

# Basics of MAOP





# Basic Premise of MAOP

MAOP – taking a percentage of SMYS and operating at that level to ensure safe operation.

Multiple Factors involved – Materials used, Formula and Factors chosen, and Test Pressure.

Design Formula's are found in:

- Steel – 192.105
- Plastic – 192.121

## ECFR CONTENT

	Part / Section
▼ <b>Title 49</b> Transportation	
▼ <b>Subtitle B</b> Other Regulations Relating to Transportation	100 – 1699
▼ <b>Chapter I</b> Pipeline and Hazardous Materials SAFETY Administration, Department of Transportation	100 – 199
▶ <b>Subchapter A</b> Hazardous Materials and Oil Transportation	100 – 110
▶ <b>Subchapter B</b> Oil Transportation	130
▶ <b>Subchapter C</b> Hazardous Materials Regulations	171 – 185
▼ <b>Subchapter D</b> Pipeline SAFETY	186 – 199
<i>Parts 186-189 [Reserved]</i>	
<b>Part 190</b> Pipeline SAFETY Enforcement and Regulatory Procedures	190.1 – 190.411
<b>Part 191</b> Transportation of Natural and Other Gas by Pipeline; Annual Reports, Incident Reports, and SAFETY-Related Condition Reports	191.1 – 191.29
<b>Part 192</b> Transportation of Natural and Other Gas by Pipeline: Minimum Federal SAFETY Standards	192.1 – 192.1015
<b>Part 193</b> Liquefied Natural Gas Facilities: Federal SAFETY Standards	193.2001 – 193.2917
<b>Part 194</b> Response Plans for Onshore Oil Pipelines	194.1 – 194.121



# Barlow's Formula

Barlow's formula uses the Yield strength of the pipe, nominal wall thickness and nominal outside diameter to calculate the Specified Minimum Yield Strength (SMYS) of the pipe. This will be used to calculate your MAOP, your MOP, and can factor into your Test Pressure.

$$P = \frac{2St}{D}$$

# Design Formula



- You must use the formula to determine **MOP**
- You already figured out SMYS or the first part of the formula
- To figure out what F, E, & T are you reference code sections 192.111, 192.113, and 192.115.
- F, E, & T are your de-rating factors based on SMYS

$$P = \left( \frac{2St}{D} \right) \times F \times E \times T$$



# E\*F\*T



**You must use 192.111 for F**  
**This is your class location derating factor**

Class location	Design factor (F)
1	0.72
2	0.60
3	0.50
4	0.40

**You must use 192.113 to find E**  
**This is your seam-type from the manufacture derating factor**

Specification	Pipe Class	Longitudinal joint factor (E)
ASTM A53/A53M	Seamless	1.00
	Electric resistance welded	1.00
	Furnace butt welded	0.60
ASTM 106	Seamless	1.00
ASTM A133/ A333M	Seamless	1.00
	Electric resistance welded	1.00
ASTM A381	Double submerged arc welded	1.00
ASTM A671	Electric fusion welded	1.00
ASTM A672	Electric fusion welded	1.00
ASTM A691	Electric fusion welded	1.00
API Spec 5L	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 (102 millimeters)	0.80
Other	Pipe 4 inches or less (102 millimeters)	0.60

**You must use 192.115 to find T**  
**This is your temperature derating factor**

Gas Temperature in degrees Fahrenheit (Celsius)	Temperature derating factor (T)
250°F (121°C) or less	1.000
300°F (149°C)	0.967
350°F (177°C)	0.933
400°F (204°C)	0.900
450°F (232°C)	0.867



# Example for how to get SMYS

We want to find the SMYS for a system that is being built with X42, Seamless 4" .188 wall thickness steel piping. Using the formula, we get?

Yield Strength/Pipe Grade	S	42000	Barlow's Formula
Nominal Wall Thickness	t	0.188	$(2*S*t/D)$
Nominal OD	D	4.5	3509.3



# Example of MAOP

Now that we have SMYS, we can figure out what our MAOP is for 20% SMYS

Yield Strength/Pipe Grade	S	42000	Barlow's Formula	20% SMYS
Nominal Wall Thickness	t	0.188	$(2*S*t/D)$	SMYS * 0.20
Nominal OD	D	4.5	3509.3	702



# Example of MOP

To figure out the Maximum Operating Pressure we can run this pipe at, we take the design formula.

Yield Strength/Pipe Grade	S	42000	Barlow's Formula	
Nominal Wall Thickness	t	0.188	$(2*S*t/D)$	
Nominal OD	D	4.5		3509.3
Design Factor	F	0.5	MOP Formula	
Joint Factor	E	1	$(2*S*t/D)*F*E*T$	
Temperature Derating:	T	1		1754.7





# Test Pressure Calculation

To get Test Pressures you take your desired MAOP and times it by the appropriate factor for steel under 192.619(a)(2)(ii)

Yield Strength/Pipe Grade	S	42000	Barlow's Formula	20% SMYS	Test Pressure
Nominal Wall Thickness	t	0.188	(2*S*t/D)	SMYS * 0.20	Desired Pressure * 1.5
Nominal OD	D	4.5		3509.3	702
					1053

(ii) For steel pipe operated at 100 psi (689 kPa) gage or more, the test pressure is divided by a factor determined in accordance with the Table 1 to paragraph (a)(2)(ii).

TABLE 1 TO PARAGRAPH (a)(2)(ii)

Class location	Installed before (Nov. 12, 1970)	Factors, <sup>1,2</sup> segment -		
		Installed after (Nov. 11, 1970) and before July 1, 2020	Installed on or after July 1, 2020	Converted under §192.14
1	1.1	1.1	1.25	1.25
2	1.25	1.25	1.25	1.25
3	1.4	1.5	1.5	1.5
4	1.4	1.5	1.5	1.5

# MAOP Verification – INDIANA ONLY



This is for Transmission Lines with no TVC Records.

**§192.624 Maximum allowable operating pressure reconfirmation: Onshore steel transmission pipelines.**

**(5) Method 5: Pressure Reduction for Pipeline Segments with Small Potential Impact Radius. Pipelines with a potential impact radius (PIR) less than or equal to 150 feet may establish the MAOP as follows:**

**(i) Reduce the MAOP to no greater than the highest actual operating pressure sustained by the pipeline during 5 years preceding October 1, 2019, divided by 1.1. The highest actual sustained pressure must have been reached for a minimum cumulative duration of 8 hours during one continuous 30-day period.**



# MAOP Verification – INDIANA



**The IURC – Pipeline Safety has decided if this works for PHMSA on transmission lines, it will work for DISTRIBUTION LINES.**

**Understand, this will not work for every operator in every situation. The process will probably need to be completed during the warmer months.**

**We are trying to help the operators that can't prove MAOP of a system.**

**However, We will enforce the 5 years preceding October 1, 2019 deadline!**



# MAOP Verification – INDIANA



## **170 IAC 5-3-2.6 Establishment of MAOP on Distribution System**

**Sec. 2.6. (a) An operator complies with 49 CFR 192.619(a)(4) for existing pipelines less than 100 psi if the operator establishes the MAOP on a section of distribution system pipeline in compliance with Method 5 for establishing MAOP in 49 CFR 192.624(c)(5). For purposes of this section, the following table replaces Table 1 to § 192.624(c)(5)(ii):**

**(iii) Under Method 5, future uprating of the pipeline segment in accordance with subpart K is allowed for transmission.**

**In Indiana this will be allowed for distribution lines.**





# MAOP Verification - INDIANA

## 170 IAC 5-3-2,6 Establishment of MAOP on a Distribution System

Required Patrols	Leakage surveys
<b>After the final leak survey to establish the MAOP under this section, at least 1 additional patrol within the following 3 months is required.</b>	<b>After the final leak survey to establish the MAOP under this section, at least 1 additional leak survey within the following 3 months.</b>

(b) Pipelines with an MAOP established under this section shall thereafter be patrolled and surveyed in accordance with 49CFR 192.721 and 192.723.

# MAOP Verification – INDIANA 170 IAC 5-3-2(i)



**The operator shall submit a copy of the uprate procedure 30 days to the PSD prior to work commencing.**

**We are NOT approving the project; we just want the opportunity to review it.**

# MAOP Verification - INDIANA



# Questions?





# INDIANA UTILITY REGULATORY COMMISSION

101 W. Washington Street, Suite 1500 East  
Indianapolis, IN 46204

[www.irc.in.gov](http://www.irc.in.gov)