Mr. J. F. Nienhueser
Administrative Assistant
Missouri Power and Light Company
101 Madison Street
Jefferson City, Missouri 65101

Dear Mr. Nienhueser:

This is in answer to your letter of November 4, 1970, requesting information on hoop stress and current method used by this Office for determining hoop stress in steel pipe.

Hoop stress is defined in Section 805.32 of ANSI B31.8 (formerly USAS B31.8) as follows:

> "Hoop stress is the stress in a pipe wall, acting circumferentially in a plan perpendicular to the longitudinal axis of the pipe and produced by the pressure of the fluid in the pipe."

The hoop stress, then, is an action which is attempting to pull the pipe apart in a circumferential direction with the "pull" being produced on the pipe wall by the internal pressure of the natural gas or other fluid in the pipe.

Barlow's Formula is the common method used to determine hoop stress in the wall of pipe. The formula is written as follows:

$$S = \frac{PD}{2t}$$

where: S = hoop stress, psi
P = internal pressure, psi
D = diameter, in.
T = wall thickness, in.

This basic formula written in terms of solving for the pressure is used in Part 192 to determine the design pressure for steel pipe. The formula, located in Section 192.105, contains factors in addition to the basic formula which limit the design pressure in gas pipelines for safety purposes.

An example of applying hoop stress in Part 192 would probably be helpful. Section 192.241(b) requires the nondestructive testing of welds on pipeline "to be operated at a pressure that produces a hoop stress of 20 percent or more of SMYS." If, for instance, the pipe being installed

is Grade B, the SMYS is 35,000 pounds per square inch (psi) and 20 percent of 35,000 psi is 7,000 psi. For this particular example the, nondestructive testing of welds is required where the operating pressure will produce a hoop stress of 7,000 psi or more.

The pressure which will produce a hoop stress of 7,000 psi is now determined by using the formula in Section 192.105 and solving for "P". In this example all of the elements in the formula would be as defined in Section 192.105 except for "S" which is no longer the hoop stress at yield but a hoop stress of 7,000 psi, and "P" which is no longer the design pressure but the pressure which will produce a hoop stress of 7,000 psi.

If the proposed operating pressure is equal to or greater than the pressure solved for, nondestructive testing is required. If the proposed operating pressure is less than this pressure, nondestructive testing is not required.

I hope this explanation answers your questions. If I can be of any further assistance, please contact me.

Sincerely,

/signed/

Joseph C. Caldwell
Director, Acting
Office of Pipeline Safety

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