

## **SECTION 23 05 16 - EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Metal-bellows expansion joints.
  - 2. Expansion compensators.
  - 3. Rubber expansion joints.
  - 4. Flexible-hose expansion joints.
  - 5. Packed slip expansion joints.
  - 6. Flexible ball joints.
  - 7. Pipe bends and loops.
  - 8. Alignment guides and anchors.

#### **1.3 DEFINITIONS**

- A. BR: Butyl rubber.
- B. Buna-N: Nitrile rubber.
- C. CR: Chlorosulfonated polyethylene synthetic rubber.
- D. CSM: Chlorosulfonyl-polyethylene rubber.
- E. EPDM: Ethylene-propylene-diene terpolymer rubber.
- F. NR: Natural rubber.
- G. PTFE: Polytetrafluoroethylene plastic.

#### **1.4 PERFORMANCE REQUIREMENTS**

- A. Compatibility: Products shall be suitable for piping system fluids, materials, working pressures, and temperatures.
- B. Capability: Products shall absorb 200 percent of maximum axial movement between anchors.

## 1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Delegated-Design Submittal: For each anchor and alignment guide indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
  - 1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and bends.
  - 2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
  - 3. Alignment Guide Details: Detail field assembly and attachment to building structure.
  - 4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.
- C. Welding certificates.
- D. Product Certificates: For each type of pipe expansion joint, signed by product manufacturer.
- E. Maintenance Data: For pipe expansion joints to include in maintenance manuals.

## 1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
  - 1. Steel Shapes and Plates: AWS D1.1, "Structural Welding Code - Steel."

## PART 2 - PRODUCTS

### 2.1 EXPANSION JOINTS

- A. Metal-Bellows Expansion Joints: ASTM F 1120, circular-corrugated-bellows type with external tie rods.
  - 1. Manufacturers: Subject to compliance with requirements, **available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:**
    - a. Adsko Manufacturing, LLC.
    - b. Anamet, Inc.
    - c. Badger Industries.
    - d. Expansion Joint Systems, Inc.
    - e. Flex-Hose Co., Inc.
    - f. Flexicraft Industries.
    - g. Flex-Pression, Ltd.
    - h. Flex-Weld, Inc.
    - i. Hyspan Precision Products, Inc.
    - j. Metraflex, Inc.
    - k. Piping Technology & Products, Inc.
    - l. Proco Products, Inc.

- m. Senior Flexonics, Inc.; Pathway Division.
    - n. Tozen America Corp.
    - o. Unaflex Inc.
    - p. WahlcoMetroflex.
  - 2. Metal-Bellows Expansion Joints for Copper Piping: Single- or multiple-ply phosphor-bronze bellows, copper pipe end connections, and brass shrouds.
  - 3. Metal-Bellows Expansion Joints for Stainless-Steel Waterway: Single-ply stainless-steel bellows, stainless-steel-pipe end connections, and steel shroud.
  - 4. Metal-Bellows Expansion Joints for Steel Piping: Single- or multiple-ply stainless-steel bellows, steel pipe end connections, and carbon-steel shroud.
  - 5. Minimum Pressure Rating: 175 psig (1200 kPa) unless otherwise indicated.
  - 6. Configuration: Single- or double-bellows type with base, unless otherwise indicated.
  - 7. End Connections: Flanged or weld.
- B. Expansion Compensators: Double-ply corrugated steel, stainless-steel, or copper-alloy bellows in a housing with internal guides, antitorque device, and removable end clip for positioning.
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Adsko Manufacturing, LLC.
    - b. Flexicraft Industries.
    - c. Flex-Pression, Ltd.
    - d. Flex-Weld, Inc.
    - e. Hyspan Precision Products, Inc.
    - f. Metraflex, Inc.
    - g. Senior Flexonics, Inc.; Pathway Division.
    - h. Unaflex Inc.
  - 2. Minimum Pressure Rating: 175 psig (1200 kPa), unless otherwise indicated.
  - 3. Configuration for Copper Piping: Two-ply phosphor-bronze or stainless-steel bellows and bronze or stainless-steel shroud.
  - 4. Configuration for Steel Piping: Two-ply stainless-steel bellows and carbon-steel shroud.
  - 5. End Connections for Copper Tubing NPS 2 (DN 50) and Smaller: Solder joint.
  - 6. End Connections for Copper Tubing NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Solder joint.
  - 7. End Connections for Steel Pipe NPS 2 (DN 50) and Smaller: Threaded.
  - 8. End Connections for Steel Pipe NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged.
- C. Rubber Expansion Joints: ASTM F 1123, fabric-reinforced rubber with external control rods and complying with FSA's "Technical Handbook: Non-Metallic Expansion Joints and Flexible Pipe Connectors."
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Flex-Hose Co., Inc.
    - b. Flexicraft Industries.
    - c. Flex-Weld, Inc.
    - d. Garlock Sealing Technologies.
    - e. General Rubber Corp.
    - f. Mason Industries, Inc.; Mercer Rubber Co.

- g. Metraflex, Inc.
    - h. MG Piping Products Co.
    - i. Proco Products, Inc.
    - j. Red Valve Company, Inc.
    - k. Senior Flexonics, Inc.; Pathway Division.
    - l. Tozen America Corp.
    - m. Unaflex Inc.
    - n. Vibration Mountings & Controls, Inc.
  - 2. Arch Type: Single or multiple arches.
  - 3. Spherical Type: Single or multiple spheres.
    - a. Minimum Pressure and Temperature Ratings for NPS 1-1/2 to NPS 4 (DN 40 to DN 100): 150 psig (1035 kPa) at 220 deg F (104 deg C).
    - b. Minimum Pressure and Temperature Ratings for NPS 5 and NPS 6 (DN 125 and DN 150): 140 psig (966 kPa) at 200 deg F (93 deg C).
    - c. Minimum Pressure and Temperature Ratings for NPS 8 to NPS 12 (DN 200 to DN 300): 140 psig (966 kPa) at 180 deg F (82 deg C).
  - 4. Material: EPDM.
  - 5. End Connections: Full-faced, integral, steel flanges with steel retaining rings.
- D. Flexible-Hose Expansion Joints: Manufactured assembly with two flexible-metal-hose legs joined by long-radius, 180-degree return bend or center section of flexible hose; with inlet and outlet elbow fittings, corrugated-metal inner hoses, and braided outer sheaths.
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Flex-Hose Co., Inc.
    - b. Flexicraft Industries.
    - c. Flex-Pression, Ltd.
    - d. Metraflex, Inc.
  - 2. Flexible-Hose Expansion Joints for Copper Piping: Copper-alloy fittings with **solder-** joint end connections.
    - a. NPS 2 (DN 50) and Smaller: Bronze hoses and single-braid bronze sheaths with 450 psig at 70 deg F (3100 kPa at 21 deg C) and 340 psig at 450 deg F (2340 kPa at 232 deg C) ratings.
    - b. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Stainless-steel hoses and single-braid, stainless-steel sheaths with 300 psig at 70 deg F (2070 kPa at 21 deg C) and 225 psig at 450 deg F (1550 kPa at 232 deg C) ratings.
  - 3. Flexible-Hose Expansion Joints for Steel Piping: Carbon-steel fittings with threaded end connections for NPS 2 (DN 50) and smaller and **flanged** end connections for NPS 2-1/2 (DN 65) and larger.
    - a. NPS 2 (DN 50) and Smaller: Stainless-steel hoses and single-braid, stainless-steel sheaths with 450 psig at 70 deg F (3100 kPa at 21 deg C) and 325 psig at 600 deg F (2250 kPa at 315 deg C) ratings.

- b. NPS 2-1/2 to NPS 6 (DN 65 to DN 150): Stainless-steel hoses and single-braid, stainless-steel sheaths with 200 psig at 70 deg F (1380 kPa at 21 deg C) and 145 psig at 600 deg F (1000 kPa at 315 deg C) ratings.
  - c. NPS 8 to NPS 12 (DN 200 to DN 300): Stainless-steel hoses and single-braid, stainless-steel sheaths with 125 psig at 70 deg F (860 kPa at 21 deg C) and 90 psig at 600 deg F (625 kPa at 315 deg C) ratings.
- E. Packed Slip Expansion Joints: ASTM F 1007, carbon-steel, packing type designed for repacking under pressure and pressure rated for 250 psig at 400 deg F (1725 kPa at 204 deg C) minimum. Include asbestos-free PTFE packing, compound limit stops, and drip connection if used for steam piping.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Adscos Manufacturing, LLC.
    - b. Advanced Thermal Systems, Inc.
    - c. Hyspan Precision Products, Inc.
  - 2. Configuration: Single- and double-joint class with base, unless otherwise indicated.
  - 3. End Connections: Flanged or welded ends to match piping system.
- F. Flexible Ball Joints: Carbon-steel assembly with asbestos-free composition packing, designed for 360-degree rotation and angular deflection, and 250 psig at 400 deg F (1725 kPa at 204 deg C) minimum pressure rating; complying with ASME Boiler and Pressure Vessel Code: Section II, "Materials," and with ASME B31.9, "Building Services Piping," for materials and design of pressure-containing parts and bolting.
  - 1. Angular Deflection for NPS 6 (DN 150) and Smaller: 30-degree minimum.
  - 2. Angular Deflection for NPS 8 (DN 200) and Larger: 15-degree minimum.
  - 3. End Connections for NPS 2 (DN 50) and Smaller: Threaded.
  - 4. End Connections for NPS 2-1/2 (DN 65) and Larger: Flanged.
  - 5. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Advanced Thermal Systems, Inc.
    - b. Hyspan Precision Products, Inc.

## 2.2 ALIGNMENT GUIDES

- A. Description: Steel, factory fabricated, with bolted two-section outer cylinder and base for alignment of piping and two-section guiding spider for bolting to pipe.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Adscos Manufacturing, LLC.
    - b. Advanced Thermal Systems, Inc.
    - c. Flex-Hose Co., Inc.
    - d. Flexicraft Industries.

- e. Flex-Weld, Inc.
- f. Hyspan Precision Products, Inc.
- g. Metraflex, Inc.
- h. Piping Technology & Products, Inc.
- i. Senior Flexonics, Inc.; Pathway Division.

## **2.3 MATERIALS FOR ANCHORS**

- A. Steel Shapes and Plates: ASTM A 36/A 36M.
- B. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel, hex head.
- C. Washers: ASTM F 844, 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.
  - 1. Stud: Threaded, zinc-coated carbon steel.
  - 2. Expansion Plug: Zinc-coated steel.
  - 3. Washer and Nut: Zinc-coated steel.
- E. Chemical Fasteners: Insert-type-stud bonding system anchor for use with hardened portland cement concrete, and tension and shear capacities appropriate for application.
  - 1. Bonding Material: ASTM C 881, Type IV, Grade 3, 2-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
  - 2. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud, unless otherwise indicated.
  - 3. Washer and Nut: Zinc-coated steel.
- F. Concrete: Portland cement mix, 3000 psi (20.7 MPa) minimum. Comply with requirements in Division 03 Section "Cast-in-Place Concrete" for formwork, reinforcement, and concrete.
- G. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, non-shrink, nonmetallic grout; suitable for interior and exterior applications.
  - 1. Properties: Non-staining, noncorrosive, and nongaseous.
  - 2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

## **PART 3 - EXECUTION**

### **3.1 EXPANSION-JOINT INSTALLATION**

- A. Install manufactured, nonmetallic expansion joints according to FSA's "Technical Handbook: Non-Metallic Expansion Joints and Flexible Pipe Connectors."
- B. Install expansion joints of sizes matching size of piping in which they are installed.
- C. Install alignment guides to allow expansion and to avoid end-loading and torsional stress.

### **3.2 PIPE BEND AND LOOP INSTALLATION**

- A. Install pipe bends and loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.
- B. Attach pipe bends and loops to anchors.
  - 1. Steel Anchors: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
  - 2. Concrete Anchors: Attach by fasteners. Follow fastener manufacturer's written instructions.

### **3.3 SWING CONNECTIONS**

- A. Connect risers and branch connections to mains with at least **five** pipe fittings, including tee in main.
- B. Connect risers and branch connections to terminal units with at least **four** pipe fittings, including tee in riser.
- C. Connect mains and branch connections to terminal units with at least **four** pipe fittings, including tee in main.

### **3.4 ALIGNMENT-GUIDE INSTALLATION**

- A. Install guides on piping adjoining pipe expansion fittings and loops.
- B. Attach guides to pipe and secure to building structure.

### **3.5 ANCHOR INSTALLATION**

- A. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.
- B. Fabricate and install steel anchors by welding steel shapes, plates, and bars to piping and to structure. Comply with ASME B31.9 and AWS D1.1.
- C. Construct concrete anchors of poured-in-place concrete of dimensions indicated and include embedded fasteners.
- D. Install pipe anchors according to expansion-joint manufacturer's written instructions if expansion joints or compensators are indicated.
- E. Use grout to form flat bearing surfaces for expansion fittings, guides, and anchors installed on or in concrete.

**END OF SECTION**