

MAOP

Maximum Allowable Operating Pressure

means the maximum pressure at which a pipeline or segment of a pipeline may be operated under this part.

(§192.3 – Definitions)

MAOP

Applies to:

- Regulated gathering lines
 - Gas transmission lines
 - Distribution Lines
- Master meter and LPG systems

MAOP

- **MAOP is Calculated by using:**
 - § **192.619 - Maximum allowable operating pressure - Steel or plastic pipelines**
 - § **192.621 - Maximum allowable operating pressure: High-Pressure distribution systems.**
 - § **192.623 - Maximum and minimum allowable operating pressure: Low-pressure distribution systems.**
 - § *192.620 - Alternative maximum allowable operating pressure for certain steel pipelines*

Factors Affecting MAOP

- Class location (Steel pipelines)
- Design of pipe and components
- System pressure or leakage test
- Operating history
- Overpressure protection

§192.619 (a)

No person may operate a segment of steel or plastic pipeline at a pressure that exceeds a maximum allowable operating pressure determined under paragraph (c) or (d) of this section, or the lowest of the following:

§192.619 (a)

MAOP cannot exceed the **LOWEST** of:

- Design pressure of weakest element
- Test Pressure (de-rated by class location factor)
- MOP during the 5 years preceding applicable date
- Maximum safe pressure determined by the operator

§192.619 (a)

MAOP cannot exceed the **LOWEST** of:

- Design pressure of weakest element
- Test Pressure (de-rated by class location factor)
- MOP during the 5 years preceding applicable date
- Maximum safe pressure determined by the operator

Design Pressure

The pressure for which a pipeline or segment of a pipeline is designed using appropriate engineering parameters, formulas, and component pressure ratings

Design

- Pipe Design Formulas
 - Steel - §192.105
 - Plastic - §192.121
 - Limitations for Plastic - §192.123
 - Copper pipe limitations - §192.125



- Components
 - Manufacturer's rating

MAOP based on Design

- Based on the weakest link
 - Pipe
 - Component
 - Fabricated fitting



Double Stamped Pipe

- Meets requirements of both grades
- Operator must specify which grade is being used, and consistently use that grade

219W AP51 ERW GR-X42 X52 29.3"/FT SK-208

MAOP based on Design

- Design also includes:
 - Pipe replacements
 - Repairs such as leak clamps, sleeves
 - Component replacements such as valves, regulators, fittings or other appurtenances
 - Hot taps



§192.619

MAOP cannot exceed the **LOWEST** of:

- Design pressure of weakest element
- Test Pressure (steel de-rated by class location factor)
- MOP during the 5 years preceding applicable date
- Maximum safe pressure determined by the operator

Test Pressure



- Tested according to the requirements of Subpart J and operators procedures

Test Pressure

- Steel
 - Test pressure de-rated by class location factor
- Plastic
 - Test Pressure divided by 1.5 for all locations
 - §192.513 requires TP 150% of MAOP or 50 psi, whichever is greater
- Service Lines – §192.511
 - Leak tested only



MAOP based on Test Pressure

- Test Pressures also includes:
 - Pipe replacements
 - Ensure pretested pipe to appropriate pressures
 - Fabricated components
 - ASME Vessels
 - ASME only to 1.3 times, must consider Part 192 requirements



§192.619

MAOP cannot exceed the **LOWEST** of:

- Design pressure of weakest element
- Test Pressure (de-rated by class location factor)
- MOP during the 5 years preceding applicable date
- Maximum safe pressure determined by the operator

5 Year MOP

- The highest operating pressure in the 5 years preceding
 - Onshore pipelines – 7/1/1970
 - Gathering pipelines – 3/15/2006 or date line becomes subject to this part, whichever is later
- **Unless**
 - Tested in accordance with §192.619(a)(2) after July 1, 1965 or
 - Updated in accordance with Part 192 Subpart K

5 Year MOP

Except for newly regulated gathering lines, using the 5-year pressure to establish MAOP is not an option!

§192.619

MAOP cannot exceed the **LOWEST** of:

- Design pressure of weakest element
- Test Pressure (de-rated by class location factor)
- MOP during the 5 years preceding applicable date
- Maximum safe pressure determined by the operator

Maximum Safe Pressure

The pressure determined by the operator to be the maximum safe pressure after considering the history of the segment, particularly known corrosion and the actual operating pressure.

Used for derating pressure only!

§192.619 (a)

MAOP cannot exceed the **LOWEST** of:

- Design pressure of weakest element
- Test Pressure (de-rated by class location factor)
- MOP during the 5 years preceding applicable date
- Maximum safe pressure determined by the operator

§192.619 (b)

- If MAOP established by a maximum safe pressure (§192.619(a)(4)), must have overpressure protective devices installed on the segment in a manner that will prevent the maximum allowable operating pressure from being exceeded, in accordance with §192.195.

§192.619 (c)

The requirements on pressure restrictions in this section do not apply in the following instance.



§192.619 (c) (Grandfather Clause)

An operator may operate a segment of pipeline found to be in satisfactory condition, considering its operating and maintenance history, at the highest actual operating pressure to which the segment was subjected during the 5 years preceding the applicable date in the second column of the table in paragraph (a)(3) of this section.

§192.619 (c) (Grandfather Clause)

- The highest operating pressure in the 5 years preceding
 - Onshore pipelines – 7/1/1970
 - Gathering pipelines – 3/15/2006
 - Newly regulated gathering lines - The five years prior to the date the line becomes regulated

OTHER

Instances where
MAOP must be
revised for a class
change as required
by §192.611



Steel MAOP Calculation

Steel transmission line constructed in 1964
6", Grade B pipe, 0.280 wall thickness
Installed in a Class 1 location
Valves, fittings ANSI 300 (740 psig)
Tested to 900 psig for 12 hours
Operated at 900 psi in 1968

What is the MAOP?

§192.619 (a)

MAOP cannot exceed the **LOWEST** of:

- Design pressure of weakest element
- Test Pressure (de-rated by class location factor)
- MOP during the 5 years preceding applicable date
- Maximum safe pressure determined by the operator

MAOP Steel Pipe - §192.619(a)(1)

- §192.105 – Design of Steel Pipe

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

S=Grade of pipe

t = thickness

D=diameter

F=Design Factor §192.111

E=Longitudinal Joint Factor §192.113

T=Temperature Derating Factor §192.115

MAOP Steel Pipe - §192.619(a)

- §192.105 – Design of Steel Pipe

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

S=Grade of pipe Grade B or 35,000

t = thickness 0.280"

D=diameter 6.625"

F=Design Factor §192.111 0.72

E=Longitudinal Joint Factor §192.113 1.0

T=Temperature Derating Factor §192.115 1.0

MAOP Steel Pipe - §192.619(a)

- §192.105 – Design of Steel Pipe

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

$$P = ((2 \times 35,000 \times 0.280) / 6.625) \times 0.72 \times 1 \times 1$$

$$P = 2130 \text{ psig (6.625")}$$

$$P = 2352 \text{ psig (6")}$$

Fittings – ANSI 300 = 740 psig

ANSI 300 in 1964 - 720 psig

MAOP by Design = 720 psig

§192.619 (a)

MAOP cannot exceed the **LOWEST** of:

- Design pressure of weakest element = **720 psig**
- Test Pressure (de-rated by class location factor)
- MOP during the 5 years preceding applicable date
- Maximum safe pressure determined by the operator

MAOP Steel Pipe – §192.619 (a)(2)

- Test Pressure (de-rated by class location factor)

MAOP = Test Pressure/Class Location Factor

Test Pressure = 900 psig

Class Location Factor for class 1 = 1.1

MAOP = 900/1.1

MAOP by test pressure = 818 psig

§192.619 (a)

MAOP cannot exceed the **LOWEST** of:

- Design pressure of weakest element = **720 psig**
- Test Pressure = **818 psig**
- MOP during the 5 years preceding applicable date
- Maximum safe pressure determined by the operator

MAOP Steel Pipe – §192.619 (a)(3)

- The highest operating pressure in the 5 years preceding applicable date
 - Onshore pipelines – 7/1/1970
 - Gathering pipelines – 3/15/2006 or date line becomes subject to this part, whichever is later
 - Operated at 900 psi in 1968

MAOP by 5 year is 900 psig

§192.619 (a)

MAOP cannot exceed the **LOWEST** of:

- Design pressure of weakest element = **720 psig**
- Test Pressure = **818 psig**
- MOP during the 5 years preceding applicable date = **900 psig**
- Maximum safe pressure determined by the operator

MAOP Steel Pipe – §192.619 (a)(4)

- Maximum safe pressure determined by the operator

Not applicable

§192.619 (a)

MAOP cannot exceed the **LOWEST** of:

- Design pressure of weakest element = **720 psig**
- Test Pressure = **818 psig**
- MOP during the 5 years preceding applicable date = **900 psig**
- Maximum safe pressure determined by the operator = **NA**

MAOP of steel pipeline = 720 psig as determined by §192.619 (a)(1)

BUT WAIT ...

§192.619 (c) (Grandfather Clause)

- The highest operating pressure in the 5 years preceding
 - Onshore pipelines – 7/1/1970
 - Gathering pipelines – 3/15/2006
 - Newly regulated gathering lines - The five years prior to the date the line becomes regulated

Operated at 900 psig in 1968

§192.619

(a) MAOP cannot exceed the **LOWEST** of:

- Design pressure of weakest element = **720 psig**
- Test Pressure = **818 psig**
- MOP during the 5 years preceding applicable date = **900 psig**
- Maximum safe pressure determined by the operator = **NA**

(c) MAOP by grandfather = **900 psig**

MAOP of steel pipeline = 900 psig as determined by §192.619 (c)

Plastic MAOP Calculation

Plastic line constructed in 2005

2", PE 3408, SDR =11

Installed in a Class 2 location

Tested to 150 psig

What is the MAOP?

§192.619 (a)

MAOP cannot exceed the **LOWEST** of:

- Design pressure of weakest element
- Test Pressure (de-rating factor)
- MOP during the 5 years preceding applicable date
- Maximum safe pressure determined by the operator

MAOP Plastic Pipe - §192.619(a)(1)

- §192.121 – Design of Plastic Pipe

$$P = (2S/SDR - 1) \times DF$$

S = HDB (Hydrostatic Design Basis) in accordance with listed specification at given temperature

SDR = Standard dimension ratio

DF=Design Factor 0.32 or 0.40 for PA-11

Hydrostatic Design Basis Thermoplastic Pipe

Material	73°F	100°F	120°F	140°F
2406	1250	1250	1000	800
3408	1600	1250	1000	800

MAOP Plastic Pipe - §192.619(a)(1)

- §192.121 – Design of Plastic Pipe

$$P = (2S/SDR - 1) \times DF$$

S = HDB (Hydrostatic Design Basis) in accordance with listed specification at given temperature = 1600

SDR = Standard dimension ratio = 11

DF=Design Factor 0.32

MAOP Plastic Pipe - §192.619(a)(1)

- §192.121 – Design of Plastic Pipe

$$P = (2S/SDR - 1) \times DF$$

$$P = (2)(1600)/(11-1) \times 0.32$$

$$P = 3200/10 \times 0.32$$

$$P = 320 \times 0.32 = 102$$

MAOP by Design = 102psig

§192.619 (a)

MAOP cannot exceed the **LOWEST** of:

- Design pressure of weakest element = **102 psig**
- Test Pressure (de-rating factor)
- MOP during the 5 years preceding applicable date
- Maximum safe pressure determined by the operator

MAOP Plastic Pipe – §192.619 (a)(2)

- Test Pressure (de-rating factor)

$$\text{MAOP} = \text{Test Pressure}/1.5$$

$$\text{MAOP} = 150/1.5$$

MAOP by test pressure = 100 psig

§192.619 (a)

MAOP cannot exceed the **LOWEST** of:

- Design pressure of weakest element = **102 psig**
- Test Pressure = **100 psig**
- MOP during the 5 years preceding applicable date
- Maximum safe pressure determined by the operator

MAOP Plastic Pipe – §192.619 (a)(3)

- The highest operating pressure in the 5 years preceding applicable date
 - Onshore pipelines – 7/1/1970
 - Gathering pipelines – 3/15/2006 or date line becomes subject to this part, whichever is later

Not applicable, built in 2005

§192.619 (a)

MAOP cannot exceed the **LOWEST** of:

- Design pressure of weakest element = **102 psig**
- Test Pressure = **100 psig**
- MOP during the 5 years preceding applicable date = **NA**
- Maximum safe pressure determined by the operator

MAOP Plastic Pipe – §192.619 (a)(4)

- Maximum safe pressure determined by the operator

Not applicable

§192.619 (a)

MAOP cannot exceed the **LOWEST** of:

- Design pressure of weakest element = **102 psig**
- Test Pressure = **100 psig**
- MOP during the 5 years preceding applicable date
= **NA**
- Maximum safe pressure determined by the operator
= **NA**

MAOP of plastic pipeline = 100 psig as determined by §192.619 (a)(2)

For Distribution

Not done calculating MAOP yet!

From §192.619, must move to:
High pressure distribution - §192.621
Low pressure distribution - §192.623

High Pressure Distribution System



A distribution system in which the gas pressure in the main is higher than the pressure provided to the customer. (*Service Regulators*)

§192.621 MAOP High Pressure Distribution Systems

Lowest of the following:

Design (*redundant from §192.619*)

60# - unless service lines equipped with pressure limiting devices meeting §192.197(c)

§192.621 MAOP High Pressure Distribution Systems

- 25# - Cast Iron Pipe if there are Unreinforced Bell and Spigot Joints
- "The Pressure Limits to which a Joint could be Subjected without the Possibility of its Parting."
- Maximum Safe Pressure determined by the Operator ~Must provide Overpressure Protection per §192.195 (**Redundant from §192.619**)

Low Pressure Distribution

A distribution system in which the gas pressure in the main is substantially the same as the pressure provided to the customer.

(No Service Regulators)



§192.623 – Low Pressure Distribution Systems

- *Maximum* and Minimum Allowable Operating Pressure

Cannot operate at a pressure high enough or low enough to make unsafe the operation of properly adjusted low - pressure gas burning equipment.



Conversion of Service §192.14

- Steel pipeline previously used in service not subject to this part qualifies for use under this part if:
 - Pipeline must be tested according to Subpart J
 - MAOP established by Subpart L (§192.619)

Established MAOP

**Do not have to
operate at MAOP**

Established MAOP

- Once established, MAOP not lost unless:
 - Down rate pipe according to maximum safe pressure §192.619(a)(4)
 - Install pipe or component that does not comply with design formula or pressure requirements
 - Install untested or low tested pipe
 - Class location change §192.611

Temporary Pressure Reductions

- May have temporary pressure reductions due to:
 - Operations and maintenance issues
 - Safety related conditions
 - IM requirements

 - Pressure reductions due to PHMSA orders

What should an operator do to raise operating pressure if the pipeline has been operating for a significant time at a pressure lower than established MAOP?

Re-establish MAOP

Technically.....

NOTHING

Re-establish MAOP

- Realistically.....

**Determine fitness for
service (FFS)**

Fitness for Service

Fitness for service is the pipelines ability to operate in a manner that ensures the safety of the people that live and work near pipelines, protects the environment, while dependably transporting natural gas from sources to markets. (INGAA)

Verify MAOP

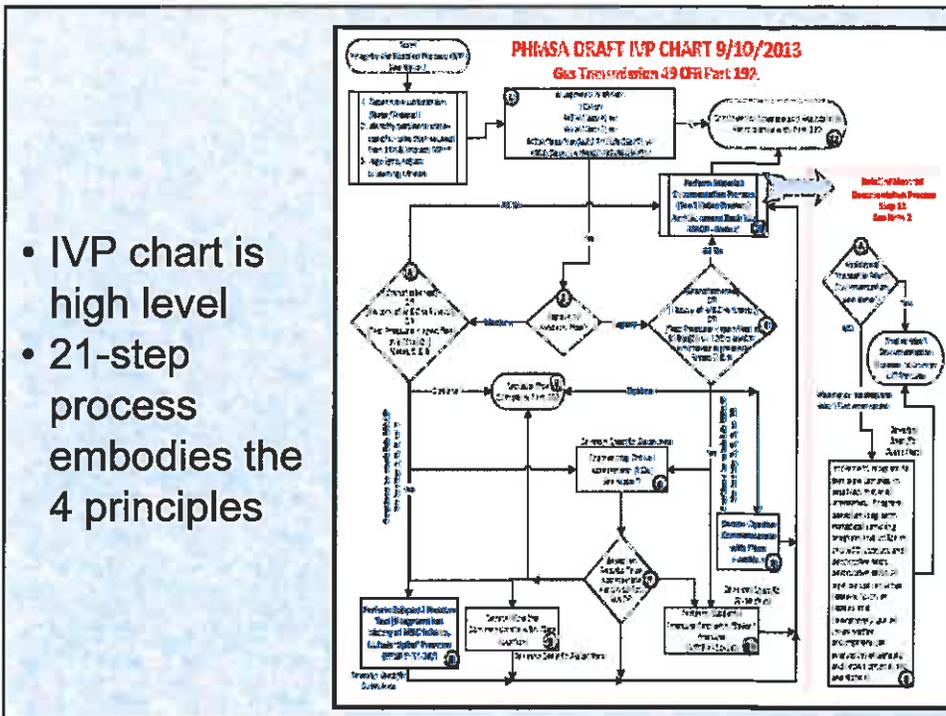
- Recommend follow requirements similar to §192.555 or §192.557
 - Review the design, operating, and maintenance history of the segment of pipeline to determine whether the proposed increase is safe and consistent with the requirements of this part
 - Make any repairs, replacements or alterations in the segment of pipeline that are necessary for safe operation at the increased pressure
 - Written plan for procedure, maintain records

Integrity Verification Process (IVP)

- Seeks to address the various technical issues and challenges associated with verifying the mechanical integrity of existing pipelines
 - “Grandfathered” under existing regulations, or
 - Adequate records do not exist to establish existing pressure limits.
- Result of NTSB recommendations and mandates from Congress

Basic IVP Principles

- Proposed process is based on 4 principles:
 1. Apply to higher risk locations such as high consequence areas (HCAs) and moderate consequence areas (MCAs)
 2. Screen segments for categories of concern (e.g., “grandfathered” or no pressure tests)
 3. Assure adequate material and documentation
 4. Perform assessments to establish MAOP



IVP

- Establishes MAOP verification options that are equivalent to pressure testing
- Addresses Class 1 and 2 pipe in higher risk locations to address related NTSB recommendations
- Strategy for addressing/correcting segments without adequate records
- Process accommodates actions necessary commensurate with specific documentation shortcomings on a segment-specific basis

IVP

The IVP will apply to pipeline segments with:

- Grandfathered pipe
- Lack of records to substantiate MAOP
- Lack of adequate pressure tests
- Operating pressures over 72% SMYS (pre-Code)
- History of failures attributable to manufacturing and construction defects

IVP

- PHMSA's draft IVP is a multi-disciplinary, risk-based engineering approach to verify that safe operating pressure limits are appropriately and demonstrably established and documented
- Proposed process also applied to pipelines that may contain flaws, sustained damage or aged so integrity cannot be evaluated solely by reliance on original construction codes or regulations
- PHMSA estimated the proposed IVP would apply to approximately 76,000 miles of steel natural gas transmission pipelines



 U.S. Department of Transportation
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Public Information



Mary Friend
405-686-2332
mary.friend@dot.gov