

PI-70-0113

December 28, 1970

Mr. Don Corwin
Superintendent of Gas and Water Construction
Cedar Falls Utilities
612 East 12th Street
Cedar Falls, Iowa 50613

Dear Mr. Corwin:

This is in answer to your letter of November 12, 1970 requesting our definition of "hoop stress." and an explanation of the term.

Our definition of "hoop stress" is the same as appears in Section 805.32 of ANSI B31.8 (formerly USAS B31.8) which is as follows

"Hoop stress is the stress in a pipe wall, acting circumferentially in a plane 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, pounds per square inch (psi)

P = internal pressure, psi

D = diameter, inches

T = wall thickness, inches.

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 pipelines "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 psi and 20 percent of 35,000 psi is 7,000 psi. For this particular example then, 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 7000 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 it no longer the design pressure but the pressure which will produce a hoop stress of 7000 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

Cedar Falls Utilities
612 East 12th Street
Cedar Falls, Iowa 50613

November 12, 1970

Secretary of Transportation
400 Sixth Street S.W.
Washington, D. C.

Attention: Mr. William C. Jennings, Acting Director Office of Pipeline Safety

Dear Mr. Jennings:

In several sections of your rules and regulations of Part 192 of the Code of Federal Regulations we find you referring to hoop stress in the determination of the applicable conditions. We would appreciate receiving your definition and explanation of the term, "hoop stress" to aid in our evaluation of our distribution system and its operation.

I thank you for taking your time to clarifying this term for US.

Very truly yours,

Don Corwin

Supt. of Gas & Water Const.