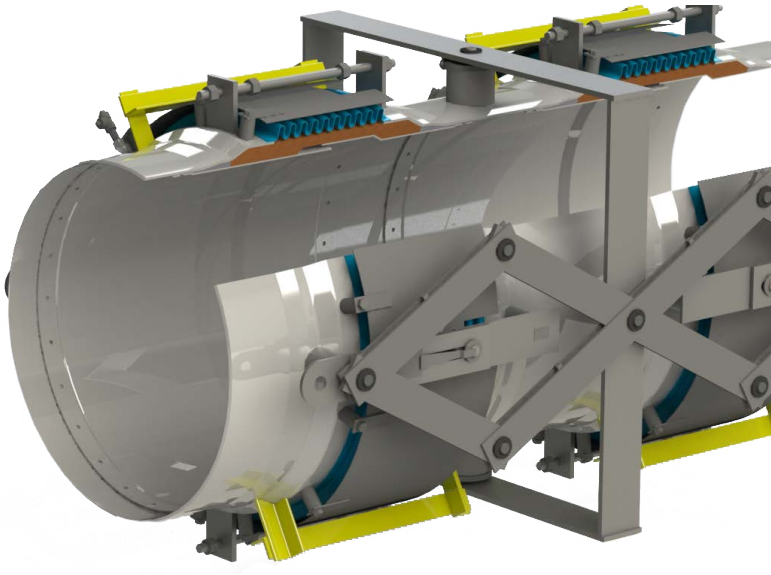
Senior Operations LLC
PATHWAY
Performance under Pressure

Storage, Installation, Operation & Maintenance Instructions for EXPANSION JOINTS IN CATOFIN® SERVICE



In order to assist our valued customers, Senior Flexonics Pathway has prepared the following best practice instructions to be used throughout the service life of expansion joints used in Catofin service. Catofin service is severe with very high temperatures, extreme flow velocities, potential coke formation, and large cyclic movements. As such, correct installation and subsequent monitoring is imperative for long life expectancy. This document is provided as a general guide based on Pathway's experience with expansion joints in this service environment.

Pathway's expansion joints are fully inspected at the factory and are packaged to arrive at the job site in good condition. Because an expansion joint is required to absorb thermal and/or mechanical movements, the bellows must be constructed of a relatively thin gauge material. This requires special precautions to carefully protect the bellows throughout the storage and installation process. Failure to comply with the following instructions could lead to premature failure and void the warranty.

STORAGE PRIOR TO INSTALLATION:

1. Immediately upon receipt at the job site, verify that there is no freight damage; i.e. dents, scratches, broken hardware, loose shipping bars, etc.

2. The area around the expansion joint should be cleared of any sharp objects or protrusions. If not removable, they should be noted so they can be avoided.

3. Expansion joints are provided with lifting lugs and should only be lifted using these designated lifting lugs.

4. The shipping bars are installed on an expansion joint to maintain shipping length and to give the expansion joint stability during transit and installation. Do not remove the shipping bars until the installation is complete.

5. Confirm tag information, overall length, and flow direction.

6. Store the expansion joint in a clean, dry place prior to installation. Care should be taken to keep the internal and external insulation bags free from moisture prior to installation.

INSTALLATION:

1. Remove any protective covering from the ends of the expansion joint. Plywood covers may have been used to protect the flange faces or weld ends. Check inside the expansion joint for dessicant bags or any other material.

2. Verify the installation location and orientation according to the system drawings. This is of particular importance for hinge and slotted hinge expansion joints that only angulate in one plane.

3. Verify the flow direction and confirm that the flow arrow is pointing in the direction of flow.

4. Examine the opening into which the expansion joint will be installed and verify that the opening is sized properly. Do not use the expansion joint to make up for excessive piping misalignment. Doing so may severely reduce the service life of the bellows. If the opening exceeds the tolerance, notify Pathway for resolution.

5. Confirm that the attachment edges of the pipe or duct are smooth, clean, and parallel to each other.

6. Using lifting lugs, lift the expansion joint to the desired location and position into pipe line or ducting.

7. For weld-end expansion joints:

    a. Prior to welding, cover the bellows element with a chloride free fire retardant cloth. This is to prevent arc strikes, weld splatter, etc. from damaging the bellows element.

    b. Using the proper electrode, weld the expansion joint to the adjacent piping. Do not use the bellows to correct for misalignment beyond the specified installation tolerances.

AFTER INSTALLATION BUT PRIOR TO PRESSURE TESTING:

1. Inspect entire system to ensure that the anchors, guides, spring-hangers, and pipe supports are installed in strict accordance with piping system drawings.

2. Anchors must be designed for the test pressure thrust loads. Unrestrained expansion joints exert a force equal to the test pressure times the effective area of the bellows during pressure test. The effective area of the bellows is indicated on the expansion joint drawings.

3. Remove shipping bars (painted yellow) prior to pressure testing. Shipping bars are not designed to restrain the pressure thrust loads.

4. The system test pressure must not exceed the test pressure as indicated on the expansion joint drawings.

OTHER PRECAUTIONS:

1. Cleaning agents, soaps and solvents may contain chlorides, caustics, or sulfides and can cause stress corrosion, which appears only after a bellows is put into service.

2. Wire brushes, steel wool, and abrasives should not be used on the bellows element.

3. Some types of insulation leach chlorides when wet. Only chloride free insulation materials should be used for insulating an expansion joint.

4. Confirm that insulation is as shown on the expansion joint drawing. Do not insulate over the bellows or any pressure restraining hardware on the expansion joint.

START-UP AND 48 HOURS AFTER START-UP:

1. As the system starts up and gets hot, carefully check each expansion joint and spring hanger for excessive or unexpected movements. Report any unforeseen movements to Pathway.

2. Remove vent plug and install pressure gauge 48 hours after startup. Note that the 48 hour operation at temperature will allow any excess moisture to escape between the bellows plies.

WEEKLY OR MONTHLY VISUAL INSPECTIONS:

1. Monitor the movement indicators and note the maximum axial compression or angulation.

2. Read the pressure gauge or Red-Top leak indicator to confirm that there is no pressure between the bellows plies. If not visible to maintenance personnel, it may be necessary to relocate the pressure gauge or leak indicator.

3. Check the control rods and hinge hardware to confirm that there is no binding during operation.

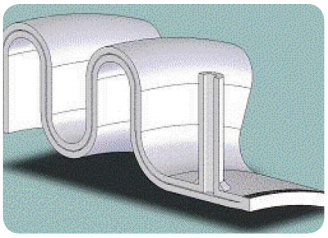
4. Perform temperature measurements of the bellows and bellows attachment weld areas in the hot condition. For expansion joints with fabric covers, there should be a flap or window to allow measurement of the bellows temperature without removal of the cover.

INSPECTION AT MAJOR TURNAROUNDS:

1. Remove covers and completely inspect bellows condition. Check for dents, scratches, non-uniform convolutions, permanent deformation, or signs of corrosion. Notify Pathway of problem areas.

2. Inspect internal liners and insulation. Check for liner attachment weld cracks. Check for bulging or distortion near the bellows attachment welds due to coke formation inside expansion joints in hydrocarbon service. Notify Pathway of problem areas.

Ply Testable Cut Away
Ply-testable bellows with redundant plies are a critical feature of expansion joints in this service.



3. **Perform two-ply test of bellows as follows: Pathway has a 2 Ply Test Kit available, which can be found on our website (Click here)**

   a. Remove the existing pressure gauge or Red-Top leak indicator.

   b. Attach a calibrated pressure gauge to the monitor connection using appropriate valves to isolate the test medium.

   c. Carefully pressurize the bellows plies to 15 psig (unless otherwise specified) using dry air or nitrogen. Use caution, do not over-pressurize the bellows.

   d. Apply soap & water or other soapy solution to all welds and connections under pressure while inspecting for leaks.

   e. The test pressure shall be maintained with no signs of leakage for 15 minutes. Notify Pathway if there is any loss of pressure during the test.

   f. Reinstall pressure gauge or Red-Top leak indicator and cover.

If a problem is identified, please contact Dru Moore at dmoore@sfpathway.com or 830-629-8080 ext.2240 for resolution. If possible, please provide pictures with expansion joint tag number or drawing number. You may also contact our 24 hour emergency response number at 830-608-3427.

If a problem is identified that needs immediate repair, Pathway's experienced field engineers and welders can be dispatched to the site.

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