

From the desk of G. A. Aaker, Jr., PE.

**SAMPLE CALCULATIONS TO
DETERMINE THE REQUIRED MINIMUM WALL THICKNESS
PER DOT 192 / ASME B31.8 FOR
GAS TRANSMISSION AND DISTRIBUTION PIPING SYSTEMS**

192.103 GENERAL

Pipe must be designed with sufficient wall thickness, (solve for t) 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:

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

(equation from ASME B1.8 to calculate pressure) [Eq.1]

Where,

**P = Design pressure in pounds per square inch gage
(The operating pressure is: 1440 psi)**

**S = Yield Strength in pounds per square inch determined in accordance with §192.107
(The Yield Strength in pounds per square inch is: 65,000 psi)**

§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 in §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) 80 percent of the average yield strength determined by the tensile tests. (ii) The lowest yield strength determined by the tensile tests. (2) If the pipe is not tensile tested as provided in paragraph (b)(1) of this section, 24,000 psi (165 Mpa).

**D = nominal outside diameter of pipe, in inches
The nominal pipe diameter is: 20 inches O. D. (Outside Diameter)**

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.

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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.

§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 percent 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 (508 millimeters) in outside diameter, nor more than 1.11 times the smallest measurement taken on pipe 20 inches (508 millimeters) or more in outside diameter.

**F = Design factor determined in accordance with §192.111
(The Design Factor F is: 0.72)**

Please Note: The maximum design factor may be as much as 0.80 with special permitting. (i.e. grandfather, untested pipe can exceed this, should not but can. I need to get a clarification on untested pipe.

§192.111

- (a) 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 Factor
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.

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- (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.

**E = Longitudinal joint factor determined in accordance with §192.113.
(The Longitudinal Joint Factor (E) for API 5L, GRADE X-60 is: 1.00**

§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:

PIPE SPEC	PIPE CLASS	E FACTOR
A-53 / 53M	SEAMLESS	1.00
A-106	SEAMLESS	1.00
API 5L	SEAMLESS, ERW, SUBMERGED ARC	1.00
Other	Pipe over 4 inches	0.80
Other	Pipe 4 inch and 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."

**T =Temperature derating factor determined in accordance with §192.115.
(The Temperature derating factor is: 1.0)**

GAS TEMPERATURE F	TEMPERATURE DERATING FACTOR (T)
250 OR LESS	1.0
300	0.967
350	0.933
400	0.900
450	0.867

For intermediate gas temperature, the derating factor (T) is determine by interpolation

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- (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 welding, the design pressure is limited to 75 percent of the pressure determined under paragraph (a) of this 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.

(rewrite [Eq. 1] above to calculate for minimum wall thickness (t))

$$t = (P \times D) / (2 \times F \times E \times T \times S) \text{ [Eq. 2]}$$

$$t = (1440 \times 20.0) / (2 \times 0.72 \times 1.0 \times 1.0 \times 65,000)$$

$$t = 28,800 / 93,600$$

***t (minimum wall thickness required
@
1,440 psi, using 20 inch X-65 pipe in a Class 1 Location) = 0.307 inches***

*The required minimum wall thickness to safely operate this
Gas Gathering Line, exceed all the required safety factors,
including F, E, T, and S for this class location.*

§192.8 How are onshore gathering lines and regulated onshore gathering lines determined?

(a) An operator must use API RP 80 (incorporate by reference, see §192.7), to determine if an onshore pipeline (or part of a connected series of pipelines) is an onshore gathering line. The determination is subject to the limitations listed below. After making this determination, an operator must determine if the onshore gathering line is a regulated onshore gathering line under paragraph (b) of this section.

- (1) The beginning of gathering, under section 2.2(a)(1) of API RP 80, may not extend beyond the furthest downstream point in a production operation as defined in section 2.3 of API RP 80. **This furthest downstream point does not include equipment that can be used in either production or transportation, such as separators or dehydrators, unless that equipment is involved in the processes of "production and preparation for transportation or delivery of hydrocarbon gas" with-in the meaning of "production operation."**

Please Note: As long as any of the special conditions are not encountered (i.e. uncased crossing, meter station, etc., ????) then 0.6 or 0.5. I need to get a clarification?

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- (2) The endpoint of gathering, under section 2.2(a)(1)(A) of API RP 80, may not extend beyond the first downstream natural gas processing plant, unless the operator can demonstrate, using sound engineering principles, that gathering extends to a further downstream plant.
- (3) If the endpoint of gathering, under section 2.2(a)(1)(C) of API RP 80, is determined by the commingling of gas from separate production fields, the fields may not be more than 50 miles from each other, unless the Administrator finds a longer separation distance is justified in a particular case (see 49 CFR §190.9).
- (4) The endpoint of gathering, under section 2.2(a)(1)(D) of API RP 80, may not extend beyond the furthestmost downstream compressor used to increase gathering line pressure for delivery to another pipeline.

(b) For purposes of §192.9, "regulated on-shore gathering line" means:

- (1) Each onshore gathering line (or segment of onshore gathering line) with a feature described in the second column that lies in an area described in the third column; and
- (2) As applicable, additional lengths of line described in the fourth column to provide a safety buffer:

Type	Feature	Area	Safety Buffer
A	<p>—Metallic and the MAOP produces a hoop stress of 20 percent or more of SMYS. If the stress level is unknown, an operator must determine the stress level according to the applicable provisions in subpart C of this part.</p> <p>—Non-metallic and the MAOP is more than 125 psig (862 kPa).</p>	Class 2, 3, or 4 location (see § 192.5).	None.
B	<p>—Metallic and the MAOP produces a hoop stress of less than 20 percent of SMYS. If the stress level is unknown, an operator must determine the stress level according to the applicable provisions in subpart C of this part.</p> <p>—Non-metallic and the MAOP is 125 psig (862 kPa) or less.</p>	<p>Area 1. Class 3 or 4 location.</p> <p>Area 2. An area within a Class 2 location the operator determines by using any of the following three methods:</p> <p>(a) A Class 2 location.</p> <p>(b) An area extending 150 feet (45.7 m) on each side of the centerline of any continuous 1 mile (1.6 km) of pipeline and including more than 10 but fewer than 46 dwellings.</p>	<p>If the gathering line is in Area 2(b) or 2(c), the additional lengths of line extend upstream and downstream from the area to a point where the line is at least 150 feet (45.7 m) from the nearest dwelling in the area.</p> <p>However, if a cluster of dwellings in Area 2 (b) or 2(c) qualifies a line as Type B, the Type B classification ends 150 feet (45.7 m) from the nearest dwelling in the cluster.</p>

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		(c) An area extending 150 feet (45.7 m) on each side of the centerline of any continuous 1000 feet (305 m) of pipeline and including 5 or more dwellings	
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§192.9 What requirements apply to gathering lines?

- (a) **Requirements.** An operator of a gathering line must follow the safety requirements of this part as prescribed by this section.
- (b) **Offshore lines.** An operator of an off-shore gathering line must comply with requirements of this part applicable to transmission lines, except the requirements in §192.150 and in subpart O of this part.
- (c) **Type A lines.** An operator of a Type A regulated onshore gathering line must comply with the requirements of this part applicable to transmission lines, except the requirements in §192.150 and in subpart O of this part. However, an operator of a Type A regulated onshore gathering line in a Class 2 location may demonstrate compliance with subpart N by de-scribing the processes it uses to determine the qualification of persons performing operations and maintenance tasks
- (d) **Type B lines.** An operator of a Type B regulated onshore gathering line must comply with the following requirements:
 - (1) If a line is new, replaced, relocated, or otherwise changed, the design, installation, construction, initial inspection, and initial testing must be in accordance with requirements of this part applicable to transmission lines;
 - (2) If the pipeline is metallic, control corrosion according to requirements of subpart I of this part applicable to transmission lines
 - (3) Carry out a damage prevention program under §192.614;
 - (4) Establish a public education program under §192.616;
 - (5) Establish the MAOP of the line under §192.619; and
 - (6) Install and maintain line markers according to the requirements for transmission lines in §192.707.
- (e) **Compliance deadlines.** An operator of a regulated onshore gathering line must comply with the following deadlines, as applicable.

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- (1) An operator of a new, replaced, relocated, or otherwise changed line must be in compliance with the applicable requirements of this section by the date the line goes into service, unless an exception in §192.13 applies.
- (2) If a regulated onshore gathering line existing on April 14, 2006 was not previously subject to this part, an operator has until the date stated in the second column to comply with the applicable requirement for the line listed in the first column, unless the Administrator finds a later deadline is justified in a particular case:

Requirement	Compliance Deadline
Control corrosion according to Subpart I requirements for transmission lines.	April 15, 2009
Carry out a damage prevention program under §192.614.	October 15, 2007
Establish MAOP under §192.619	October 15, 2007
Install and maintain line markers under §192.707.	April 15, 2007
Establish a public education program under §192.616.	April 15, 2007
Other provisions of this part as required by paragraph (c) of this section for Type A lines.	April 15, 2007

- (3) If, after April 14, 2006, a change in class location or increase in dwelling density causes an onshore gathering line to be a regulated on-shore gathering line, the operator has 1 year for Type B lines and 2 years for Type A lines after the line becomes a regulated onshore gathering line to comply with this section.

§192.13 What general requirements apply to pipelines regulated under this part?

- (a) No person may operate a segment of pipeline listed in the first column that is readied for service after the date in the second column, unless:
 - (1) The pipeline has been designed, installed, constructed; initially inspected, and initially tested in accordance with this part; or
 - (2) The pipeline qualifies for use under this part according to the requirements in §192.14