**Section 178.331 Specification MC 311; Cargo Tanks Constructed of Ferrous Metals or Aluminum, Primarily For the Transportation of Corrosive Liquids**

(Source: Added at 5 Ill. Reg. 1715, effective February 9, 1981)

**Section 178.331.0.1 [178.331-1] General Requirements**

a) Spec. MC 311 cargo tanks constructed on or before September 1, 1967 for the bulk transportation of hazardous materials must meet all the requirements contained in this section.

b) Tank design.

1) Ferrous materials.

A) Cargo tanks built of ferrous materials under this specification that are unloaded by pressure must be built of welded construction in accordance with

i) the 1949 edition,

ii) 1950 edition,

iii) 1952 edition, or

iv) the 1959 edition of Section VIII of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code, no revisions, except that for sheet thicknesses of less than 3/16 inch wherein the Code specifies both minimum and maximum limits of tensile value of materials, the maximum limits need not apply.

B) Such tanks shall not have head, bulkhead, baffle or shell thicknesses less than that specified in Section 178.331.0.3 (a) and (b), nor shall the spacing of bulkheads, baffles or shell stiffeners exceed that specified in those paragraphs.

2) Nonferrous materials. Methods of design, fabrication, and construction for nonferrous materials shall be such as to result in a cargo tank having properties at least equal to those of a ferrous cargo tank.

c) When divided into compartments. When the interior of the tank is divided into compartments, each compartment shall be designed, constructed and tested as a separate tank.

(Source: Added at 5 Ill. Reg. 1715, effective February 9, 1981)

**Section 178.331.0.2 [178.331-2] Material**

a) ASME Code materials. Cargo tanks required to comply with Section VIII of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code must be manufactured of materials authorized by the Code except that for sheet thicknesses of less than 3/16 inch wherein the Code specifies both minimum and maximum limits of tensile value of materials, the maximum limits need not apply.

b) Ferrous metal properties. Materials used in cargo tanks built to conform with the tables in Section 178.331.0.1 must have the following minimum physical properties:

Yield point 25,000 p.s.i.

Ultimate strength 45,000 p.s.i.

Minimum elongation, 2-inch sample 20 percent

c) Aluminum properties. Aluminum materials must have the following minimum physical properties:

Yield point 12,000 p.s.i.

Ultimate strength 17,000 p.s.i.

Minimum elongation, 2-inch sample 6 percent

d) Lining. Except as provided in paragraph (e) of this Section, cargo tanks must be lined and the material used for lining each cargo tank subject to this specification shall be homogenous, nonporous, imperforate when applied, not less elastic than the metal of the tank proper, and substantially immune to attack by the commodities to be transported therein. It shall be of substantially uniform thickness, and it shall be directly bonded or attached by other equally satisfactory means. Joints and seams in the lining shall be made by fusing the material together, or by other equally satisfactory means. The interior of the tank shall be free from scale, oxidation, moisture, and all foreign matter during the lining operation.

e) Conditions under which tanks need not be lined. Tanks need not be lined as provided in paragraph (d) of this Section, if:

1) The material of the tank is substantially immune to attack by the materials to be transported therein.

2) The material of the tank is thick enough to withstand 10 years' normal service without being reduced at any point to less thickness than that specified in Section 178.331.0.3 corresponding to its type, or

3) The chemical reaction between the material of the tank and the commodity to be transported therein is such as to allow the tank to be properly passivated or neutralized.

(Source: Added at 5 Ill. Reg. 1715, effective February 9, 1981)

**Section 178.331.0.3 [178.331-3] Thickness of Metal**

a) Head, bulkhead and baffle thicknesses. Tanks built under this specification that are not constructed in accordance with Section 178.331.0.2 (a) shall have head thicknesses conforming with those in the following tables:

Table I – Minimum Thickness of Heads, Bulkheads, and

Baffles (Dished, Corrugated, Reinforced or Rolled) –

For Mile High – Tensile and Stainless Steels

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Weight of product at 60°F. in pounds per gallon |  | | | |
|  | Volume capacity of tank in gallons per inch of length | | | |
|  | 10 or less | Over 10 to 14 | Over 14 to 18 | Over 18 |
| Less than 10 | 12 gauge1 | 10 gauge | 9 gauge | 8 gauge |
| 10 to 13 | 10 gauge | 8 gauge | 3/16-inch | ¼-inch |
| 13 to 16 | 8 gauge | 3/16-inch | ¼-inch | ¼-inch |

1 Wherever gauges are specified, the reference shall be to U.S. Standard gauge.

b) Shell thickness. Tanks built under this specification that are not constructed in accordance with Section 178.331.0.2 (a), shall have shell thicknesses conforming with those in the following tables:

Table II – For Liquids Less Than 10 Pounds Per Gallon

Minimum Shell Thickness to United States Standard Gauge

and Inches – for Mild, High – Tensile and Stainless Steel

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Distance between attachments of bulkheads, baffles or other shell stiffeners |  | | | |
|  | Volume capacity of tank in gallons per inch of length | | | |
|  | 10 or less | Over 10 to 14 | Over 14 to 18 | Over 18 |
|  | Maximum shell radius of less than 70 inches | | | |
| 36 inches or less | 12 gauge | 12 gauge | 12 gauge | 10 gauge |
| Over 36 inches to 54 inches | 12 gauge | 12 gauge | 10 gauge | 9 gauge |
| Over 54 inches to 60 inches | 12 gauge | 10 gauge | 9 gauge | 8 gauge |
|  | Maximum shell radius 70 inches or more but less  than 90 inches | | | |
| 36 inches or less | 12 gauge | 12 gauge | 10 gauge | 9 gauge |
| Over 36 inches to 54 inches | 12 gauge | 10 gauge | 9 gauge | 8 gauge |
| Over 54 inches to 60 inches | 10 gauge | 9 gauge | 8 gauge | 3/16-inch |
|  | Maximum shell radius 90 inches or more but less  than 125 inches | | | |
| 36 inches or less | 12 gauge | 10 gauge | 9 gauge | 8 gauge |
| Over 36 inches to 54 inches | 10 gauge | 9 gauge | 8 gauge | 3/16-inch |
| Over 54 inches to 60 inches | 9 gauge | 8 gauge | 3/16-inch | 3/16-inch |
|  | Maximum shell radius 125 inches or more | | | |
| 36 inches or less | 10 gauge | 9 gauge | 8 gauge | 3/16-inch |
| Over 36 inches to 54 inches | 9 gauge | 8 gauge | 3/16-inch | 3/16-inch |
| Over 54 inches to 60 inches | 8 gauge | 3/16-inch | 3/16-inch | ¼-inch |

Table III – For Liquids Over 10 to 13 Pounds Per Gallon

Minimum Shell Thickness to United States Standard Gauge

and Inches – for Mild, High – Tensile and Stainless Steel

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Distance between attachments of bulkheads, baffles or other shell stiffeners |  | | | |
|  | Volume capacity of tank in gallons per inch of length | | | |
|  | 10 or less | Over 10 to 14 | Over 14 to 18 | Over 18 |
|  | Maximum shell radius of less than 70 inches | | | |
| 36 inches or less | 10 gauge | 10 gauge | 10 gauge | 8 gauge |
| Over 36 inches to 54 inches | 10 gauge | 10 gauge | 8 gauge | 3/16-inch |
| Over 54 inches to 60 inches | 10 gauge | 8 gauge | 3/16 gauge | ¼-inch |
|  | Maximum shell radius 70 inches or more but less  than 90 inches | | | |
| 36 inches or less | 10 gauge | 10 gauge | 8 gauge | 3/16-inch |
| Over 36 inches to 54 inches | 10 gauge | 8 gauge | 3/16-inch | ¼-gauge |
| Over 54 inches to 60 inches | 8 gauge | 3/16-inch | ¼-inch | ¼-inch |
|  | Maximum shell radius 90 inches or more but less  than 125 inches | | | |
| 36 inches or less | 10 gauge | 8 gauge | 3/16-inch | 8 gauge |
| Over 36 inches to 54 inches | 8 gauge | 3/16-inch | ¼-inch | ¼-inch |
| Over 54 inches to 60 inches | 3/16-inch | ¼-inch | ¼-inch | ¼-inch |
|  | Maximum shell radius 125 inches or more | | | |
| 36 inches or less | 8 gauge | 3/16-inch | ¼-inch | ¼-inch |
| Over 36 inches to 54 inches | 3/16-inch | ¼-inch | ¼-inch | ¼-inch |
| Over 54 inches to 60 inches | ¼-inch | ¼-inch | ¼-inch | 5/16-inch |

Table IV – Liquids Over 13 to 16 Pounds Per Gallon

Minimum Shell Thickness to United States Standard Gauge

and Inches – for Mild, High – Tensile and Stainless Steel

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Distance between attachments of bulkheads, baffles or other shell stiffeners |  | | | |
|  | Volume capacity of tank in gallons per inch of length | | | |
|  | 10 or less | Over 10 to 14 | Over 14 to 18 | Over 18 |
|  | Maximum shell radius of less than 70 inches | | | |
| 36 inches or less | 8 gauge | 8 gauge | 8 gauge | 8 gauge |
| Over 36 inches to 54 inches | 8 gauge | 8 gauge | 3/16-inch | ¼-inch |
| Over 54 inches to 60 inches | 8 gauge | 3/16-inch | ¼-inch | ¼-inch |
|  | Maximum shell radius 70 inches or more but less  than 90 inches | | | |
| 36 inches or less | 8 gauge | 8 gauge | 3/16-inch | ¼-inch |
| Over 36 inches to 54 inches | 8 gauge | 3/16-inch | ¼-inch | ¼-inch |
| Over 54 inches to 60 inches | 3/16-inch | ¼-inch | ¼-inch | 5/16-inch |
|  | Maximum shell radius 90 inches or more but less  than 125 inches | | | |
| 36 inches or less | 8 gauge | 3/16-inch | ¼-inch | ¼-inch |
| Over 36 inches to 54 inches | 3/16-inch | ¼-inch | ¼-inch | 5/16-inch |
| Over 54 inches to 60 inches | ¼-inch | ¼-inch | 5/16-inch | 5/16-inch |
|  | Maximum shell radius 125 inches or more | | | |
| 36 inches or less | 3/16-inch | ¼-inch | ¼-inch | 5/16-inch |
| Over 36 inches to 54 inches | ¼-inch | ¼-inch | 5/16-inch | 5/16-inch |
| Over 54 inches to 60 inches | ¼-inch | 5/16-inch | 5/16-inch | 3/8-inch |

1. Cargo tanks built of non-ferrous metals. Cargo tanks constructed of materials other than mild high-tensile or stainless steel shall have shell and head thicknesses designed in accordance with the following formula:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | | | | | 3 x 107 |
| Thickness for materials other than steel | = | Steel thickness from tables | x | 3 | Modulus of elasticity of material to be used |

(Source: Added at 5 Ill. Reg. 1715, effective February 9, 1981)

**Section 178.331.0.4 [178.331-4] Joints**

All joints and seams formed in the manufacture of any cargo tank shall be made tight by welding.

(Source: Added at 5 Ill. Reg. 1715, effective February 9, 1981)

**Section 178.331.0.5 [178.331-5] Bulkheads, Baffles, Ring Stiffeners, Tank Supports, and Compartmentation**

Flat heads or flat bulkheads without reinforcement are not permitted. The use of baffles is not a specification requirement.

(Source: Added at 5 Ill. Reg. 1715, effective February 9, 1981)

**Section 178.331.0.6 [178.331-6] Closures for Manholes**

The manhole cover shall be designed to provide a secure closure of the manhole. All joints between manhole covers and their seats shall be made tight against leakage of vapor and liquid by use of gaskets of suitable material not subject to attack by the corrosive liquid to be transported in the tank.

(Source: Added at 5 Ill. Reg. 1715, effective February 9, 1981)

**Section 178.331.0.7 [178.331-7] Overturn Protection**

All closures for filling openings and outlets shall be protected from damage in the event of overturn of the motor vehicle by being enclosed within the body of the tank or dome attached thereto or the use of substantial metal guards securely attached to the cargo tank or frame of the motor vehicle.

(Source: Added at 5 Ill. Reg. 1715, effective February 9, 1981)

**Section 178.331.0.8 [178.331-8] Outlets**

a) Outlet construction. No cargo tank, except those used for shipments of sludge acid or alkaline corrosive liquids, shall have bottom discharge outlets; outlets leaving the cargo tank at or near the top but having the end of the outlet below the top liquid level shall not be considered as bottom outlets but such outlets must be equipped with a shut-off valve at the point of outlet from the cargo tank and a shut-off valve of a blank flange or screw-on cap at the discharge end of the outlet, and must not be moved with any of the contents in the line beyond the point where it leaves the cargo tank. The valve at the tank shall be protected against damage in the event of overturn. Cargo tanks used for the transportation of sludge acid and/or alkaline corrosive liquids may be equipped with bottom outlets when the products to be transported are too viscous to be unloaded through a dome connection or top outlet.

b) Bottom outlets. Bottom outlets, when permitted in accordance with paragraph (a) of this Section, shall be of metal not subject to rapid deterioration by the lading, and each shall be provided with a valve or plug at its upper end and a liquid-tight closure at its lower end. Every such valve or plug shall be such as to insure against unseating due to stresses or shocks incident to transportation. Bottom outlets must be equipped with an effective and reliable shut-off valve located inside the shell of the tank, tank compartment outlet, or sump if the sump is integral with the tank.

c) Bottom washout chambers. Cargo tanks may be equipped with bottom washout chambers. Bottom washout chambers shall be of metal not subject to rapid deterioration by the lading and shall be provided with a liquid-tight closure at its lower end. If used for loading or unloading, they shall be equipped with a valve or plug at the upper end.

(Source: Added at 5 Ill. Reg. 1715, effective February 9, 1981)

**Section 178.331.0.9 [178.331-9] Vents, Valves, and Connections**

a) Safety vent. Each cargo tank or compartment thereof must be equipped with suitable pressure relief devices as required by the Code, or shall be fitted with suitable rupture discs in the dome or manhole assemblies in lieu of mechanical pressure-relief valves. Such discs shall be designed to rupture at not to exceed 1½ times the design pressure.

b) Gauging, loading and air-inlet devices. Gauging, loading and air-inlet devices, including their valves, shall be provided with adequate means for their secure closure, and means shall also be provided for the closing of pipe connections of valves.

(Source: Added at 5 Ill. Reg. 1715, effective February 9, 1981)

**Section 178.331.1.0 [178.331-10] Protection of Fittings**

Draw-off valves and fittings of cargo tanks projecting beyond the frame, or if the vehicle be frameless, beyond the shell, shall be adequately protected in the event of a collision by steel bumpers or other equally effective devices.

(Source: Added at 5 Ill. Reg. 1715, effective February 9, 1981)

**Section 178.331.1.1 [178.331-11] Emergency Discharge Control**

Each product discharge opening authorized by Section 178.331.0.8 (a) must be equipped with emergency discharge controls as specified by that Section.

(Source: Added at 5 Ill. Reg. 1715, effective February 9, 1981)

**Section 178.331.1.2 [178.331-12] Shear Section**

a) Discharge connections. There shall be provided between each shut-off valve seat and discharge valve a shear section which will break under strain, unless the discharge piping is so arranged as to afford equivalent protection, and leave the shut-off valve seat intact in case of accident to the discharge valve or piping.

b) Heater coils. Heater coils, when installed, shall be so constructed that the breaking off of their external connections will not cause leakage of contents of tanks.

(Source: Added at 5 Ill. Reg. 1715, effective February 9, 1981)

**Section 178.331.1.3 [178.331-13] Anchoring of Tank**

No applicable provision.

(Source: Added at 5 Ill. Reg. 1715, effective February 9, 1981)

**Section 178.331.1.4 [178.331-14] Gauging Devices**

Every cargo tank, and every compartment must be equipped with a means of indicating outage.

(Source: Added at 5 Ill. Reg. 1715, effective February 9, 1981)

**Section 178.331.1.5 [178.331-15] Pumps and Compressors**

No applicable provision.

(Source: Added at 5 Ill. Reg. 1715, effective February 9, 1981)

**Section 178.331.1.6 [178.331-16] Testing Requirements**

a) Test for leaks. Before being certified in accordance with Section 178.331.1.8, every cargo tank shall be tested by completely filling the tank and dome with water or other liquid having a similar viscosity, or with a corrosive liquid permitted to be transported in the cargo tank, the temperature of which shall not exceed 100°F. during the test, and applying a pressure of 1½ times the design pressure but not less than 3 psig. The pressure shall be gauged at the top of the tank. The tank must hold the prescribed pressure for at least 10 minutes without failure, undue distortion, leakage or evidence of impending failure. All closures shall be in place while test is made.

b) Test for distortion or failure. Before being certified in accordance with Section 178.331.1.8, every cargo tank shall be tested by the pressures prescribed in paragraph (a) of this Section and shall withstand such pressures without undue distortion or other indication of impending failure. If there is undue distortion or if failure impends or occurs, the cargo tank shall not be returned to service unless a suitable repair is made. The suitability of the repair shall be determined by the same method of test.

c) Test of heating system. After an interior heating system consisting of coil piping is installed, and before the tanks to which they are fitted are placed in service, the heating system shall be tested. Systems employing media such as steam or hot water under pressure for heating the contents of cargo tanks shall be tested with hydrostatic pressure and proved to be tight at 200 psig. Systems employing flues for the heating of contents of cargo tanks shall be suitably tested to insure against the leakage of the contents of the tanks either into the flues or into the atmosphere.

d) Retest requirements. Every cargo tank shall be retested in accordance with 92 Ill. Adm. Code 177.824.

(Source: Added at 5 Ill. Reg. 1715, effective February 9, 1981)

**Section 178.331.1.7 [178.331-17] Marking of Cargo Tanks**

a) Metal identification plate. There shall be on every cargo tank a metal plate located on the right side, near the front, in a place - readily accessible for inspection. This plate shall be permanently affixed to the tank by means of soldering, brazing, welding, or other suitable means; and upon it shall be marked by stamping, embossing, or other means of forming letters into or on the metal of the plate itself in the manner illustrated below, at least the information indicated below. The plate shall not be so painted as to obscure the markings thereon.

Carrier's Serial Number1

Manufacturer's Name2

Date of Manufacture2

ICC MC \*\*\*3

Maximum Working Pressure

Material

Lining

Nominal Capacity ............................................................. U.S. Gallons

Density of Cargo, Maximum ................................................. Lb/gallon

1 Carriers are not required to number their tanks serially; any designation regularly used by the carrier to identify the tank may be put in this space.

2 In the event the identity of the tank manufacturer or the date of manufacture is not known and cannot be ascertained, the spaces indicated shall be marked "MAKE UNKNOWN" and/or "DATE OF MANUFACTURE UNKNOWN."

3 For MC 311 cargo tanks insert MC 311-IIS for steel tanks designed in accordance with Table II of Section 178.331.0.3 (b); MC 311-IIIS for steel tanks designed in accordance with Table III of Section 178.331.0.3 (b); and MC 311-IVS for steel tanks designed in accordance with Table IV of Section 178.331.0.3 (b). For aluminum tanks substitute AL for S.

b) Test date markings. Every cargo tank constructed in accordance with this specification shall be marked with the test date as prescribed in 92 Ill. Adm. Code 177.824(h).

c) Additional markings. In addition to the above markings, cargo tanks must be marked as required by 92 Ill. Adm. Code 177.823.

(Source: Added at 5 Ill. Reg. 1715, effective February 9, 1981)

**Section 178.331.1.8 [178.331-18] Certification**

A certificate from the manufacturer of the cargo tank, or from a competent testing agency, certifying that each such cargo tank is designed and constructed in accordance with the requirements of the specification shall be procured, and such certificate shall be retained in the files of the carrier during the time that such cargo tank is employed by him. In lieu of this certificate, if the motor carrier himself elects to ascertain if any such tank fulfills the requirements of the specification by his own test, he shall similarly retain the test data.

(Source: Added at 5 Ill. Reg. 1715, effective February 9, 1981)