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<table>
<thead>
<tr>
<th>Section</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Introduction</strong></td>
</tr>
<tr>
<td>Scope</td>
</tr>
<tr>
<td><strong>2. References</strong></td>
</tr>
<tr>
<td>2.1 Process Industry Practices</td>
</tr>
<tr>
<td>2.2 Industry Codes and Standards</td>
</tr>
<tr>
<td><strong>3. Definitions</strong></td>
</tr>
<tr>
<td><strong>4. General Requirements</strong></td>
</tr>
<tr>
<td><strong>5. Scope of Examination</strong></td>
</tr>
<tr>
<td><strong>6. Examination Selection Basis</strong></td>
</tr>
<tr>
<td><strong>7. Testing Selection Basis</strong></td>
</tr>
<tr>
<td><strong>8. Test Methods</strong></td>
</tr>
<tr>
<td>8.1 Hydrostatic Test</td>
</tr>
<tr>
<td>8.2 Special Hydrostatic Test</td>
</tr>
<tr>
<td>8.3 Pneumatic Test</td>
</tr>
<tr>
<td>8.4 Project Special Test</td>
</tr>
<tr>
<td><strong>9. Test Pressure</strong></td>
</tr>
<tr>
<td><strong>10. Pre-Test Procedures</strong></td>
</tr>
</tbody>
</table>
1. **Introduction**

**Scope**

This Practice describes guidelines for specifying requirements for examination and leak testing of metallic pipeline systems designed in accordance with *ASME B31.8 Gas Transmission and Distribution Piping Systems*. This Practice provides guidelines for specifying requirements for examination of piping materials, components, fabrication, assembly, installation, and associated documentation. This Practice provides guidelines for the extent of examination, criteria for acceptance, and correction of defective work. This Practice describes the types of leak tests, basis for selecting the appropriate tests, and arrangements for testing piping.

2. **References**

Applicable parts of the following Practices and industry codes and standards, including codes referenced therein, shall be considered an integral part of this Practice. The edition in effect on the date of contract award shall be used, except as otherwise noted. Short titles are used herein where appropriate.

2.1 **Process Industry Practices (PIP)**

- PIP PLC00002 – *Abbreviated Pipeline Terms and Acronyms*
- PIP PLCM0001 – *Pipeline Systems Nomenclature*
- PIP PLSC0001 – *Fabrication and Examination of ASME B31.8 Metallic Piping*
- PIP PLSC0021 – *Leak Testing of Piping Systems*

2.2 **Industry Codes and Standards**

- American Petroleum Institute (API)
  - API 1110 – *Recommended Practice for the Pressure Testing of Steel Pipelines For the Transportation of Gas, Petroleum Gas, Hazardous Liquids, Highly Volatile Liquids, or Carbon Dioxide*

- American Society of Mechanical Engineers (ASME)
  - ASME B16.5 – *Pipe Flanges and Flanged Fittings*
  - ASME B31.8 – *Gas Transmission and Distribution Piping Systems*
  - ASME PCC-2 – *Repair of Pressure Equipment and Piping*

- Pipeline Research Council International (PRCI)
  - *Pipeline Repair Manual, Contract PR-186-0324*

- U.S. Department of Transportation
  - Code of Federal Regulations 49 Part 192 – *Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards Part J Test Requirements*
3. **Definitions**

For definitions of terms used in this Practice, see the *Code, PIP PLC00002, and PIP PLCM0001*.

4. **General Requirements**

All testing shall ensure the integrity of the piping, the wellbeing of the public and employees, and the protection of the environment.

4.1 An approved documented procedure is required for the pressure test.

4.2 All additional piping and equipment used during the pressure test shall be rated for the test pressure.

4.3 All piping shall be successfully retested after any required repairs.

5. **Scope of Examination**

5.1 The *Code* requires that each pipeline be examined to the extent specified using the methods specified.

5.2 The purpose of examining piping is to expose errors and defects in the work and to correct the defects before the piping is placed in service.

5.3 Piping systems should be examined for conformance with design drawings and project specifications prior to the pressure test. The following design and construction requirements should be verified, if applicable:

a. P&ID or Flow Diagram Conformance
   
   (1) Line identification
   
   (2) Line size(s)
   
   (3) Terminals, nozzle connections
   
   (4) Shut-off valves, other valves
   
   (5) In-line equipment, instruments, blinds
   
   (6) Vents and drains
   
   (7) Conformance to all notes on drawings

b. Line Class Conformance

Pipe, fittings, flanges, valves, and piping specialties should be verified in regard to the following characteristics. Nipples, bolts, gaskets, and joining materials should be similarly verified, to the extent possible. All specialty items shall be evaluated for hydrotest pressure.

(1) Material (e.g., ASTM Standard and grade)

(2) Rating or wall thickness

(3) Type and end connection

(4) Standard if applicable (e.g., ASME, MSS, API)
(5) Dimensions if applicable  
(6) Free of visible defects or damage  
(7) Free of defects in metallic components that are examined by radiography or other means  

c. Joints and Fabrication Conformance  
   (1) Condition and make-up of threaded joints  
   (2) Alignment and make-up of flanged joints and other bolted joints  
   (3) Free of visible defects in welds; brazed, soldered, and bonded joints; bends; formed and machined work  
   (4) Free of defects in metallic welds examined by radiography or other means  
   (5) Condition and tightness of packing glands  

d. Installation Conformance  
   (1) Piping location, in accordance with alignment and profile drawings or model, including any as-built drawings.  
   (2) Locations and details of anchors, guides, and supports  
   (3) Clearances from other piping  
   (4) Clearances from electrical and instrument lines, equipment, other structures, and spaces reserved for personnel and vehicle traffic  
   (5) Clearances at operating temperature  
   (6) Accessibility for operation and maintenance  

6. Examination Selection Basis  

6.1 Important factors governing the selection of examination requirements are as follows:  
   a. Code requirements  
   b. Piping material and types of components and joints  
   c. Contents  
   d. Safeguarding, consequences of piping failure, and other design considerations  
   e. Operating hoop stress  
   f. Jurisdictional requirements  

6.2 The examinations required, the extent of examination, and the procedures to be used for each system are described in PIP PLSC0001.  

7. Testing Selection Basis  

7.1 The following tests are required by the Code for the listed fluid services:  
   a. Strength Test
b. Leak test

7.2 A hydrostatic test is preferred over a pneumatic test.

7.3 Brittle materials (e.g., cast iron, ductile iron) should not be pneumatically tested.

7.4 If a pneumatic test is considered, see *ASME B31.8*, paragraph 841.3.1(c) for cautions and risk assessment considerations.

8. Test Methods

Leak test methods are described in this section. Test conditions, procedures, and post-test requirements are described in *PIP PLSC0021*.

8.1 Hydrostatic Test

8.1.1 Water is the preferred test liquid.

8.1.2 Chloride deionization should be used only if shown to be necessary.

8.1.3 If a large test volume is involved, the method of disposal of the test fluid from the system after the test should be considered. The fluid may be useable for hydrotesting other systems.

8.1.4 If the piping is required to be water-free after a hydrostatic test, warm, dry air should be circulated through the piping or a vacuum may be applied (with owner approval), rather than selecting a different test liquid or a pneumatic test. Pigging may be appropriate to remove residual water.

8.1.5 It is typically acceptable to use a water header (e.g., potable, deionized, or well water) for the test supply. For a large project, several taps from a water header may be required.

8.1.6 The construction contractor may be requested to provide an acceptable test water supply.

8.2 Special Hydrostatic Test

Instructions shall be provided for recovery or disposal arrangements if liquids other than water are used.

8.3 Pneumatic Test

8.3.1 Because of the hazard of a possible disruptive release of energy stored in the compressed gas, pneumatic testing shall be used only after reasonable alternates to test with a liquid have been exhausted.

8.3.2 Pneumatic testing shall not be permitted for brittle material (e.g., cast iron).

8.3.3 For carbon and low-alloy steel piping, pneumatic testing shall not be permitted if the ambient temperature is less than the design minimum temperature. See *Code*, Paragraph 323.2.2.

8.3.4 A piping system shall be prepared for a pneumatic test in accordance with *PIP PLSC0021*.

8.3.5 The area surrounding the piping system shall be vacated during a pneumatic test until the pressure is lowered for close inspection. Article 5.1, Mandatory
Appendices II, III and IV in ASME PCC-2 provide guidance on stored energy and safe distance calculations, as well as risk evaluation considerations.

8.3.6 Pneumatic testing may limit Code-allowed pressure and temperature excursions. See Code, Paragraph 302.2.4.

8.4 Project Special Test

If a piping system has special project requirements for a leak test that cannot be performed in accordance with the previously described leak test methods, a Project Special Test may be performed.

9. Test Pressure

Test pressures for the leak test methods described in this Practice should be in accordance with the following as appropriate:

a. ASME B31.8, Table 841.3.2-1 Test Requirements for Steel Pipelines and Mains to Operate at Hoop Stresses of 30% or More of the Specified Minimum Yield Strength of the Pipe; or

b. ASME B31.8, Table 841.3.3-1 Maximum Hoop Stress Permissible During an Air or Gas Test

10. Pre-Test Procedures

Leak test methods are described in this section and are identified by Test Symbols, procedures, and post-test requirements for each test method are described in PIP PLSC0021.