MAOP

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

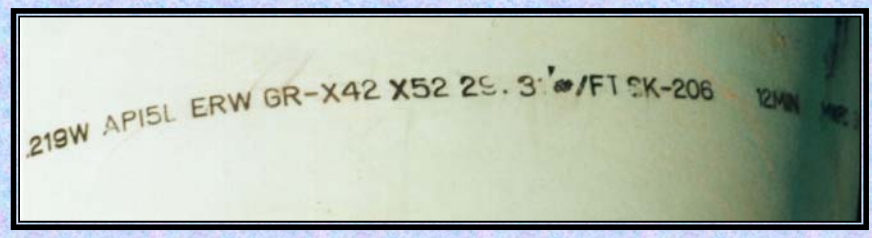
- Components
  - Manufacturer's rating

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



MAOP based on Design

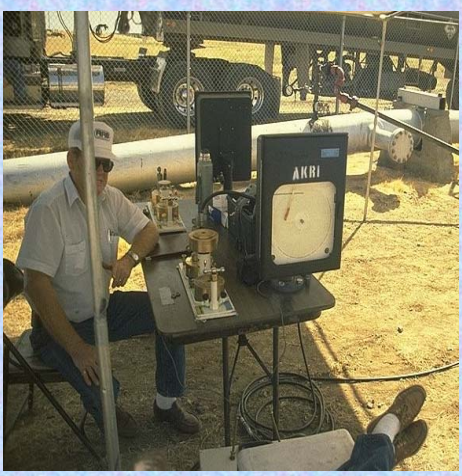
- Design also includes:
  - Pipe replacements
  - Repairs such as leak clamps, sleeves
  - Component replacements such as valves, regulators, fittings or other appurtenances
  - Hot taps

§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
  - Uprated 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:

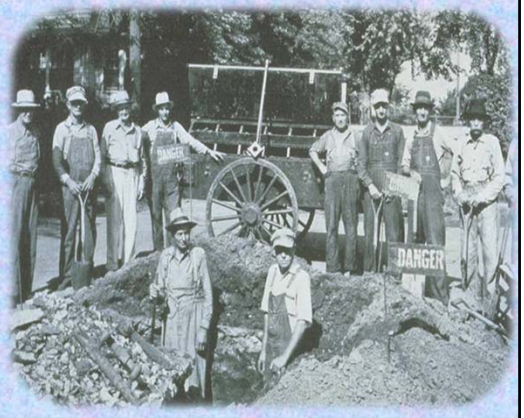
- Design pressure of weakest element
- Test Pressure (de-rated by class location factor)
- MOP during the 5 years preceding applicable date
- Maximum safe pressure determined by the operator

§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 1995

6", Grade B pipe, 0.280 wall thickness

Installed in a Class 2 location

Valves, fittings ANSI 300 (740 psig)

Tested to 650 psig for 8 hours

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) x F x E x 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)xFxExT

S=Grade of pipe	Grade B or 35,000
t = thickness	0.280”
D=diameter	6.625”
F=Design Factor §192.111	0.6
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)xFxExT

  P = ((2x35,000x0.280)/6.625)x0.6x1x1

  P=1775 psig for pipe

Fittings – ANSI 300 = **740 psig**

MAOP by Design – 740 psig

§192.619 (a)

MAOP cannot exceed the **LOWEST** of:

- Design pressure of weakest element = **740 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 = 650 psig

Class Location Factor for class 2 = 1.25

MAOP = 650/1.25

MAOP by test pressure = 520 psig

§192.619 (a)

MAOP cannot exceed the **LOWEST** of:

- Design pressure of weakest element = **740 psig**
- Test Pressure = **520 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

Not applicable, built in 1995

§192.619 (a)

MAOP cannot exceed the **LOWEST** of:

- Design pressure of weakest element = **740 psig**
- Test Pressure = **520 psig**
- MOP during the 5 years preceding applicable date = **NA**
- 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 = **740 psig**
- Test Pressure = **520 psig**
- MOP during the 5 years preceding applicable date = **NA**
- Maximum safe pressure determined by the operator = **NA**

MAOP of steel pipeline = 520 psig as determined by §192.619 (a)(2)

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) x F x E x 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)xFxExT

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)xFxExT
  - P = ((2x35,000x0.280)/6.625)x0.72x1x1
  - **P = 2130 psig (6.625")**
  - ***P = 2352 psig (6")***
  - Fittings – ANSI 300 = **740 psig**

MAOP by Design = 740 psig

§192.619 (a)

MAOP cannot exceed the **LOWEST** of:

- Design pressure of weakest element = **740 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 = **740 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 = **740 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 = **740 psig**
- Test Pressure = **818 psig**
- MOP during the 5 years preceding applicable date = **900 psig**
- Maximum safe pressure determined by the operator = **NA**

BUT WAIT …

MAOP of steel pipeline = 740 psig as determined by §192.619 (a)(1)

§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 = **740 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) x 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

Piping Material	73º F	100º F	120º F	140º 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) x 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) x DF

  P = (2)(1600)/(11-1) X 0.32

  P = 3200/10 x 0.32

  P = 320 x 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)

MAOP = Test Pressure/1.5

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 to make unsafe the operation of properly adjusted low -pressure gas burning equipment.

§192.623 – Low Pressure Distribution Systems

- *Maximum* and Minimum Allowable Operating Pressure

- Cannot operate at a pressure lower than the minimum pressure at which the safe and continuing operation of any properly adjusted low-pressure gas burning equipment can be assured.

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 ability of a system or component to provide continued service, within established regulations and margins for safety, until the end of some desired period of operations or scheduled inspection or reassessment.

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)

MAOP Records

ADB 11-01 – Establishing MAOP/MOP using records

ADB 12-06 - Verification of Records Establishing MAOP and MOP.

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; and
  - 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

Verify MAOP

- Check for
  - Any component changes since installation
  - Class changes
  - Regulation and overpressure protection
  - Leak history and repairs

Pipeline really suitable to be operated at higher pressure?

Re-establish MAOP

- Modified §192.555(e) or §192.557(c)
- Where a segment of pipeline has a pressure increase to established MAOP, the increase in pressure should be made in increments that are equal to:
  - (1) 10 percent of the operating pressure before the increase; or
  - (2) 25 percent of the total pressure increase, whichever produces the fewer number of increments.

Re-establish MAOP

- Modified requirements of §192.553
  - At the end, the pressure should be held constant while the entire segment of the pipeline that is leak surveyed
  - Each leak detected must be repaired before a further pressure increase is made, except that:
  - a leak determined not to be potentially hazardous need not be repaired if it is monitored during the pressure increase and it does not become potentially hazardous.

Summary

- Consider fitness for service prior to re-establishing MAOP
  - Design, repairs, operating and maintenance history
  - Written procedure
  - Incremental pressure increases
  - Leak surveys

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