

Subpart C**Design Requirements****§ 195.100 Scope**

This subpart prescribes minimum design requirements for new pipeline systems constructed with steel pipe and for relocating, replacing, or otherwise changing existing systems constructed with steel pipe. However, it does not apply to the movement of line pipe covered by § 195.424.

§ 195.101 Qualifying Metallic Components Other Than Pipe

Notwithstanding any requirement of the subpart which incorporates by reference an edition of a document listed in § 195.3, a metallic component other than pipe manufactured in accordance with any other edition of that document is qualified for use if-

- (a) It can be shown through visual inspection of the cleaned component that no defect exists which might impair the strength or tightness of the component; and
- (b) The edition of the document under which the component was manufactured has equal or more stringent requirements for the following as an edition of that document currently or previously listed in § 195.3:

Approved: Signature on file Date:
Manager, Safety, Health, and Environmental

Approved: Signature on file Date:
Environmental Manager

- (1) Pressure testing;
- (2) Materials; and
- (3) Pressure and temperature ratings

DocumentationLocation Filed

RKGP

Post-DOT Construction/Maint. Records A-4DOT Files**ESI RESPONSE to § 195.101:**

All components of piping systems including valves, flanges, fittings, headers, special assemblies, etc., shall be designed in accordance with the applicable requirements of ASME/ANSI B31.4, good engineering judgment, and design practices to withstand operating pressures and other specified loadings. Components shall be selected that are designed to withstand the specified field test pressure without failure, leakage or impairments of serviceability. Piping components not having established pressure ratings may be qualified for use as specified in paragraphs 404.7 and 423.1 (b) ASME/ANSI B31.4. Piping and valves connecting two lines with different pressures shall be designed for the higher pressure. Reference section 5 Materials and Equipment in ESIESI's "Hazardous Liquid Pipeline Plant Engineering Specification" for more information.

§ 195.102 Design Temperature

- (a) Material for components of the system must be chosen for the temperature environment in which the components will be used so that the pipeline will maintain its structural integrity.

ESI RESPONSE to § 195.102:

Pressure ratings for components in temperature service from 100°F (-30°C) to 250°F (120°C) shall conform to the requirements for 100°F for material standards listed in

Section 2 and Table 423.1, Materials Standards, ASME/ANSI B31.4. Metallic trim, packing, seals, and gaskets shall be corrosion-resistant to the piping fluids and temperature-pressure-resistant to the conditions of the fluid.

§ 195.104 Variations In Pressure

If, within a pipeline system, two or more components are to be connected at a place where one will operate at a higher pressure than another, the system must be designed so that any component operating at the lower pressure will not be overstressed.

ESI RESPONSE to § 195.104:

The maximum steady state operating pressure shall not exceed the internal design pressure and pressure ratings for the components used in normal operations.

The level of pressure rise due to surges and other variations from normal operations shall not exceed the internal design pressure at any point in the piping system and equipment by more than 10 %.

Piping and valves connecting two lines with different pressures shall be designed for the higher pressure. Reference section 7.2 Design Criteria of ESI's "Hazardous Liquid Pipelines Plant Engineering Specification".

§ 195.106 Internal Design Pressure

- (a) Internal design pressure for the pipe in a pipeline is determined in accordance with the following formula:

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

P = Internal design pressure in pounds per square inch gauge.

S = Yield strength in pounds per square inch determined in accordance with paragraph (b) of this section.

t = Nominal wall thickness of the pipe in inches. If this is unknown, it is determined in accordance with paragraph (c) of this section.

- D** = Nominal outside diameter of the pipe in inches.
- E** = Seam joint factor determined in accordance with paragraph (e) of this section.
- F** = A design factor of 0.72, except that a design factor of 0.60 is used for pipe, including risers, on a platform located offshore or on a platform in inland navigable waters, and 0.54 is used for pipe that has been subjected to cold expansion to meet the specified minimum yield strength and is subsequently heated, other than by welding or stress relieving as a part of welding, to a temperature higher than 900°F (482°C) for any period of time over 600°F (316°C) for more than 1 hour.

ESI RESPONSE to § 195.106:

Pipe and piping components at any point in the piping system shall be designed for an internal design pressure which shall not be less than the maximum steady state operating pressure (MSSOP), i.e., the sum of the static head pressure, pressure required to overcome friction losses, and any required back pressure. Pressure rise due to surges and other variations from normal operations is allowed.

The level of pressure rise due to surges and other variations from normal operations shall not exceed the internal design pressure at any point in the piping system and equipment by more than 10 %.

- (b) The yield strength to be used in determining the internal design pressure under paragraph (a) of this section is the specified minimum yield strength. If the specified minimum yield strength is not known, the yield strength to be used in the design formula is one of the following:

- (1) (i) The yield strength determined by performing all of the tensile tests of API Specification 5L on randomly selected specimens with the following number of tests:

Pipe Size	Number of Tests
Less than 168.3 mm (6 5/8 in) nominal outside diameter.	One test for each 200 lengths.
168.3 through 323.8 mm (6 5/8 through 12 3/4 in) nominal outside diameter.	One test for each 100 lengths.
Larger than 323.8 mm (12 3/4 in.) nominal outside diameter.	One test for each 50 lengths.

Comment [v1]:

Comment [v2]:

- (ii) If the average yield-tensile ratio exceeds 0.85, the yield strength shall be taken as 165,474 kPa (24,000 p.s.i.) If the average yield-tensile ratio is 0.85 or less, the yield strength of the pipe is taken as the lower of the following:

- (A) Eighty percent of the average yield strength determined by the tensile tests.
- (B) The lowest yield strength determined by the tensile tests.

- (2) If the pipe is not tensile tested as provided in paragraph (b) of this section, the yield strength shall be taken as 165,474 kPa (24,000 psi).

- (c) If the nominal wall thickness to be used in determining internal design pressure under paragraph (a) of this section is not known, it is determined by measuring the thickness of each piece of pipe at quarter points on one end. However, if the pipe is of uniform grade, size, and thickness, only 10 individual lengths or 5 percent of all lengths, whichever is greater, need be measured. The thickness of the lengths that are not measured must be verified by applying a gage set to the minimum thickness found by the measurement. The nominal wall thickness

to be used is the next wall thickness found in commercial specifications that is below the average of all the measurements taken. However, the nominal wall thickness may not be more than 1.14 times the smallest measurement taken on pipe that is less than 508 mm (20 inches) nominal outside diameter, nor more than 1.11 times the smallest measurement taken on pipe that is 508 mm (20 inches) or more in diameter.

- (d) The minimum wall thickness of the pipe may not be less than 87.5 percent of the value used for nominal wall thickness in determining the internal design pressure under paragraph (a) of this section. In addition, the anticipated external loads and external pressures that are concurrent with internal pressure must be considered in accordance with §§ 195.108 and 195.110 and, after determining the internal design pressure, the nominal wall thickness must be increased as necessary to compensate for these concurrent loads and pressures.

ESI RESPONSE to § 195.106:

The piping system shall be designed to withstand the maximum possible differential between external and internal pressures to which the components will be exposed. Temperature, dynamic effects (external factors such as impact either external or internal, wind loading, fatigue, etc.), weight effects (live or dead loads), thermal expansion and contraction loads, relative movement of connected components, shall be taken into account in the design.

The design pressure shall not exceed 85% of the mill test pressure, unless the pipe is retested in the field. The design pressure may not exceed 85% of the second pressure. Additional wall thickness may be required for loading due to transportation of the pipe during construction, weight of water during testing, and soil loading and other secondary loads during operation. Consideration should also be given to welding or mechanical joining requirements. The pipe wall thickness shall not be reduced to less than 90% of the design thickness under any circumstances including transportation, construction, operation, and maintenance. Refer to section 7.0 Design of the ESI's "Hazardous Liquid Pipelines Plant Engineering Specification".

- (e) The seam joint factor used in paragraph (a) of this section is determined in accordance with the following table:

Specification	Pipe class	Seam joint factor
ASTM A53.....	Seamless.....	1.00
	Electric resistance welded.....	1.00
	Furnace lap welded.....	0.80
	Furnace butt welded.....	0.60
ASTM 106.....	Seamless.....	1.00
ASTM A33/A333M.....	Seamless.....	1.00
	Welded.....	1.00
ASTM A381.....	Double submerged arc welded....	1.00
ASTM A671.....	Electric-fusion welded.....	1.00
ASTM A672.....	Electric-fusion welded.....	1.00
ASTM A691.....	Electric-fusion welded.....	1.00
API 5L.....	Seamless.....	1.00
	Electric resistance welded.....	1.00
	Electric flash welded.....	1.00
	Submerged arc welded.....	1.00
	Furnace lap welded.....	0.80
	Furnace butt welded.....	0.60

The seam joint factor for pipe which is not covered by this paragraph must be approved by the Secretary.

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DOT Determination Study for Liquids F-1 DOT Files**§ 195.108 External Pressure**

Any external pressure that will be exerted on the pipe must be provided for in designing a pipeline system.

ESI RESPONSE to § 195.108:

The piping system shall be designed to withstand the maximum possible differential between external and internal pressures to which the components will be exposed. Temperature, dynamic effects (external factors such as impact either external or internal, wind loading, fatigue, etc.), weight effects (live or dead loads), thermal expansion and contraction loads, relative movement of connected components, shall be taken into account in the design. Refer to section 7.0 Design of the ESI's "Hazardous Liquid Pipelines Plant Engineering Specification".

§ 195.110 External Loads

- (a) Anticipated external loads (e.g.), earthquakes, vibration, thermal expansion, and contraction must be provided for in designing a pipeline system. In providing for expansion and flexibility, § 419 of ASME/ANSI B31.4 must be followed.
- (b) The pipe and other components must be supported in such a way that the support does not cause excess localized stresses. In designing attachments to pipe, the added stress to the wall of the pipe must be computed and compensated for.

ESI RESPONSE to § 195.110:

The piping system shall be designed to withstand the maximum possible differential between external and internal pressures to which the components will be exposed. Temperature, dynamic effects (external factors such as impact either external or internal, wind loading, fatigue, etc.), weight effects (live or dead loads), thermal expansion and contraction loads, relative movement of connected components, shall be taken into account in the design.

The design pressure shall not exceed 85% of the mill test pressure, unless the pipe is retested in the field. The design pressure may not exceed 85% of the second pressure. Additional wall thickness may be required for loading due to transportation of the pipe during construction, weight of water during testing, and soil loading and other secondary loads during operation. Consideration should also be given to welding or mechanical joining requirements. The pipe wall thickness shall not be reduced to less than 90% of the design thickness under any circumstances including transportation, construction,

operation, and maintenance. Refer to section 7.0 Design of the ESIESI's "Hazardous Liquid Pipelines Plant Engineering Specification".

§ 195.111 **Fracture Propagation**

A carbon dioxide pipeline system must be designed to mitigate the effects of fracture propagation.

NOT APPLICABLE. ESIDOES NOT HAVE CARBON DIOXIDE PIPELINES.

§ 195.112 **New Pipe**

Any new pipe installed in a pipeline system must comply with the following:

- (a) The pipe must be made of steel of the carbon, low alloy-high strength, or alloy type that is able to withstand the internal pressures and external loads and pressures anticipated for the pipeline system.
- (b) The pipe must be made in accordance with a written pipe specification that sets forth the chemical requirements for the pipe steel and mechanical tests for the pipe to provide pipe suitable for the use intended.
- (c) Each length of pipe with a nominal outside diameter of 114.3 mm (4 1/2 inches) or more must be marked on the pipe or pipe coating with the specification to which it was made, the specified minimum yield strength or grade, and the pipe size. The marking must be applied in a manner that does not damage the pipe or pipe coating and must remain visible until the pipe is installed.

ESI RESPONSE to § 195.112:

The materials which are used on Company hazardous pipeline projects in new construction or maintenance shall conform to the list of piping material specification in Section 2 of ESIESI's "Hazardous Liquid Pipeline Plant Engineering Specification" and Table 423.1 Materials Standards, ASME/ANSI B31.4. As an alternative, materials shall meet the requirements for materials not listed as a part the ESI specification if qualification procedures are followed without exception. All valves, fittings, flanges, bolting, pipe, and tubing shall be marked in accordance with the marking section of the

standards and specifications to which the items were manufactured or in accordance with the requirements of MSS SP-25.

§ 195.114 **Used Pipe**

Any used pipe installed in a pipeline system must comply with § 195.112 (a) and (b) and the following:

- (a) The pipe must be of a known specification and the seam joint factor must be determined in accordance with § 195.106(e). If the specified minimum yield strength or the wall thickness is not known, it is determined in accordance with § 195.106 (b) or (c) as appropriate.
- (b) There may not be any:
 - (1) Buckles;
 - (2) Cracks, grooves, gouges, dents, or other surface defects that exceed the maximum depth of such a defect permitted by the specification to which the pipe was manufactured; or
 - (3) Corroded areas where the remaining wall thickness is less than the minimum thickness required by the tolerances in the specification to which the pipe was manufactured.

However, pipe that does not meet the requirements of paragraph (b)(3) of this section may be used if the operating pressure is reduced to be commensurate with the remaining wall thickness.

ESI RESPONSE to § 195.114:

Requirements for the reuse of steel line pipe are summarized in paragraph 405.2.1, ASME/ANSI B31.4 with subparagraphs (c) showing the necessary qualifications for pipe for use at SMYS above 24,000 psi or for service involving close coiling or bending. Qualification tests include:

- (a) Inspection
- (b) Bending and coiling properties for pipe NPS 2 and smaller.

- (c) Determination of wall thickness
- (d) Longitudinal joint factor
- (e) Weldability
- (f) Surface defects
- (g) Determination of yield strength
- (h) S value
- (i) Hydrostatic test

The Company Engineering Department should be contacted for assistance when the reuse of steel pipe is considered. A cost effective test program will be developed for each case.

The allowable stress value to be used for design calculations for used (reclaimed) pipe of known specification shall be subject to the testing requirements of paragraphs 437.4.1 ASME/ANSI B31.4 (test to 1.25 times the internal design pressure for not less than 4 hours), 437.6.1 ASME/ANSI B31.4 (through visual inspection with repairs in accordance with paragraph 434.5 ASME/ANSI B31.4), 437.6.3 ASME/ANSI B31.4 (determination of wall thickness), and 437.6.4 ASME/ANSI B31.4 (determination of weld joint factor).

The allowable stress value to be used for design calculations for used pipe of unknown or ASTM A 120 specifications shall be established in accordance with limitations in paragraph 405.2.1(c) ASME/ANSI B31.4 subject to the testing requirements of paragraphs 437.4.1. ASME/ANSI B31.4 (test to 1.25 times the internal design pressure for not less than 4 hours), 437.4.3 ASME/ANSI B31.4 (leak test at 1.25 times internal design pressure for pipelines with hoop stress less than 20% SMYS of the pipe), 437.6.1 ASME/ANSI B31.4 (visual inspection), 437.6.3 ASME/ANSI B31.4 (determination of wall thickness), 437.6.4 ASME/ANSI B31.4 (determination of weld joint factor), and 437.6.5 ASME/ANSI B31.4 (weldability).

§ 195.116 Valves

Each valve installed in a pipeline system must comply with the following:

- (a) The valve must be of a sound engineering design.
- (b) Materials subject to the internal pressure of the pipeline system, including welded and flanged ends, must be compatible with the pipe or fittings to which the valve is attached.

- (c) Each part of the valve that will be in contact with the carbon dioxide or hazardous liquid stream must be made of materials that are compatible with carbon dioxide or each hazardous liquid that it is anticipated will flow through the pipeline system.
- (d) Each valve must be both hydrostatically shell tested and hydrostatically seat tested without leakage to at least the requirements set forth in Section 5 of API Standard 6D.
- (e) Each valve other than a check valve must be equipped with a means for clearly indicating the position of the valve (open, closed, etc.).
- (f) Each valve must be marked on the body or the nameplate, with at least the following:
 - (1) Manufacturer's name or trademark.
 - (2) Class designation or the maximum working pressure to which the valve may be subjected.
 - (3) Body material designation (the end connection material, if more than one type is used..
 - (4) Nominal valve size.

ESI RESPONSE to § 195.116:

Pipeline valves must be manufactured to the requirements in API 6D, Pipeline Valves. Refer to section 7.6 Valves and Pressure Reducing Devices in ESI's "Hazardous Liquid Pipelines Plant Engineering Specification". All valves, fittings, bolting, pipe, and tubing shall be marked in accordance with the marking section of the standards and specifications to which the items were manufactured or in accordance with the requirements of MSS SP-25.

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Post-DOT Construction/Main. Records A-1DOT Files**§ 195.118 Fittings**

- (a) Butt-welding type fittings must meet the marking, end preparation, and the bursting strength requirements of ASME/ANSI B16.9 or MSS Standard Practice SP-75.
- (b) There may not be any buckles, dents, cracks, gouges, or other defects in the fitting that might reduce the strength of the fitting.
- (c) The fitting must be suitable for the intended service and be at least as strong as the pipe and other fittings in the pipeline system to which it is attached.

ESI RESPONSE to § 195.118:

Steel butt welding fittings shall comply with either ANSI B16.9 or MSS SP-75 and shall have pressure/temperature ratings based on stresses for pipe of the same or equivalent material. The actual bursting strength of fittings shall equal the computed bursting strength of pipe of designated material and wall thickness. Refer to section 7.5 Fittings, Elbows, Bends, and Intersections of ESI's "Hazardous Liquid Pipelines Plant Engineering Specification".

§ 195.120 Passage of Internal Inspection Devices

- (a) Except as provided in paragraphs (b) and (c) of this section, each new pipeline and each line section of a pipeline where the line pipe, valve, fitting or other line component is replaced; must be designed and constructed to accommodate the passage of instrumented internal inspection devices.
- (b) This section does not apply to:

- (1) Manifolds
 - (2) Station piping such as at pump stations, meter stations, or pressure reducing stations;
 - (3) Piping associated with tank farms and other storage facilities.
 - (4) Cross-overs;
 - (5) Sizes of pipe for which an instrumented internal inspection device is not commercially available
 - (6) Offshore pipelines, other than main lines 10 inches or greater in nominal diameter, that transport liquids to onshore facilities; and
 - (7) Other piping that the Administrator under § 190.9 of this chapter, finds in a particular case would be impracticable to design and construct to accommodate the passage of instrumented internal inspection devices.
- (c) An operator encountering emergencies, construction time constraints and other unforeseen construction problems need not construct a new or replacement segment of a pipeline to meet paragraph (a) of this section, if the operator determines and documents why an impracticability prohibits compliance with paragraph (a) of this section. Within 30 days after discovering the emergency or construction problem the operator must petition, under § 190.9 of this chapter, for approval that design and construction to accommodate passage of instrumented internal inspection devices would be impracticable. If the petition is denied, within 1 year after the date of the notice of denial, the operator must modify that segment to allow passage of instrumented internal inspection devices.

ESI RESPONSE to § 195.120:

Scraper traps (pig receivers and launchers) shall be installed as required by Company Engineering Specifications, ESI's procedure DOT-003 Pipeline Pigging Operations Procedure, ASME/ANSI B31.4 and 49CFR195.

§ 195.122 Fabricated Branch Connections

Each pipeline system must be designed so that the addition of any fabricated branch connections will not reduce the strength of the pipeline system.

ESI RESPONSE to § 195.122:

Factory made fittings shall have essentially the same mechanical properties and chemical composition as the pipe material. They may be installed if the components meet all requirements of the ANSI/ASME B31.4, Company Engineering Specifications and ESIESI's "Hazardous Liquid Pipelines Plant Engineering Specification".

§ 195.124 Closures

Each closure to be installed in a pipeline system must comply with the ASME Boiler and Pressure Vessel Code, Section VIII, Pressure Vessels, Division 1, and must have pressure and temperature ratings at least equal to those of the pipe to which the closure is attached.

ESI RESPONSE to § 195.124:

Closures requirements are in ESI's "Hazardous Liquid Pipeline Plant Engineering Specification" section 7.5.6 Closures. This section covers quick opening closures, closure fittings, closure heads, fabricated closures, and bolted blind flange connections.

§ 195.126 Flange Connection

Each component of a flange connection must be compatible with each other component and the connection as a unit must be suitable for the service in which it is to be used.

ESI RESPONSE to § 195.126:

Flanged connections shall conform to the requirements of paragraphs 408.1 (sizes, materials, dimensions, rectangular cross section), 408.3 (facings), 408.4 (gaskets), 408.5 (bolting) ASME/ANSI B31.4. Refer to section 7.7 Flanges, Facings, Gaskets, and Bolting in ESIESI's "Hazardous Liquid Pipelines Plant Engineering Specification" for more information.

§ 195.128 Station Piping

Any pipe to be installed in a station that is subject to system pressure must meet the applicable requirements of this subpart.

ESI RESPONSE to § 195.128:

All piping including, but not limited to, main unit interconnection, manifolds, scraper traps, etc. which can be subjected to mainline pressure shall be constructed in accordance with ESI's "Hazardous Liquid Pipeline Specifications", corrosion control requirements and ASME/ANSI B31.4

§ 195.130 Fabricated Assemblies

Each fabricated assembly to be installed in a pipeline system must meet the applicable requirements of this subpart.

ESI RESPONSE to § 195.130:

Fabricated items shall be inspected before assembly into the mainline or manifold. Defects shall be repaired in accordance with provisions of the standard or specification applicable to the manufacturer.

All welding shall be performed using procedures and welders that are qualified to the section 6 Welding in ESI's "Hazardous Liquid Pipeline Plant Engineering Specification" and paragraph 434.8, Welding, ASME/ANSI B31.4. Branch connections shall meet the design requirements in ANSI B31.4, paragraphs 404.3.1. Prefabricated units, other than regularly manufactured butt welding fittings, which use plate and longitudinal seams shall be designed, constructed, and tested under requirements of the ASME BPV Code. Every prefabricated unit produced under this part shall be hydrotested to a pressure equal to the test pressure for the system in which the unit will be installed. For installation in existing facilities, the fabricated unit shall withstand a leak test at the operating pressure of the line.

§ 195.132 Above Ground Breakout Tanks

Each above ground breakout tank must be designed to withstand the internal pressure produced by the hazardous liquid to be stored therein and any anticipated external loads.

ESI RESPONSE to § 195.132:

Refer to Section 8.1.22 Storage and Working Tankage in ESI's "Hazardous Liquid Pipelines Plant Engineering Specification"; general, location, tanks, and pipe-type storage, foundations, dikes, or firewalls for detailed information.

Engineering Services, LP