

Pressure Testing of Steel Pipelines for the Transportation of Gas, Petroleum Gas, Hazardous Liquids, Highly Volatile Liquids, or Carbon Dioxide

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Introduction

This Recommended Practice (RP) provides guidelines for pressure testing steel pipelines for the transportation of gas, petroleum gas, hazardous liquids, highly volatile liquids, or carbon dioxide. The RP provides guidance so that:

- a) Pipeline operators can select a pressure test suitable for the conditions under which the test will be conducted—this includes, but is not limited to, pipeline material characteristics, pipeline operating conditions, and various types of anomalies or other risk factors that may be present;
- b) Pressure tests are planned to meet the overall objectives of the pressure test;
- c) Site-specific procedures are developed and followed during all phases of the pressure testing process;
- d) Pressure tests consider personnel safety, public safety, and environmental impacts;
- e) Pressure tests are implemented by qualified personnel;
- f) Pressure tests are conducted to meet stated acceptance criteria and pressure test objectives;
- g) Pressure test records are developed, completed, and retained for the useful life of the facility.

Users of this RP should be aware that further or differing requirements may be necessary for some applications. Nothing in this RP is intended to inhibit the use of engineering solutions that are not covered by the RP. This may be particularly applicable where there is innovative developing technology. Where an alternative is offered, the RP may be used, provided all variations from the RP are identified and documented.

The guiding principles of this RP are as follows:

- a) This RP provides a consistent means of preparing, assessing, using, and verifying pressure test results to help ensure that the objectives of the pressure test are met.
- b) Provide guidance for meeting the requirements of Integrity Management as stated in API Recommended Practice 1160 and ASME B31.8S. Further information on using hydrostatic testing as an integrity management tool can be found in API Technical Report 1179, *Hydrostatic Testing as an Integrity Management Tool*.
- c) This RP is not technology specific. It accommodates present and future technologies used for pressure testing steel pipelines.
- d) This RP is performance-based and provides guidelines for the qualification of the pressure testing processes. It does not define how to meet those guidelines.
- e) This RP provides guidelines for documenting important information during each phase of the pressure testing process.
- f) Wherever possible, this RP utilizes existing terms and definitions from other applicable industry documents. Definitions of terms used in this RP are listed in [Section 3](#).
- g) The use of a pressure testing process to manage the integrity of pipelines requires an appropriate amount of interaction between the inspection service, if one is used, and the operator. This RP provides guidelines that will enable inspectors and operators to clearly define the areas of cooperation required and thus facilitate the satisfactory outcome of the pressure testing process.

Although many operators use vendors during various phases of the pressure testing process, the operator is ultimately responsible for:

- a) Identifying specific risks and threats to be assessed as part of the pressure testing process,
- b) Choosing the proper pressure test to assess identified risks and threats, and
- c) Confirming and verifying pressure test results.

Pressure Testing of Steel Pipelines for the Transportation of Gas, Petroleum Gas, Hazardous Liquids, Highly Volatile Liquids, or Carbon Dioxide

1 Scope

This RP applies to all parts of a pipeline or pipeline facility including line pipe, pump station piping, terminal piping, compressor station piping, metering station piping, delivery station piping, regulator station piping, appurtenances connected to line pipe, appurtenances connected to facility piping, fabricated assemblies, valves, tees, elbows, reducers, flanges, and any other pipeline equipment or appurtenances.

This RP does not apply to pumping units, compressor units, breakout tanks, pressure vessels, control piping, sample piping, instrument piping/tubing, or any component or piping system for which other codes specify pressure testing requirements (i.e. ASME *Boiler and Pressure Vessel Code* or piping systems covered by building codes).

Although this RP contains guidelines that are based on sound engineering judgment, it is important to note that certain governmental requirements may differ from the guidelines presented in this document.

This RP does not address pipeline systems that are pressure tested with natural gas, nitrogen, or air.

2 Normative References

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any addenda) applies.

API Recommended Practice 1160, *Managing System Integrity for Hazardous Liquid Pipelines*

ASME B31.4 ¹, *Pipeline Transportation Systems for Liquid Hydrocarbons and Other Liquids*

ASME B31.8, *Gas Transmission and Distribution Piping Systems*

ASME B31.8S, *Managing System Integrity of Gas Pipelines*

3 Terms, Definitions, and Abbreviations

3.1 Terms and Definitions

For the purposes of this document, the following definitions apply.

3.1.1

anomaly

Possible unexplained deviations from the norm in sound pipe material, coatings, or welds.

3.1.2

appurtenance

A component attached to the pipeline (e.g. valve, tee, instrument connection, supports, or anchors).

3.1.3

bend

A physical pipe configuration that changes pipeline direction.

¹ ASME International, 3 Park Avenue, New York, NY 10016-5990, www.asme.org.

3.1.4**carbon dioxide****CO₂**

A fluid consisting of more than 90 % carbon dioxide molecules compressed to a supercritical state.

3.1.5**characteristic**

Any physical descriptor of a pipeline (e.g. grade, wall thickness, manufacturing process) or an anomaly (e.g. type, size, shape).

3.1.6**component**

Any physical part of the pipeline, other than line pipe, including but not limited to valves, welds, tees, flanges, fittings, taps, branch connections, outlets, supports, and anchors.

3.1.7**corrosion**

The volumetric deterioration resulting in metal loss through a reaction with its environment.

3.1.8**crack**

A fracture type discontinuity characterized by a sharp tip and high ratio of length to width (i.e. opening displacement).

3.1.9**deadweight tester****deadweight**

An instrument consisting of a finely machined piston mounted vertically in a close-fitting cylinder used for maintaining a calculable pressure; also known as a "piston gauge."

NOTE When fitted with a means of pressure control, the complete system is commonly known as a "deadweight tester."

3.1.10**examination**

A direct physical inspection of an anomaly by a person, which may include the use of nondestructive examination techniques.

3.1.11**feature**

Any physical object detected by an ILI system.

NOTE Features may be anomalies, components, nearby metallic objects, welds, appurtenances, or some other item.

3.1.12**freeze plug**

A pipeline isolation point created by freezing hydrostatic test water inside the pipeline by the application of liquid nitrogen to the outer surface of the pipe.

NOTE Normally used to separate a test section into smaller test segments to identify leaks more readily or used to establish a test boundary.

3.1.13**gas**

Any hydrocarbon vapor, mixture of hydrocarbon vapors, hydrogen, or hydrogen blend, suitable for use as, or processing into, domestic or industrial fuel or process feedstock and transmitted or distributed to the user through a piping system.

3.1.14

gouge

Elongated grooves or cavities usually caused by mechanical removal of metal.

3.1.15

hazardous liquid

Petroleum, petroleum products, or anhydrous ammonia.

3.1.16

high pressure test

A test, potentially exceeding the minimum requirements of a qualifying test, used to address or assess for an identified or targeted pipeline threat.

3.1.17

highly volatile liquid

A hazardous liquid that forms a vapor cloud when released to the atmosphere and has a vapor pressure exceeding 40 psia (276 kPa) at 100 °F (37.8 °C).

3.1.18

inspection

The use of a nondestructive testing technique.

3.1.19

leak test

A pipeline test designed to determine the presence or absence of leaks in a pipeline system.

NOTE A leak test can be used alone or in addition to a spike pressure test or a strength pressure test as required by the pressure testing plan.

3.1.20

nondestructive testing

A process that involves the inspection, testing or assessment of materials, components, and assemblies for materials' discontinuities and properties without further impairing or destroying the part's serviceability.

3.1.21

operating pressure

The actual steady state pressure at a discrete point within a pipeline system at a specific time.

3.1.22

operating pressure limit

A generic term used to describe the upper end of the operating pressure range of a pipeline.

NOTE In international codes and standards, it is often referred to as the maximum steady state operating pressure or maximum allowable operating pressure.

3.1.23

operator

Entity that operates a pipeline or facility.

3.1.24

petroleum

Crude oil, condensate, natural gasoline, natural gas liquids, and liquefied petroleum gas.

3.1.25**petroleum gas**

Propane, propylene, butane (normal butane or isobutanes), and butylenes (including isomers), or mixtures composed predominantly of these gases, having a vapor pressure not exceeding 20 psig (1434 kPa) at 100 °F (37.8 °C).

3.1.26**petroleum products**

Products obtained from distilling and processing of crude oil, unfinished oils, natural gas liquids, blend stocks, and other miscellaneous hydrocarbon compounds.

3.1.27**pipeline**

A continuous part of a pipeline facility used to transport a gas, petroleum gas, hazardous liquids, highly volatile liquids, or carbon dioxide, which includes pipe, valves, and other appurtenances attached to pipe.

3.1.28**pipeline system**

All portions of the physical facilities through which gas, petroleum gas, hazardous liquids, highly volatile liquids, or carbon dioxide moves during transportation.

NOTE This includes pipe, valves, and other appurtenances attached to the pipe, compressor units, pumping units, metering stations, regulator stations, delivery stations, breakout tanks, holders, and other fabricated assemblies.

3.1.29**pressure reversal**

A phenomenon whereby a pipeline segments fails at progressively lower test pressures during subsequent pressure tests.

3.1.30**qualification (personnel)**

The process of demonstrating skill and knowledge, along with documented training and experience required for personnel to properly perform the duties of a specific job.

3.1.31**qualifying test****strength pressure test**

A test used to establish the operating pressure limit of a pipeline segment.

3.1.32**seam**

The longitudinal or spiral weld in fabricated line pipe.

3.1.33**specified minimum yield strength****SMYS**

The minimum yield strength prescribed by the specification under which pipe and fittings are purchased from the manufacturer.

3.1.34**spike pressure test**

A pressure test of short duration (typically less than 1 hour) and high amplitude (test pressure ratio typically greater than 1.25).

3.1.35**stress**

Tensile, shear, or compressive force per unit area.