

# The Bellows Bottom Line

## Practical advice on expansion joints

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### This month - Thermal Growth of Rings on Cylinders *Dealing with temperature differences*

#### Expanding or contracting hole?

Thermal growth Pop quiz! Oh stop complaining and get out a number 2 pencil. Show your work.

*As the metal disk in figure 1 gets hotter, the hole in the center will -*

- a) Get smaller
- b) Get larger
- c) Stay the same

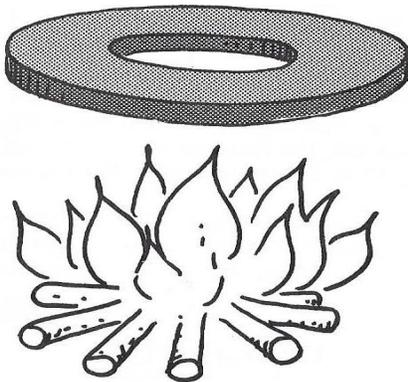
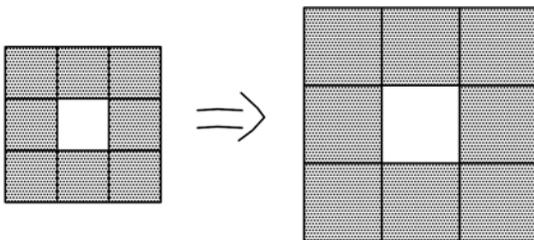


Fig. 1 - From the book, *Thinking Physics*, by Lewis Carroll Epstein

The metal will expand in all directions, and it is obvious the outside diameter will get larger; but the hole? The answer is (b), it will also get larger.

Visualize a *photo* of the ring that then gets enlarged, everything in that photo gets bigger, even the hole.

Also consider a square made up of smaller metal squares with one missing in the middle. As the metal squares expand, so does the space in the center.

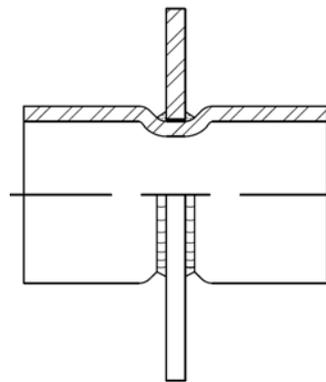


That's why the cylinder, and the ring around it, will expand equally without interference - *if they are at the same temperature.*

#### Unequally yoked temperatures

Piping systems and vessels often have support rings; in high temperature applications the welds between the ring and the cylinder can develop cracks.

Here's why – the heat of the media conducts quickly into the pipe wall but not very well into the ring, and so the pipe is hotter (and therefore grows more) than the ring.



Full penetration welds can improve the heat transfer into the ring. In addition, the ring acts like a cooling fin and so needs to be well insulated along with the pipe.

Even with the above recommendations, the thermal differences may cause too much stress.

On high temperature stainless steel expansion joints with support rings, we use a floating ring that butts up, *but is not welded to*, a shear pad. The hot pipe can then grow out without being restrained by the cooler support ring.



*Low profile shear pad (on left), floating ring added (on right)*

#### The Bottom Line

Thermal growth cannot be avoided – but it should be understood when designing equipment.

Turn in your paper. Don't forget to write your name in the upper right hand corner.