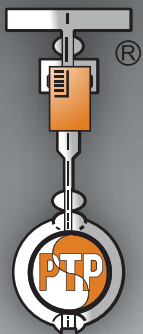


# TECHNICAL BULLETIN



## EXPANSION JOINTS FEA - DUAL HINGED EXPANSION JOINTS



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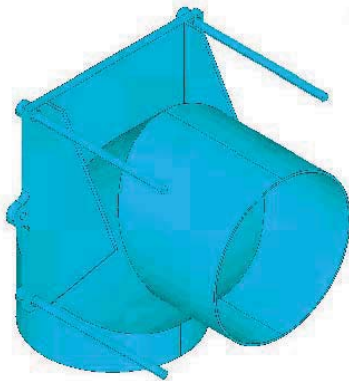
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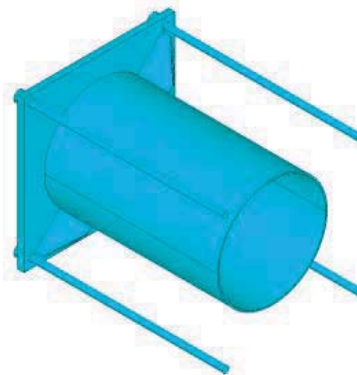
## Objective

Stress analysis was performed on a dual hinged expansion joint to determine whether the plate thicknesses are sufficient to insure that the stresses are within code allowable.

## 36" and 18" Bellows



**Figure 1.**  
Portion of a 36 inch Bellows assembly (EJ-004)



**Figure 2.**  
Portion of a 18 inch Bellows assembly (EJ-009)

**Figures 1 and 2** show a portion of a similar dual hinged expansion joint that was built by U.S. Bellows, Inc. The figures show the connection of the tie rods to the bellows. The tie rods are connected to a plate-gusset assembly, which is welded to the bellows. This note describes a stress analysis to determine whether the plate thicknesses are sufficient to insure that the stresses are within code allowable.

## Parameters

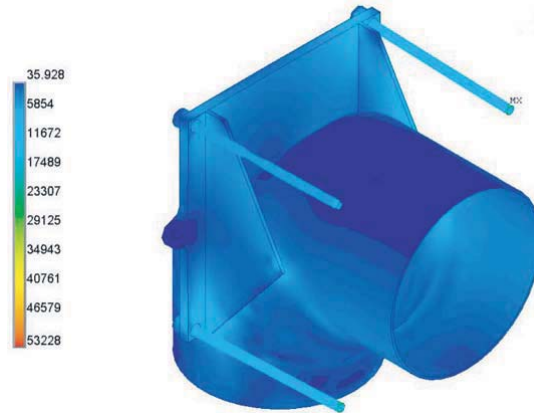
Table 1. Parameters of the two tie rods supports analyzed.

Tag	EJ-004	EJ-009
Bellows Diameter	36 in	18 in
Plate Dimesions	46 x 46 x 2 in	24 3/4 x 24 3/4 x 1 in
Tie Rod Diameter	1 in	1 in
Gusset Thickness	3/4 in	3/8 in
Load per Tie Rod	19,297 lbs	5,443 lbs
Steel	A240 tp304H	A240 tp304H
Bellows Operating Temp.	1076 oF	1076 oF
Allowable Stress	10 ksi	10 ksi

# Ansyes Finite Element Program

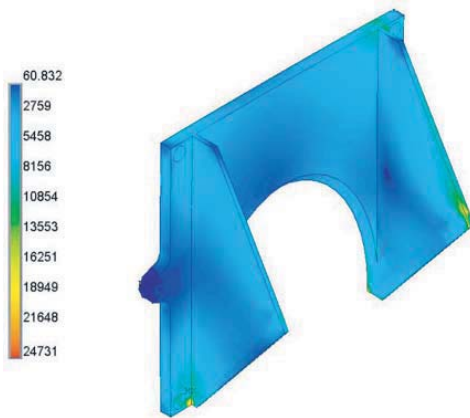
The analysis was done using Ansys Finite Element Program. The element used was the Ansys solid 187 element, a 10 node tetrahedral element.

The results for EJ-004 are shown in **Figures 3, 4, and 5**. **Figure 3** shows the stresses in the complete assembly.



**Figure 3.** Von Mises Stresses for complete assembly.

## Stresses in the Plate



**Figure 4.**  
Stresses in the plate-gusset assembly of EJ-004 (Front View)

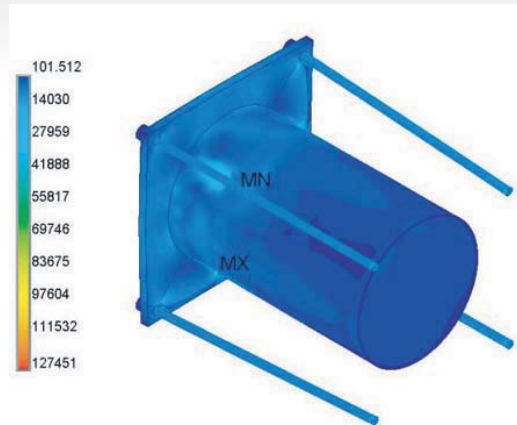


**Figure 5.**  
Stresses in the plate-gusset assembly of EJ-004 (Back View)

The stresses on the assembly are all nearly below the allowable. There are two small areas where there are stress concentrations, but the areas are small, and the stresses drop rapidly away from the peak. These local areas should not be of concern.

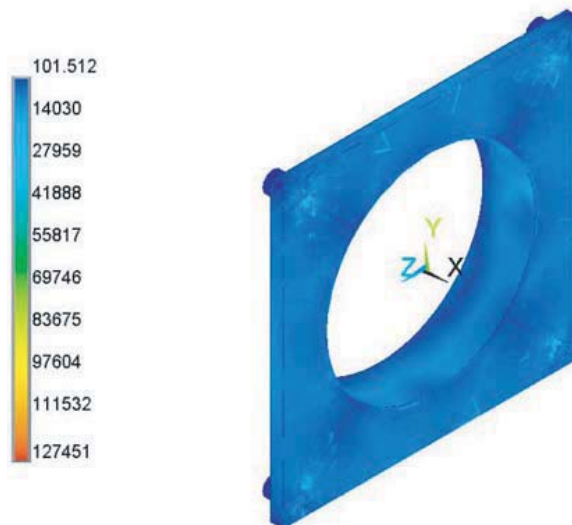
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## Stresses in EJ-009 Assembly



**Figure 6.** Stresses in the complete assembly for EJ-009

**Figure 6** shows the stresses in the complete portion of the assembly analyzed. There are some quite high stresses shown. These are in the pipe at the tip of the gussets. They are clearly due to very large change in stiffness at that point, - from 3/8 in. in the pipe to 1 7/8 in. at the tip of the gusset.



**Figure 7.** Stresses on the tie rod plate for EJ-009

**Figure 7** shows the tie rod support plate. The stresses are all clearly below the allowable. In conclusion, the thickness of both plates analyzed are adequate.