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Welded flange means a flange attached to the tank by a weld joining the tank shell to the cylindrical outer surface of the flange, or by a fillet weld joining the tank shell to a flange shaped to fit the shell contour.

(d) A manufacturer of a cargo tank must hold a current ASME certificate of authorization and must be registered with the Department in accordance with part 107, subpart F of this chapter.

(e) All construction must be certified by an Authorized Inspector or by a Registered Inspector as applicable to the cargo tank.

(f) Each cargo tank must be designed and constructed in conformance with the requirements of the applicable cargo tank specification. Each DOT 412 cargo tank with a ''MAWP'' greater than 15 psig, and each DOT 407 cargo tank with a maximum allowable working pressure greater than 35 psig must be ''constructed and certified in conformance with Section VIII of the ASME Code'' (IBR, see §171.7 of this subchapter) except as limited or modified by the applicable cargo tank specification. Other cargo tanks must be ''constructed in accordance with Section VIII of the ASME Code,'' except as limited or modified by the applicable cargo tank specification.

(g) Requirements relating to parts and accessories on motor vehicles, which are contained in part 393 of the Federal Motor Carrier Safety Regulations of this title, are incorporated into these specifications.

(h) Any additional requirements prescribed in part 173 of this subchapter that pertain to the transportation of a specific lading are incorporated into these specifications.

(i) *Cargo tank motor vehicle composed of multiple cargo tanks.* (1) A cargo tank motor vehicle composed of more than one cargo tank may be constructed with the cargo tanks made to the same specification or to different specifications. Each cargo tank must conform in all respects with the specification for which it is certified.

(2) The strength of the connecting structure joining multiple cargo tanks in a cargo tank motor vehicle must meet the structural design requirements in §178.345–3. Any void within the connecting structure must be vented to the atmosphere and have a drain located on the bottom centerline. Each drain must be accessible and must be kept open at all times. The drain in any void within the connecting structure of a carbon steel, self-supporting cargo tank may be either a single drain of at least 1.0 inch diameter, or two or more drains of at least 0.5 inch diameter, 6.0 inches apart, one of which is located on the bottom centerline.

(j) *Variable specification cargo tank.* A cargo tank that may be physically altered to conform to another cargo tank specification must have the required physical alterations to convert from one specification to another clearly indicated on the variable specification plate.

[Amdt. 178–89, 54 FR 25020, June 12, 1989, as amended at 55 FR 37058, Sept. 7, 1990; Amdt. 178–105, 59 FR 55173, Nov. 3, 1994; Amdt. 178–118, 61 FR 51340, Oct. 1, 1996; 66 FR 45387, 45389, Aug. 28, 2001; 68 FR 19283, Apr. 18, 2003; 68 FR 52371, Sept. 3, 2003; 68 FR 75755, Dec. 31, 2003; 70 FR 56099, Sept. 23, 2005]

§178.345–2 Material and material thickness.

(a) All material for shell, heads, bulkheads, and baffles must conform to Section II of the ASME Code (IBR, see §171.7 of this subchapter) except as follows:

(1) The following steels are also authorized for cargo tanks ''constructed in accordance with the ASME Code'', Section VIII.

ASTM A 569
ASTM A 570
ASTM A 572
ASTM A 622
ASTM A 656
ASTM A 715
ASTM A 1008/ A 1008M, ASTM A 1011/A 1011M

(2) Aluminum alloys suitable for fusion welding and conforming with the 0, H32 or H34 tempers of one of the following ASTM specifications may be used for cargo tanks ''constructed in accordance with the ASME Code'':

ASTM B–209 Alloy 5052
ASTM B–209 Alloy 5086
ASTM B–209 Alloy 5154
ASTM B–209 Alloy 5254
ASTM B–209 Alloy 5454
ASTM B–209 Alloy 5652

All heads, bulkheads and baffles must be of 0 temper (annealed) or stronger

tempers. All shell materials shall be of H 32 or H 34 tempers except that the lower ultimate strength tempers may be used if the minimum shell thicknesses in the tables are increased in inverse proportion to the lesser ultimate strength.

(b) *Minimum thickness.* The minimum thickness for the shell and heads (or baffles and bulkheads when used as tank reinforcement) must be no less than that determined under criteria for minimum thickness specified in §178.320(a).

(c) *Corrosion or abrasion protection.* When required by 49 CFR part 173 for a particular lading, a cargo tank or a part thereof, subject to thinning by corrosion or mechanical abrasion due to the lading, must be protected by providing the tank or part of the tank with a suitable increase in thickness of material, a lining or some other suitable method of protection.

(1) *Corrosion allowance.* Material added for corrosion allowance need not be of uniform thickness if different rates of attack can reasonably be expected for various areas of the cargo tank.

(2) *Lining.* Lining material must consist of a nonporous, homogeneous material not less elastic than the parent metal and substantially immune to attack by the lading. The lining material must be bonded or attached by other appropriate means to the cargo tank wall and must be imperforate when applied. Any joint or seam in the lining must be made by fusing the materials together, or by other satisfactory means.

[Amdt. 178–89, 54 FR 25021, June 12, 1989, as amended at 55 FR 37059, Sept. 7, 1990; 56 FR 27876, June 17, 1991; Amdt. 178–97, 57 FR 45465, Oct. 1, 1992; Amdt. 178–118, 61 FR 51341, Oct. 1, 1996; 68 FR 19283, Apr. 18, 2003; 68 FR 75755, Dec. 31, 2003; 70 FR 34076, June 13, 2005]

§178.345–3 Structural integrity.

(a) *General requirements and acceptance criteria.* (1) The maximum calculated design stress at any point in the cargo tank wall may not exceed the maximum allowable stress value prescribed in Section VIII of the ASME Code (IBR, see §171.7 of this subchapter), or 25 percent of the tensile strength of the material used at design conditions.

(2) The relevant physical properties of the materials used in each cargo tank may be established either by a certified test report from the material manufacturer or by testing in conformance with a recognized national standard. In either case, the ultimate tensile strength of the material used in the design may not exceed 120 percent of the minimum ultimate tensile strength specified in either the ASME Code or the ASTM standard to which the material is manufactured.

(3) The maximum design stress at any point in the cargo tank must be calculated separately for the loading conditions described in paragraphs (b) and (c) of this section. Alternate test or analytical methods, or a combination thereof, may be used in place of the procedures described in paragraphs (b) and (c) of this section, if the methods are accurate and verifiable.

(4) Corrosion allowance material may not be included to satisfy any of the design calculation requirements of this section.

(b) *ASME Code design and construction.* The static design and construction of each cargo tank must be in accordance with Section VIII of the ASME Code. The cargo tank design must include calculation of stresses generated by the MAWP, the weight of the lading, the weight of structures supported by the cargo tank wall and the effect of temperature gradients resulting from lading and ambient temperature extremes. When dissimilar materials are used, their thermal coefficients must be used in the calculation of thermal stresses.

(1) Stress concentrations in tension, bending and torsion which occur at pads, cradles, or other supports must be considered in accordance with appendix G in Section VIII of the ASME Code.

(2) Longitudinal compressive buckling stress for ASME certified vessels must be calculated using paragraph UG–23(b) in Section VIII of the ASME Code. For cargo tanks not required to be certified in accordance with the ASME Code, compressive buckling