packing. The area of the packing in contact with the sliding slip shall be a minimum of 15 times the nominal pipe size of the joint. Provide multiple packing cylinders with integral stainless steel safety valve and internal acme thread and plungers to inject packing into the expansion joint without blowback. Furnish one clean-out tool to loosen impacted packing prior to adding injectable packing. Provide three extra packing plugs for each packing cylinder for each joint.
8. Locate expansion joint with sufficient clearance from wall or other obstruction to allow access to and removal of all packing ram plungers and use of clean-out tool.

C. Grooved End Type: Grooved end expansion joints shall be of the same manufacturer as the adjoining couplings.

1. Packless, Gasketed, Slip, Expansion Joints 2- to 6-inch: 350-psig maximum working pressure, steel pipe fitting consisting of telescoping body and slip-pipe sections, PTFE modified polyphenylene sulfide coated slide section, with grooved ends. Suitable for axial end movement to 3 inches. Victaulic Style 150.
2. ¾ inch and larger: Expansion joint consisting of a series of grooved end pipe nipples joined in tandem with Victaulic Style 77 flexible couplings. Total joint movement dependent on the number of couplings and nipples used. Victaulic

Series 155.

D. Rubber Type: ASTM F1123, fabric-reinforced butyl rubber, and pressure rated for 175 psig at 240 degrees F minimum.

1. Configuration: Full-faced, integral, steel-flanged-end connections; external control rods; and steel retaining rings drilled to match flange bolt holes.
2. Type: Single sphere or double sphere.

E. Flexible Ball Type:

1. Carbon-steel assembly with asbestos-free composition packing, designed for 360-degree rotation and angular deflection.
2. 250 psig at 400 degrees F minimum pressure rating; comply with ASME Boiler and Pressure Vessel Code: Section II, and ASME B31.9 for materials and design of pressure-containing parts and bolting.
3. End connections shall be threaded up to 2-inch and flanged for all other sizes.
4. Joints for 6-inch and smaller shall be 30-degree angular deflection minimum. Joints for 8-inch and larger shall be 15-degree angular deflection minimum.

2.07 UL-LISTED SEISMIC EXPANSION JOINT

A. All sprinkler and fire standpipe piping passing through or crossing building seismic joints shall contain a flexible expansion loop designed for seismic movement.

B. Flexible loops shall impart no thrust loads to system support anchors or building structure. Loops shall be located at, or near, the building seismic joint.

C. A vertical support hanger, located within 4 pipe diameters, shall be installed on each side of the flexible loop. Each hanger to be transversely and longitudinally braced per local codes. Seismic bracing shall not pass through building seismic joint and shall not connect or tie together different sides or parts of building structure.

D. Flexible loops shall be capable of movement in the ±X, ±Y, ±Z planes. Movement requirements and location, relative to seismic separation, shall be confirmed by the structural design engineer.

E. Flexible loops may be installed to accommodate thermal expansion, seismic movement, and building settlement.

F. Flexible loop connections to sprinkler piping shall be installed, inspected, and tested in accordance with current NFPA 13 standards.

G. Flexible loops shall consist of two flexible sections of hose and braid, two 90-degree elbows, and 180-degree return. Loops shall include a factory supplied, center support nut located at the bottom of the 180-degree return, and a drain/air release plug.

H. Materials of construction and end fitting type shall be consistent with pipe material and equipment/pipe connection fittings.

I. Flexible expansion/seismic loops to be Metraloop® Fireloop™ as manufactured by The MetraFlex Company, Chicago, IL.

2.08 MISCELLANEOUS MATERIALS

A. Guides shall be steel, factory fabricated, with bolted two-section outer cylinder and base for alignment of piping and two-section guiding spider for bolting to pipe.

B. Bolts and Nuts: ASME B18.10 or ASTM A183, steel, hex head.

C. Washers: ASTM F844, steel, plain, flat washers.

D. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened Portland cement concrete, and tension and shear capacities appropriate for application.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Provide at least two (2) guides each side of each expansion loop or joint. Size guide cylinder to allow the full insulation thickness to be carried through the guide with ample clearance and without restricting the free movement of the pipe. Size guide cylinder for sufficient length to contain the total movement of the spider. Rigidly anchor pipe guide to building structure.

B. Install expansion fittings according to manufacturer's written instructions in sizes matching pipe size in which they are installed. Align expansion fittings to avoid end-loading and torsional stress.

C. Provide expansion loops or joints as shown on the Drawings.

D. Provide minimum of three (3) elbow offsets on branch pipe connections into mains and at each riser takeoff to allow piping flexibility and expansion.

E. Install flexible loop within four (4) pipe diameters, both upstream and downstream, from a pipe guide or anchor.

3.02 EXPANSION JOINT INSTALLATION

A. The bellows element shall be protected from damage. Dents, scores, arc strikes, weld spatter, and other damage can cause the joint to fail. Damaged joints shall not be used.

B. Align joint flange and pipe flange holes. Do not try to compensate for flange or pipe misalignment by putting a torsional, compressive, extension, or offset loads on the expansion joint. Good practice requires that a mating flange in the piping system remain unwelded until the expansion joint has been bolted into position.

C. All anchors, guides, and supports must be installed according to manufacturer's recommendations.

D. Internally pressurized expansion joints shall be installed in the correct orientation with respect to direction of flow.

E. Unit lengths must not be altered during installation except for the application of cold pull.

F. Remove shipping restraints after installation, but before hydrotesting. Test pressure shall not exceed 1½ times design pressure. Water free of halogens shall be used for hydrotesting.

G. If testing medium is significantly heavier than the product to be carried in the system, care must be taken to support the additional weight.

H. Paints containing low melting point metals or their compounds, particularly aluminum, lead or zinc, must not be allowed to come into contact with the bellows convolutions.

3.03 EXPANSION JOINTS (SLIP TYPE)

A. Verify that the joint has been pre-compressed the correct amount for the application, including the temperature difference between the installation condition and the operating condition.

B. Adjust pre-compression as required.

C. Provide protection for the chrome-plated slip during the entire installation process. Replace packing if it has become imbedded with dirt, gravel, or other foreign material.

D. Install alignment guides as indicated on the Drawings or in accordance with the joint manufacturer's instructions, whichever is more restrictive.

E. For joints furnished with bases, provide bolts in all bolt holes to obtain the maximum anchor strength.

F. Install a drip trap or drain plug on joints furnished with a drain connection.

G. On lines specified to be insulated, install the insulation blanket, furnished by the expansion joint supplier, in accordance with the manufacturer's instructions. Provide a reusable, removable insulation blanket utilizing T-304 stainless steel wire twist fasteners for the body and silicon fiberglass belting with stainless buckles for the sliding slip, designed to allow access to the packing cylinder plungers for repacking without removal of the blanket. Thermal resistance shall be equal to the insulation covering the adjoining piping.

END OF SECTION 23 05 16