one safety relief valve and a temperature relief valve or a pressure-temperature relief valve. The valve temperature setting must not be more than 99 °C (210 °F).

§ 53.05–3 Materials (modifies HG–401.2).

(a) Materials for valves must be in accordance with HG–401.2 of the ASME Code except nonmetallic materials may be used only for gaskets and packing.

§ 53.05–5 Discharge capacities and valve markings.

(a) The discharge capacities and valve markings must be as indicated in HG–402 of the ASME Code. The discharge capacities must be certified by the National Board of Boiler and Pressure Vessel Inspectors.

Subpart 53.10—Tests, Inspection, Stamping, and Reporting (Article 5)

§ 53.10–1 General.

(a) The tests, inspection, stamping, and reporting of heating boilers shall be as indicated in Article 5, Part HG of section IV of the ASME Code except as noted otherwise in this subpart.

§ 53.10–3 Inspection and tests (modifies HG–500 through HG–540).

(a) The inspections required by HG–500 through HG–540 must be performed by the ''Authorized Inspector'' as defined in HG–575 of the ASME Code. The Authorized Inspector shall hold a valid commission issued by the National Board of Boiler and Pressure Vessel Inspectors. After installation, heating boilers must be inspected for compliance with this part by a marine inspector.

(b) Automatically controlled boilers must be subjected to the operating tests prescribed in part 63 of this subchapter.

(c) All heating boilers must have the operation of their pressure relieving devices checked after the final installation.

[CGD 81–79, 50 FR 9436, Mar. 8, 1985]

§ 53.10–10 Certification by stamping.

Stamping of heating boilers shall be as indicated in HG–530 of the ASME Code.

[CGD 81–79, 50 FR 9436, Mar. 8, 1985]

§ 53.10–15 Manufacturers' data report forms.

The manufacturers' data report forms required by HG–520 of the ASME Code must be made available to the marine inspector for review. The Authorized Inspector's National Board commission number must be included on the manufacturers' data report forms.

[CGD 81–79, 50 FR 9436, Mar. 8, 1985]

Subpart 53.12—Instruments, Fittings, and Controls

§ 53.12–1 General (modifies HG–600 through HG–640).

(a) The instruments, fittings and controls for heating boilers shall be as indicated in HG–600 through HG–640 of section IV of the ASME Code except as noted otherwise in this section.

(b) For control systems for automatic auxiliary heating equipment, the requirements in part 63 of this subchapter govern and shall be followed.

PART 54—PRESSURE VESSELS

Subpart 54.01—General Requirements

Sec.

Subpart 54.03—Low Temperature Operation

AUTHORITY: 33 U.S.C. 1509; 43 U.S.C. 1333; 46 U.S.C. 3306, 3703; E.O. 12234, 45 FR 58801, 3 CFR, 1980 Comp., p. 277; 49 CFR 1.46.

SOURCE: CGFR 68–82, 33 FR 18828, Dec. 18, 1968, unless otherwise noted.

Subpart 54.01—General Requirements

§ 54.01–1 Incorporation by reference.

(a) Certain material is incorporated by reference into this part with the approval of the Director of the Federal Register in accordance with 5 U.S.C. 552(a). To enforce any edition other than that specified in paragraph (b) of this section, the Coast Guard must publish notice of change in the FEDERAL REGISTER and make the material available to the public. All approved material is on file at the Office of the Federal Register, 800 North Capitol Street, NW., suite 700, Washington, DC, and at the U.S. Coast Guard, Office of Design and Engineering Standards (G–MSE), 2100 Second Street SW., Washington, DC 20593–0001 and is available from the sources indicated in paragraph (b) of this section.

(b) The material approved for incorporation by reference in this part and the sections affected are:

American Society of Mechanical Engineers (ASME) International

Three Park Avenue, New York, NY 10016—5990

Boiler and Pressure Vessel Code, section VIII, Division 1, Pressure Vessels, July 1989 with 1989 addenda 54.01–2; 54.01–5; 54.01–15; 54.01–18; 54.01–25; 54.01–30; 54.01–35; 54.03–1; 54.03–5; 54.05–1; 54.10–1; 54.10–3; 54.10–5; 54.10–10; 54.10–15; 54.15–1; 54.15–5; 54.15–10; 54.15–13; 54.20–1; 54.20–3; 54.25–1; 54.25–3; 54.25–5; 54.25–8; 54.25–10; 54.25–15; 54.25–20; 54.25–25; 54.30–3; 54.30–5; 54.30–10

American Society for Testing and Materials (ASTM)

100 Barr Harbor Drive, West Conshohocken, PA 19428–2959.

ASTM A–20, Steel Plates for Pressure Vessels, 1980 .....54.25–10

ASTM A–203, Pressure Vessel Plates, Alloy Steel, Nickel, 1980.....54.05–20

ASTM A–370, Mechanical Testing of Steel Products, 1977.....54.25–20

ASTM E–23, Notched Bar Impact Testing of Metallic Materials, 1980.....54.05–5

ASTM E–208, Conducting Drop-Weight Test to Determine Nil-Ductility Transition Temperature of Ferritic Steels, 1969.....54.05–5

Compressed Gas Association (CGA)

500 Fifth Avenue, New York, NY 10036

S–1.2, Safety Relief Device Standards—Cargo and Portable Tanks for Compressed Gases, 1979.....54.15–25

S–1.2.5.2, Flow Test of Safety Relief Valves, 1979 .....54.15–10

Manufacturers Standardization Society (MSS)

127 Park Street, NE. Vienna, VA 22180

SP–25, Standard Marketing System for Valves, Fittings, Flanges and Unions, 1978 .....54.01–25

[CGD 88–032, 56 FR 35822, July 29, 1991 as amended by CGD 95–072, 60 FR 50462, Sept. 29, 1995; CGD 95–027, 61 FR 26000, May 23, 1996; CGD 96–041, 61 FR 50727, Sept. 27, 1996; CGD 97–057, 62 FR 51044, Sept. 30, 1997; USCG–1999–6216, 64 FR 53224, Oct. 1, 1999]

§ 54.01–2 Adoption of division 1 of section VIII of the ASME Code.

(a) Pressure vessels shall be designed, constructed, and inspected in accordance with division 1 of section VIII of the ASME (American Society of Mechanical Engineers) Code, as limited, modified, or replaced by specific requirements in this part. The provisions in the appendices to division 1 of section VIII of the ASME Code are adopted and shall be followed when the requirements in section VIII make them mandatory. For general information Table 54.01–1(a) lists the various paragraphs in division 1 of section VIII of the ASME Code which are limited, modified, or replaced by regulations in this part.

TABLE 54.01–1(A)—LIMITATIONS AND MODIFICATIONS IN THE ADOPTION OF DIVISION 1 OF SECTION VIII, ASME CODE

Paragraphs in Section VIII, ASME Code[1] and disposition	Unit of this part
U–1 and U–2 modified by	54.01–5 through 54.01–16.
U–1(c) replaced by	54.01–5.
U–1(d) replaced by	54.01–5(a) and 54.01–15.
U–1(e) modified by	54.01–10.
U–1(h) replaced by	54.01–15.
UG–11 modified by	54.01–25.
UG–22 modified by	54.01–30.
UG–25 modified by	54.01–35.
UG–28 modified by	54.01–40.
UG–84 replaced by	54.05–1.
UG–90 through UG–103 modified by.	54.10–1.
UG–90 and UG–91 replaced by	54.10–3.
UG–92 through UG–103 modified by.	54.10–3.
UG–98 reproduced by	54.10–5.
UG–99 modified by	54.10–10.
UG–100 modified by	54.10–15.
UG–115 through UG–120 modified by.	54.10–1.
UG–116, except (k) replaced by	54.10–20(a).
UG–116(k) replaced by	54.10–20(b).
UG–117 replaced by	54.10–20(c).
UG–118 replaced by	54.10–20(a).
UG–119 modified by	54.10–20(d).
UG–120 modified by	54.10–25.
UG–125 through UG–134 modified by.	54.15–1 through 54.15–15.
UG–125 modified by	54.15–5.
UG–125 modified by	54.15–10, 54.15–15.
UG–127 modified by	54.15–13.
UW–1 through UW–65 modified by	54.20–1.
UW–2(a) replaced by	54.01–5(b) and 54.20–2.
UW–2(b) replaced by	54.01–5(b).
UW–9, UW–11(a), UW–13, UW–16 modified by.	54.20–3.
UW–11(a) modified by	54.25–8.
UW–26, UW–27, UW–29, UW–47, UW–48 modified by.	54.20–5.
UW–52(c)(3) replaced by	54.20–10.
UB–1 modified by	54.23–1
UB–2 modified by	52.01–95(d) and 56.30–30(b)(1).
UCS–6 modified by	54.25–3.
UCS–25 replaced by	54.25–5.
UCS–56 modified by	54.25–7.
UCS–57, UNF–57, UHA–33, and UHT–57 modified by.	54.25–8.
UCS–65 through UCS–67 replaced by.	54.25–10.

TABLE 54.01–1(A)—LIMITATIONS AND MODIFICATIONS IN THE ADOPTION OF DIVISION 1 OF SECTION VIII, ASME CODE—Continued

Paragraphs in Section VIII, ASME Code[1] and disposition	Unit of this part
UHA–23(b) and UHA–51 modified by.	54.25–15.
UHT–5(c), UHT–6, UHT–23 modified by.	54.25–20.
UHT–82 modified by	54.25–20, 54.25–25.
UA–60 modified by	54.15–3.

[1] The references to specific provisions in the ASME Code are coded. The first letter ''U'' refers to division 1 of section VIII. The second letter, such as ''G'', refers to a subsection within section VIII. The number refers to the paragraph within the subsection.

(b) References to the ASME Code, such as paragraph UG–125, indicate:

U=Division 1 of section VIII, Pressure Vessels, ASME Code.
G=Part containing general requirements.
125=Paragraph within part.

(c) When a paragraph or a section of the regulations in this part relates to material in division 1 of section VIII of the ASME Code, the relationship with the code will be shown immediately following the heading of the section or at the beginning of the paragraph as follows:

(1) (Modifies U .) This indicates that the material in U is generally applicable but is being altered, amplified or augmented.

(2) (Replaces U .) This indicates that U does not apply.

(3) (Reproduces U .) This indicates that U is being identically reproduced for convenience, not for emphasis.

[CGFR 68–82, 33 FR 18828, Dec. 18, 1968, as amended by CGFR 69–127, 35 FR 9976, June 17, 1970; CGFR 72–59R, 37 FR 6188, Mar. 25, 1972; CGD 72–206R, 38 FR 17226, June 29, 1973; CGD 73–254, 40 FR 40163, Sept. 2, 1975; CGD 77–147, 47 FR 21809, May 20, 1982; CGD 85–061, 54 FR 50963, Dec. 11, 1989. Redesignated by CGD 88–032, 56 FR 35822, July 29, 1991]

§54.01–5 Scope (modifies U–1 and U–2).

(a) This part contains requirements for pressure vessels. Table 54.01–5(a) gives a breakdown by parts in this subchapter of the regulations governing various types of pressure vessels, boilers, and thermal units.

(b) Pressure vessels are divided into Classes I, I–L (low temperature), II, II–L (low temperature), and III. Table 54.01–5(b) describes these classes and sets out additional requirements for welded pressure vessels.

(c) The requirements for pressure vessels by class are as follows:

(1) Class I–L and II–L pressure vessels must meet the applicable requirements in this part.

(2) Pressure vessels containing hazardous materials as defined in §150.115 of this chapter must meet the requirements of this part or, as applicable, the requirements in 49 CFR parts 171–177 or part 64 of this chapter.

(3) Except as provided in paragraph (c)(4) of this section, Classes I, II, and III pressure vessels not containing hazardous materials must be designed and constructed in accordance with the requirements in Section VIII, division 1, of the ASME Code and must be stamped with the ASME ''U'' symbol. These pressure vessels must also comply with the requirements that are listed or prescribed in paragraphs (d) through (g) of this section. Compliance with other provisions in this part is not required.

(4) Classes II and III pressure vessels that have a net internal volume of less than 0.14 cubic meters (5 cubic feet) and do not contain hazardous materials must be stamped with either the ASME ''U'' or ''UM'' symbol. Compliance with other provisions in this part is not required.

(d) Pressure vessels described in paragraph (c)(3) of this section must—

(1) Have detailed plans that include the information required by §54.01–18 (approved by the Office of Management and Budget under OMB control number 2130–0181);

(2) Meet §54.01.01–35, §54.20–3(c), and §54.25–3 of this part;

(3) Have pressure relief devices required by subpart 54.15;

(4) Meet the applicable requirements in §§54.10–3, 54.10–20, and 54.10–25 for inspection, reports, and stamping;

(5) If welded, meet the post weld heat treatment and minimum joint and radiography requirement in Table 54.01–5(b); and

(6) If a steam generating pressure vessel, meet §54.01–10.

(e) The plans required by paragraph (d)(1) of this section must be certified by a registered professional engineer to

meet the design requirements in paragraph (d) of this section and in section VIII, division 1, of the ASME Code. The certification must appear on all drawings and analyses. The plans must be made available to the Coast Guard prior to the inspection required by § 54.10–3(c).

(f) If a pressure vessel has more than one independent chamber and the chambers have different classifications, each chamber must, as a minimum, meet the requirements for its classification. If a single classification for the entire pressure vessel is preferred, the classification selected must be one that is required to meet all of the regulations applicable to the classification that is not selected. For example, if one chamber is Class I and one chamber is Class II–L, the only single classification that can be selected is Class I–L.

(g) The design pressure for each interface between two chambers in a multichambered pressure vessel must be—

(1) The maximum allowable working pressure (gauge) in the chamber with the higher pressure; or

(2) If one chamber is a vacuum chamber, the maximum allowable working pressure (absolute) in the other chamber minus the least operating pressure (absolute) in the vacuum chamber.

TABLE 54.01–5(A)—REGULATION REFERENCE FOR BOILERS, PRESSURE VESSELS, AND THERMAL UNITS

Service and pressure temperature boundaries	Part of subchapter regulating mechanical design	Part of subchapter regulating automatic control
Main (power) boiler: All	52	62
Pressure vessel: All	54	NA
Fired auxiliary boiler[1] (combustion products or electricity):		
(a) Steam:		
More than 103 kPa (15 psig)	52	[2] 62 or 63
Equal to or less than 103 kPa (15 psig)	53	63
(b) Hot water heating:		
More than 689 kPa (100 psig) or 121 °C (250 °F)	52	63
Equal to or less than 689 kPa (100 psig) and 121 °C (250 °F)	53	63
(c) Hot water supply:		
More than 689 kPa (100 psig) or 121 °C (250 °F)	52	63
Equal to or less than 689 kPa (100 psig) and 121 °C (250 °F)	53	63
Other:		
(a) Fired thermal fluid heaters: All	52	63
(b) Unfired steam boiler:		
More than 206 kPa (30 psig) or 454 °C (850 °F)[3]	52	NA
Equal to or less than 206 kPa (30 psig) and 454 °C (850 °F)	54	NA
(c) Evaporators and heat exchangers: More than 103 kPa (15 Sig)[4]	54	NA
(d) Unfired hot water supply or heating boiler: More than 103 kPa (15 psig)[4]	54	NA

[1] Including exhaust gas types.
[2] Boilers with heat input ratings >=12,500,000 Btu/hr. must have controls that meet part 62. Boilers with heat input ratings <12,500,000 Btu/hr. must have controls that meet part 63.
[3] Temperature of working fluid.
[4] Relief device is required even if designed for less than 103 kPa (15 psig).

TABLE 54.01–5(B)—PRESSURE VESSEL CLASSIFICATION [8]

Class	Service contents	Class limits on pressure and temperature	Joint requirements [1,6,7]	Radiography requirements, section VIII, ASME Code [3,7]	Post weld heat treatment required [5,7]	Shop inspect. required	Plan approval required
I	(a) Vapor or gas (b) Liquid (c) Hazardous materials [2].	Over 600 p.s.i. or 700 °F Over 600 p.s.i. or 400 °F	(1) For category A; (1) or (2) For category B. All categories C and D must have full penetration welds extending through the entire thickness of the vessel wall or nozzle wall.	Full on all butt joints regardless of thickness. Exceptions listed in Table UCS–57 of ASME Code do not apply.	For carbon or low alloy steel, in accordance with Table UCS–56, regardless of thickness. For other materials, in accordance with section VIII, ASME Code.	Yes [4]	Yes [4].
I–L Low temperature.	(a) Vapor or gas (b) Liquid (c) Hazardous materials [2]	Over 250 p.s.i. and service temperature below 0 °F Over 250 p.s.i. and service temperature below 0 °F	(1) for categories A and B. All categories C and D must have full penetration welds extending through the entire thickness of the vessel wall or nozzle wall. No backing rings or strips left in place.	Full on all butt joints regardless of thickness. Exceptions listed in Table UCS–57 of ASME Code do not apply.	For carbon or low alloy steel, in accordance with Table UCS–56, regardless of thickness. For other materials, in accordance with section VIII, ASME Code.	Yes	Yes.
II	(a) Vapor or gas (b) Liquid (c) Hazardous materials [2,3,6]	30 through 600 p.s.i. or 275° through 700 °F 200 through 600 p.s.i. or 250° through 400 °F	(1) or (2) for category A. (1), (2), or (3) for category B. Categories C and D in accordance with UW–16 of ASME Code.	Spot, unless exempted by UW–11(c) of ASME Code.	In accordance with section, VIII of ASME Code.	Yes [4]	Yes [4].
II–L Low temperature.	(a) Vapor or gas (b) Liquid (c) Hazardous materials [2]	0 through 250 p.s.i. and service temperature below 0 °F 0 through 250 p.s.i. and service temperature below 0 °F	(1) for category A; (1) or (2) for category B. All categories C and D must have full penetration welds extending through the entire thickness of the vessel wall or nozzle wall.	Spot. The exemption of UW–II(c) of ASME Code does not apply.	Same as for I–L except that mechanical stress relief may be substituted if allowed under subpart 54.30 of this chapter.	Yes	Yes.
III	(a) Vapor or gas (b) Liquid (c) Hazardous materials [2,3,6]	Under 30 p.s.i. and 0° through 275 °F Under 200 p.s.i. and 0° through 250 °F	In accordance with Section VIII of AMSE Code.	Spot, unless exempted UW–II(c) of ASME Code.	In accordance with Section VIII of ASME Code.	Yes [4].	Yes [4].

[1] Welded joint categories are defined under UW–3 of the ASME Code. Joint types are described in Table UW–12 of the ASME Code, and numbered "(1)," "(2)", etc.
[2] See §54.20–2.
[3] See §§54.25–8(c) and 54.25–10(d).
[4] See §§54.01–15 and 54.10–3 for exemptions.
[5] Specific requirements modifying Table UCS–56 of the ASME Code are found in §54.25–7.
[6] See §54.20–3 (c) and (f)
[7] Applies only to welded pressure vessels.

(Approved by the Office of Management and Budget under OMB control number 2130–0181)

[CGFR 68–82, 33 FR 18828, Dec. 18, 1968, as amended by CGFR 69–127, 35 FR 9976, June 17, 1970; CGD 77–147, 47 FR 21809, May 20, 1982; 55 FR 696, Jan. 8, 1990; CGD 88–057, 55 FR 24236, June 15, 1990; CGD 85–061, 55 FR 41917, Oct. 16, 1990; CGD 95–027, 61 FR 26000, May 23, 1996]

§ 54.01–10 Steam generating pressure vessels (modifies U–1(e)).

(a) Pressure vessels in which steam is generated are classed as ''Unfired Steam Boilers'' except as required otherwise by paragraph (b) of this section. Unfired steam boilers must be fitted with an efficient water level indicator, a pressure gage, a blowdown valve, and an approved safety valve as required by § 54.15–15. Unfired steam boilers must be constructed in accordance with this part other than when the pressures are more than 206 kPa (30 psig) or the temperatures of the working fluid are more than 454 °C (850 °F) when such boilers must be constructed in accordance with part 52 of this subchapter.

(b) Vessels known as ''Evaporators'' or ''Heat Exchangers'' are not classified as unfired steam boilers. They shall be fitted with an approved safety device as required under § 54.15–15 and constructed in accordance with this part.

(c) An evaporator in which steam is generated shall be fitted with an efficient water level indicator, a pressure gage, and a blowdown valve.

[CGFR 68–82, 33 FR 18828, Dec. 18, 1968, as amended by CGD 81–79, 50 FR 9436, Mar. 8, 1985; CGD 95–012, 60 FR 48044, Sept. 18, 1995]

§ 54.01–15 Exemptions from shop inspection and plan approval (replaces U–1(c) (6) through (9)).

(a) The following classifications are exempt from shop inspection and plan approval requirements of this part:

(1) Vessels containing water at a pressure not greater than 100 pounds per square inch gage, nor a temperature above 200 °F., including those containing air, the compression of which serves only as a cushion. Air charging lines may be permanently attached provided the air pressure does not exceed 15 pounds per square inch gage.

(2) Hot water supply storage tanks heated by steam or any other indirect means when none of the following limitations is exceeded:

(i) A heat input of 200,000 B.t.u. per hour;

(ii) A water temperature of 200 °F.;

(iii) A nominal water-containing capacity of 120 gallons; or

(iv) A pressure of 100 pounds per square inch gage.

The exemption of any tank under this subparagraph requires that it shall be fitted with a safety relief valve of at least 1-inch diameter, set to relieve below the maximum allowable working pressure of the tank.

(3)(i) Vessels having an internal operating pressure not exceeding 15 pounds per square inch gage with no limitation on size. (See UG–28(e) of the ASME Code.)

(ii) Cargo tanks of pressure vessel configuration are not included in the exemption in paragraph (a)(3)(i) of this section.

(4) Class I, II, and III pressure vessels that meet the requirements of § 54.01–5(c)(3) and (c)(4).

(5) Condensers and heat exchangers, regardless of size, where the design is such that the liquid phase is not greater than 100 pounds per square inch gage and 200 °F. and the vapor phase is not greater than 15 pounds per square inch gage provided system over pressure conditions are considered.

(b) For fluid conditioner fittings see § 56.15–1 of this subchapter.

[CGFR 68–82, 33 FR 18828, Dec. 18, 1968, as amended by CGFR 69–127, 35 FR 9977, June 17, 1970; CGFR 70–143, 35 FR 19906, Dec. 30, 1970; CGD 77–147, 47 FR 21810, May 20, 1982]

§ 54.01–17 Pressure vessel for human occupancy (PVHO).

Pressure vessels for human occupancy (PVHO's) must meet the requirements of subpart B (Commercial Diving Operations) of part 197 of this chapter.

[CGD 76–009, 43 FR 53683, Nov. 16, 1978]

§ 54.01–18 Plan approval.

(a) Manufacturers intending to fabricate pressure vessels, heat exchangers, evaporators, and similar appurtenances, covered by the regulations in this part shall submit detailed plans in accordance with subpart 50.20 of this subchapter.

(b) The following information shall be submitted:

(1) Calculations for all pressure containment components including the maximum allowable working pressure, the hydrostatic or pneumatic test pressure, and the intended safety device setting.

(2) Joint design and methods of attachment of all pressure containment components.

(3) Foundations and supports (design and attachment).

(4) Pertinent calculations for pressure vessel foundations and/or supports.

(5) A bill of material meeting the requirements of section VIII of the ASME Code, as modified by this part.

(6) A diagrammatic arrangement drawing of the assembled unit indicating location of internal and external components.

§ 54.01–25 Miscellaneous pressure components (modifies UG–11).

(a) Pressure components for pressure vessels shall be as required by UG–11 of the ASME Code except as noted otherwise in this section.

(b) All pressure components conforming to an accepted ANSI (American National Standards Institute) Standard referred to in an adopted code, specification or standard or in this subchapter shall also be marked in accordance with MSS (Manufacturers' Standardization Society) Standard SP–25.

[CGFR 68–82, 33 FR 18828, Dec. 18, 1968, as amended by CGFR 69–127, 35 FR 9977, June 17, 1970]

§ 54.01–30 Loadings (modifies UG–22).

(a) The loadings for pressure vessels shall be as required by UG–22 of the ASME Code except as noted otherwise in this section.

(b) In evaluating loadings for certain pressure vessel applications, the Commandant may require consideration of the following loads in addition to those listed in UG–22 of the ASME Code:

(1) Loading imposed by vessel's attitude in roll, list, pitch and trim.

(2) Dynamic forces due to ship motions.

§ 54.01–35 Corrosion (modifies UG– 25).

(a) Vessels or portions of vessels subject to corrosion shall be as required by UG–25 of the ASME Code except as noted otherwise in this section.

(b) The pressure portions of pressure vessels shall:

(1) Normally have a corrosion allowance of one-sixth of the calculated thickness, or one-sixteenth inch, whichever is smaller, added to the calculated thickness as determined by the applicable design formula.

(2) Be specifically evaluated in cases where unusually corrosive cargoes will be involved, for the possible increase of this corrosion allowance.

(3) Have no additional thickness required when acceptable corrosion resistant materials are used.

(4) Not normally need additional thickness allowance when the effective stress (either S or SE depending on the design formula used) is 80 percent or less of the allowable stress listed in section VIII of the ASME Code for calculating thickness.

(c) Telltale holes shall not be permitted in pressure vessels containing dangerous fluids, such as acid, poison, corrosives, etc.

(d) Exemption from these corrosion allowance requirements will be granted by the Commandant in those cases where:

(1) The contents of the pressure vessel is judged to be sufficiently noncorrosive; and,

(2) Where the external surface is also protected from corrosion. A suitable vapor barrier is adequate protection, while paint or other thin coatings exposed to weather or mechanical damage are not acceptable.

NOTE: No applied linings except as provided in Part UCL of the ASME Code shall be acceptable.

[CGFR 68–82, 33 FR 18828, Dec. 18, 1968, as amended by CGFR 72–59R, 37 FR 6189, Mar. 25, 1972]

§ 54.01–40 External pressure (modifies UG–28).

(a) The exemption from external pressure consideration provided by the note under UG–28(f) does not apply.

(b) Vessels which may at times be subjected to partial vacuum due to nature of the contents, temperature, unloading operations, or other facet of employment shall either have vacuum breaker protection or be designed for not less than one-half atmosphere of external pressure.

[CGFR 70–143, 35 FR 19906, Dec. 30, 1970]

Subpart 54.03—Low Temperature Operation

§ 54.03–1 Scope.

(a) The pressure vessels for low temperature operation shall be as required by section VIII of the ASME Code as modified by this subpart.

§ 54.03–5 General.

(a) Requirements for ferritic steels, high alloy steels, and heat treated ferritic steels are contained in §§ 54.25–10, 54.25–15, and 54.25–20 respectively of this subchapter.

(b) Requirements for toughness testing of material product forms and weldments (including weld procedure qualification and production toughness tests) are contained in subpart 54.05.

(c) Materials suitable for a given minimum service temperature may be used in warmer service. Steels differing in chemical composition, mechanical properties, or heat treatments from those specified may be specially approved by the Commandant. Similarly, aluminum alloys and other nonferrous materials not intended to be covered by these sections may be specially considered by the Commandant for service at any low temperature.

[CGFR 68–82, 33 FR 18828, Dec. 18, 1968, as amended by CGFR 69–127, 35 FR 9977, June 17, 1970]

Subpart 54.05—Toughness Tests

§ 54.05–1 Scope (replaces UG–84).

(a) The toughness tests of materials used in pressure vessels shall be as required by this subpart in lieu of requirements in UG–84 of the ASME Code.

§ 54.05–3 Tests required.

(a) Where material or welding toughness tests are required by §§ 54.25–10, 54.25–15, 54.25–20, and subpart 57.03 or 57.06 of this subchapter, the following requirements shall apply:

(1) Additional requirements for ferritic steels with properties enhanced by heat treatment are in § 54.25–20.

(2) Certified reports of toughness tests by the material manufacturer will be acceptable evidence provided the specimens taken are representative of the material delivered and that the material is not subject to treatment during or following fabrication that will reduce its impact properties. If such treatment is subsequently applied to the material, test specimens shall be so taken and treated as to be representative of the material in the finished vessel.

(b) The requirements of this subpart are also applicable to nonpressure vessel type low temperature tanks and associated secondary barriers, as defined in § 38.05–4 of subchapter D (Tank Vessels) of this chapter.

[CGFR 68–82, 33 FR 18828, Dec. 18, 1968, as amended by CGFR 69–127, 35 FR 9977, June 17, 1970]

§ 54.05–5 Toughness test specimens.

(a) *Charpy V-notch impact tests.* Where required, Charpy V-notch tests shall be conducted in accordance with ASTM Specification E–23, ''Notched Bar Impact Testing of Metallic Materials'', using the Type A specimen shown in Figure 4 of the specification. Special attention is drawn to the fact that the Charpy Keyhole and U-notch specimens are not acceptable substitutes for the Charpy V-notch specimen and shall not be used to qualify materials within the scope of this subpart. Each set of Charpy impact tests shall consist of three specimens. For materials ½-inch thick or less, the largest possible Charpy specimens for that thickness shall be cut centered at the material's mid-thickness. For materials thicker than ½-inch, full size Charpy specimens shall be cut centered at a location as near as practicable to a point midway between the material's surface and half-thickness. Except where otherwise specified, transversely oriented specimens must be used. When longitudinal specimens are used, the required energy values may not be less than 1.5 times the values required for transversely oriented specimens. In all cases the notch shall be cut normal to the material's surface. Test specimens shall be taken at least one ''t'' from any heat treated edge (where ''t'' is the material's nominal thickness).

(b) *Drop weight tests.* Where required, drop weight tests shall be conducted for no-break performance in accordance with ASTM Specification E–208,

''Conducting Drop-Weight Test to Determine Nil-Ductility Transition Temperature of Ferritic Steels''. For material thicknesses between ½-inch and ⅝-inch, the ASTM E–208 specimen P–3, machined to ½-inch thickness, shall be used with a stop distance of 0.090–inch. In preparing weld specimens for dropweight testing, weld reinforcement shall be ground flush, the hard facing bead centered on and transverse to the weld, and the notch centered on and parallel to the weld axis.

(c) *Retest procedures.* (1) When Charpy V-notch impact specimens are used and the average value of the three initial specimens fails to meet the stated requirements by an amount not exceeding 15 percent, or the value for more than one specimen is below the required average value of when the value for one specimen is below the minimum value permitted for a single specimen by an amount not exceeding 15 percent, three additional specimens from the same material may be tested and the results combined with those previously obtained to form a new average. This new average of six specimens must exceed the specified minimum average. In the event the Charpy retests fail, the material may still be qualified by exhibiting a no-break performance when tested in accordance with the drop weight procedure, if applicable. Two drop weight specimens shall be tested for each Charpy V-notch set of three initial specimens which failed to qualify. Failure of either or both of these drop weight specimens will constitute rejection of the material or weldments represented, except as outlined in paragraph (c)(3) of this section.

(2) When drop weight specimens are used, retests shall be permitted only within the limits prescribed in ASTM Specification E–208, except as outlined in paragraph (c)(3) of this section.

(3) If, for heat treated base material, the required toughness results are not obtained in the initial test or in the retest, the material may be reheat treated one time and tested again in accordance with the initial requirements for the material.

(d) *Alternate toughness tests.* The Charpy V-notch impact values of §§ 54.05–20(a) and 54.05–25(a) are representative of those which correlate with the nil-ductility transition temperature determined by the drop-weight tests for the steels specified in § 54.25–10. For materials for which there are other data showing suitable correlation between Charpy V-notch and drop-weight tests, V-notch acceptance limits different from those tabulated herein may be specially approved by the Commandant, based upon the actual correlation. In the case of steels for which the tabulated Charpy V-notch values can be shown to be inapplicable or in the case of specially considered steels, or as an alternative to complying with the tabulated impact requirements, acceptance may be based upon the material exhibiting a no-break performance when tested in accordance with the drop-weight procedure. Whenever the drop-weight test is used as an alternative to the Charpy V-notch test, two drop-weight specimens shall be tested for each set of three Charpy V-notch specimens otherwise required. If the drop-weight test cannot be performed because of material thickness limitations (less than one-half inch) or product shape, or is otherwise inapplicable (because of heat treatment, chemistry, etc.), other tests and/or test criteria will be specified by the Commandant to assure the adequacy of the material for the intended application.

[CGFR 68–82, 33 FR 18828, Dec. 18, 1968, as amended by CGD 73–254, 40 FR 40163, Sept. 2, 1975]

§ 54.05–6 Toughness test temperatures.

Each toughness test must be conducted at temperatures not warmer than −20 °F or 10 °F below the minimum service temperature, whichever is lower, except that for service at or below −320 °F, the tests may be conducted at the service temperature in accordance with § 54.25–10(a)(2).

[CGD 85–061, 54 FR 50964, Dec. 11, 1989]

§ 54.05–10 Certification of material toughness tests.

(a) *Plate material.* The manufacturer of plates may certify such material, provided it has been given an appropriate heat-treatment, by reporting the

results of tests of one set of Charpy impact specimens or of two drop weight specimens, as applicable, taken from each plate as rolled. Impact specimens shall be taken as outlined in section 4(b) of ASTM A–300. The long axis of the Charpy specimen must be perpendicular to the final direction of rolling. When the direction of maximum stress is unknown, the manufacturer may certify on the basis of specimens taken parallel to the final direction of rolling.

(b) *Pipe or tube material.* (1) The manufacturer of pipe, tube, or welded fittings formed from pipe or tube may certify such material by reporting the results of tests of one set of Charpy impact specimens, provided the requirement for production in this paragraph (b)(1) or paragraph (b)(2) of this section, as well as the requirement for sampling in paragraph (b)(3) of this section are met. The specimens shall have the major axis parallel to the length of pipe or tube. In the case of welding fittings, the specimens may be taken from the tubing prior to forming provided the fittings are normalized after forming. Such specimens shall be normalized before testing.

(2) One set of specimens may represent each five (5) short tons, or less, of the pipe, tubes, or welding fittings produced from one heat of steel poured from a single melting furnace charge and subsequently processed in the same manner, provided all are given a normalizing heat-treatment in a continuous treating furnace in which the temperature is automatically controlled and checked by recording pyrometer.

(3) One set of specimens may represent each five (5) short tons, or less, of the pipe, tubes, or welding fittings that have been given a normalizing heat-treatment as a single charge in a batch-treating furnace equipped with recording pyrometer provided all have been produced from a single melting furnace heat and are subsequently processed in the same manner. If more than one melting furnace heat is present in the batch heat-treating furnace, means of identification shall be provided and one set of specimens shall be taken from each heat.

(4) One set of impact specimens shall be taken from one pipe or tube picked at random from each heat or furnace batch or portion thereof to be certified.

(c) *Forgings and forged or rolled fittings.* (1) The manufacturer of forgings for any purpose may certify them by reporting the results of tests of one set of Charpy impact specimens or two drop-weight specimens, as applicable, taken from each 5 short tons of product from each melting heat provided the requirements in this paragraph for production and sampling are met.

(2) One or more test blocks shall be cut from billets or blooms selected at random from each heat of material. Each test block shall be forge-reduced in thickness to the thickness of the finished forgings to be certified, within the limitations set below. After forging to the reduced thickness, the test block shall be heat-treated in the same manner as the finished forgings represented, which heat-treatment of test blocks may be carried out in the furnace with the forgings, or separately. If carried out separately, both heat-treatments shall be done in automatically controlled furnaces equipped with calibrated recording pyrometers, the certified records of which shall be made available to the inspector.

(3) One set of Charpy impact specimens or two drop-weight specimens, as applicable, shall be cut from each such test block and these specimens shall represent all forgings (up to 5 short tons) that are from the same heat of material and given the same heat-treatment as the test block, and the thickness of which does not differ from that of the test block by more than plus or minus 50 percent of 1½ inches, whichever is less, except that forged flanges and tube sheets thicker than 5½ inches may be qualified from a 4-inch test block.

(4) As many test blocks shall be made as are required under the foregoing rule in paragraph (c)(3) of this section to cover the weight of product and range of thickness found in the forgings represented. The major axis of the test specimens shall be parallel to the length of the test block.

(d) *Bars and shapes, rolled or forged.* (1) The manufacturer of forged or rolled bars and shapes may certify such

by reporting the results of one set of Charpy impact specimens, or two drop-weight specimens, as applicable, produced from each 5 short tons from a single melting furnace heat, processed in a similar manner and heat-treated as a single furnace batch, if heat-treated. The impact specimens shall be cut from the heaviest section, clear of fillets, of the shape being tested with the axis of the specimens parallel to the axis of the bar or shape.

(e) *Castings.* (1) The manufacturer of castings may certify them by reporting the results of one set of Charpy impact specimens or two drop-weight specimens, as applicable, taken from each 5 short tons of product from each melting furnace heat. These specimens shall be taken either directly from a production casting or from test coupons cast attached thereto provided the additional requirements in this paragraph are met.

(2) One set of Charpy impact or two drop-weight specimens may represent all castings (up to 5 short tons) that are from the same heat of material and that have a thickness that does not differ from the thickness of the section from which the specimens were taken by more than plus or minus 25 percent, or 1½ inches, whichever is less. A wider range of thicknesses from one heat may be covered by taking additional sets of specimens from thicker or thinner material as may be required.

(3) The test specimens shall be heat-treated in the same manner as the castings represented, which heat-treatment of specimens may be carried out in the furnace with the castings represented, or separately, but if carried out separately both heat-treatments shall be done in automatically controlled furnaces equipped with calibrated recording pyrometers, the certified records of which shall be made available to the marine inspector.

(f) *Small parts.* The manufacturer of small parts, either cast or forged, may certify a lot of not more than 20 duplicate parts or 5 short tons, whichever is less, by reporting the results of one set of Charpy impact specimens, or two drop-weight specimens, as applicable, taken from one such part selected at random, provided the same kind of material and the same process of production were used for all of the lot. When the part is too small to provide the specimens of at least minimum size, no impact test need be made. For such parts too small to impact test, toughness qualifications shall be determined by the Commandant based on material, chemical, and mechanical properties.

[CGFR 68–82, 33 FR 18828, Dec. 18, 1968, as amended by CFR 73–254, 40 FR 40164, Sept. 2, 1975]

§ 54.05–15 Weldment toughness tests—procedure qualifications.

(a) Plate for which Charpy V-notch impact testing is required in the parent material and for which V-notch minima are specified shall similarly have welding procedures qualified for toughness by Charpy V-notch testing. For these tests, the test plates shall be oriented with their final rolling direction parallel to the weld axis (i.e., so that transverse impact specimens result), and with the V-notch normal to the plate surface. The sample weld joint preparation shall be the same as that used in production. The number of test specimens and the location of their notches shall be as shown in Figure 54.05–15(a) and as described in paragraphs (a) (1) through (5) of this section.

(1) Three specimens with the notch centered in the weld metal.

(2) Three specimens with the notch centered on the fusion line between parent plate and weld. (The fusion line may be identified by etching the specimen with a mild reagent.)

(3) Three specimens with the notch centered in the heat affected zone, 1 mm from the fusion line.

(4) Same as paragraph (a)(3) of this section, but 3 mm from the fusion line.

(5) Same as paragraph (a)(3) of this section, but 5 mm from the fusion line.

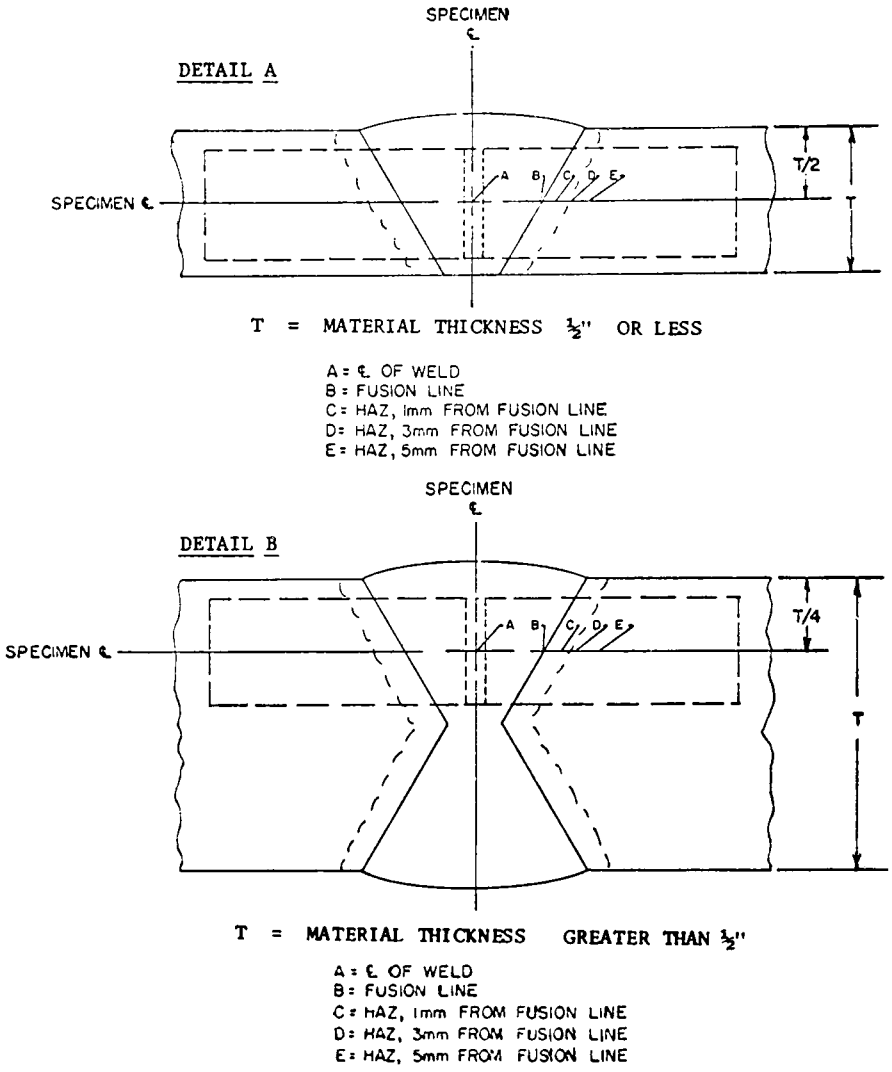


FIGURE 54.05–15(a)—Charpy V-notch specimen removal details.

(b) Plate materials for which Charpy V-notch minimums are not specified, or for which a Charpy V-notch correlation with NDT is not known, and which are themselves tested for toughness by the drop-weight procedure, shall have welding procedures similarly qualified by the drop-weight test. For such qualifications, two drop-weight specimens are to be tested, with the notch positioned directly above and parallel to the centerline of the weld.

(c) Piping welding toughness tests shall be qualified, by making Charpy V-notch impact tests as prescribed in paragraph (a) of this section.

(d) Materials which are specially approved based on toughness criteria or

tests, other than those discussed in paragraphs (a) and (b) of this section, shall have welding procedures tested and qualified for toughness as deemed appropriate and necessary by the Commandant.

(e) In the case of stainless steels, weld procedure toughness tests may be limited to weld metal only if this is all that is required by §54.25–15.

§54.05–16 Production toughness testing.

(a) For vessels of welded construction, production toughness test plates shall be prepared for each 50 feet of longitudinal and circumferential butt weld in each Class I–L vessel, or for each 150 feet in each Class II–L vessel, except for material other than stainless steel that is exempted from impact test requirements by this subchapter. In the case of stainless steels, weld production toughness tests may be limited to weld metal only if this is all that is required be §54.25–15. The test-plate thickness shall be the same as that of the vessel wall at the location of the production weld being sampled. The test plates shall be prepared, wherever possible, as run-off tabs attached at the ends of weld butts or seams. The rolling direction of the run-off tabs should be oriented parallel to the rolling direction of the adjacent production material. The test-plate material shall be taken from one of the heats of material used in the vessel, and both the electrodes and welding procedures shall be the same as used in the fabrication of the vessel. From each test plate, one set of three Charpy impact bars or two drop-weight specimens, as applicable according to the test used in procedure qualification, shall be taken transverse to the weld axis. For Charpy V-notch specimens, the notch shall be normal to the material surface and its location alternated (approximately) on successive tests between the weld metal and heat affected zone. Thus, approximately half of all weld production impact tests will be of weld metal and half of heat affected zone material. For the weld metal tests, the V-notch is to be centered between the fusion lines. For the heat affected zone tests, the notch is to be centered so as to sample, as nearly as practicable, the most critical location for toughness observed in the weld procedure qualification tests. Where the drop weight specimen is used in production weld testing, it shall be prepared in the same manner as specified for procedure qualification testing, §54.05–15(b).

(b) For vessels not exceeding 5 cubic feet in volume, one set of impact specimens, or two drop-weight specimens, as applicable according to the test used in procedure qualification, may represent all vessels from the same heat of material not in excess of 100 vessels, or one heat-treatment furnace batch. In addition, when such vessels are welded, one weld test plate made from one of the heats of material used, and two sets of impact specimens or two drop-weight specimens, as applicable, cut therefrom, may represent the weld metal in the smallest of: One lot of 100 vessels or less; or each heat-treatment furnace batch; or each 50 feet of welding for Class I–L vessels; or each 150 feet of welding for Class II–L vessels.

(c) For several vessels or parts of vessels being welded in succession, the plate thickness of which does not vary by more than one-fourth inch, and which are made of the same grade of material, a test plate shall be furnished for each 50 feet of welding for Class I–L vessels or 150 feet of welding for Class II–L vessels. For each 50- or 150-foot increment of weld, as applicable, the test plates shall be prepared at the time of fabrication of the first vessel involving that increment.

(d) The test plates and any other test material from which toughness test specimens are cut shall be given the same heat-treatment as the production material they represent. Test specimens representing other material than the weld toughness test plates shall preferably be cut from a part of the vessel material but may be cut from like material that has been heat-treated within the temperature range specified by the producer in treating the actual vessel material.

(e) For nonpressure vessel type tanks and associated secondary barriers, as defined in §38.05–4, subchapter D (Tank Vessels) of this chapter, production toughness test plates shall be prepared in accordance with paragraphs (a) and (d) of this section. One set of toughness

test plates shall be prepared for each 165 feet (50 meters) of production butt type welds.

§ 54.05–17 Weld toughness test acceptance criteria.

(a) For Charpy V-notch impact tests the energy absorbed in both the weld metal and heat affected zone impact tests in weld qualification and production shall be:

(1) For weld metal specimens, not less than the transverse values required for the parent material.

(2) For heat affected zone specimens, when the specimens are transversely oriented, not less than the transverse values required for the parent material.

(3) For heat affected zone specimens, when the specimens are longitudinally oriented, not less than 1.5 times the transverse values required for the parent material.

(b) For drop-weight tests both specimens from each required set shall exhibit a no-break performance.

[CGFR 68–82, 33 FR 18828, Dec. 18, 1968, as amended by CGD 73–254, 40 FR 40164, Sept. 2, 1975]

§ 54.05–20 Impact test properties for service of 0 °F and below.

(a) *Test energy*. The impact energies of each set of transverse Charpy specimens may not be less than the values shown in Table 54.05–20(a). Only one specimen in a set may be below the required average and the value of that specimen must be above the minimum impact value permitted on one specimen only. See § 54.05–5(c) for retest requirements.

TABLE 54.05–20(A)—CHARPY V-NOTCH IMPACT REQUIREMENTS

Size of specimen	Minimum impact value required for average of each set of 3 specimens foot-pounds [1]	Miminum impact value permitted on one specimen only of a set, foot-pounds
10 × 10 mm	20.0	13.5
10 × 7.5 mm	16.5	11.0
10 × 5 mm	13.5	9.0
10 × 2.5 mm	10.0	6.5

[1] Straight line interpolation for intermediate values is permitted.

(b) Transversely oriented Charpy V-notch impact specimens of ASTM A–203 nickel steels must exhibit energies not less than the values shown in § 54.05–20 (a). Requirements for 9 percent nickel steels are contained in § 54.25–20. Other nickel alloy steels, when specially approved by the Commandant, must exhibit a no-break performance when tested in accordance with the drop weight procedure. If, for such materials, there are data indicating suitable correlation with drop-weight tests, Charpy V-notch tests may be specially considered by the Commandant in lieu of drop-weight tests. If the drop-weight test cannot be performed because of material thickness limitations (less than one-half inch), or product shape, or is otherwise inapplicable (because of heat treatment, chemistry etc.) other tests or test criteria will be specified by the Commandant.

(c) Where sufficient data are available to warrant such waiver, the Commandant may waive the requirements for toughness testing austenitic stainless steel materials. Where required, austenitic stainless steels are to be tested using the drop-weight procedure and must exhibit a no-break performance. Where data are available indicating suitable correlation of Charpy V-notch results with drop-weight NDT or no-break performance, Charpy V-notch tests may be specially considered by the Commandant in lieu of dropweight tests. If the dropweight test cannot be performed because of material thickness limitations (less than one-half inch), or product shape, or is otherwise inapplicable (because of heat treatment, chemistry, etc.) other tests and/or test criteria will be specified by the Commandant.

[CGD 73–254, 40 FR 40164, Sept. 2, 1975]

§ 54.05–25 [Reserved]

§ 54.05–30 Allowable stress values at low temperatures.

(a) The Coast Guard will give consideration to the enhanced yield and tensile strength properties of ferrous and nonferrous materials at low temperature for the purpose of establishing allowable stress values for service temperature below 0 °F.

(b) The use of such allowable stress values must be specially approved by the Coast Guard for each application.

Further information may be obtained by writing to the Coast Guard (G–MSE).

(c) Submittals must include information and calculations specified by the Coast Guard (G–MSE) to demonstrate that the allowable stress for the material cannot be exceeded under any possible combination of vessel loads and metal temperature.

[CGD 73–133R, 39 FR 9179, Mar. 8, 1974, as amended by CGD 82–063b, 48 FR 4781, Feb. 3, 1983; CGD 95–072, 60 FR 50462, Sept. 29, 1995; CGD 96–041, 61 FR 50727, 50728, Sept. 27, 1996]

Subpart 54.10—Inspection, Reports, and Stamping

§ 54.10–1 Scope (modifies UG–90 through UG–103 and UG–115 through UG–120).

(a) The inspection, tests, stamping, and reports for pressure vessels shall be as required by paragraphs UG–90 through UG–103 and UG–115 through UG–120 of the ASME Code except as noted otherwise in this subpart.

§ 54.10–3 Marine inspectors (replaces UG–90 and UG–91, and modifies UG–92 through UG–103).

(a) Only marine inspectors shall apply the Coast Guard Symbol. They will not apply any other code symbol to pressure vessels.

(b) All pressure vessels not exempted under provisions of § 54.01–15 shall be inspected by a marine inspector referring to procedures outlined in UG–92 through UG–103 of the ASME Code and §§ 50.30–10, 50.30–15, and 50.30–20 of this subchapter. The marine inspector will then stamp the vessel with the Coast Guard Symbol.

(c) Pressure vessels described in § 54.01–5(c)(3), except pressure vessels in systems regulated under § 58.60 of this chapter, must be visually examined by a marine inspector prior to installation. The marine inspector also reviews the associated plans and manufacturers' data reports. If, upon inspection, the pressure vessel complies with the applicable requirements in § 54.01–5, the marine inspector stamps the pressure vessel with the Coast Guard Symbol.

[CGFR 68–82, 33 FR 18828, Dec. 18, 1968, as amended by CGD 77–147, 47 FR 21810, May 20, 1982]

§ 54.10–5 Maximum allowable working pressure (reproduces UG–98).

(a) The maximum allowable working pressure for a vessel is the maximum pressure permissable at the top of the vessel in its normal operating position at the operating temperature specified for that pressure. It is the least of the values found for maximum allowable working pressure for any of the essential parts of the vessel by the principles given in paragraph (b) of this section and adjusted for any difference in static head that may exist between the part considered and the top of the vessel. (See UA–60 (a) of the ASME Code.)

(b) The maximum allowable working pressure for a vessel part is the maximum internal or external pressure, including the static head thereon, as determined by the rules and formulas in this Division (ASME Code), together with the effect of any combination of loadings listed in UG–22 of the ASME Code (see § 54.01–30) which are likely to occur, for the designated coincident operating temperature, excluding any metal thickness specified as corrosion allowance. (See UG–25 of the ASME Code.)

(c) Maximum allowable working pressure may be determined for more than one designated operating temperature, using for each temperature the applicable allowable stress value.

NOTE: Table 54.10–5 gives pictorially the interrelation among the various pressure levels pertinent to this part of the regulations. It includes reference to section VIII of the ASME Code for definitions and explanations.

TABLE 54.10–5—PICTORIAL INTER-RELATION AMONG VARIOUS PRESSURE LEVELS WITH REFERENCES TO SPECIFIC REQUIREMENTS [1]

Pressure differential, psi [2]	Test pressures [3]	Relief device pressure settings	Pressures upon which relief device flow capacity is based
	Burst proof test (UG–101(m) of ASME Code).	.	
	Yield proof test (UG–101(j) of ASME Code).	.	
	Standard hydrostatic test (UG–99 of ASME Code).	.	
	.....	.....	Fire exposure, 120% MAWP.
	Pneumatic test (UG–100 of ASME Code).	.	
	.....	Rupture disk burst (§ 54.15–13).	
	.....	.....	Normal, 110% MAWP.
	Maximum allowable working pressure (MAWP), UG–98 and UA–60(a) of ASME Code.	Maximum allowable working pressure (MAWP), UG–98 and UA–60(a) of ASME Code.	Maximum allowable working pressure (MAWP), UG–98 and UA–60(a) of ASME Code.
	Design pressure, UG–21, and UA–60(b) of ASME Code.	Design pressure, UG–21 and UA–60(b) of ASME Code.	Design pressure, UG–21 and UA–60(b) of ASME Code.
	.....	Safety or relief value setting (UG–133 of ASME Code).	
	Operating pressure (UA–60(f) of ASME Code).	Operating pressure (UA–60(f) of ASME Code).	Operating pressure (UA–60(f) of ASME Code).

[1] For basic pressure definitions see § 52.01–3(g) of this subchapter.
[2] For pressure differentials above 3,000 pounds per square inch (p.s.i.), special requirements may apply.
[3] For the basis for calculating test pressures, see UA–60(e) of the ASME Code.

§ 54.10–10 Standard hydrostatic test (modifies UG–99).

(a) All pressure vessels shall satisfactorily pass the hydrostatic test prescribed by this section, except those pressure vessels noted under § 54.10–15(a).

(b) The hydrostatic test pressure shall be at least one and one-half times the maximum allowable working pressure stamped on the pressure vessel, multiplied by the ratio of the stress value ''S'' at the test temperature to the stress value ''S'' at the design temperature for the materials of which the pressure vessel is constructed. The values for ''S'' shall be taken from Tables UCS 23, UNF 23, UHA 23, or UHT 23 of the ASME Code. The value of ''S'' at test temperature shall be that taken for the material of the tabulated value of temperature closest to the test temperature. The value of ''S'' at design temperature shall be as interpolated from the appropriate table. No ratio less than one shall be used. The stress resulting from the hydrostatic test shall not exceed 90 percent of the yield stress of the material at the test temperature. External loadings which will exist in supporting structure during the hydrostatic test should be considered. The design shall consider the combined stress during hydrostatic testing due to pressure and the support reactions. This stress shall not exceed 90 percent of the yield stress of the material at the test temperature. In addition the adequacy of the supporting structure during hydrostatic testing should be considered in the design.

(c) The hydrostatic test pressure shall be applied for a sufficient period of time to permit a thorough examination of all joints and connections. The test shall not be conducted until the vessel and liquid are at approximately the same temperature.

(d) Defects detected during the hydrostatic test or subsequent examination shall be completely removed and then inspected. Provided the marine inspector gives his approval, they may then be repaired.

(e) Vessels requiring stress relieving shall be stress relieved after any welding repairs have been made. (See UW–40 of the ASME Code.)

(f) After repairs have been made the vessel shall again be tested in the regular way, and if it passes the test, the marine inspector may accept it. If it

does not pass the test, the marine inspector can order supplementary repairs, or, if in his judgment the vessel is not suitable for service, he may permanently reject it.

§ 54.10–15 Pneumatic test (modifies UG–100).

(a) Pneumatic testing of welded pressure vessels shall be permitted only for those units which are so designed and/or supported that they cannot be safely filled with water, or for those units which cannot be dried and are to be used in a service where traces of the testing medium cannot be tolerated.

(b) Proposals to pneumatically test shall be submitted to the cognizant Officer in Charge, Marine Inspection, for approval.

(c) Except for enameled vessels, for which the pneumatic test pressure shall be at least equal to, but need not exceed, the maximum allowable working pressure to be marked on the vessel, the pneumatic test pressure shall be at least equal to 1.25 times the maximum allowable working pressure to be stamped on the vessel multiplied by the lowest ratio (for the materials of which the vessel is constructed) of the stress value ''S'' for the test temperature of the vessel to the stress value ''S'' for the design temperature (see UG–21 of the ASME Code). In no case shall the pneumatic test pressure exceed 1.25 times the basis for calculated test pressure as defined in UA–60(e) of the ASME Code.

(d) The pneumatic test of pressure vessels shall be accomplished as follows:

(1) The pressure on the vessel shall be gradually increased to not more than half the test pressure.

(2) The pressure will then be increased at steps of approximately one-tenth the test pressure until the test pressure has been reached.

(3) The pressure will then be reduced to the maximum allowable working pressure of the vessel to permit examination.

(e) Pressure vessels pneumatically tested shall also be leak tested. The test shall be capable of detecting leakage consistent with the design requirements of the pressure vessel. Details of the leak test shall be submitted to the Commandant for approval.

(f) After satisfactory completion of the pneumatic pressure test, the vessel may be stamped in accordance with § 54.10–20. A marine inspector shall observe the pressure vessel in a loaded condition at the first opportunity following the pneumatic test. The tank supports and saddles, connecting piping, and insulation if provided shall be examined to determine if they are satisfactory and that no leaks are evident.

(g) The pneumatic test is inherently more hazardous than a hydrostatic test, and suitable precautions shall be taken to protect personnel and adjacent property.

§ 54.10–20 Marking and stamping.

(a) *Pressure vessels (replaces UG–116, except paragraph (k), and UG–118).* Pressure vessels that are required by § 54.10–3 to be stamped with the Coast Guard Symbol must also be stamped with the following information:

(1) Manufacturer's name and serial number.

(2) Coast Guard number, see § 50.10–30 of this subchapter.

(3) Coast Guard Symbol, which is affixed only by the marine inspector.

(4) Maximum allowable working pressure kPa (psig) at °C (°F).

(5) Class.

(6) Minimum service temperature allowed, if below −18 °C (0 °F)

(7) Water capacity in liters (U.S. gallons), if a cargo carrying pressure vessel.

(b) *Multichambered pressure vessels (replaces UG–116(k)).* In cases where more than one pressure vessel is involved in an integral construction, as with a heat exchanger, the manufacturer may elect to class the component pressure vessels differently. In such cases he shall stamp the combined structures as required in paragraph (a) of this section with information for each pressure vessel. Where an item for stamping is identical for both vessels, as with name and address of manufacturer, it need not be duplicated. However, where differences exist, each value and the vessel to which it applies shall be clearly indicated.

(c) *Stamping data* (*replaces UG–117*). Except as noted in paragraph (d) of this section, the data shall be stamped directly on the pressure vessel. The data shall be legibly stamped and shall not be obliterated during the service life of the pressure vessel. In the event that the portion of the pressure vessel upon which the data is stamped is to be insulated or otherwise covered, the data shall be reproduced on a metal nameplate. This plate shall be securely attached to the pressure vessel. The nameplate shall be maintained in a legible condition such that it may be easily read.

(1) Those parts of pressure vessels requiring Coast Guard shop inspection under this part which are furnished by other than the shop of the manufacturer responsible for the completed vessel shall be stamped with the Coast Guard Symbol, the Marine Inspection Office identification letters (see § 50.10–30 of this subchapter) and the word ''Part'', the manufacturer's name and serial number, and the design pressure.

(d) Thin walled vessels (modifies UG–119). In lieu of direct stamping on the pressure vessel, the information required by paragraph (a) of this section shall be stamped on a nameplate permanently attached to the pressure vessel when the pressure vessel is constructed of—

(1) Steel plate less than one-fourth inch thick; or

(2) Nonferrous plate less than one-half inch thick.

[CGFR 68–82, 33 FR 18828, Dec. 18, 1968, as amended by CGFR 69–127, 35 FR 9977, June 17, 1970; CGD 72–206R, 38 FR 17226, June 29, 1973; CGD 77–147, 47 FR 21810, May 20, 1982]

§ 54.10–25 Manufacturers' data report forms (modifies UG–120).

(a) The Manufacturers' data report form, as provided by the Coast Guard, shall be completed in duplicate and certified by the manufacturer for each pressure vessel required to be shop inspected under these regulations. The original of this form shall be delivered to the Coast Guard inspector.

(b) Data forms for those parts of a pressure vessel requiring inspection, which are furnished by other than the shop of the manufacturer responsible for the completed unit, shall be executed in triplicate by the manufacturer of the parts. The original and one copy shall be delivered to the Coast Guard inspector who shall forward one copy of the report to the Officer in Charge, Marine Inspection, having cognizance over the final assembly. These partial data reports, together with the final inspection and tests, shall be the final Coast Guard inspector's authority to apply the Coast Guard symbol and number. A final data report shall be executed by the manufacturer or assembler who completes the final assembly and tests.

(c) If a pressure vessel is required to be inspected in accordance with § 54.10–3(c), the manufacturer's data reports required by UG–120 must be made available to the Coast Guard inspector for review prior to inspection of the pressure vessel.

(Approved by the Office of Management and Budget under control number 2130–0181)

[CGFR 69–127, 35 FR 9977, June 17, 1970 as amended by CGD 77–147, 47 FR 21810, May 20, 1982]

Subpart 54.15—Pressure-Relief Devices

§ 54.15–1 General (modifies UG–125 through UG–136).

(a) All pressure vessels built in accordance with applicable requirements in Division 1 of section VIII of the ASME Code must be provided with protective devices as indicated in UG–125 through UG–136 except as noted otherwise in this subpart.

(b) The markings shall be in accordance with this chapter for devices covered by § 54.15–10.

[CGFR 68–82, 33 FR 18828, Dec. 18, 1968, as amended by CGD 88–032, 56 FR 35822, July 29, 1991]

§ 54.15–3 Definitions (modifies UA–60).

(a) Definitions applicable to this subpart are in § 52.01–3 of this subchapter.

§ 54.15–5 Protective devices (modifies UG–125).

(a) All pressure vessels must be provided with protective devices. The protective devices must be in accordance with the requirements of UG–125 through UG–136 of the ASME Code except as modified in this subpart.

(b) An unfired steam boiler evaporator or heat exchanger (see §54.01–10) shall be equipped with protective devices as required by §54.15–15.

(c) All pressure vessels other than unfired steam boilers shall be protected by pressure-relieving devices that will prevent the pressure from rising more than 10 percent above the maximum allowable working pressure, except when the excess pressure is caused by exposure to fire or other unexpected source of heat.

(d) Where an additional hazard can be created by exposure of a pressure vessel to fire or other unexpected sources of external heat (for example, vessels used to store liquefied flammable gases), supplemental pressure-relieving devices shall be installed to protect against excessive pressure. Such supplemental pressure-relieving devices shall be capable of preventing the pressure from rising more than 20 percent above the maximum allowable working pressure of the vessel. The minimum required relief capacities for compressed gas pressure vessels are given under §54.15–25. A single pressure-relieving device may be used to satisfy the requirements of this paragraph and paragraph (c) of this section, provided it meets the requirements of both paragraphs.

(e) Pressure-relieving devices should be selected on the basis of their intended service. They shall be constructed, located, and installed so that they are readily accessible for inspection and repair and so arranged that they cannot be readily rendered inoperative.

(f) Where pressure-indicating gages are used, they shall be chosen to be compatible with the pressure to be indicated. The size of the visual display, the fineness of graduations, and the orientation of the display will be considered. In no case shall the upper range of the gage be less than 1.2 times nor more than 2 times the pressure at which the relieving device is set to function.

(g) The Commandant may authorize or require the use of a rupture disk in lieu of a relief or safety valve under certain conditions of pressure vessel use and design. See §54.15–13.

(h) Vessels that are to operate completely filled with liquid shall be equipped with liquid relief valves unless otherwise protected against overpressure.

(i) The protective devices required under paragraph (a) of this section shall be installed directly on a pressure vessel except when the source of pressure is external to the vessel, and is under such positive control that the pressure in the vessel cannot exceed the maximum allowable working pressure at the operating temperature except as permitted in paragraphs (c) and (d) of this section.

(j) Pressure-relieving devices shall be constructed of materials suitable for the pressure, temperature, and other conditions of the service intended.

(k) The opening through all pipes and fittings between a pressure vessel and its pressure-relieving device shall have at least the area of the pressure-relieving device inlet, and in all cases shall have sufficient area so as not to unduly restrict the flow to the pressure-relieving device. The opening in the vessel shall be designed to provide direct and unobstructed flow between the vessel and its pressure-relieving device.

(l) Safety devices need not be provided by the pressure vessel manufacturer. However, overpressure protection shall be provided prior to placing the vessel in service.

[CGFR 68–82, 33 FR 18828, Dec. 18, 1968, as amended bu CGD 88–032, 56 FR 35822, July 29, 1991; CGD 95–012, 60 FR 48049, Sept. 18, 1995]

§54.15–10 Safety and relief valves (modifies UG–126).

(a) All safety and relief valves for use on pressure vessels or piping systems shall be designed to meet the protection and service requirements for which they are intended and shall be set to relieve at a pressure which does not exceed the ''maximum allowable working pressure'' of the pressure vessel or piping system. Relief valves are not required to have huddling chambers for other than steam service. In addition, safety valves used on vessels in which steam is generated shall meet §52.01–120 of this subchapter except §52.01–120(a)(9). For steam service below 206 kPa (30 psig), bodies of safety

valves may be made of cast iron. Safety relief valves used in liquefied compressed gas service shall meet subpart 162.017 or 162.018 in subchapter Q (Specifications) of this chapter as appropriate.

(b) Pilot-valve control or other indirect operation of safety valves is not permitted unless the design is such that the main unloading valve will open automatically at not over the set pressure and will discharge its full rated capacity if some essential part of the pilot or auxiliary device should fail. All other safety and relief valves shall be of the direct spring loaded type.

(c) Safety and relief valves for steam or air service shall be provided with a substantial lifting device so that the disk can be lifted from its seat when the pressure in the vessel is 75 percent of that at which the valve is set to blow.

(d) Safety and relief valves for service other than steam and air need not be provided with a lifting device although a lifting device is desirable if the vapors are such that their release will not create a hazard.

(e) If the design of a safety or relief valve is such that liquid can collect on the discharge side of the disk, the valve shall be equipped with a drain at the lowest point where liquid can collect (for installation, see UG–134 of section VIII of the ASME Code).

(f) Cast iron may be employed in the construction of relief valves for pressures not exceeding 125 pounds per square inch and temperatures not exceeding 450 °F. Seats or disks of cast iron are prohibited.

(g) The spring in a relief valve in service for pressures up to and including 250 pounds per square inch shall not be reset for any pressure more than 10 percent above or 10 percent below that for which the relief valve is marked. For higher pressures, the spring shall not be reset for any pressure more than 5 percent above or 5 percent below that for which the relief valve is marked.

(h) The rated relieving capacity of safety and relief valves for use on pressure vessels shall be based on actual flow test data and the capacity shall be certified by the manufacturer in accordance with one of the following:

(1) 120 percent of the valve set pressure for valves rated in accordance with Compressed Gas Association Standard S–1.2.5.2.

(2) 110 percent of the valve set pressure for valves rated in accordance with UG–131 of section VIII of the ASME Code.

(3) 103 percent of the valve set pressure for steam in accordance with PG–69 of the ASME Code.

[CGFR 68–82, 33 FR 18828, Dec. 18, 1968, as amended by CGD 81–79, 50 FR 9436, Mar. 8, 1985]

§ 54.15–13 Rupture disks (modifies UG–127).

(a) Paragraph UG–127 of the ASME Code provides for the use of rupture disks in series with spring loaded safety or relief valves.

(b) For certain pressure vessels containing substances which may render a relief or safety valve inoperative, or where the installation of a valve is considered impractical, the Commandant may authorize or require the use of a rupture disk in parallel with or in lieu of a spring loaded safety or relief valve. These rupture disks shall:

(1) Comply with the general provisions of § 54.15–5 except as noted otherwise in this section;

(2) Have a capacity for discharge such that the volume of release is sufficient to prevent the internal pressure from exceeding 120 percent of the ''maximum allowable working pressure'' with the pressure vessel exposed to fire conditions (see § 54.15–25); and,

(3) Operate at a pressure level which does not produce fatigue failure of the disk. The normal maximum operating pressure multiplied by 1.3 shall not exceed the nominal disk burst pressure. (Notice that this restriction for protection of the rupture disk will usually require operation below the ''maximum allowable working pressure'' of the pressure vessel and therefore should be considered in design.)

(c) All disks shall be oriented so that if rupture occurs, the disk fragments and pressure vessel discharge will be directed away from operating personnel and vital machinery.

§ 54.15–15 Relief devices for unfired steam boilers, evaporators, and heat exchangers (modifies UG–126).

(a) An approved safety valve set to relieve at a pressure not exceeding the ''maximum allowable working pressure'' of the shell shall be fitted to all unfired steam boilers and evaporators except for evaporators of the atmospheric type designed for vapor discharge direct to a distiller with no shutoff valve in the discharge line. The distiller connected to atmospheric evaporators shall be fitted with a vent to prevent a buildup in pressure. In no case shall the vent be less than 1½ inches in diameter. Evaporators operating between atmospheric pressure and 15 p.s.i.g., may use a rupture disc as an alternative to the safety valve.

(b) Safety valves for use on pressure vessels in which steam or pressure is generated shall comply with the requirements of § 54.15–10. Rupture discs used in lieu of these safety valves, as provided for in paragraph (a) of this section, shall comply with the requirements of § 54.15–13.

(c) The relieving capacity of evaporator safety valves required by paragraph (a) of this section shall be at least equal to the capacity of the orifice fitted in the steam supply to the evaporator. The orifice capacity shall be determined in accordance with the formula in paragraph (c)(1) or (2) of this section as appropriate:

(1) Where the set pressure of the evaporator shell safety valve is 58 percent or less than the setting of the safety valve in the steam supply:

$$W=51.45AP$$

(2) Where the set pressure of the evaporator shell safety valve exceeds 58 percent of the setting of the safety valve on the steam supply:

$$W=105.3A\sqrt{P_1(P-P_1)}$$

where:

W=The required orifice capacity, in pounds per hour.

A=Cross-sectional area of rounded entrance orifice, in square inches. The orifice shall be installed near the steam inlet or the coils or tubes and where no orifice is employed the area used in the formula shall be that of the inlet connection or manifold.

P=Set pressure of steam supply safety valve, in pounds per square inch, absolute.

P_1=Set pressure of evaporator shell safety valve, in pounds per square inch, absolute.

(d) The relieving capacity of safety valves on unfired steam boilers shall not be less than the maximum generating capacity of the unfired steam boiler as certified by the manufacturer.

(e) On new installations and where the orifice size of an existing unfired steam boiler or evaporator is increased, an accumulation test shall be made by closing all steam outlet connections except the safety valves for a period of five minutes. When conducting the accumulation test, the water shall be at the normal operating level and the steam pressure shall be at the normal operating pressure, and while under this test the pressure shall not rise more than 6 percent above the safety valve setting.

(f) A heat exchanger with liquid in the shell and the heating medium in the tubes or coils, shall be fitted with a liquid relief valve meeting the requirement of § 54.15–5.

(g)(1) A heat exchanger with steam in the shell and liquid in the tubes or coils at a pressure exceeding that in the shell, shall have a liquid relief valve fitted to protect the shell against excess pressure.

(2) The discharge capacity of such relief valves shall be calculated on the basis of the discharge from one tube using the difference in pressures between that in the shell and that in the tubes and shall be not less than that determined by the following formula:

$$Q=29.81KD^2\sqrt{P_1-P_2}$$

where:

Q=Required relief valve discharge capacity, in gallons per minute, based on relief valve set pressure.

P_1=Pressure in the tube or coils, in pounds per square inch.

P_2=Set pressure of the shell relief valve, in pounds per square inch.

D=Internal diameter of the largest tube or coil, in inches.

K=Coefficient of discharge=0.62.

[CGFR 68–82, 33 FR 18828, Dec. 18, 1968, as amended by CGD 72–206R, 38 FR 17226, June 29, 1973]

§ 54.15–25 Minimum relief capacities for cargo tanks containing compressed or liquefied gas.

(a) Each tank shall be fitted with one or more safety relief valves designed, constructed, and flow tested in accordance with subpart 162.017 or 162.018 in subchapter Q (Specifications) of this chapter. Valves conforming to specification subpart 162.017 shall be limited to use on tanks whose maximum allowable working pressure is not in excess of 10 pounds per square inch. With specific approval of the Commandant, such valves may be connected to the vessel in lieu of being directly fitted to the tanks.

(b) The discharge pressure and the maximum overpressure permitted shall be in accordance with § 54.15–5.

(c) The rate of discharge for heat input of fire must meet the following formula:

$$Q = FGA^{0.82}$$

where:

Q=minimum required rate of discharge in cubic meters (cubic feet) per minute of air at standard conditions 0 °C and 1.03 kp/cm² (60 °F and 14.7 psia).

F=fire exposure factor for the following tank types:

F=1.0 for tanks without insulation located on the open deck.

F=0.5 for tanks on the open deck having insulation that has approved fire proofing, thermal conductance, and stability under fire exposure.

F=0.5 for uninsulated independent tasks installed in holds.

F=0/2 for insulated independent tanks in holds or for uninsulated independent tanks in insulated holds.

F=0.1 for insulated independent tanks in inerted holds or for uninsulated independent tanks in inerted, insulated holds.

F=0.1 for membrane and semi-membrane tanks.

G=gas factor of:

$$G = \frac{177}{LC}\sqrt{\frac{ZT}{M}} \left(G = \frac{633{,}000}{LC}\sqrt{\frac{ZT}{M}} \right)$$

where:

L=latent heat of the material being vaporized at the relieving conditions, in Kcal/kg (Btu per pound).

C=constant based on relation of specific heats (k), Table § 54.15–25(c) (if k is not known, C=.606(315)).

Z=compressibility factor of the gas at the relieving conditions (if not known, Z=1.0).

T=temperature in degrees K=(273 + degrees C) (R=(460 + degrees F)) at the relieving conditions (120% of the pressure at which the pressure relief valve is set).

M=molecular weight of the product.

A=external surface area of the tank in m² (sq. ft.) for the following tank types:

For a tank of a body of revolution shape:

A=external surface area.

For a tank other than a body of revolution shape:

A=external surface area less the projected bottom surface area.

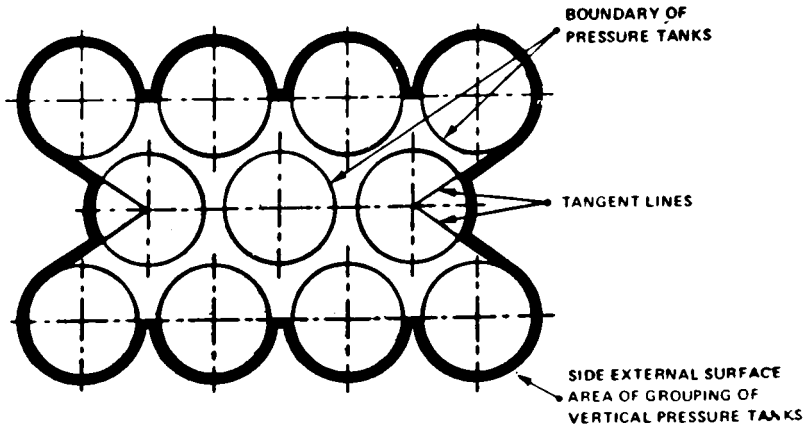
For a grouping of pressure vessel tanks having insulation on the vessel's structure:

A=external surface area of the hold without the projected bottom area.

For a grouping of pressure tanks having insulation on the tank:

A=external surface area of the pressure tanks excluding insulation, and without the projected bottom area.[1]

[1] Figure 54.15–25(c) shows a method of determining the side external surface area of a grouping of vertical pressure tanks.



SIDE EXTERNAL SURFACE AREA OF GROUPING OF VERTICAL PRESSURE TANKS

Figure 54.15–25 (c)

TABLE 54.15–25(C)—CONSTANT C

k	C	
1.00	.606	(315)
1.02	.611	(318)
1.04	.615	(320)
1.06	.620	(322)
1.08	.624	(324)
1.10	.628	(327)
1.12	.633	(329)
1.14	.637	(331)
1.16	.641	(333)
1.18	.645	(335)
1.20	.649	(337)
1.22	.652	(339)
1.24	.658	(341)
1.26	.660	(343)
1.28	.664	(345)
1.30	.667	(347)
1.32	.671	(349)
1.34	.674	(351)
1.36	.677	(352)
1.38	.681	(354)
1.40	.685	(356)
1.42	.688	(358)
1.44	.691	(359)
1.46	.695	(361)
1.48	.698	(363)
1.50	.701	(364)
1.52	.704	(366)
1.54	.707	(368)
1.56	.710	(369)
1.58	.713	(371)
1.60	.716	(372)
1.62	.719	(374)
1.64	.722	(376)
1.66	.725	(377)
1.68	.728	(379)
1.70	.731	(380)
1.72	.734	(382)
1.74	.736	(383)
1.76	.739	(384)
1.78	.742	(386)
1.80	.745	(387)

TABLE 54.15–25(C)—CONSTANT C—Continued

k	C	
1.82	.747	(388)
1.84	.750	(390)
1.86	.752	(391)
1.88	.755	(392)
1.90	.758	(394)
1.92	.760	(395)
1.94	.763	(397)
1.96	.765	(398)
1.98	.767	(399)
2.00	.770	(400)
2.02	.772	(401)
2.20	.792	(412)

(c–1) For an independent tank that has a portion of the tank protruding above the open deck, the fire exposure factor must be calculated for the surface area above the deck and the surface area below the deck, and this calculation must be specially approved by the Commandant (G–MSE).

(d) In determining the total safety valve relieving capacity, the arrangement and location of the valves on the tank will be evaluated. The valves shall be placed so that a number of valves sufficient to provide the required relieving capacity shall always be in communication with the cargo vapor phase. The possible motions which the tank may see in its intended service and attendant changes in cargo liquid level will be considered. Shut off valves shall not be installed between

the vessel and the safety relief valves. Manifolds for mounting multiple relief valves may be fitted with acceptable interlocking shut off valves so arranged that the required capacity of discharge will be ''lined up'' at all times.

(e)(1) Each safety relief valve shall be tested in the presence of a marine inspector before being placed in service except as noted otherwise in paragraph (e)(2) of this section. The test shall satisfactorily show that the valve will start to discharge at the required minimum pressure.

(2) Each safety relief valve fitted with a breaking pin and rupture disk need not be tested in the presence of a marine inspector before being placed in service. In lieu thereof, a certificate shall be furnished with the valve attested to by the manufacturer that the test requirements of paragraph (e)(1) of this section have been met.

[CGFR 68–82, 33 FR 18828, Dec. 18, 1968, as amended by CGD 74–289, 44 FR 26007, May 3, 1979; CGD 82–063b, 48 FR 4781, Feb. 3, 1983; CGD 95–072, 60 FR 50462, Sept. 29, 1995; CGD 96–041, 61 FR 50728, Sept. 27, 1996]

Subpart 54.20—Fabrication by Welding

§ 54.20–1 Scope (modifies UW–1 through UW–65).

(a) Pressure vessels and vessel parts that are fabricated by welding shall be as required by paragraphs UW–1 through UW–65 of section VIII of the ASME Code except as noted otherwise in this subchapter.

(b) [Reserved]

§ 54.20–2 Fabrication for hazardous materials (replaces UW–2(a)).

(a) Pressure vessels containing hazardous materials as defined in § 150.115 of this chapter must be of the class and construction required by subchapter D, I, O, or, when not specified, of a class determined by the Commandant.

(b) Class III pressure vessels must not be used for the storage or stowage of hazardous materials unless there is specific authorization in subchapters D, I, or O.

[CGD 77–147, 47 FR 21810, May 20, 1982]

§ 54.20–3 Design (modifies UW–9, UW–11(a), UW–13, and UW–16).

(a) Fabrication by welding shall be in accordance with the provisions of this part and with part 57 of this subchapter.

(b) Welding subject to UW–11(a) of the ASME Code shall be modified as described in § 54.25–8 for radiographic examination.

(c) A butt welded joint with one plate edge offset, as shown in Figure UW–13.1(k) of the ASME Code, may only be used for circumferential joints of Class II and Class III pressure vessels.

(d) Attachment welds for nozzles and other connections shall be in accordance with UW–16 of the ASME Code. When nozzles or connections are made to pressure vessels, as shown in Figure UW–16.1 (a) and (c) of the ASME Code, and are welded from one side only, backing strips shall be used unless it can be determined visually that a full penetration weld has been achieved.

(e) When fabricating by welding the minimum joint requirements shall be as specified under the column headed ''minimum joint requirements'' in Table 54.01–5(b) for various classes of pressure vessels.

(f) Joints in Class II or III pressure vessel cargo tanks must meet the following:

(1) Category A and B joints must be type (1) or (2).

(2) Category C and D joints must have full penetration welds extending through the entire thickness of the vessel wall or nozzle wall.

[CGFR 68–82, 33 FR 18828, Dec. 18, 1968, as amended by CGD 77–147, 47 FR 21810, May 20, 1982; CGD 85–061, 54 FR 50964, Dec. 11, 1989]

§ 54.20–5 Welding qualification tests and production testing (modifies UW–26, UW–28, UW–29, UW–47, and UW–48).

(a) *Performance and procedure qualification.* No production welding shall be done until welding procedures and welders have been qualified in accordance with part 57 of this subchapter.

(b) *Tests.* Production tests are required in accordance with § 57.06–1 of this subchapter.

[CGFR 68–82, 33 FR 18828, Dec. 18, 1968, as amended by CGFR 69–127, 35 FR 9977, June 17, 1970]

Subpart 54.23—Fabrication by Brazing

§54.23–1 Scope (modifies UB–1).

(a) Fabrication by brazing shall be in accordance with the provisions of this part and with part 57 of this subchapter.

[CGFR 69–127, 35 FR 9977, June 17, 1970]

Subpart 54.25—Construction With Carbon, Alloy, and Heat Treated Steels

§54.25–1 Scope.

(a) The carbon, alloy, and heat treated steels used in construction of pressure vessels and parts shall be as indicated in section VIII of the ASME Code except as noted otherwise in this subpart.

§54.25–3 Steel plates (modifies UCS–6).

(a) The steels listed in UCS–6(b) and UCS–6(c) of the ASME Code will be allowed only in Class III pressure vessels (see Table 54.01–5(b)).

§54.25–5 Corrosion allowance (replaces UCS–25).

(a) The corrosion allowance shall be as required in §54.01–35 in lieu of requirements in UCS–25 of the ASME Code.

§54.25–7 Requirement for postweld heat treatment (modifies UCS–56).

(a) Postweld heat treatment is required for all carbon and low alloy steel Class I, I–L, and II–L vessels regardless of thickness. (Refer to Table 54.01–5(b) for applicable requirements.)

(b) Cargo tanks which are fabricated of carbon or low alloy steel as Class II pressure vessels, designed for pressures exceeding 100 pounds per square inch gage and used in the storage or transportation of liquefied compressed gases shall be postweld heat treated regardless of thickness.

[CGFR 69–127, 35 FR 9977, June 17, 1970]

§54.25–8 Radiography (modifies UW–11(a), UCS–57, UNF–57, UHA–33, and UHT–57).

(a) Full radiography is required for all Class I and Class I–L vessels regardless of thickness. (Refer to Table 54.01–5(b) for applicable requirements.)

(b) Class II–L vessels shall be spot radiographed. The exemption provided in UW–11(c) of the ASME Code does not apply. (Refer to Table 54.01–5(b) for applicable requirements.)

(c) Each butt welded joint in a Class II or III pressure vessel cargo tank must be spot radiographed, in accordance with UW–52, regardless of diameter or thickness, and each weld intersection or crossing must be radiographed for a distance of at least 10 thicknesses from the intersection.

[CGFR 68–82, 33 FR 18828, Dec. 18, 1968, as amended by CGD 85–061, 54 FR 50964, Dec. 11, 1989]

§54.25–10 Low temperature operation—ferritic steels (replaces UCS–65 through UCS–67).

(a) *Scope.* (1) This section contains requirements for pressure vessels and nonpressure vessel type tanks and associated secondary barrier, as defined in §38.05–4 and §154.7 of this chapter, and their parts constructed of carbon and alloy steels which are stressed at operating or hydrostatic test temperatures below 0 °F.

(2) The service temperature is the minimum temperature of a product at which it may be contained, loaded and/or transported. However, the service temperature shall in no case be taken higher than given by the following formula:

$$t_s = t_w - 0.25(t_w - t_B)$$

where:

t_s=Service temperature.

t_w=Boiling temperature of gas at normal working pressure of container but not higher than +32 °F.

t_B=Boiling temperature of gas at atmospheric pressure.

Only temperatures due to refrigerated service usually need to be considered in determining the service temperature, except pressure vessel type cargo tanks operating at ambient temperatures must meet paragraph (d) of this section. ''Refrigerated service'', as used in this paragraph, means a service in which the temperature is controlled by the process and not by atmospheric conditions.

(b) *Specifications.* Materials used in the construction of vessels to operate

below 0 °F. (but not below the designated minimum service temperature) shall conform to a specification given in Table UCS–23 in the ASME Code and the following additional requirements:

NOTE: For high alloy steels refer to § 54.25–15. For heat treated steels refer to § 54.25–20.

(1)(i) For minimum service temperatures not lower than −67 °F., ferritic steels shall be made with fine grain practice and shall have an austenitic grain size of 5 or finer, and shall be normalized. Consideration will be given to other heat treatments. Refer to § 57.03–1(d) of this subchapter. Plate for pressure vessel applications shall conform to the requirements of ASTM A–20. It may be produced by the open hearth, basic oxygen or electric furnace process and shall conform to the requirements of Table 54.25–10(b)(1). (Other alloying elements may only be present in trace amounts.)

(ii) Mechanical properties shall be within the following limits:

Ultimate strength ..... —58,000[1]–85,000[1] p.s.i.
Yield strength ..... —Minimum 35,000 p.s.i.
—Maximum 80 percent of ultimate.
Elongation minimum .... —20 percent in 8 inches, or
—24 percent in 2 inches, or
—22 percent in 5.65 √A, where "A" is the test specimen cross sectional area.

TABLE 54.25–10(B)(1)

Minimum service[1] temperature °F	Max. C[1] percent	Manganese range[1] percent
−30	0.20	0.70–1.35
−50	.16	1.15–1.50
−67	.12	1.30–1.60

[1]At service temperatures intermediate between those specified, intermediate amounts of carbon and manganese will be allowed (in proportion to the actual service temperature variation from that listed), provided all other chemical and mechanical properties specified for steels in this temperature range are satisfied.

	Range percent
Si	0.10–0.50
	Maximum
S	0.035
P	0.035
Ni	0.80
Cr	0.25
Mo	0.08
Cu	0.035
Nb	0.05
V	0.08

(2) For minimum service temperature below −67 °F., but not below the designated minimum service temperature, ferritic steels shall be normalized, low carbon, fully killed, fine grain, nickel alloy type, conforming to any one of the specifications in Table 54.25–10(b)(2). Consideration will be given to other heat treatments. Refer to § 57.03–1(d) of this subchapter for quenched and tempered steels. The ultimate and yield strengths shall be as shown in the applicable specification and shall be suitable to the design stress levels adopted. The service temperature shall not be colder than the minimum specified in Table 54.25–10(b)(2) for each steel.

TABLE 54.25–10(B)(2)

Steel	Minimum service temperature
A–203, 2¼ percent, Ni, normalized.	−80 °F. for Grade A. −75 °F. for Grade B.
A–203, 3½ percent, Ni, normalized.	−130 °F. for Grade D. −110 °F. for Grade E.
5 percent Ni, normalized	Dependent on chemical and physical properties.

(3) The materials permitted under paragraphs (b) (1) and (2) of this section shall be tested for toughness in accordance with and shall satisfy the applicable requirements of subpart 54.05.

(4) Welded pressure vessels or non-pressure vessel type tanks and associated secondary barriers, as defined in § 38.05–4 of subchapter D (Tank Vessels) of this chapter shall meet the toughness requirements of subparts 57.03 and 57.06 of this subchapter with regard to weld procedure qualifications and production testing.

(5) The material manufacturer's identification marking required by the material specification shall not be die-stamped on plate material less than one-fourth inch in thickness.

(c) *Design*. Pressure vessels must meet the requirements for Class I–L and II–L construction. (See Table 54.01–5(b) for applicable requirements). Except as permitted by § 54.05–30, the allowable stress values used in the design of low temperature pressure vessels may not exceed those given in Table UCS–23 of the ASME Code for temperatures of 0 °F. to 650 °F. For materials not listed in this Table allowable stress values are determined in accordance with Appendix P of Section VIII of the ASME Code.

(d) Weldments and all materials used in pressure vessel type cargo tanks operating at ambient temperatures and constructed of materials listed in Table UCS–23 must pass Charpy impact tests in accordance with UG–84 at a temperature of −20 °F or colder, except as provided by paragraphs (d)(1), (d)(2), and (d)(3) of this section.

(1) Charpy impact tests are not required for any of the following ASTM materials if the thickness for each is 5/8 inch or less, unless otherwise indicated:

(i) A–182, normalized and tempered.

(ii) A–302, Grades C and D.

(iii) A–336, Grades F21 and F22 that are normalized and tempered.

(iv) A–387, Grades 21 and 22 that are normalized and tempered.

(v) A–442, Grade 55 with a nominal thickness of 1″ or less.

(vi) A–516, Grades 55 and 60.

(vii) A–533, Grades B and C.

(viii) All other plates, structural shapes and bars, and other product forms, except for bolting, if produced to a fine grain practice and normalized.

(2) Charpy impact tests are not required for any of the following ASTM materials if the thickness for each is 1¼ inch or less:

(i) A–203.

(ii) A–442, produced to a fine grain practice and normalized.

(iii) A–508, Class 1.

(iv) A–516, normalized.

(v) A–524.

(vi) A–537.

(vii) A–612, normalized.

(viii) A–662, normalized.

(ix) A–724, normalized.

(3) Charpy impact tests are not required for any of the following bolt materials:

(i) A–193, Grades B5, B7, B7M, and B16.

(ii) A–307, Grade B

(iii) A–325, Type 1.

(iv) A–449.

[CGFR 68–82, 33 FR 18828, Dec. 18, 1968, as amended by CGFR 69–127, 35 FR 9977, June 17, 1970; CGD 73–133R, 39 FR 9178, Mar. 8, 1974; CGD 74–289, 44 FR 26007, May 3, 1979; CGD 77–069, 52 FR 31626, Aug. 21, 1987; CGD 85–061, 54 FR 50964, Dec. 11, 1989]

§ 54.25–15 Low temperature operation—high alloy steels (modifies UHA–23(b) and UHA–51).

(a) Toughness tests for the materials listed in UHA–51(a) of the ASME Code for service temperatures below −425 °F., UHA–51(b)(1) through (5) for service temperatures below 0 °F., and UHA–51(c) for all service temperatures, shall be performed in accordance with the requirements of subpart 54.05. These requirements are also applicable to nonpressure vessel type, low temperature tanks and associated secondary barriers, as defined in § 38.05–4 in subchapter D (Tank Vessels) of this chapter. Such tests are required regardless of the vessel's design stress. Service temperature is defined in § 54.25–10(a)(2).

(b) Materials for pressure vessels with service temperatures below −320 °F. shall be of the stabilized or low carbon (less than 0.10 percent) austenitic stainless steel type, produced according to the applicable specifications of Table UHA–23 of the ASME Code. These materials and their weldments shall be tested for toughness according to the requirements of subpart 54.05 except that the Charpy V-notch testing acceptance criteria will be in accordance with UHT–6(a)(4) and (5) of the ASME Code.''

(c) Except as permitted by § 54.05–30, the allowable stress values used in the design of low temperature pressure vessels may not exceed those given in Table UHA–23 of the ASME Code for temperatures of −20 °F. to 100 °F.

[CGFR 68–82, 33 FR 18828, Dec. 18, 1968, as amended by CGD 73–133R, 39 FR 9178, Mar. 8, 1974; CGD 73–254, 40 FR 40164, Sept. 2, 1975]

§ 54.25–20 Low temperature operation—ferritic steels with properties enhanced by heat treatment (modifies UHT–5(c), UHT–6, UHT–23, and UHT–82).

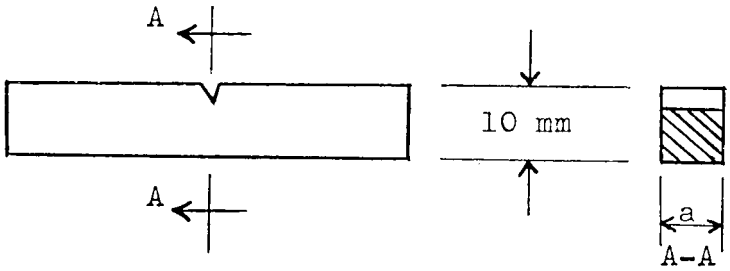
(a) For service temperatures below 0 °F. but not below the designated minimum service temperature, steel conforming to the specifications of Table 54.25–20(a) may be used in the fabrication of pressure vessels and nonpressure vessel tanks and associated secondary barriers, as defined in § 38.05–4 of subchapter D (Tank Vessels) of this chapter. The ultimate and yield

strengths shall be as shown in the applicable specification and shall be suitable for the design stress levels adopted. The service temperature shall not be colder than −320 °F. Service temperature is defined in § 54.25–10(a) (2).

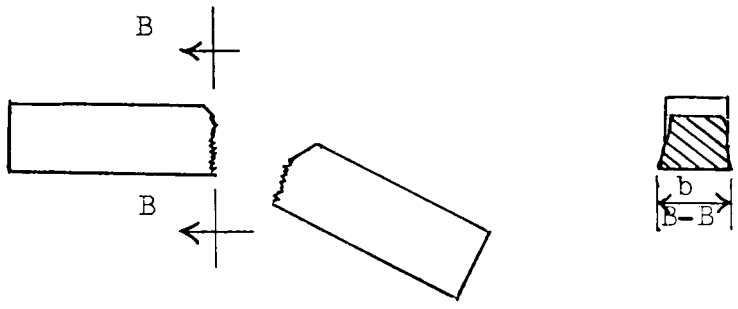
TABLE 54.25–20(A)

Steel	Minimum service temperature, °F.
A–333, 9 percent Ni, grade 8	−320
A–334, 9 percent Ni, grade 8	−320
A–353, 9 percent Ni, double normalized and tempered	−320
A–522, 9 percent Ni, NNT, Q and T, forging	−320
A–553, 9 percent Ni, quenched and tempered	−320

(b) The materials permitted under paragraph (a) of this section shall be tested for toughness in accordance with the requirements of UHT–6 of the ASME Code except that tests shall be conducted at the temperature specified in § 54.05–6 in lieu of that in UHT–5(c) of the ASME Code. Lateral expansion in a broken Charpy V-notch specimen is illustrated in Figure 54.25–20(b) and shall be measured in accordance with the procedure outlined in ASTM A–370.



CHARPY V-NOTCH SPECIMEN



BROKEN SPECIMEN

LATERAL EXPANSION = (b-a)

(c) The qualification of welding procedures and welders and weld production testing for the steels of Table 54.25–20(a) shall conform to the requirements of part 57 of this subchapter and subpart 54.05 except that the Charpy V-notch testing acceptance criteria shall be in accordance with UHT–6(a) (4) and (5) of the ASME Code.

(d) The values of absorbed energy in foot-pounds and of fracture appearance in percentage shear, which are recorded for information when complying with paragraphs (b) and (c) of this section shall also be reported to the marine inspector or the Commandant, as applicable.

(e) Except as permitted by § 54.05–30, the allowable stress values may not exceed those given in Table UHT–23 of the ASME Code for temperatures of 150 °F. and below.

[CGFR 68–82, 33 FR 18828, Dec. 18, 1968, as amended by CGD 73–133R, 39 FR 9179, Mar. 8, 1974]

§ 54.25–25 Welding of quenched and tempered steels (modifies UHT–82).

(a) The welding requirements in UHT–82 of the ASME Code shall be modified to require that the qualification of welding procedures and welders and weld production testing shall conform to the requirements of part 57 of this subchapter. The requirements are § 57.03–1(d) of this subchapter are applicable to welded pressure vessels and nonpressure vessel type tanks of quenched and tempered steels other than 9 percent nickel.

(b) [Reserved]

Subpart 54.30—Mechanical Stress Relief

§ 54.30–1 Scope.

(a) Certain pressure vessels may be mechanically stress relieved in accordance with the requirements in this subpart.

(b) [Reserved]

§ 54.30–3 Introduction.

(a) Large conventional pressure vessels used to transport liquefied petroleum and natural gases, at ''low temperatures'' may often be difficult to thermally stress relieve. Where no other problem, such as corrosion exists, mechanical stress relief will be permitted for Class II–L pressure vessels.

(b) Mechanical stress relief serves to cause small flaws, particularly in the weld zone, to yield plastically at the flaw tip resulting in a local relief of stress and a blunting of the crack tip. To achieve the maximum benefit from mechanical stress relief, it is necessary that the stresses so imposed be more severe than those expected in normal service life. At the same time, it is necessary that the stresses which are imposed are not so high as to result in appreciable deformation or general yielding.

(c) The weld joint efficiencies as listed in Table UW–12 of the ASME Code shall apply except that a minimum of spot radiography will be required. UW–12(c) of the ASME Code which permits omitting all radiography does not apply. Spot examination shall follow UW–52 of the ASME Code and in addition these vessels will be required to have radiographic examination of intersecting circumferential and longitudinal joints for a distance of at least 20 times the plate thickness from the junction. See § 54.20–10 on spot radiography.

(d) Severe cold forming will not be permitted unless thermal stress relief is used. For example, parts of the vessels which are individually cold formed, such as heads, must be thermally stress relieved, where the extreme fiber strain measured at the surface exceeds 5 percent as determined by:

$$\text{Percent strain} = (65t/R_f)[1-(R_f/R_o)]$$

where:

t = Plate thickness.

R_f = Final radius.

R_o = Original radius (equals infinity for flat plate).

§ 54.30–5 Limitations and requirements.

(a) Class II–L pressure vessels which require stress relief (see Table 54.01–5(b)) may be mechanically stress relieved provided:

(1) The steels from which they are fabricated do not specifically require thermal stress relief in UCS–56 of the ASME Code and have a ratio of yield to

ultimate tensile strength not greater than 0.8. For example: A–537 steels could be mechanically stress relieved.

(2) Pressure difference across the shell is not greater than 100 pounds per square inch, thickness of shell is not greater than 1 inch, and the design temperature is not greater than 115 °F.

(3) It will carry liquids of specific gravity no greater than 1.05.

(4) Design details are sufficient to eliminate stress concentrators: Mechanical stress relief is not acceptable in designs involving the following types of welded connections shown in UW–16.1 of the ASME Code:

(i) Types l, m, n, and p because of nonintegral reinforcement. Type o will be acceptable provided the plate, nozzle, and reinforcement assembly are furnace stress relieved and the reinforcement is at least 6 inches or 10t, whichever is larger, from the plate head.

(ii) Types d, e, and f because expansion and contraction stresses are concentrated at the junction points.

(5) That no slip-on flanges in sizes greater than 2 inches are used.

(6) The categories A and B joints are type one as described in Table UW–12 of the ASME Code and all categories C and D joints are full penetration welds. See UW–3 of the ASME Code for definition of categories.

(b) When a pressure vessel is to be mechanically stress relieved in accordance with §54.30–10(a)(1), its maximum allowable working pressure will be 40 percent of the value which would otherwise be determined. However, an increase of this 40 percent factor may be permitted if the stress relief is carried out at a pressure higher than that required by §54.30–10(a)(1) and an experimental strain analysis is carried out during stress relief. This evaluation should provide information as to the strains at the saddles, welded seams and nozzles as well as the body of the vessel. The hydrostatic pressure applied during stress relief should be such that, except in the case of welds, the stresses in the vessel shall closely approach but not exceed 90 percent of the yield stress of the material at the test temperature. The proposed experimental program should be submitted to the Commandant for approval prior to its use. Photo-elastic coating, strain gaging, or a brittle coating technique is suggested for the experimental analysis.

§54.30–10 Method of performing mechanical stress relief.

(a) The mechanical stress relief shall be carried out in accordance with the following stipulations using water as the pressurizing medium:

(1) At a hydrostatic pressure (measured at the tank top) of 1½ times the design pressure. (See UA–60(e) of the ASME Code.)

(2) At a temperature of 70 °F. or the service temperature plus 50 °F., whichever is higher. Where the ambient temperature is below 70 °F., and use of water at that temperature is not practical, the minimum temperature for mechanical stress relief may be below 70 °F. but shall not be less than 50 °F. above service temperature.

(3) The stress relief shall be at the required temperature and pressure and held for a period not less than 2 hours per inch of metal thickness, but in no case less than 2 hours.

(b) It is considered preferable that mechanical stress relief be accomplished with the tanks in place on their saddles or supporting structure in the barge or ship in which they will be utilized. In any case, it is considered mandatory that the tank be supported only by its regular saddles or supporting structure, without any auxiliary or temporary supports.

§54.30–15 Requirement for analysis and computation.

(a) A stress analysis shall be performed to determine if the tank may be exposed to excessive loadings during the mechanical stress relief process. This analysis should include consideration of the local stresses in way of saddles or other supporting structure and additional bending stresses due to the weight of the pressurizing liquid particularly in areas of high stress concentration. While it is necessary that the general stress level during the process be in excess of the normal working level, the calculated maximum stress during test shall not exceed 90 percent of the yield strength of the material at test temperature. The

supporting structure shall be analyzed to verify its adequacy.

(b) In all cases where the tanks are mechanically stress relieved in place in the ship or barge and the tanks are designed to carry cargoes with a specific gravity less than 1.05, the ship or barge shall be shown to have adequate stability and buoyancy, as well as strength to carry the excess weight of the tank during the stress relief procedure.

PART 56—PIPING SYSTEMS AND APPURTENANCES

Subpart 56.01—General

Sec.

Subpart 56.04—Piping Classification

Subpart 56.07—Design

Subpart 56.10—Components

Subpart 56.15—Fittings

Subpart 56.20—Valves

Subpart 56.25—Pipe Flanges, Blanks, Flange Facings, Gaskets, and Bolting

Subpart 56.30—Selection and Limitations of Piping Joints

Subpart 56.35—Expansion, Flexibility and Supports

Subpart 56.50—Design Requirements Pertaining to Specific Systems