How to troubleshoot expansion joint failures

Non-metallic (rubber) expansion joints are a critical part of any pump piping system as they provide the flexibility necessary to absorb system dynamics associated with vibration and/or temperature and pressure changes within piping. Careful selection of expansion joint design and material for a given application, as well as properly engineered installation, are important factors for determining performance. When designed, applied and installed properly, it is not unusual to achieve useful service life for 15 to 20 years in most industrial applications.

Unlike metal expansion joints, the majority of failures related to rubber expansion joints are not catastrophic in nature. During routine inspections, signs of fatigue and/or premature failure can be easily detected in rubber expansion joints, long before the actual failure occurs.

Common Signs of Rubber Expansion Joint Fatigue

Cracking (See Figure 1)

Exterior surface cracking is most commonly the result of aging and/or elevated temperature. As rubber ages, it becomes hard and brittle and loses inherent flexibility and resilience. Cracking or crazing may not be serious if only the outer cover is involved and the fabric is not exposed. If necessary, repair onsite with rubber cement where cracks are minor. Carefully inspect cracks to determine if underlying fabric reinforcing plies are compromised.

Cracking where the fabric is exposed and torn, indicates the expansion joint should be replaced. Such cracking is usually the result of excess extension, angular or lateral movements. Such cracking is identified by (1) a flattening of the arch, (2) cracks at the base of the arch and/or (3) cracks at the base of the flange. Cracking at the base of the flange/arch is more associated with movement and misalignment.

Note: As a corrective action, measure the face-to-face and lateral alignment prior to ordering a replacement and install control units to maintain acceptable movement limits of the expansion joint during operation.

Blisters/Deformation/Ply Separation (See Figure 2)

Some blisters or deformations—when on the external portions of an expansion joint—may not adversely affect the performance of the expansion joint. These blisters or deformations are cosmetic in nature and do not require repair.

If major blisters, deformations and/or ply separations or delamination exist in the tube, the expansion joint should be replaced as soon as possible. The root cause of delamination is either over-torqued bolts, chemical attack by the media, aged rubber or some other form of break in the inner tube layer. Corrective actions include replacing the aged product and ensuring the correct material selection for the application.

Ply separation at the flange outer diameter (O.D.) can sometimes be observed and is not a cause for replacement of the expansion joint.

Figure 1. Typical Expansion Joint Surface Cracking

Figure 2. Expansion Joint Surface Delamination

Exposure of Metal Reinforcement
If the metal reinforcement of an expansion joint is visible through the cover, the expansion joint should be replaced as soon as possible.

Dimensions
Any inspections should verify that the installation is correct; no excessive misalignment between the flanges exists; and the installed face-to-face dimension is correct. Check for over-elongation, over compression, lateral or angular misalignment. If incorrect installation has caused the expansion joint to fail, adjust the piping and order a new expansion joint to fit the existing installation.

Rubber Deterioration
If the joint feels soft or gummy, plan to replace the expansion joint as soon as possible. Chemical attack is the most likely cause. Joints can be made compatible with almost any media, so it is vital that the manufacturer be advised as to what media will contact the joint when reordering.

Leakage (See Figure 3)
It is most important to determine where the leak originated prior to implementing any corrective action. If leakage or weeping is occurring from any surface of the expansion joint, except where flanges meet, replace the joint immediately. If leakage occurs between the mating flange and expansion joint flange,

Figure 3. Leaking Expansion Joint

tighten all bolts. (Make sure that a gasket has NOT been installed between the joint's flange face and the mating flange.)

If this is not successful, turn off the system pressure, loosen all flange bolts and then retighten bolts in stages by alternating around the flange. Make sure there are washers under the bolt heads, particularly at the split in the retaining rings. There should be no gap at the retaining ring split. Remove the expansion joint and inspect both rubber flanges and pipe mating flange faces for damage and surface condition. Repair or replace as required. Also, make sure the expansion joint is not over-elongated as this can tend to pull the joint flange away from the

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Fluid Sealing Association

Sealing Sense is produced by the **Fluid Sealing Association** as part of our commitment to industry consensus technical education for pump users, contractors, distributors, OEMs and reps. *This month's Sealing Sense was prepared by FSA Member Lloyd Aanonsen.* As a source of technical information on sealing systems and devices, and in cooperation with the **European Sealing Association**, the FSA also supports development of harmonized standards in all areas of fluid sealing technology. The education is provided in the public interest to enable a balanced assessment of the most effective solutions to pump technology issues on rational Total Life Cycle Cost (LCC) principles.

The **Piping Systems Non-Metallic Expansion Joint** division of the FSA is one of five with a specific product technology focus. As part of their mission they develop publications such as the Technical Handbook Non-Metallic Expansion Joints and Flexible Pipe Connectors and the Non-Metallic Piping Expansion Joint Installation Guide. The former provides construction, installation and application details while the latter is a "hands-on" simplified guide for maintenance operators and engineers. Both are primers intended to complement manufacturer's documents produced by the member companies. In addition, standards such as *FSA-PSJ-701-06 Non-Metallic Expansion Joint Hydrotesting and Vacuum Testing, FSA-PSJ-702-06 Rubber Flanged Non-Metallic Expansion Joint Installation, Maintenance, and Storage, and FSA-NMEJ-703-99 Specifications of Elastomers Used in Piping Systems Non-Metallic Expansion Joints* have been developed in response to important user issues.

The following members of the **Piping Systems Non-Metallic Expansion Joint** division sponsor this *Sealing Sense* series:

Bachmann Dampjoint, Inc.
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third consideration is the overall quality of construction, in terms of both material quality and manufacturing quality.

Pumps should be constructed of rugged cast iron material for the pump castings (casings, motor enclosures and impellers) to provide long life in the field. High performance/high quality coatings (primer and top coats) should be applied to protect the exterior surfaces from corrosion.

All sleeve bearing pumps should have the bearing journals and thrust surfaces ground between centers to ensure alignment and surface finish. All pump shaft, impeller and motor assemblies should be dynamically balanced to assure long-term vibration-free operation.

Durable electric supply power cords also help ensure reliable transformer pump performance. These should be capable of withstanding ultraviolet rays, oil, water and extreme weather conditions.

The Economics

Investment in high quality new and remanufactured transformer oil pumps has a high economic return. A good pump will typically cost much less than 1 percent of the cost of the transformer it supports, yet it provides long-term insurance against breakdown, damage or failure of the transformer. As all owners of large critical transformers will attest, a failure or major outage of this equipment can cause severe upheaval to the wellbeing of their electrical power distribution system.

High quality pumps also pay for themselves in lowered maintenance and replacement costs. Properly designed sleeve bearing pumps reliably perform 15+ years—more than 3 to 4 times the typical useful life of ball bearing pumps. In addition, pumps with ultrasonic monitoring systems are less costly to operate because preventative maintenance can be efficiently planned.

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mating flange resulting in leakage. If leakage persists, consult the manufacturer for additional recommendations.

Root Causes Include: Under-torqued bolts; irregular sealing surface (optimal mating surface is full face flat flanges); overextension; and chemical attack by the media.

Corrective Action: Tighten the bolts to the manufacturer's torque recommendations. Change to proper design and chemically compatible material. Measure the face-to-face dimension prior to replacement.

Replacement Criteria

If an expansion joint is in a critical service and is five or more years old, consideration should be given to maintaining a spare or replacing the unit at a scheduled outage. If the service is not critical in nature, observe the expansion joint on a regular basis and plan to replace after ten years service to ensure a margin of safety. Applications vary and life can be as long as 30 years in some cases.

Summary

Rubber expansion joints have been specified and successfully used for many years to accommodate pressure loads, relieve movement stresses, reduce noise, isolate vibration, compensate for misalignment after plants go on stream and prolong the life of pumps and other motive equipment. Periodic inspection to confirm satisfactory installation and operation is important to ensure reliability. Plant-approved maintenance procedures should be applied as required.

Once in service, the expansion joint should be protected from any ozone generating processes such as nearby welding. Proper storage in a cool dry location prior to installation will help prolong service life. It is always prudent to consult the manufacturers for questions dealing with any aspect of expansion joint application.

Next Month: *How can I troubleshoot expansion joint failures?*

We invite your questions on sealing issues and will provide best efforts answers based on FSA publications. Please direct your questions to: sealingquestions@fluidsealing.com.

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