

**NATURAL GAS
PART 192****GAS PIPELINE TRANSMISSION
OPERATION AND MAINTENANCE
MANUAL****Subpart C****Pipe Design****§ 192.101 Scope**

This subpart prescribes the minimum requirements for the design of pipe.

§ 192.103 General

Pipe must be designed with sufficient wall thickness, or must be installed with adequate protection, to withstand anticipated external pressures and loads that will be imposed on the pipe after installation.

§ 192.105 Design Formula for Steel Pipe

- (a) The design pressure for steel pipe is determined in accordance with the following formula:

$$P = (2 St/D) \times F \times E \times T$$

P = Design pressure in pounds per square inch gauge.

S = Yield strength in pounds per square inch determined in accordance with § 192.107.

Approved: Signature on file Date:
Manager, Safety, Health, and Environmental

Approved: Signature on file Date:
Environmental Manager

D = Nominal outside diameter of the pipe in inches.

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t = Nominal wall thickness of the pipe in inches. If this is unknown, it is determined in accordance with §192.109. Additional wall thickness required for concurrent external loads in accordance with § 192.103 may not be included in computing design pressure.

F = Design factor determined in accordance with § 192.111.

E = Longitudinal joint factor determined in accordance with § 192.11

T = Temperature derating factor determined in accordance with § 192.115.

- (b) If steel pipe that has been subjected to cold expansion to meet the SMYS is subsequently heated, other than by welding or stress relieving as a part of section if the temperature of the pipe exceeds 900° F (482° C) at any time or is held above 600° F (316° C) for more than one hour.

ESI RESPONSE TO § 192.105**STEEL PIPING SYSTEMS:**

The basic equation in § 192.105(a) shall be used to calculate the minimum wall thickness for a given pressure or a maximum allowable operating pressure for a given wall thickness; provided the requirements of subpart B, “Materials”, and subpart J “Test Requirements” are met in all cases.

The wall thickness used in determining design pressure shall not include any corrosion allowances for special considerations such as internal corrosion. If corrosion allowances have been included during the preliminary design phase, these allowances must be subtracted from the nominal or actual pipe wall thickness prior to using § 192.105(a).

Design pressures for various combinations of pipe parameters are included in Guide No. 1, “Primary Hoop Stress Design Tables” ASME/ANSI B31.8. This guide assumes conformance with subpart B “Materials” and subpart J “Test Requirements”.

The design pressure of all piping systems including their associated components shall not exceed the lowest pressure rating (including temperature derating factors, etc.) of any component within the system.

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SPECIAL CONSIDERATIONS FOR PIPE DESIGN:**Mill Test - - Steel Pipe**

See subpart L § 192.619(a)(4), (a)(5), and ESI's response for this section for Maximum Allowable Operating Pressure for Steel or Plastic Pipelines, for limitations.

Internal Corrosion

If a corrosive gas is to be transported, appropriate measures as listed below shall be taken to compensate for or minimize internal corrosion.

- (a) Apply a suitable internal coating.
- (b) Apply a suitable internal coating and inject a gas phase corrosion inhibitor.
- (c) Install pigging facilities to facilitate cleaning internal surfaces of the pipeline. In most cases, corrosion inhibitors are used to compliment pigging programs.
- (d) Remove the corrosive agents with process changes or chemical agents.
- (e) Reduce water content of the gas to less than operating dewpoint to eliminate aqueous corrosion.
- (f) Increase the pipe wall thickness over the thickness computed from § 192.105. (Since corrosion attack is generally non-uniform, increasing wall thickness is not a preferred method to compensate for corrosion losses.)

Compressor Stations

- (a) The minimum piping grade shall be API 5L Grade B or equal.
- (b) For applications where higher strength steels are required, consideration should be given to the following types of materials:
 - (1) Fine grain steels
 - (2) Heat treated steels
 - (3) Low alloy steels

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- (c) Where excessive vibration and pulsation are experienced or anticipated, studies shall be made to determine the methods or correction of such conditions.
- (d) Double extra strong pipe is required for all gas piping of 2" nominal pipe size and smaller when used for the fabrication of branch connections in locations susceptible to excessive vibration.

Threaded Pipe

Threaded pipe shall not be used for nominal pipe sizes larger than indicated in Table C1 (see page 11 and 12 of this document).

Flexibility Design

ESI will use subpart D, 192.159 for flexibility design and appendix E "Flexibility and Stress Intensification Factors" of ASME/ANSI B31.8 "Gas Transmission and Distribution Piping Systems".

§ 192.107 Yield Strength (S) for Steel Pipe

- (a) For pipe that is manufactured in accordance with a specification listed in section I of appendix B of this part, the yield strength to be used in the design formula in § 192.105 is the SMYS stated in the listed specification, if that value is known.
- (b) For pipe that is manufactured in accordance with a specification not listed in section I of appendix B to this part or whose specification or tensile properties are unknown, the yield strength to be used in the design formula is § 192.105 is one of the following:
 - (1) If the pipe is tensile tested in accordance with section II-D of appendix B to this part, the lower of the following:
 - (i) The lowest yield strength determined by the tensile tests.
 - (ii) The lowest yield strength determined by the tensile tests, but not more than 52,000 p.s.i.
 - (2) If the pipe is not tensile tested as provided in paragraph (b)(1) of this section 24,000 p.s.i.

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MANUAL****ESI RESPONSE TO § 192.107****YIELD STRENGTH(S) FOR STEEL PIPE**

ESI will utilize appendix D ASME/ANSI B31.8 provides specified minimum yield strength (SMYS) data for steel pipe commonly used in piping systems. For pipelines that the specified minimum yield strength (SMYS) has not been documented 192.1.7 b. 2 value of 24,000 psi will be utilized.

§ 192.109 Nominal Wall Thickness (t) for Steel Pipe

- (a) If the nominal wall thickness for steel pipe is not known, it is determined by measuring the thickness of each piece of pipe at quarter points on one end.
- (b) However, if the pipe is of uniform grade, size, and thickness and there are more than 10 lengths, only 10% of the individual lengths, but not less than 10 lengths, need be measured. The thickness of the lengths that are not measured must be verified by applying a gauge set to the minimum thickness found by the measurement. The nominal wall thickness to be used in the design formula in § 192.105 is the next wall thickness found in commercial specifications that is below the average of all the measurements taken. However, the nominal wall thickness used may not be more than 1.14 times the smallest measurement taken on pipe less than 20 inches in outside diameter, nor more than 1.11 times the smallest measurement taken on pipe 20 inches or more in outside diameter.

§ 192.111 Design Factor (F) for Steel Pipe

- (a) Except as otherwise provided in paragraphs (b), (c), and (d) of this section, the design factor to be used in the design formula in § 192.105 is determined in accordance with the following table:

Class	Design
Location	Factor (F)

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1.....	0.72
2.....	0.60
3.....	0.50
4.....	0.40

- (b) A design factor of 0.60 or less must be used in the design formula in § 192.105 for steel pipe in Class 1 locations that:
- (1) Crosses the right-of-way of an unimproved public road, without a casing;
 - (2) Crosses without a casing, or makes a parallel encroachment on, the right-of-way of either a hard surfaced road, a highway, a public street, or a railroad;
 - (3) Is supported by a vehicular, pedestrian, railroad, or pipeline bridge; or
 - (4) Is used in a fabricated assembly, (including separators, mainline valve assemblies, cross-connections, and river crossing headers) or is used within five pipe diameters in any direction from the last fitting of a fabricated assembly, other than a transition piece or an elbow used in place of a pipe bend which is not associated with a fabricated assembly.
- (c) For Class 2 locations, a design factor of 0.50, or less, must be used in the design formula in § 192.105 for uncased steel pipe that crosses the right-of-way of a hard surfaced road, a highway, a public street, or a railroad.
- (d) For Class 1 and Class 2 locations, a design factor of 0.50, or less, must be used in the design formula in § 192.105 for---
- (1) Steel pipe in a compressor station, regulating station, or measuring station, and
 - (2) Steel pipe, including a pipe riser, on a platform located offshore or in inland navigable waters.

§ 192.113 Longitudinal joint factor (E) for steel pipe

The longitudinal joint factor to be used in the design formula in § 192.105 is determined in accordance with the following table:

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<u>Specification</u>	<u>Pipe Class</u>	<u>Longitudinal Joint Factor</u>	
		<u>(E)</u>	
ASTM A 53	Seamless.....	1.00	
	Electric resistance welded..		1.00
	Furnace butt welded.....		0.60
ASTM A 106	Seamless.....	1.00	
ASTM A 333/A 333M	Seamless.....	1.00	
	Electric resistance welded..		1.00
ASTM A 381	Double submerged arc welded.		1.00
ASTM A 671	Electric fusion welded.....		1.00
ASTM A 672	Electric fusion welded.....		1.00
ASTM A 691	Electric fusion welded.....		1.00
API 5 L	Seamless.....	1.00	
	Electric resistance welded..		1.00
	Electric flash welded.....		1.00
	Submerged arc welded.....	1.00	
	Furnace butt welded.....		0.60
Other	Pipe over 4 inches.....		0.80
Other	Pipe 4 inches or less.....		0.60

If the type of longitudinal joint cannot be determined, the joint factor to be used must not exceed that designated for "Other."

§ 192.115 Temperature Derating Factor (T) for Steel Pipe

The temperature derating factor to be used in the design formula in § 192.105 is determined as follows:

<u>Gas Temp. in degrees Fahrenheit</u>	<u>Temperature derating factor (T)</u>
250 or less.....	1.000
300.....	0.967
350.....	0.933
400.....	0.900
450.....	0.867

For intermediate gas temperatures, the derating factor is determined by interpolation.

§ 192.117 [Reserved]

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§ 192.119 [Reserved]

§ 192.121 Design of Plastic Pipe

NOT APPLICABLE. ESI DOES NOT UTILIZE PLASTIC PIPE FOR DOT PIPELINES.

§ 192.125 Design of Copper Pipe.

NOT APPLICABLE. ESI DOES NOT UTILIZE COPPER PIPE FOR DOT PIPELINES.

Engineering Services, LP