Pipeline Records: Traceable, Verifiable, Complete & Reliable

Period 4

Pipeline Integrity 2017

February 22, 2017
MAOP / MOP

• GAS Pipelines: MAOP
  – Maximum
  – Allowable
  – Operating
  – Pressure

• Liquid Pipelines: MOP
  – Maximum
  – Operating
  – Pressure

Same thing, different acronym
Gas - MAOP

• Maximum Allowable Operating Pressure (MAOP) means the maximum pressure at which a pipeline or segment of a pipeline may be operated under this part.

• NOTE: *Maximum actual operating pressure* is defined as the maximum pressure that occurs during normal operations over a period of 1 year. *(this is not MAOP)*
  – some call this MOP, but MOP isn’t defined
MAOP Value: 192.619

• Lowest of the following:
  (a)(1) Design
  (a)(2) Test Pressure / Factor
  (a)(3) Max. Operating Pressure for 5 years preceding regulation
  (a)(4) Maximum Safe Pressure determined by the Operator
MAOP Value

Design of Pipe and Components

Pipe
- For Steel - §192.105
- For Plastic - §192.121

Components
- Manufacturers Rating
Design of Steel Pipe

\[ P = \frac{2St}{D} \times (F)(E)(T) \]

- \( P \) = Design Pressure
- \( S \) = Yield Strength
- \( D \) = Nominal Outside Diameter
- \( t \) = Nominal Wall Thickness
- \( F \) = Design factor - §192.111
- \( E \) = Longitudinal joint factor - §192.113
- \( T \) = Temperature derating factor - §192.115
Yield Strength (S) §192.107

• Known SMYS
  – Listed Specification (App. B, Section I)

• Unknown SMYS
  – Tensile Tests (App. B, Section II-D), lowest of
    • 80% of avg. yield strength
    • Lowest yield strength
  – Assume 24,000 psi
## Design Factor (F) for Gas

<table>
<thead>
<tr>
<th>Class Location</th>
<th>Design Factor (F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>.72</td>
</tr>
<tr>
<td>2</td>
<td>.60</td>
</tr>
<tr>
<td>3</td>
<td>.50</td>
</tr>
<tr>
<td>4</td>
<td>.40</td>
</tr>
</tbody>
</table>
Alternative Design Factors (Gas)

- **Design Factor (F)**
  - Class 1 = 0.80
  - Class 2 = 0.67
  - Class 3 = 0.56
  - Class 4 = NA

- **Additional Requirements**
  - Design (192.112)
  - Construction (192.328)
  - Class Location Change (192.611)
  - Operations & Maintenance (192.620)

CAUTION: Don’t bother unless this is for new pipeline construction
## Longitudinal Joint Factor (E) §192.113

<table>
<thead>
<tr>
<th>Specification</th>
<th>Pipe class</th>
<th>Longitudinal joint factor (E)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM A 53/A53M</td>
<td>Seamless</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td>Electric resistance welded</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td>Furnace butt welded</td>
<td>.60</td>
</tr>
<tr>
<td>ASTM A 106</td>
<td>Seamless</td>
<td>1.00</td>
</tr>
<tr>
<td>ASTM A 333/A 333M</td>
<td>Seamless</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td>Electric resistance welded</td>
<td>1.00</td>
</tr>
<tr>
<td>ASTM A 381</td>
<td>Double submerged arc welded</td>
<td>1.00</td>
</tr>
<tr>
<td>ASTM A 671</td>
<td>Electric-fusion-welded</td>
<td>1.00</td>
</tr>
<tr>
<td>ASTM A 672</td>
<td>Electric-fusion-welded</td>
<td>1.00</td>
</tr>
<tr>
<td>ASTM A 691</td>
<td>Electric-fusion-welded</td>
<td>1.00</td>
</tr>
<tr>
<td>API 5 L</td>
<td>Seamless</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td>Electric resistance welded</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td>Electric flash welded</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td>Submerged arc welded</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td>Furnace butt welded</td>
<td>.60</td>
</tr>
<tr>
<td>Other</td>
<td>Pipe over 4 inches (102 millimeters)</td>
<td>.80</td>
</tr>
<tr>
<td>Other</td>
<td>Pipe 4 inches (102 millimeters) or less</td>
<td>.60</td>
</tr>
</tbody>
</table>
## Temperature Derating Factor (T) §192.115

<table>
<thead>
<tr>
<th>Gas temperature in degrees Fahrenheit (Celsius)</th>
<th>Temperature derating factor (T)</th>
</tr>
</thead>
<tbody>
<tr>
<td>250°F (121°C) or less</td>
<td>1.000</td>
</tr>
<tr>
<td>300°F (149°C)</td>
<td>0.967</td>
</tr>
<tr>
<td>350°F (177°C)</td>
<td>0.933</td>
</tr>
<tr>
<td>400°F (204°C)</td>
<td>0.900</td>
</tr>
<tr>
<td>450°F (232°C)</td>
<td>0.867</td>
</tr>
</tbody>
</table>
Pipe Specifications

API 5L
Grade B
8"
.322" wt.
For a Class 3 Location

\[
P = (2)(35,000)(0.322)(0.50)
\]

\[
8.625
\]

\[
P = 1307\#
\]
Component Design

Components

♦ 1000 WOG Valve - 1000#
♦ ANSI Class 300 Flange - 720#
♦ ANSI Class 600 Valve - 1440#

Manufacturers Rating

Note: ANSI Class 600 rating now is 1480 psig
Design

Components = 720#

Pipe = 1307#
MAOP Value: 192.619

• Lowest of the following:
  (a)(1) Design
  (a)(2) **Test Pressure / Factor**
  (a)(3) Max. Operating Pressure for 5 years preceding regulation
  (a)(4) Maximum Safe Pressure determined by the Operator
## Testing - Steel > 100#

<table>
<thead>
<tr>
<th>Class location</th>
<th>Installed before (Nov. 12, 1970)</th>
<th>Installed after (Nov. 11, 1970)</th>
<th>Covered under §192.14</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.1</td>
<td>1.1</td>
<td>1.25</td>
</tr>
<tr>
<td>2</td>
<td>1.25</td>
<td>1.25</td>
<td>1.25</td>
</tr>
<tr>
<td>3</td>
<td>1.4</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>4</td>
<td>1.4</td>
<td>1.5</td>
<td>1.5</td>
</tr>
</tbody>
</table>
Test Pressure / Factor

Test Pressure - 1964 = 1500#

For Class 3 -

1500/1.4 = 1071#
MAOP Value: 192.619

• Lowest of the following:
  
  (a)(1) Design
  (a)(2) Test Pressure / Factor
  (a)(3) Max. Operating Pressure for 5 years preceding regulation
  (a)(4) Maximum Safe Pressure determined by the Operator
Max. Operating Pressure (Gas)

- 5 years preceding 7/1/1970

Unless:

- Tested in accordance with §192.619(a)(2) after July 1, 1965

- Uprated in accordance with Subpart K of Part 192
MOP

Operating Charts for 1968 - 850#
MAOP Value: 192.619

• Lowest of the following:
  (a)(1) Design
  (a)(2) Test Pressure / Factor
  (a)(3) Max. Operating Pressure for 5 years preceding regulation
  (a)(4) Maximum Safe Pressure determined by the Operator
Maximum Safe Pressure

Considering:

- History
- Corrosion
- Actual Operating Pressure
Typical System – Station to Station
MAOP Value: 192.619

- Lowest of the following:
  (a)(1) Design - 1307, 100, 720, 1440
  (a)(2) Test Pressure / Factor - 1071
  (a)(3) Max. Operating Pressure for 5 years preceding regulation - 850
  (a)(4) Maximum Safe Pressure determined by the Operator
Common MAOP Problems

• Uncased road crossings – incorrect design factor
  – 0.72 – 0.60 – 0.50? (dependent upon class location)
  – Road / pipe installation date considerations

• Non-compliant hydrotests
  – Test length, lower test pressures

• Unknown Pipe Seam (Joint Factor)

• Undocumented Up-rate Studies
PHMSA Enforcement Guidance: Examples of Probable Violations

- All applicable elements required in a MAOP calculation were not adequately documented.
- Actual operating pressure exceeded MAOP, without the occurrence of an equipment malfunction or failure.
- Lack of records is a violation of 195.404.
- Operator did not have any equipment to protect the MOP/MAOP. This includes foreign lines that interconnect with their lines.
View of Rupture Site
Pipeline Information

• Installed circa 1956
• Documentation indicated 30-inch diameter, seamless, grade X-42 pipe
• Maximum operating pressure was 375 psi
• Maximum allowable operating pressure was 400 psi
Ruptured Pipe Segment

Fracture Initiation

North End  Direction of flow  South End
Cross Section of Pipe Seams

The way it should have been:

The way it was:
NTSB Safety Recommendations
NTSB Safety Recommendations

- To PHMSA - Notify operators of circumstances and consequences of San Bruno for corrective actions
- To CPUC - Oversee PG&E records search for transmission pipelines w/o hydro-tests
- To PG&E - “Aggressively and diligently search” all records of Transmission PLs w/o hydro-tests. Establish MAOP based on weak link. If inadequate records, establish MAOP with spike test followed by hydro-test or down-rate MAOP.
- Six Technical Reports & thousands of pages of info
NTSB Recommendations to DOT

• Re-evaluate PHMSA’s approach to performance-based regulations (i.e. IMP) – metrics, inspection protocols and standards of performance, and enforcement

• Re-evaluate PHMSA’s state certification program to ensure it is effective for intra-state pipelines.
NTSB Recommendations to PHMSA

- 17 Recommendations to PHMSA including:
  - System-specific information provided to local responders
  - Immediate notification for emergencies
  - Better leak detection pinpointing capabilities
  - Installation of remote/automatic shutoff valves
  - Eliminate hydrotest grandfather clause
  - Make all pipelines ILI compliant
California PUC MAOP Decision
Decision 11-06-017, June 9, 2011

• Applies to all intra-state gas transmission

• Eliminates grandfather clause for establishing MAOP (192.619(c))
  – highest operating pressure for pre-1970 lines without pressure tests

• Future impact for everyone ...
  – ADB 11-01 MAOP (traceable, verifiable, complete) and ADB 12-06
  – PHMSA re-authorization
  – Plan for document reviews, pressure tests and replacements
PHMSA GUIDANCE
MAOP Verification: Gas

- 2011 Act requires gas transmission pipeline operators to report to DOT any pipeline segments with insufficient MAOP records (2012 Annual Report). DOT is required to establish requirements for pipeline operators to address these issues.
Advisory Bulletin 11-01
MAOP / MOP

• Must have reliable records for entire system
  – “Traceable, verifiable, and complete”
  – Hydro-test Records - Acceptable if complete
  – Design and Material Records – Acceptable if complete for life of the pipeline
  – Five Year Highest Pressure - Not allowed; Advisory disregarded existing code provisions for MAOP

• Pipelines =>30% SMYS
  – “aggressive” program to get missing data
  – maybe interim pressure reduction of 20%

• Superceded by the Gas Pipeline Safety, Regulatory Certainty and Job Creation Act of 2011
Advisory Bulletin 12-06
MAOP / MOP

• Gas & Liquid operators should verify records used for establishing MAOP/MOP for entire systems
• Gas operators will need to report mileage with and w/o verifiable records in 2012 annual report
• NTSB’s recommendation to eliminate Grandfather Clause – PHMSA will act on this following collection of data, including annual reports
Traceable, Verifiable & Complete
PHMSA’s definitions (ADB 12-06)

**Traceable records**

“Clearly linked to original information”

- Examples are pipe mill info, purchase requisition or as-built info that documents SMYS, seam type, wall thickness, diameter

- Transcribed records may have errors – use only with supporting documents
Traceable, Verifiable & Complete
PHMSA’s definitions (ADB 12-06)

**Verifiable records**
Information confirmed by complementary supporting documents

- Examples are 1.) contract specs for a pressure test plus pressure charts; 2.) purchase order with pipe specs plus metallurgical tests from same pipe segment
- However, PHMSA later stated that a single record with all needed information is sufficient
- Only acceptable use of an affidavit is as a complementary document and must be prepared and signed at the time of the test or inspection
Traceable, Verifiable & Complete
PHMSA’s definitions (ADB 12-06)

Complete Records

• Record is finalized as evidenced by signature, date or other appropriate marking.

• A record must be specifically linked to an individual pipe segment.
Gas Mega-Rule!

- Add Moderate Consequence Areas (MCA)
- Eliminate Grandfather clause for MAOP
- Prescriptive risk model and IMP requirements
- Integrity requirements outside current HCAs
- Strict material verification requirements
- Expanded regulation of gathering lines
- Special inspections after severe weather
- ... and more! Stay tuned.
Interpretations

What about all those gray areas?

• GPTC Guide (ANSI Z380.1-2012)
• PHMSA Letters of Interpretation website

Note: Obsolete letters and obsolete rules are NOT removed from the website. Use with care!

• A competent Subject Matter Expert
Records

• New Appendix A
  – Records Retention Schedule for Transmission Pipelines

• “Reliable” + Traceable, Verifiable, and Complete (RTVC)
  – RTVC standard applies to “records that demonstrate compliance with this Part” (i.e. ALL of Part 192 !?!)  

• Material records for original steel pipe manufacturing, valves & other components >= 42,000 psi
  – Transmission pipelines only
    – Manufacturing specification, tests, inspections, pressure rating, yield strength, ultimate tensile strength, chemical composition

• If material records are NOT available for onshore, steel, transmission pipelines, located in HCA’s or Class 3 or 4 areas ... re-establish per
  – 192.607 Verification of Pipeline Material: Onshore steel transmission pipelines
If RTVC material records not available

- Material documentation plan w/in **6 months**
  
  - *No timeline given to complete verification*

- NDE, destructive, examinations & assessments
  
  - Very prescriptive criteria
    
    - Defines population types of non-RTVC materials
    - Minimum number/spacing of excavations per population type
    - Detailed list of pipeline attributes not necessarily required for MAOP (toughness, coating type, etc.)
    - Prescriptive tests for SCC, seam cracking, selective seam weld corrosion

  - If inconsistencies found w/in test population, more tests required

- Other or alternate technology
  
  - submitted to PHMSA >180 days prior to use
  - must receive “no objection” letter from PHMSA
MAOP Verification, Onshore Steel Pipelines
§192.624

• Applicability
  – Located in HCA, class 3 or 4, or ILI capable MCA
  – Experiences a reportable incident due to manufacturing, construction, fabrication, cracking defect since last Subpart J test
  – Pressure test records used to establish MAOP are not RTVC
  – “Grandfathered” pipeline (MAOP est. using 192.619(c))

• Completion dates for MAOP verification
  – Develop plan within 1 year
  – 50% within 8 years
  – 100% within 15 years
MAOP Verification, Onshore Steel Pipelines §192.624

• MAOP determination methods
  – Pressure test
    • spike test legacy pipe or reportable incident due to manufacturing, construction, fabrication, or crack-like defects
  – Pressure reduction
    • Considerable amount of prescriptive if/then requirements
  – Engineering Critical Assessment
    • Considerable amount of data analysis & predicted failure pressure analysis
  – Pipe replacement
  – Pressure reduction for <=8”, <=150’PIR, <30% SMYS & not ILI or pressure test capable
    • Numerous prescriptive actions (DA, odorization, increased patrols, etc.)
  – Alternative technology approved by PHMSA
    • Written request >180 days, must receive “no objection letter”
MAOP Verification, Onshore Steel Pipelines §192.624

• Fracture mechanic modeling for failure stress & crack growth analysis
  – Applies to any pipeline regardless of HCA, class location...
  – If segment susceptible to cracks based upon any available information
  – Determine remaining life of pipeline
    • If calculated remaining life <5 years, pressure test or reduce pressure within 1 year
    • Otherwise, re-evaluate at the lesser of 50% estimated remaining life or 15 years
    • Reviewed & confirmed by metallurgy & fracture mechanics SME

• Records to accomplish §192.624 must be RTVC
Path to Final Rule
- Quickest scenario imaginable

July – December 2016
PHMSA reviews NPRM comments

December 2016 – March 2017
PHMSA presents path forward to Gas Pipeline Advisory Committee (3 meetings)

April 2017
PHMSA makes necessary modifications

May – June 2017
Secretary of Transportation office reviews & approves Final Rule

July – October 2017
Office of Management & Budget reviews & approves Final Rule

November 2017
Final Rule Publication

May 2018
Effective date of Final Rule
Comments can be viewed at:

www.regulations.gov

Docket: PMHSA-2011-0023