

The Bellows Bottom Line

Practical advice on expansion joints

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JAN 2012

This month - **Avoid Bad Design Features In The LP Turbine Expansion Joints**

Lessons learned in steam extraction piping - Part 1

Maximizing reliability

Most expansion joints inside the LP turbine last over 30 years. I've seen a few failures that could have been easily avoided. And when expansion joints fail in this application; they fail really badly.

The problem is not the bellows

What's really bad? When you walk into a room to help diagnose an expansion joint failure and most of the fragments can fit inside a bucket; that's bad. The worst part about this failure was that the expansion joint supplier had gone to great lengths to talk the utility into upgrading the bellows from stainless steel to 2-ply of Alloy 625 (\$\$\$), only to have it fail because of a bad liner design. The previous single ply stainless steel bellows had lasted 32 years.

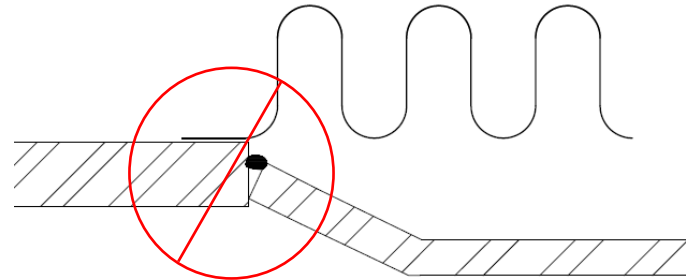


A 2-ply alloy 625 bellows failed after only 5 years in service

The liner attachment weld failed due to poor penetration, resulting in high steam flow vibrating the bellows until it resonated itself into bucket size pieces.

The faulty liner attachment design was intended to improve fabrication by eliminating the need for a tight tolerance fit. Instead of slipping inside the pipe, the liner butts up to the pipe edge. Unless the liner edge is beveled, this design makes it difficult to complete a full thickness weld. In this case the weld only penetrated 1/8 of an inch on the 3/8 inch thick liner.

In addition, this weld is nearly impossible to inspect after assembly.



A typical V-groove weld has an angle opening of 75 degrees (two times 37.5). The angle opening of this not-uncommon liner design is around 25 degrees, way too small to get electrode penetration.



This failed liner attachment weld had very little penetration

The Bottom Line

For steam extraction applications, expansion joint liner attachment welds should have either a full thickness fillet weld, or a full thickness V groove large enough to ensure proper weld penetration.



Next Issue - More lessons learned in steam extraction piping