Superintendencia de
Electricidad y Combustibles

DEPTO. TECNICO PRODUCTOS DE COMBUSTIBLES

PROTOCOLO DE ANALISIS Y/O ENSAYOS DE PRODUCTOS DE COMBUSTIBLES LIQUIDOS

PC Nº 104 / : **FECHA: 26 de Julio de 1991.**

PRODUCTO : **ESTANQUES PARA TRANSPORTE DE COMBUSTIBLES LIQUIDOS.**

ESPECIFICACION TECNICA : **DOT MC-306, estanques para transporte (cláusulas 178.340 y 178.341).**

DISPOSICIONES LEGALES : **Resolución Exenta de SEC Nº 642 de 1988 y Decreto de Economía Nº 278 de 1982.**

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NOTAS: (1) El pasillo superior de los estanques debe ser construido con un material antideslizante.

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(2) **Para la información contenida en la placa de identificación del estanque se tendrán presentes las siguientes consideraciones:**

a) **En fabricante del vehículo, se debe entender fabricante del estanque.**

b) **En especificación técnica, se debe hacer mención al presente protocolo, como sigue: SEC-PC Nº 104.**

c) **Utilizar unidades S.I. y entre paréntesis otras unidades.**

II.- SISTEMAS DE CERTIFICACION

2.1 CERTIFICACION

2.1.1 **Los Laboratorios o Entidades de Certificación autorizados por SEC deben verificar que los estanques se fabriquen conforme a todas las exigencias de a especificación técnica MC-306 del D.O.T. (Departamento de Transporte de EE.UU. de Norteamérica) y disposiciones del Decreto Nº 278 de 1982 del Ministerio de Economía, Fomento y Reconstrucción.**

2.1.2 **Responsabilidad por la certificación de los estanques.**

Mandante

Cuando la fabricación de un estanque sea requerida por un mandante determinado, bajo sus especificaciones, será responsabilidad de éste solicitar la certificación respectiva a través de un Laboratorio o Entidad de Certificación.

Fabricante

El fabricante que desee comercializar directamente un estanque bajo sus especificaciones, será responsabilidad de éste obtener la certificación respectiva, previo a la comercialización de dichos productos.

2.1.3 **Los certificados y los informes de la fabricación del estanque deberán ser mantenidos por el propietario o mandante, según corresponda, durante un período no menor al de la inspección periódica del estanque. Asimismo, las radiografías deberán ser guardadas en un lugar adecuado por un período no menor de 5 años.**

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2.2 CALIFICACION DEL FABRICANTE DEL ESTANQUE

Previo a la certificación de los estanques el Laboratorio o Entidad de Certificación deberá calificar la infraestructura humana y física del fabricante, a fin de determinar si éste cuenta con los medios necesarios para fabricar estanques de combustibles que satisfagan los requisitos del presente protocolo. Esta calificación debe considerar al menos los siguientes aspectos:

- **Medios de producción y medios de control.**
- **Calificación del personal técnico relacionado directamente con la fabricación.**
- **Deberá exigir planos de los estanques y procedimiento de fabricación para ellos.**

2.3 APROBACION DE TIPO

Para la aprobación de tipo se deberán considerar los requisitos mínimos prescritos en el Capítulo I. Se entenderá por tipo a un estanque para transporte de combustibles líquidos, de dimensiones, materiales y uso específico.

Se deberá entregar al laboratorio o Entidad de Certificación una memoria de cálculo, la que contendrá a lo menos: materiales; espesores de pared de manto y cabezales, mamparos y rompeolas, soportes y anclajes y refuerzos circunferenciales; planos y especificaciones del estanque incluyendo los métodos de fabricación que se emplearán en su construcción; la calificación del procedimiento de soldadura, los soldadores y operadores, de acuerdo a la sección IX del Código ASME.

Sobre la base de estos antecedentes evaluados, fabricar un estanque, el que será sometido a los análisis y/o ensayos prescritos en el Capítulo I para su aprobación.

2.4 VERIFICACION EN FABRICA

Posterior a la aprobación de tipo, durante el proceso de fabricación, todos los estanques serán sometidos, como mínimo, a los siguientes análisis y/o ensayos:

2.4.1 Inspección de los materiales.

2.4.1.1 Verificar la calidad de los materiales a usar a través de los certificados del fabricante de estos, que el fabricante del estanque tiene la obligación de entregar a la entidad de certificación.

2.4.1.2 Verificar que los espesores y otras dimensiones sean los requeridos por el diseño.

2.4.1.3 Examinar todos los materiales para detectar, tanto como sea posible, imperfecciones que puedan afectar la resistencia del estanque.

2.4.1.4 Aprobar el método a aplicar en la reparación de los defectos en los materiales y presenciar la reparación. La Entidad de Certificación debe confeccionar sus informes con el método aplicado y los ensayos efectuados.

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2.4.1.5 Verificar las marcas de identificación de los materiales y que éstas sean correctamente transferidas.

2.4.1.6 Verificar tipos de hilos y tolerancias en coplas y niples.

2.4.2 Revisar y aprobar el o los procedimientos de soldadura que se aplicarán, según ASME sección IX.

2.4.3 Comprobar la calificación de los soldadores y operadores de equipos de soldar, según ASME sección IX.

2.4.4 Verificar las uniones soldadas de los mantos.

2.4.5 Verificar las uniones soldadas de los cabezales.

2.4.6 Verificar las dimensiones de los compartimientos y las uniones soldadas de los mamparos con el estanque.

2.4.7 Verificar las uniones de soportes y anclajes.

2.4.8 Verificar las uniones de los refuerzos circunferenciales.

2.4.9 Verificar el tipo de conexiones de tuberías y sus uniones soldadas.

2.4.10 Verificar la geometría y las uniones soldadas.

2.4.11 Verificar limpieza de los biseles y áreas adyacentes de soldar.

2.4.12 Verificar visualmente y por medición, que las uniones soldadas de tope no tengan socavaciones ni exceso de refuerzo.

2.4.13 Verificar visualmente o por medios apropiados que las uniones soldadas de filete tengan adecuada penetración en la raíz y no tengan socavación.

2.4.14 Verificar la dimensión de la soldadura.

2.4.15 Inspección radiográfica de la soldadura.

2.4.16 Ensayos con partículas magnéticas o líquidos penetrantes de la soldadura y/o transición cónica de unión manto cabezal, si fuese necesario.

2.4.17 Inspección a medida que la fabricación progresa para detectar imperfecciones en los materiales que quedan al descubierto durante la fabricación y para asegurarse que el trabajo está siendo realizado apropiadamente.

2.4.18 Efectuar el control dimensional del estanque, coplas, niples, etc.

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2.4.19 Una vez terminado deben medirse y registrarse en un diagrama de ubicación los espesores del manto y cabezales, en varios puntos para que sirvan de referencia en futuras inspecciones.

2.4.20 Verificar requisitos e instalación de cierres para escotillas de llenado y pasahombre.

2.4.21 Verificar requisitos e instalación de válvulas de venteo y emergencia.

2.4.22 Presenciar el ensayo de hermeticidad.

2.4.23 Certificar la fabricación del estanque registrando los resultados de la inspección, ya sea incluidos en el mismo certificado o en informes adicionales.

III.- REQUISITOS ADICIONALES

3.1 Aunque no forma parte de los requisitos para la certificación de los estanques antes señalados, para el transporte de combustibles líquidos por camiones estanques se debe cumplir adicionalmente con lo dispuesto en el Decreto de Economía Nº 278 de 1982, en los puntos:

- 5.1.9 Instalación eléctrica
- 5.1.11 Identificación y letreros
- 5.1.12 Equipos auxiliares

3.2 Por otra parte, se debe tener presente que todos los requisitos que guardan relación con el vehículo para el estanque, a saber: camión, tractocamión, remolque y semiremolque, deben cumplir con las disposiciones pertinentes dispuestas por la Autoridad Competente (Ministerio de Transportes y Telecomunicaciones).

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§ 178.337-15 Pumps and compressors. See § 173.33 (g) (6) and (10) of this subchapter.

§ 178.337-16 Testing. (a) Inspection and tests. Inspection of materials of construction of the tank and its appurtenances and original test and inspection of the finished tank and its appurtenances must be as required by the ASME Code and as further required by this specification except that for tanks constructed in accordance with Part UHT of the ASME Code the original test pressure must be at least twice the tank design pressure.

(b) Weld testing and inspection.

(1) Each tank constructed in accordance with Part UHT of the ASME Code must be subjected, after postweld heat treatment and hydrostatic tests, to a wet fluorescent magnetic particle inspection to be made on all welds in or on the tank shell and heads both inside and out. The method of inspection must conform to Appendix VI of the ASME Code, paragraph UA-70 through UA-72 except that permanent magnets shall not be used.

(2) On tanks of over 3,500 gallons water capacity other than those described in subparagraph (1) of this paragraph unless fully radiographed, a test must be made of all welds in or on the shell and heads both inside and outside by either the wet fluorescent magnetic particle method conforming to Appendix VI of the ASME Code, liquid dye penetrant method, or ultrasonic testing in accordance with Appendix U of the ASME Code. Permanent magnets must not be used to perform the magnetic particle inspection.

(c) All defects found shall be repaired, the tanks shall then again be postweld heat treated, if such heat treatment was previously performed, and the repaired areas shall again be tested.

§ 178.337-17 Marking. (a) Metal identification plate. Each tank shall have a non-corrosive metal plate permanently affixed by brazing or welding around its perimeter, on the right side near the front, in a place readily accessible for inspection and maintained legible. On multitank vehicles plates shall be attached to each tank at the front in a place readily accessible for inspection. Each insulated tank shall have an additional plate, as described, affixed to the jacket in the location specified. Neither the plate itself nor the means of attachment to the tank or jacket may be subject to attack by the tank contents. If the plate is attached directly to the tank by welding it shall be welded thereto before the tank is postweld heat treated. The plate shall be plainly marked by stamping, embossing, or other means of forming letters into the metal of the plate, with the following information in addition to that required by the ASME Code, in characters at least 3/8 inch high:

Vehicle Manufacturer
Vehicle Manufacturer's Serial Number
D. O. T. Specification Number MC-331
Vessel Material Specification Number
Water Capacity in Pounds (see Note 1)
Original Test Date

NOTE 1: See § 173.315 (a) regarding water capacity.

(b) Each tank motor vehicle must also be marked as required by § 177.823.

§ 178.337-18 Certification. (a) For each tank the tank vehicle manufacturer shall supply and the owner shall obtain the tank manufacturer's data report required by the ASME Code, and a certificate stating that the completed tank vehicle is in complete compliance in all respects with specification MC 331 including the ASME Code. The certificate must be signed by a responsible official of the fabricating firm. The certificate must state whether or not it includes certification that all valves, piping, and protective devices comply with the requirements of the specification. If it does not so certify the installer of any such valve, piping, or device shall supply and the owner shall obtain a certificate asserting complete compliance with these specifications for such devices. The certificates, will include sufficient sketches, drawings, and other information to indicate the location, make, model, and size of each valve and the arrangement of all piping associated with the tank.

(1) The certificate must contain a statement indicating whether or not the cargo tank was post-weld heat treated for anhydrous ammonia as specified in § 178.337-1(f).

(b) The owner shall retain the copy of the data report and certificates and related papers in his files throughout his ownership of the tank and for at least one year thereafter; and in the event of change in ownership, retention by the prior owner of nonfading photographically reproduced copies will be deemed to satisfy the requirement. Each motor carrier using the tank, if not the owner thereof, shall obtain a copy of the data report and certificate and retain them in his files during the time he uses the tank and for at least one year thereafter.

§ 178.340 General design and construction requirements applicable to specifications MC 306 (§ 178.341), MC 307 (§ 178.342), and MC 312 (§ 178.343) cargo tanks.

§ 178.340-1 Specification requirements for MC 306, MC 307 and MC 312 cargo tanks. (a) Specification MC 306, MC 307 and MC312 cargo tanks constructed on or after December 1, 1967, for the bulk transportation of hazardous commodities must meet the requirements contained in this section in addition to the requirements of each applicable specification as contained in § 178.341 (MC 306), § 178.342 (MC 307) and § 178.343 (MC 312).

(b) All of these specification requirements are minimum requirements.

§ 178.340-2 General requirements. (a) Every cargo tank and vessel shall be designed and constructed in accordance with the best known and available practices in addition to the other applicable cargo tank specification requirements.

(b) Those requirements relating to parts and accessories applicable to all motor vehicles engaged in interstate commerce as contained in Part 393 of the Motor Carrier Safety Regulations are an integral part of this specification.

(c) Where applicable the additional requirements prescribed in Part 173 to accommodate specific commodities are considered an integral part of these specifications.

(d) Multi-purpose cargo tank.

(1) A single cargo tank may be divided into compartments of different specification construction. Each such compartment shall conform to specification requirements concerned.

(2) A single cargo tank may be physically altered to comply with another cargo tank specification in these regulations; or altered to accommodate a commodity not requiring a DOT specification tank.

§ 178.340-3 Material. (a) All sheet and plate material for shell, heads, bulkheads and baffles for cargo tanks which are not required to be constructed in accordance with the American Society of Mechanical Engineers' Boiler and Pressure Vessel Code shall meet the following minimum applicable requirements:

(1) ALUMINUM ALLOYS (AL). Only aluminum alloy material suitable for fusion welding and in compliance with one of the following ASTM specifications shall be used:

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

All heads, bulkheads, baffles, and ring stiffeners may use 0 temper (annealed) or stronger tempers. All shells shall be made of materials with properties equivalent to H 32 or H 34 tempers, except that lower ultimate strength tempers may be used if the minimum shell thicknesses in Table II in §§ 178.341-2, 178.342-2, or 178.343-2 are increased in inverse proportion to the lesser ultimate strength.

(2) STEEL.

	Mild steel (MS)	High strength low alloy steel (HSLA)	Austenitic stainless steel (SS)
Yield	25,000 psi	45,000 psi	25,000 psi
Ultimate strength	45,000 psi	60,000 psi	70,000 psi
Elongation, 2-inch samples	20%	25%	30%

§ 178.340-4 Structural integrity. (a) Maximum stress values. The maximum calculated stress value must not exceed 20 percent of the minimum ultimate strength of the material as authorized in § 178.340-3, except when ASME Code pressure vessel design requirements apply.

(b) Loadings. Cargo tanks shall be provided with additional structural elements as necessary to prevent resulting stresses in excess of those permitted in paragraph (a) of this subsection. Consideration shall be given to forces imposed by each of the following loads individually, and where applicable a vector summation of any combination thereof:

(1) Dynamic loading under all product load configurations.

(2) Internal pressure.

(3) Superimposed loads such as operating equipment, insulation, linings, hose tubes, cabinets and piping.

(4) Reactions of supporting lugs and saddles or other supports.

(5) Effect of temperature gradients resulting from product and ambient temperature extremes. Thermal coefficients of dissimilar materials where used should be accommodated.

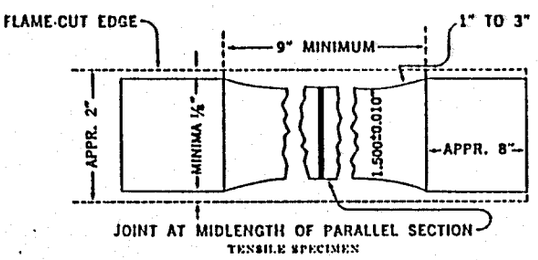
§ 178.340-5 Joints. (a) Method of joining. All joints between tank shells, heads, baffles (or baffle attaching rings), and bulkheads shall be welded in accordance with the requirements contained in this section.

(b) Strength of joints (Aluminum Alloy (AL)). All welded aluminum alloy joints shall be made in accordance with recognized good practice, and the efficiency of a joint shall be not less than 85 percent of the properties of the adjacent material. Aluminum alloys shall be joined by an inert gas arc welding process using aluminum-magnesium type of filler metals which are consistent with the material suppliers recommendations.

(c) Strength of joints (Mild Steel (MS), High Strength Low Alloy (HSLA), Austenitic Stainless Steel (SS)). Joints shall be welded in accordance with recognized good practice and the efficiency of any joint shall be not less than 85 percent of the mechanical properties of the adjacent metal in the tank.

(1) Combinations of mild steel (MS), high strength low alloy (HSLA) and/or austenitic stainless steel (SS), may be used in the construction of a single tank, provided that each material, where used, shall comply with the minimum requirements specified in § 178.340-3 (a) for the material used in the construction of that section of the tank. Whenever stainless steel sheets are used in combination with sheets of other types of steel, joints made by welding shall be formed by the use of stainless steel electrodes or filler rods and the stainless steel electrodes or filler rods used in the welding shall be suitable for use with the grade of stainless steel concerned, according to the recommendations of the manufacturer of the stainless steel electrodes or filler rods.

(d) Compliance test. Compliance with the requirements contained in paragraph (b) or (c) of this subsection for the welded joints indicated in paragraph (a) of this subsection shall be determined by preparing from materials representative of those to be used in tanks subject to this specification and by the same technique of fabrication, 2 test specimens conforming to figure as shown below and testing them to failure in tension. One pair of test specimens may represent all the tanks to be made of the same combination of materials by the same technique of fabrication, and in the same shop, within six months after the tests on such samples have been completed. The butt welded specimens tested shall be considered qualifying other types or combinations of types of weld using the same filler material and welding process as long as parent metals are of the same types of material.



TENSILE SPECIMEN

§ 178.340-6 Supports and anchoring. (a) Cargo tanks with frames not made integral with the tank as by welding, shall be provided with restraining devices to eliminate any relative motion between the tank and frame which may result from the stopping, starting or turning of the vehicle. Such restraining devices shall be readily accessible for inspection and maintenance, except that insulation and jacketing are permitted to cover the restraining devices.

(b) Any cargo tank designed and constructed so that it constitutes in whole or in part the structural member used in lieu of a frame, shall be supported in such a manner that the resulting stress levels in the cargo tank do not exceed those specified in § 178.340-4 (a). The design calculations of the support elements shall include loadings imposed by stopping, starting and turning in addition to those imposed as indicated in § 178.340-4 (b) using 20% of the minimum ultimate strength of the support material.

§ 178.340-7 Circumferential reinforcement. (a) Tanks with shell thicknesses less than ⅜ of an inch shall in addition to the tank heads be circumferentially reinforced with either bulkheads, baffles, or ring stiffeners. It is permissible to use any combination of the aforementioned reinforcements in a single cargo tank.

(1) Location. Such reinforcement shall be located in such a manner that the maximum unreinforced portion of the shell be as specified in Table II of the applicable specification and in no case more than 60 inches. Additionally such circumferential reinforcement shall be located within one inch of points where discontinuity in longitudinal shell sheet alignment exceeds 10 degrees unless otherwise reinforced with structural members capable of maintaining shell sheet stress levels permitted in § 178.340-4 (a).

(b) Baffles. Baffles or baffle attaching rings if used as reinforcement members shall be circumferentially welded to the tank shell. The welding must not be less than 50% of the total circumference of the vessel and the maximum unwelded space on this joint shall not exceed 40 times the shell thickness.

(c) Double bulkheads. Tanks designed to transport different commodities which if combined during transit will cause a dangerous condition or evolution of heat or gas shall be provided with compartments separated by an air space. This air space shall be vented and be equipped with drainage facilities which shall be kept operative at all times.

(d) Ring stiffeners. Ring stiffeners when used to comply with this section shall be continuous around the circumference of the tank shell and shall have a section modulus about the neutral axis of the ring section parallel to the shell at least equal to that determined by the following formula:

$$\frac{I}{C}\ (\text{Min}) = 0.00027\ WL\ (\text{MS, HSLA \& SS})\ \text{Steel}$$

$$\frac{I}{C}\ (\text{Min}) = 0.000467\ WL\ (\text{AL})\ \text{Aluminum Alloy}$$

where:

$\frac{I}{C}$ = section modulus (inches)³;

W = tank width or diameter (inches);

L = ring spacing (inches); i.e., the maximum distance from the midpoint of the unsupported shell on one side of the ring stiffener to the midpoint of the unsupported shell on the opposite side of the ring stiffener.

(1) If a ring stiffener is welded to the tank shell (with each circumferential weld not less than 50% of the total circumference of the vessel and the maximum unwelded space on this joint not exceeding 40 times the shell thickness) a portion of the shell may be considered as part of the ring section for purposes of computing

the ring section modulus. The maximum portion of the shell to be used in these calculations is as follows:

Circumferential ring stiffener to tank shell welds	Distance between parallel circumferential ring stiffener to shell welds	Shell section credit
1	.....	20t
2	Less than 20t	20t + W
2	20t or more	40t

where:

t = shell thickness;
W = distance between parallel circumferential ring stiffener to shell welds.

(2) If configuration of internal or external ring stiffener encloses an air space, this air space shall be arranged for venting and be equipped with drainage facilities which shall be kept operative at all times.

§ 178.340-8 Accident damage protection. (a) Appurtenances: The term "appurtenance" means any cargo tank accessory attachment that has no liquid product retention or other liquid containment function, and provides no structural support to the tank.

(1) The design, construction, and installation of any appurtenance to the shell or head of the cargo tank must be such as to minimize the possibility of appurtenance damage or failure adversely affecting the product retention integrity of the tank.

(2) Structural members, such as the suspension subframe, overturn protection and external rings, when practicable, should be utilized as sites for attachment of appurtenances and any other accessories to a cargo tank.

(3) Except as prescribed in subparagraph (5) of this paragraph, the welding of any appurtenance to a shell or head must be made by attachment to a mounting pad. The thickness of a mounting pad must not be less than that of the shell or head to which it is attached. A pad must extend at least 2 inches in each direction from any point of attachment of an appurtenance. Pads must have rounded corners or otherwise be shaped in a manner to preclude stress concentrations on the shell or head. The mounting pad must be attached by a continuous weld around the pad.

(4) The appurtenance must be attached to the mounting pad so there will be no adverse affect upon the product-retention integrity of the tank if any force is applied to the appurtenance, in any direction, except normal to the tank, or within 45° of normal.

(5) Skirting structures, conduit clips, brakeline clips, and similar lightweight attachments, which are of a metal thickness, construction, or material, appreciably less strong but not more than 72 percent of the thickness of the tank shell or head to which such a device is attached, may be secured directly to the tank shell or head if each device is so designed and installed that damage to it will not affect the product retention integrity of the tank. These lightweight attachments must be secured to the tank shell by continuous weld or in such manner as to preclude formation of pockets, which may become sites for incipient corrosion.

(b) Rear bumpers. Every cargo tank shall be provided with a rear bumper to protect the tank and piping in the event of a rear end collision and minimize the possibility of any part of the colliding vehicle striking the tank. The bumper shall be located at least 6 inches to the rear of any vehicle component which is used for loading or unloading purposes or may at any time contain lading while in transit. Dimensionally, the bumper shall conform to 49 C.F.R. 193.86. Structurally, the bumper shall be designed to successfully absorb (no damage which will cause leakage of product) the impact of the vehicle with rated payload, with a deceleration of 2 "g" using a factor of safety of two based on the ultimate strength of the bumper material. For purposes of these regulations such impact shall be considered uniformly distributed and applied horizontally (parallel to the ground) from any direction at an angle not exceeding 30° to the longitudinal axis of the vehicle.

(c) Overturn protection. All closures for filling, manhole or inspection openings shall be protected from damage which will result in leakage of lading in the event of overturning of the vehicle by being enclosed within the body of the tank or dome attached to the tank or by guards.

(1) When guards are required, they shall be designed and installed to withstand a vertical load of twice the weight of the loaded tank and a horizontal load in any direction equivalent to one-half the weight of the loaded tank. These design loads may be considered independently. Ultimate strength of the material shall be used as a calculation base. If more than one guard is used each shall carry its proportionate share of the load. If protection other than guards are considered the same design load criteria is applicable.

(2) Except for pressure actuated vents no overturn protection is required for non-operating nozzles or fittings less than five inches in diameter (which do not contain product while in transit) that project a distance less than the inside diameter of the fitting. This projected distance may be measured either from the shell or the top of an adjacent ring stiffener provided such stiffener is within 30 inches of the center of the nozzle or fitting.

(3) If the overturn protection is so constructed as to permit accumulation of liquid on the top of the tank, it shall be provided with drainage facilities directed to a safe point of discharge.

(d) Piping.

(1) Product discharge piping shall be provided with protection in such a manner as to reasonably assure against the accidental escape of contents. Such protection may be provided by:

(i) A shear section located outboard of each emergency valve seat and within 4 inches of the vessel which will break under strain and leave the emergency valve seat and its attachment to the vessel and the valve head intact and capable of retaining product. The shear section shall be machined in such a manner as to abruptly reduce the wall thickness of the adjacent piping (or valve) material by at least 20%; or

(ii) By suitable guards capable of successfully absorbing a concentrated horizontal force of at least 8000 pounds applied from any horizontal direction, without damage to the discharge piping which will adversely affect the product retention integrity of the discharge valve.

(2) Minimum road clearance. The minimum allowable road clearance of any cargo tank component or protection device located between any two adjacent axles on a vehicle or vehicle combination shall be at least ½ inch for each foot separating such axles and in no case less than 12 inches.

(3) Strength of piping, fittings, hose and hose couplings. Hose, piping and fittings for tanks to be unloaded by pressure shall be designed for a bursting pressure of at least 100 psig and not less than four times the pressure to which, in any instance, it may be subjected in service by the action of any vehicle mounted pump or other device (not including safety relief valves), the action of which may be to subject certain portions of the tank piping and hose to pressures greater than the design pressure of the tank. Any coupling used on hose to make connections shall be designed for a working pressure not less than 20% in excess of the design pressure of the hose and shall be so designed that there will be no leakage when connected.

(4) Provision for expansion and vibration. Suitable provisions shall be made in every case to allow for and prevent damage due to expansion, contraction, jarring and vibration of all pipe. Slip joints shall not be used for this purpose.

(5) 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 tank.

(6) 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.

§ 178.340-9 Pumps. (a) Loading or unloading pumps mounted on tractor or trailer, if used, shall be provided with automatic means to prevent the pressure from exceeding the design pressure of the tank mounted equipment.

§ 178.340-10 Certification. (a) Certification as required in paragraphs (b) and (c) of this subsection shall indicate that such cargo tank has been designed, constructed and tested in accordance with the applicable specification MC 306, MC 307, or MC 312 (§ 178.341, 178.342 or 178.343).

(1) Multi-purpose tanks. If a cargo tank is divided into compartments and each compartment is constructed in accordance with the requirements of a different MC Specification, there shall be a metal plate required in paragraph (b) of this subsection, located on the right side, near the front of each compartment, in a place readily accessible for inspection. Details pertaining to the multipurpose configuration shall also be clearly indicated on the manufacturer's certificate required in paragraph (c) of this subsection.

(i) If a cargo tank is constructed in accordance with the requirements of one specification and may be physically altered to meet another cargo tank specification in this part; or physically altered to accommodate a commodity not requiring a specification tank, such alterations shall be clearly indicated on the manufacturer's certificate required in paragraph (c) of this subsection and the tank mounted multi-purpose plate required in paragraph (b) (2) of this subsection.

(2) Specification shortages. If a cargo tank is manufactured which does not meet all of the applicable specification requirements, thereby requiring subsequent manufacturing involving the installation of additional components, parts, appurtenances or accessories, it is permissible for the original manufacturer to affix the metal certification plate required in paragraph (b) of this subsection. The specification requirements not complied with shall be indicated on the manufacturer's certificate required in paragraph (c) of this subsection. When the cargo tank is finally brought into complete compliance, the date such compliance is accomplished shall be stamped on the metal certification plate. The certificate shall indicate the pertinent details, date and concern (manufacturer or carrier) accomplishing complete compliance.

(b) Metal certification plate. There shall be on every cargo tank (or tank compartment if constructed to different specification) a metal plate not subject to corrosion located on the right side, near the front, in a place readily accessible for inspection. Such plate shall be permanently affixed to the tank by means of soldering, brazing, welding, or other equally suitable means; and upon it shall be marked in characters at least 5/16 inch high by stamping, embossing, or other means of forming letters into or on the metal of the plate itself, at least the information indicated below. The plate shall not be so painted as to obscure the markings thereon.

(1) If a cargo tank is to be physically altered to meet another specification (or to accommodate a commodity not requiring a specification tank) such combinations shall be indicated beside Specification Identification. Additionally the metal multi-purpose plates required in subparagraph (2) of this paragraph are required.

Vehicle manufacturer.....
Manufacturer's serial number.....
Specification Identification[1].....
DOT MC 306; or MC 307; or MC 312.....
Date of manufacture.....
Original test date.....
Certification date.....
Design pressure.....PSIG
Test pressure.....PSIG
Head material.....
Shell material.....
Weld material.....
Lining material.....
Nominal tank capacity by compartment (front to rear)....US Gal.
Maximum product load.....lbs.
Loading limits.....GPM and/or PSIG
Unloading limits.....GPM and/or PSIG

[1] The following material designations (or combinations thereof) must be added: Aluminum Alloy (AL); Mild Steel (MS); High Strength Low Alloy (HSLA); Austenitic Stainless Steel (SS). For example "DOT MC 306-AL" for cargo tanks made of aluminum. A multi-purpose cargo tank example would be "Combination MC 306 SS-307 SS."

(2) Metal multi-purpose plate. If a cargo tank is to be physically altered, metal multi-purpose plates shall be mounted adjacent to the metal certification plate readily accessible for inspection. The mounting of the plates shall be such that only the plate identifying the applicable specification is legible at all times the cargo tank is in complete compliance with such specifications. The mounting of the plates (or plate assembly) shall be secured in such a manner as to be capable of retaining the plate when subjected to normal operating conditions. The same marking size and method used on the certification plate shall be used. The plate shall contain at least the information contained below:

SPECIFICATION IDENTIFICATION MC ——
EQUIPMENT NECESSARY

	Quantity[1]
Vents	
Pressure actuated	
Fusible	
Frangible	
Product discharge	
Top	
Bottom	
Pressure unloading fitting	
Covers	
Manhole	
Fill opening	

[1] The number required to meet applicable specification. If no physical change is required the letters NC shall follow the number required. If cargo tank is not so equipped the word "NONE" shall be inserted.

(i) Color coding: Those parts which must be changed or added to meet the applicable specification requirements and the appropriate multi-purpose plate shall be identified using the following colors:

MC 306	RED
MC 307	GREEN
MC 312	YELLOW
Non Spec.	BLUE

Additionally those parts to be changed or added shall be stamped with the appropriate MC Spec. Number——.

(c) Manufacturer's certificate. A certificate signed by a responsible official of the manufacturer of the cargo tank, or from a competent testing agency, certifying that each such cargo tank is designed, constructed and tested in accordance and complies with the requirements contained in the applicable 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 plus one year. In lieu of this certificate, if the motor carrier himself elects to ascertain that any such tank fulfills the requirements of the specification by his own test, he shall similarly retain the test data.

§ 178.341 Specification MC 306; cargo tanks.

§ 178.341-1 General requirements. (a) Specification MC 306 cargo tanks must comply with the general design and construction requirements in § 178.340 in addition to the specific requirements contained in this section.

(b) Design pressure. The design pressure of each cargo tank shall not be less than that pressure exerted by the static head of the fully loaded tank in the upright position.

§ 178.341-2 Thickness of shells, heads, bulkheads and baffles. (a) Material thickness. The minimum thicknesses of tank material authorized in § 178.340-3 shall be predicated on not exceeding the maximum allowable stress level (§ 178.340-4 (a)) but in no case less than those indicated in Tables I and II below:

TABLE I—MINIMUM THICKNESS OF HEADS, BULKHEADS AND BAFFLES
(Mild Steel (MS), High Strength Low Alloy Steel (HSLA), Austenitic Stainless Steel (SS) in United States Standard Gauge—Aluminum Alloy (AL)—expressed in decimals of an inch)

	Volume Capacity in Gallons Per Inch											
	10 or Less			Over 10 to 14			14 to 18			18 and Over		
	MS	HSLA SS	AL	MS	HSLA SS	AL	MS	HSLA SS	AL	MS	HSLA SS	AL
Thickness...	14	15	.096	13	14	.109	12	13	.130	11	12	.151

TABLE II—MINIMUM THICKNESS OF SHELL SHEETS
(Mild Steel (MS), High Strength Low Alloy Steel (HSLA), Austenitic Stainless Steel (SS) in United States Standard Gauge—Aluminum Alloy (AL)—expressed in decimals of an inch)

Maximum Shell Radius	Distance Between Bulkheads, Baffles or Ring Stiffeners	Volume Capacity in Gallons Per Inch: 10 or Less			Over 10 to 14			14 to 18			18 and Over		
		MS	HSLA SS	AL	MS	HSLA SS	AL	MS	HSLA SS	AL	MS	HSLA SS	AL
Less than 70"	30" or Less	14	10	.087	14	10	.087	14	15	.096	13	14	.109
	Over 30"-54"	14	10	.087	14	15	.096	13	14	.109	12	13	.130
	54" Thru 60"	14	15	.096	13	14	.109	12	13	.130	11	12	.151
70" or more Less than 90"	30" or Less	14	10	.087	14	15	.096	13	14	.109	12	13	.130
	Over 30"-54"	14	15	.096	13	14	.109	12	13	.130	11	12	.151
	54" Thru 60"	13	14	.109	12	13	.130	11	12	.151	10	11	.173
90" or more Less than 126"	30" or Less	14	15	.096	13	14	.109	12	13	.130	11	12	.151
	Over 30"-54"	13	14	.109	12	13	.130	11	12	.151	10	11	.173
	54" Thru 60"	12	13	.130	11	12	.151	10	11	.173	9	10	.194
126" or more	30" or Less	13	14	.109	12	13	.130	11	12	.151	10	11	.173
	Over 30"-54"	12	13	.130	11	12	.151	10	11	.173	9	10	.194
	54" Thru 60"	11	12	.151	10	11	.173	9	10	.194	8	9	.216

(1) Product density. The material thicknesses contained in Tables I and II are minimums based on a maximum 7.2 pounds per gallon product weight. If the tank is designed to haul products weighing more than 7.2 pounds per gallon, the gallon per inch value used to determine the minimum thickness of heads, bulkheads, baffles or shell sheets shall be the actual section capacity required in gallons per inch multiplied by the actual product density in pounds per gallon divided by 7.2.

§ 178.341-3 Closures for fill openings and manholes. (a) Each compartment in excess of 2500 gallons capacity shall be accessible through a manhole of at least 11 inches x 15 inches. Manhole and/or fill opening covers shall be designed to provide secure closure of the openings. They shall have structural capability of withstanding internal fluid pressures of 0 psig without permanent deformation. Safety devices to prevent the manhole and/or fill cover from opening fully when internal pressure is present shall be provided.

§ 178.341-4 Vents. (a) Each cargo tank compartment shall be provided with safety relief devices in accordance with the requirements contained in this paragraph. All of such devices shall communicate with the vapor space. Shut-off valves shall not be installed between the tank opening and any safety device. Safety relief devices shall be so mounted, shielded or drained as to eliminate the accumulation of water, the freezing of which could impair the operation or discharge capability of the device.

(b) Normal venting. Each cargo tank compartment shall be provided with pressure and vacuum vents having a minimum through area of 0.44 square inch. All pressure vents shall be set to open at no more than 1 psig and all vacuum vents at no more than 6 ounces. Pressure and vacuum vents shall be designed to prevent loss of liquid through the vent in case of vehicle overturn.

(c) Loading and unloading venting protection. If the tank is designed to be loaded or unloaded with the dome cover closed, the vent or vents as described in paragraph (b) of this subsection or additional vents shall limit the vacuum to one psi and the tank pressure to 3 psig based on maximum product transfer rate to be included on the metal certification plate § 178.340-10 (b). Unless effective protection against overfilling is made, the pressure vent shall also have sufficient liquid capacity to prevent the pressure from exceeding 3 psig in case of accidental overfilling. This pressure vent may be pressure operated or interlocked with the tank loading device, and shall be designed to prevent loss of liquid through the vent under any condition of vehicle rollover attitude.

(d) Emergency venting for fire exposure.

(1) Total capacity. The total emergency venting capacity (cu. ft/hr) of each cargo tank compartment shall be not less than that determined from Table III.

(2) Pressure-actuated venting. Each cargo tank compartment shall be equipped with pressure-actuated vent or vents set to open at not less than 3 psig and close when pressure drops to 3 psig or below. The minimum venting capacity for pressure actuated vents shall be 6,000 cubic feet of free air per hour (14.7 psia and 60° F.) from a tank pressure of 5 psig. Pressure-actuated devices shall be designed so as to prevent leakage of liquid past the device in case of surge or vehicle upset, except that they shall function in case of pressure rise under any condition of vehicle rollover attitude.

(3) Fusible venting. If the pressure-actuated venting required by paragraph (d) (2) of this subsection does not provide the total venting capacity required by paragraph (d) (1) of this subsection additional capacity shall be provided by adding fusible venting devices each having a minimum area of 1.25 square inches, such fusible elements shall be so located as to not be in contact with the tank lading under normal operating conditions. The fusible vent or vents shall be actuated by elements which operate at a temperature not exceeding 250° F. The venting capacity of these devices shall be rated at not more than 5 psig.

TABLE III

MINIMUM EMERGENCY VENT CAPACITY IN CUBIC FEET FREE AIR/HOUR (14.7 PSIA and 60° F.)

Exposed area square feet	Cubic feet free air per hour	Exposed area square feet	Cubic feet free air per hour
20	15,800	275	214,300
30	23,700	300	225,100
40	31,600	350	245,700
50	39,500	400	265,000
60	47,400	450	283,200
70	55,300	500	300,600
80	63,300	550	317,300
90	71,200	600	333,300
100	79,100	650	348,800
120	94,900	700	362,700
140	110,700	750	378,200
160	126,500	800	392,200
180	142,300	850	405,900
200	158,100	900	419,300
225	191,300	950	432,300
250	203,100	1,000	445,000

Note 1: Interpolate for intermediate sizes.

(e) Flow testing and marking of vents. Each type and size of venting devices shall be flow tested in the ranges specified in the applicable preceding paragraphs. The actual rated flow capacity of the vent in cubic feet of free air per hour at the pressure in psig at which the flow capacity is determined shall be stamped on the device. The fusible vent or vents shall have their flow rating determined at 5 psig differential.

(1) These flow tests may be conducted by the manufacturer or may be delegated to a certified outside agency.

§ 178.341-5 Emergency flow control. (a) Each product discharge opening shall be equipped with a self-closing shut off valve, designed, installed, and protected in accordance with § 178.340-8 (d) and operated so as to assure against the accidental escape of contents. These valves shall be located inside the tank or at a point outside the tank where the line enters or leaves the tank. The valve seat shall be located inside the tank or within the welded flange, its companion flange, nozzle, or coupling. Such product discharge valves (outflow) shall, in addition to normal means, be closed by (1) an automatic heat actuated means which will become effective at a temperature not over 250° F., (2) a secondary closing means, remote from tank filling or discharge openings, for operation in event of fire or other accident.

§ 178.341-6 Gauging devices. (a) No applicable provisions.

§ 178.341-7 Method of test. (a) Test for leaks. Every cargo tank shall be tested by a minimum air or hydrostatic pressure of 3 psig or at least equal to the tank design pressure of § 178.341-1 (b) whichever is greater applied to the whole tank and dome if it be non-compartmented. If compartmented each individual compartment shall be similarly tested with adjacent compartments empty and at atmospheric pressure. Air pressure, if used, shall be held for a period of at least five minutes during which the entire surface of all joints under pressure shall be coated with a solution of soap and water, heavy oil, or other material suitable for the purpose, foaming or bubbling of which indicates the presence of leaks. Hydrostatic pressure, if used, shall be done by using water or other liquid having a similar viscosity, the temperature of which shall not exceed 100° F. during the test, and applying pressure as prescribed above, gauged at the top of the tank, at which time all joints under pressure shall be inspected for the issuance of liquid to indicate leaks. All closures shall be in place while test by either method is made. During these tests, operative relief devices shall be clamped, plugged, or otherwise rendered inoperative; such clamps, plugs, and similar devices shall be removed immediately after the test is finished. Any leakage discovered by either of the methods above described, or by any other method, shall be deemed evidence of failure to meet the requirements of this specification. Tanks failing to pass this test shall be suitably repaired, and the above described tests shall be continued until no leaks are discovered, before any cargo tank is put into service.

(b) Test for distortion or failure. Every cargo tank shall be tested by pressures prescribed in paragraph (a) of this section and shall withstand such pressure without undue distortion, evidence of impending failure or failure. Failure to meet this requirement shall be deemed as sufficient cause for rejection under this specification. If there is undue distortion, or if failure impends or occurs, the cargo tank shall not be placed in or returned to service unless an adequate repair is made. The adequacy of the repair shall be determined by the same method of test.

§ 178.342 Specification MC 307; cargo tanks.

§ 178.342-1 General requirements. (a) Specification MC 307 cargo tanks must comply with the general design and construction requirements in § 178.340, in addition to the specific design requirements contained in this section.

(b) The design pressure (maximum allowable working pressure) of each cargo tank shall be not less than 25 psig. For working pressures in excess of 50 p.s.i.g. the tank must be designed in accordance with the requirements of the ASME Code.

(c) Tanks shall be of circular cross-section.

§ 178.342-2 Thickness of shell, heads, bulkheads, and baffles. (a) Material thickness. The minimum thicknesses of tank material authorized in § 178.340-3 shall be not less than those obtained by applying the following formulas nor less than those specified in Tables I and II below:

$$\text{Thickness of shell} = T_s = \frac{PD}{2SE_s}$$

$$\text{Thickness of heads} = T_h = \frac{0.885PL}{SE_h} \quad \text{(for pressure on concave side only)}$$

Where:

T_s = Minimum thickness of shell material, exclusive of allowance for corrosion or other loadings;
T_h = Minimum thickness of head material, after forming, exclusive of allowance for corrosion and other loadings;
P = Design pressure, pounds per square inch;
D = Inside diameter of shell, inches;
L = Inside crown radius of head, inches;
S = Maximum allowable stress value, pounds per square inch equals one-fourth of specified minimum ultimate tensile strength. (One-fourth of aluminum alloy's annealed minimum ultimate strength.);
E_s = Lowest efficiency of any longitudinal joint in shell. (85% max.);
E_h = Lowest efficiency of any joint in head. (85% max.).

TABLE I—MINIMUM THICKNESS OF HEADS, BULKHEADS, AND BAFFLES
Mild Steel (MS), High Strength Low Alloy (HSLA) and Austenitic Stainless Steel SS) Expressed in U. S. Gauge; Aluminum Alloy (AL) in Decimals of an Inch

	Volume Capacity of Tank in Gallons Per Inch																				
	10 or Less			Over 10 to 14			14 to 18			18 to 22			22 to 26			26 to 30			30 and Over		
	MS	HSLA SS	AL	MS	HSLA SS	AL	MS	HSLA SS	AL	MS	HSLA SS	AL	MS	HSLA SS	AL	MS	HSLA SS	AL	MS	HSLA SS	AL
Thickness	14	15	.109	13	14	.130	12	13	.151	11	12	.173	10	11	.194	9	10	.216	8	9	.237

TABLE II—MINIMUM THICKNESS OF SHELL SHEETS
Mild Steel (MS), High Strength Low Alloy (HSLA) and Austenitic Stainless Steel (SS) Expressed in U. S. Gauge; Aluminum Alloy (AL) in Decimals of an Inch

Distance Between Bulkheads, Baffles or other Shell Stiffeners	Volume Capacity of Tank in Gallons Per Inch																				
	10 or Less			Over 10 to 14			14 to 18			18 to 22			22 to 26			26 to 30			30 and Over		
	MS	HSLA SS	AL	MS	HSLA SS	AL	MS	HSLA SS	AL	MS	HSLA SS	AL	MS	HSLA SS	AL	MS	HSLA SS	AL	MS	HSLA SS	AL
36" or Less	14	16	.109	14	16	.109	14	15	.109	13	14	.130	12	13	.151	11	12	.173	10	11	.194
Over 36" to 54"	14	16	.109	14	15	.109	13	14	.130	12	13	.151	11	12	.173	10	11	.194	9	10	.216
54" Thru 60"	14	15	.109	13	14	.130	12	13	.151	11	12	.173	10	11	.194	9	10	.216	8	9	.237

(1) The knuckle radius of the head shall not be less than three times the material thickness. The straight flange shall not be less than three times the material thickness for butt-welded heads.

(2) For heads with pressure on the convex side, the material thickness as obtained by the above formula shall be increased by 67% unless such heads are adequately braced to prevent excessive distortion.

(b) Corrosion allowance. Vessels or part of vessels subject to thinning by corrosion, erosion or mechanical abrasion, shall have provision made to withstand the intended life and service by a suitable increase in the thickness of the material over that determined by the design formulas, or by using some other suitable method of protection. Material added for these purposes need not be of the same thickness for all parts of the vessel if different rates of attack are expected for the various parts.

§ 178.342-3 Closures for manholes. (a) Each compartment shall be accessible through a 15 inch minimum inside diameter manhole. 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.