SPECIFICATIONS AND CHARACTERISTICS FOR THE CONSTRUCTION AND RECONSTRUCTION OF TANK-CONTAINERS INTENDED FOR THE MULTIMODAL TRANSPORT OF MATERIALS OF CLASSES 3, 4, 5, 6, 8 AND 9

1. PURPOSE

The purpose of this Official Mexican Standard is to set forth the specifications and characteristics for the construction and reconstruction of those tank-containers intended for the multimodal transport of materials of Classes 3, 4, 5, 6, 8 and 9, as well as their approval, marking and certification, and the provisions regarding transport with a view to ensuring the highest degree of safety on the general lines of communication and for their users.

2. APPLICABILITY

This Standard applies compulsorily to the manufacturers of these tank-containers, the managers of factories authorized for their reconstruction, and the carriers involved in handling these units.

This Standard does not apply to road tank-vehicles, rail tank-wagons, non-metallic containers, intermediate bulk-containers (IBCs) or containers for the transport of liquids having a capacity of less than 450 liters.

3. REFERENCES

To correctly implement this Standard, it is necessary to consult the following Official Mexican Standards:

NOM-003-SCT2-1993	CHARACTERISTICS OF THE LABELS OF THE CONTAINERS AND PACKAGINGS INTENDED FOR THE TRANSPORT OF HAZARDOUS SUBSTANCES AND WASTES.
NOM-004-SCT2-1993	SYSTEM OF IDENTIFICATION OF UNITS INTENDED FOR THE TRANSPORT OF HAZARDOUS MATERIALS AND WASTES.

NOM-027-SCT22-1993 SPECIAL PROVISIONS FOR THE FILLING INTO CONTAINERS, THE PACKAGING AND THE TRANSPORT OF ORGANIC PEROXIDES OF DIVISION 5.2.

4. DEFINITIONS

To interpret this Standard, the definitions of Standard NOM-030-SCT2-1994 must be consulted as well as the following definitions:

Tank-container.- A tank having a capacity of at least 450 liters, whose shell is fitted with all the items of service equipment and liquid structural elements [sic] necessary for the transport of hazardous liquids. The tank-container must be capable of being transported by land or by sea, and of being loaded and discharged without the need of removal of its stabilizing members external to the shell, and must be capable of being lifted when full.

Maximum allowable working pressure.- This means the higher of the following two pressures measured at the top of the tank while in operating position:

a) The maximum effective pressure authorized in the shell during filling or discharge; or

b) The maximum effective gage pressure for which tanks intended for the transport of liquids must be designed, said pressure being the sum of the following partial pressures minus 1 bar:

  I) The absolute vapor pressure (in bars) at 65EC;

  II) The partial pressure (in bars) of air and/or other gases in the empty [sic] space, determined by a temperature in said space of not more than 65EC and a liquid expansion due to the increase of the bulk mean temperature of tr - tf (tf = filling temperature, generally 15EC; tr = maximum bulk temperature, 50EC);

  III) A dynamic pressure of at least 0.35 bars (5 psi).

Test pressure.- This is the maximum pressure reached by the shell during the hydraulic pressure test.

Discharge pressure.- This is the maximum pressure that develops in the shell when it is being emptied under pressure.

Leakproofness test.- A test which consists of subjecting the shell to an effective internal pressure equivalent to the MAWP, but at least 0.2 bars (2.8 psi), by a procedure approved by the competent authorities.

Mild steel.- Steel with a minimum guaranteed tensile strength of 37 decanewtons/mm^2 and a guaranteed minimum percentage elongation of 27.

5. SPECIFICATIONS AND CHARACTERISTICS

5. Regarding the design and construction of those tank-containers intended for the multimodal transport of materials of Classes 3, 4, 5, 6, 8, and 9.

5.1.1 Tank-container shells must be *[missing word]* metallic materials suitable for shaping. For welded shells, only a material whose weldability has been fully demonstrated may be used. The welds must afford complete safety. Tank materials must be suitable for the environment in which said tanks [sic] are transported. Aluminum must not be used as a construction material, and [it must] have an insulation that prevents significant loss of its physical properties when subjected to a thermal load of 2.60 gcal/cm^2 (34,500 british thermal units per square foot and hour) for 30 minutes; the insulation must be effective at temperatures of up to 650EC and be jacketed with a material with a melting point of at least 650EC.

5.1.2 The tank-containers, their fittings and their pipings must be constructed of material:

a) Which is practically inalterable by the material transported.

b) Which is efficiently neutralized by the chemical reaction with that material.

c) Lined with other corrosion-resistant material directly bonded to the material of the shell or attached by an equivalent method.

5.1.3 The gaskets must be made of a material that cannot be attacked by the contents of the tank.

5.1.4 The lining of all tanks, tank fittings and pipings must be continuous and completely cover the face of any flange. When the external fittings are welded to the tank, the lining must be continuous and completely cover the fittings and the face of the external flanges.

5.1.5 The lining material must be inalterable by the material transported, homogeneous, non-porous, and be as elastic as the material in which the shell pipings must be made, and have thermal expansion characteristics compatible with those of said piping.

5.1.6 Precautions must be taken to avoid damages due to the galvanic corrosion resulting from the juxtaposition of dissimilar materials.

5.1.7 The materials that are used for constructing the tank, including those of any device, gaskets and/or accessories, must not affect the stability of the material being transported in said tank.

5.1.8 The tank-containers must be designed and fabricated with supports that provide a secure base during transport and with suitable lifting and tie-down attachments.

5.1.9 The shells, their attachments and their items of service and structural equipment must be designed in such a way as to withstand, without loss of contents, the internal pressure exerted by the contents and the static and dynamic stresses under normal handling and transport conditions.

5.1.10 The tank-containers that are not fitted with vacuum relief *[missing word]* must be designed so as to withstand, without permanent deformation, a permanent pressure, an external pressure of at least 0.4 bars (6 psi) above the internal pressure. The tanks fitted with vacuum relief valves must be designed so as to withstand, without permanent deformation, an external over-pressure equal to or greater than 0.21 bars (3 psi), and their vacuum relief valves must be set so that they open at 0.21 bars (3 psi).

A greater negative pressure may be used, provided that the external design pressure is not exceeded. All vacuum relief valves must be equipped with a flame arrester.[sic]

5.1.11 The tank-containers and their fastenings must absorb, when said tank carries [sic] the maximum authorized load, the following forces:

a) In the direction of travel, twice the total mass.

b) Horizontally, at a right angle to the direction of travel, the mass (when the direction of travel is not clearly determined, the forces must be equal to twice the total mass).

c) Vertically upwards, the total mass[;] and

d) Vertically downwards, twice the total mass.

5.1.11.1 For each one of the forces, the safety factors that must be applied must be the following:

a) In the case of materials having a clearly defined yield point, a safety factor of 1.5 in relation to the guaranteed 0.2% proof stress.

b) In the case of metals with no clearly defined yield point, a safety factor of 1.5 in relation to the guaranteed 0.2% proof stress.

5.1.11.2 It should be noted that the above forces do not give rise to an increase of pressure in the vapor phase [sic].

5.1.12 Tank-containers must be transported only in vehicles whose fastenings are capable of supporting, when said containers carry the maximum authorized load, the forces indicated in section 4.2.10.

5.1.13 Tank-containers intended for the transport of hazardous materials listed in Table 1 of Appendix A must have a protection which may consist of: additional thickness of the shell plate; a higher test pressure, which shall be determined by taking into account the danger presented by the materials transported; or a protective device approved by the competent authorities.

5.2 Specifications and characteristics regarding the cross-section.

5.2.1 Tank-containers intended for multimodal transport must be designed and constructed so as to withstand a test pressure of at least 1.5 times the MAWP. Nevertheless, the test pressure must never be less than 1.5 bars. Table 1 indicates some specific requirements for certain materials. The requirements for the minimum shell plate thickness, as indicated in sections 4.4.1 through 4.4.6 of this Standard for said tanks, must also be taken into account.

5.2.2 In choosing the material and in determining wall thickness, the maximum and minimum filling or service temperatures must be taken into account, having regard to the risk of brittle fracture.

5.2.2.1 At the test pressure, the stress (sigma) at the most severely stressed point of the tank-container shell, must not exceed the limitations indicated below, depending on the materials:

a) In the case of metals and alloys having a clearly defined yield point or characterized by a guaranteed conventional yield point steels [sic] (generally 0.2% residual elongation; for austenitic steels, 1% residual elongation), the stress must not exceed 0.75 Re or 0.25 Rm, whichever is less.

b) In the case of metals and alloys having no apparent yield point and characterized only by a guaranteed minimum tensile strength Rm.

c) In the case of steel, the percentile elongation at fracture must not be less than 1,000/Rm, Rm being expressed in daN/mm², with an absolute minimum of 20%[;] in the case of aluminum, the percentile elongation at fracture must not be less than 1,000/6 Rm, Rm being expressed in daN/mm², with an absolute minimum of 12%.

5.2.2.2 The specimens used to determine the elongation at fracture must be taken perpendicular to the direction of rolling and be so secured that:

$$Lo = 5\ d,$$

Where: Lo = Length of the specimen before the test
d = Diameter.

5.2.3 Tank-containers intended for the transport of flammable liquids having a flash point of not more than 55EC must be capable of being electrically grounded.

5.3 Specifications and characteristics regarding the minimum shell plate thickness.

5.3.1 In containers having a diameter not greater than 1.8 m (6 feet), the cylindrical portions and the ends of the shell must be at least 5 mm thick if they are made of mild steel or have an equivalent thickness if they are made of other metal. In containers having a diameter greater than 1.8 m (6 feet), the cylindrical portions and the ends of the shell must be at least 6 mm (1/4 inch) thick if they are made of mild steel or have an equivalent thickness if they are made of other metal. The cylindrical portions and the ends of all containers must not be less than 3 mm thick regardless of the material used.

5.3.2 Whenever a tank-container is provided with additional protection against damages, and they [sic] have a test pressure below 2.65 bars, a reduction in the minimum thickness in proportion to the additional protection of said containers may be authorized. In tank-containers with a diameter not greater than 1.8 m (6 feet), each cylinder and the ends of the shell must be at least 3 mm (1/8 inch) thick if they are made of mild steel, or have an equivalent thickness if they are made of other metal, and as regards those containers having a diameter greater than 1.80 m (6 feet), they must be at least 4 mm thick if they are made of mild steel, or have an equivalent thickness if they are made of another metal.

5.3.3 The additional protection mentioned in section 5.3.2 may be attained by means of an overall external structure, such as a "sandwich" type of covering, whose outer shielding is secured to the container or a support, a double-wall construction or a framework supporting container with longitudinal and transverse members.

5.3.4 In the case of a metal other than mild steel of a guaranteed minimum tensile strength of 37 decanewtons/mm² and a guaranteed minimum percentage elongation of 27, and the thickness equivalent to that prescribed in section 4.4.2 and *[missing word]* it shall be determined by using the following equation:

$$e1 = \frac{10eE}{3\ Rm1 \times A\ 1}$$

5.3.4.1 As regards the cases of Table 1 in which, instead of referring to the provisions of section 4.4.2, a greater minimum thickness is required, it should be pointed out that this given thickness is for a tank with a 1.8 m diameter, made of mild steel having a minimum strength of 37 daN/mm² and a guaranteed minimum percentage elongation of 27. In the case of metals with *[missing word]* characteristics and tanks with other diameters, these values must be changed by using the following equation:

$$e1 = \frac{10eEd_1}{1.8\ 3\ Rm_1 \times A_1}$$

Where e1 = Required equivalent thickness of the metal being used.

eo = Minimum thickness prescribed for mild steel in Table 1 of the appendix.

d1 = Actual diameter of the tank, in meters.

Rm1 = Guaranteed minimum tensile strength being used.

A1 = Guaranteed minimum percentile elongation at fracture under tensile stress of the metal being used (see 4.3.2).

5.3.4.2 Plate thickness must in no case be less than as indicated in section 4.4.2.

5.3.4.3 The plate thickness must not change suddenly at the attachment of the top and bottom portions to the cylindrical portions of the shell, and in no case shall the plate thickness be reduced in the rounded [sic] portion. The material used for the construction of the top, bottom and cylindrical portions of the shell must be the same.

5.3.5 All shell portions must have the minimum thickness indicated in sections 5.3.1 through 5.3.4.

5.4 Specifications and characteristics regarding the items of service equipment.

5.4.1 The items of service equipment (valves, fittings, safety devices, gages, etc.) must be so arranged as to be protected from the risk of being wrenched off or damaged during handling and transport. If the connection between the frame and the shell allows a relative movement of these sub-assemblies, the items of service equipment must be fastened in such a way that this movement produces no damage to the working parts. The protection of the items of service equipment must offer a degree of safety comparable to that of the shell.

5.4.2 All shell openings except for those meant to receive the pressure relief devices and for inspection openings, must be provided with manually operated stop-valves situated as near to the shell as possible.

5.4.3 The tank-container or each one of its compartments must be provided with an opening large enough to permit its internal inspection.

5.4.4 External fittings must be grouped together.

5.4.5 All tank connections must display inscriptions that clearly indicate the function of each one.

5.4.6 Stop valves with fine screw threads must close by clockwise rotation.

5.4.7 Moving parts such as covers, components of closure systems, etc. which are liable to come into contact, by friction or by percussion, with aluminum tank-containers intended for the transport of flammable liquids having a flash point of not more than 55EC, must not be made of unprotected corrodible steel.

5.4.8 All pipings must be made of suitable material. Pipe joints must be welded[;] as regards copper pipes, the joints must be brazed or have an equally strong metal union. The melting point of the materials used for brazing must not be lower than 525EC. Such joints must in no case decrease the strength of the tubings. Non-malleable metals must not be used for the construction of valves or accessories. The bursting strength of all pipings and all their fittings must be at least four times the strength at the MAWP of the tank, and at least four times the strength corresponding to the pressure to which the tank may be subjected in service by action of a pump or other device (except pressure relief valves) that may be subjected by certain portions of the pipings to pressures higher than the tank MAWP. In all cases, steps must be taken to prevent piping deterioration due to expansion, thermal contractions, jarring and vibrations.

5.4.9 Some materials indicated in Table A1 of Appendix A must not be transported in tank-containers with bottom openings (bottom discharge tank-containers).

5.4.10 With the exception of the various provisions applicable to tanks intended for the transport of certain crystallizable or highly viscous materials, every bottom discharge tank-container must be provided with two serially mounted and mutually independent closure devices, which shall consist of:

a) An internal stop-valve, that is, a stop-valve mounted within the tank; or within a welded flange or its companion flange; or within a coupling which is an integral part of the tank, such that:

i) The control devices are designed to prevent any accidental opening through impact or through any inadvertent act.

ii) The valve may be operated from above or from below.

iii) The valve setting (open or closed) can be checked from the ground.

b) At the end of each discharge piping:

i) A sluice valve.

ii) A bolted blank flange.

iii) A specially approved screwed cap.

5.4.11 For some materials indicated in Table 1 of Appendix A, the bottom discharge tank-containers must be provided with three serially mounted and mutually independent shut-off devices, which consist of:

a) An internal stop-valve as indicated in section 5.4.10, but which can close from an accessible position of the tank-container that is remote from the valve itself.

b) An external valve.

c) At the end of the discharge pipe:

i) A bolted blank flange.

ii) A specially approved screw-cap.

5.4.11 The internal shut-off device must be capable of operating in case of damage of the external control device.

5.4.12 To avoid any release of contents in the event of damage to the external discharge fittings (pipe sockets, lateral shut-off devices), the internal stop-valve and its seating must be protected against the risk of being wrenched off by external stresses or be designed so as to resist them. The filling and discharge devices (including flanges and threaded plugs) and the protective caps, if any, must be secured so as to avoid their accidental opening.

5.5 Specifications and characteristics regarding the safety devices.

5.5.1 Except as provided in section 4.7.2, all tank-containers must be closed and fitted with a pressure relief device.

5.5.2 In the event that the use of a tank-container without a pressure-relief device is authorized, said authorization shall be granted only if the tank is capable of withstanding the vapor pressure produced by its contents after being engulfed in flames for 30 minutes and subjected to heat as defined in section 4.12.2. The required additional strength may be provided by increasing the pressure used in the design calculations or by giving the tank a suitable fire-resistant insulation.

5.6 Pressure-reducing devices.

5.6.1 Any device [sic] with a capacity equal to or greater than 1,900 liters or any independent compartment of a shell with a similar capacity must be provided with one or several pressure-relief valves of the spring type, in addition to having a frangible disc or a fusible element mounted in parallel with the spring devices, except when reference is made, in Table 1 of the Appendix, to Section 4.8.3 prohibiting this.

5.6.2 Pressure relief devices must be designed to prevent a dangerous rise in pressure and the entry of foreign matter, the leakage and any dangerous rise in pressure.[sic]

5.6.3 Tank shells intended for the transport of those materials indicated in Table 1 must have a pressure-relief device approved by the competent authorities[. E]except in the case of tanks intended specially for the transport of a certain class of material and fitted with an approved relief valve constructed of materials compatible with the load, such device must consist of a spring valve preceded by a frangible disc. In the space between this disc and the valve, a manometer or other suitable indicator must be provided. This system permits the detection of disk rupture, perforation or leakage, which can disrupt the operation of the pressure relief valve. In this instance, the frangible disc must rupture at a pressure that is 10% above the pressure at which the pressure-relief valve starts opening.

5.6.4 Every tank-container with a capacity of less than 1,900 liters must be fitted with a pressure relief device, which may consist of a frangible disc if it complies with the requirements set forth in section 4.11.1.

5.6.5 It should be noted that the safety device must not operate except if there is an excessive rise of temperature, since the tank will not be subject during transport to excessive fluctuations of pressure due to handling operations.

5.6.6 The pressure-relief valve must be set so as to start opening at a nominal pressure of five-sixths of the test pressure, in the case of tanks whose test pressure is less than 4.5 bars (64 psi), and of two-thirds of the test pressure, in the case of tanks with a test pressure equal to or greater than 4.5 bars. After discharge, the valve must close at a pressure that is not lower than 10% below the pressure at which it starts to discharge, and must remain closed at all lower pressures. This provision must not be interpreted to mean that vacuum relief valves or mixed pressure-relief and vacuum-relief valves cannot be used.

5.6.7 The fusible elements, if they are authorized in Table 1, must melt at a temperature between 110EC and 149EC, provided that the pressure produced in the tank at the fusing temperature of the element does not exceed the test pressure of the tank. Fusible elements must not be used in tanks with a test gage pressure greater than 2.65 bars (37.6 psi).

5.6.8 Except as provided in section 4.8.3, frangible discs, if used, must rupture at a nominal pressure equal to the test pressure. If frangible discs are used, special attention must be given to the provisions pertaining to the items of service equipment, pressure-relief devices *[missing words]* [F]rangible discs must not operate within the ambient temperature range envisaged.

5.6.9 If the tank-container is fitted with an air pressure discharge or an inert gas pressure discharge system, the feeding tube must be fitted with a suitable pressure relief device set to operate at a pressure not higher than the MAWP of the shell. A stop-valve must be provided at the entry of the shell.

5.6.10 The spring-type pressure-relief valve referred to in section 5.6.1 must have a minimum diameter of 31.75 mm (1.25 inch). Depressor [sic] valves, if used, must have a minimum through area of 2.84 cm^2 (0.44 sq. inch).

5.6.11 The total venting capacity of the pressure-relief devices, in conditions of complete fire engulfment of the tank, must be sufficient so that the tank pressure is not higher by more than 20% than the pressure at which the pressure-relief valve starts opening. To reach the total prescribed venting capacity, emergency devices for pressure relief may also be used. These devices may be of the spring, frangible-discs or fusible type.

5.6.11.1 To determine the total required capacity of the pressure relief devices which may be considered equal to the sum of the capacities of each of them, one of the following equivalent formulas may be used:

a) $Q = 6{,}62 \text{ X } 10^6 \quad \frac{FA^{0,32}}{LC} \quad \frac{ZT}{M}$

Where: Q = minimum required rate of discharge of air (in 3/h),[sic] under normal temperature (15,6EC) and pressure (1 ATM) conditions;

A = total external surface area of shell (in m^2);

L = latent heat of vaporization (in cal/g);

Z = compressibility factor of the vapor (in g, m, and K);

T = absolute temperature in k (EC + 273) under pressure relief conditions;

M = molecular weight of vapor (in g);

C = a constant depending on the ratio of specific heats of vapor, equal to 315 (in m, g, H and k);

F = insulation factor, equal to 1 in the case of the tanks without insulation, and equal to

$$\frac{8u\ (650 - t)}{93{,}5 \times 10^6}$$

in that of the insulated tanks,

t being the temperature in EC of the vapor or gas in the tank when the pressure relief device is operating;

U = thermal conductivity of the insulation at 311k (in gcal/h.M^2.k), which must be a function of the thickness of the insulation.

b) $Q = 37.98 \times 10^{6} \quad \underline{FA}^{0.82} \quad \frac{ZT}{LC} \qquad M$

<u>Where</u>:

Q = minimum required rate of discharge of air (in cubic feet per hour), at a temperature of 60EF and at an absolute pressure of 14.7 psi;

A = total external surface area of shell (in square feet);

L = latent heat of vaporization (in british thermal units +btu/lb ,);

Z = compressibility factor of the vapor (in pounds, feet and Ef);

T = absolute temperature in ranking degrees (Ef + 460) at pressure relief conditions;

M = molecular weight of vapor (in pounds);

C = a constant, dependent on the ratio of specific heats of vapor, equal to 315 (in inches, pounds, hours and Ef);

F = insulation factor, equal to 1 in the case of the tanks without insulation, and equal to

$$\frac{8\ u\ (1{,}200 - T)}{34{,}500}$$

in the case of the insulated tanks, t being the temperature in Ef of the vapor or gas of the tank when the pressure relief device is operating;

U = thermal conductivity of the insulation at 100Ef (in british thermal units per hour, square feet and Ef), which must be a function of the insulation.

5.6.11.2 Instead of applying the above formulas, use may be made of the tables below for determining the dimensions of the pressure relief devices of tanks intended for the transport of liquids. In these tables, it is assumed that the insulating factor is f = 1, so that if the tank is insulated, the values must be modified accordingly. Other values used for computing these tables are as follows:

<u>IN METRIC UNITS</u>	<u>IN NON-METRIC UNITS</u>
M = 86.7	M = 86.7
T = 394EK	T = 710ER
L = 80 KCAL/KG	L = 144 BTU/POUND
C = 315	C = 315

TABLE 1 Q. MINIMUM AIR VENTING CAPACITY.
(IN CUBIC METERS/HOUR, AT ATMOSPHERIC PRESSURE AND 15EC).

SURFACE AREA	MINIMUM FREE AIR DELIVERY m³/hour	SURFACE AREA m²	MINIMUM FREE AIR DELIVERY m³/hour
2	841	37.5	9,306
3	1,172	40	9,810
4	1,485	42.5	10,308
5	1,783	45	10,806
6	2,069	47.5	11,392
7	2,348	50	11,778
8	2,621	52.5	12,258
9	2,821	55	12,732
10	3,146	57.5	13,206
12	3,665	60	13,674
14	4,146	62.5	14,142
16	4,625	65	14,604
18	5,092	67.5	15,066
20	5,556	70	15,516
22.5	6,120	75	16,422
25	6,672	80	17,316
27.5	7,212	85	18,198
30	7,746	90	19,074
32.5	8,268	95	19,938
35	8,790	100	20,790

(IN CUBIC FEET/HOUR, AT ATMOSPHERIC PRESSURE AND 60EF)

SURFACE AREA sq. ft	MINIMUM FREE AIR DELIVERY cu. ft/hr.	SURFACE AREA sq. ft	MINIMUM FREE AIR DELIVERY cu. ft/hr.

20	27,600	275	237,000
30	38,500	300	256,000
40	48,600	350	289,500
50	58,600	400	322,100
60	67,700	450	355,900
70	77,000	500	391,000
80	85,500	550	417,500
90	94,800	600	450,000
100	104,000	650	479,000
120	121,000	700	512,000
140	136,000	750	540,000
160	152,000	800	569,000
180	168,200	850	597,000
200	184,000	900	621,000
225	199,000	950	656,000
250	219,500	1,000	685,000

5.6.12 Connections to pressure-relief devices must be of a sufficient size for the discharge flow to pass unrestricted through the safety device. No stop-valve must be installed between the container shell and the relief devices, except where these devices have been duplicated for maintenance reasons[;] the stop-valves of the devices must remain locked open or the stop-valves must be interlocked so that at least one of the devices is always in use. The vents from the pressure relief devices, where used, must deliver the relieved vapor or liquid to the atmosphere in conditions of minimum back-pressure in the relieving device.

5.6.13 Pressure relief valve inlets must be sited in the top part of the container, in a longitudinal and transverse position as close to the container center as possible. Said inlets must be situated in the vapor space of the container and so arranged as to ensure that the escaping vapor does not impinge on the container shell. Where required, protective devices for deflecting the flow of vapor are permitted provided that the valve capacity is not reduced.

5.6.14 Steps must be taken so that unauthorized persons do not have access to these valves and to protect said valves from damage caused by the container overturning.

5.6.15 Any pressure-reducing device must display, marked with clearly legible and indelible characters, the pressure or temperature at which it is expected to operate and the rated free-air delivery of the device.

5.7 Gaging devices.

5.7.1 Level gages made of glass, or gages made of other easily destructible materials, which are in direct communication with the contents of the tank, must not be used.

5.8 Supports, frameworks and lifting attachments for tank-containers.

5.8.1 Tank-containers must be designed and manufactured with a support that ensures their stability during transport. Skids, frameworks, cradles and other similar elements are considered acceptable. In connection with this aspect of the design, the loadings indicated in section 5.1.12 must also be taken into account.

5.8.2 The combined action of the supports (cradles, frameworks, etc.) and of the lifting and tie-down attachments of the tank-containers must not subject any point of the shell to an excessive stress. All tanks must be fitted with permanent lifting and tie-down attachments. It is preferrable that said attachments be fitted to the tank supports, but they may be fitted onto reinforcement plates secured to the shell at the points of support.

5.8.3 In the design of supports and frameworks, due regard must be paid to the effects of environmental corrosion. In calculations for all structural members not made of anticorrosive materials, a minimum corrosion allowance will have to be provided.

5.8.4 Tank-container frameworks which must be lifted or secured by their corner castings shall be subjected to internationally accepted tests (for example, those of the International Standards Organization +ISO ,). The use of such frameworks within an integrated system is generally recommended.

5.8.5 Forklift entrance pockets must be provided in tank-containers with a capacity equal to or greater than 10,000 liters.

6. Tests and approval.

6.1 A tank-container will have to be approved at least for each design [and] each size[;] nevertheless, it is understood that a series of tests performed on a tank-container of a certain size may serve for the approval of smaller tank-containers made of a material of the same class and same thickness, using the same manufacturing technique, with identical supports and equivalent closure systems and other appurtenances.

6.2 The shell and the various items of equipment of ach tank-container must be inspected and tested, together or separately, first before being put into service (initial inspection and tests) and thereafter at intervals of five years at the most (periodic inspection and tests).

6.2.1 As part of the initial inspection and tests, a check of the design characteristics must be conducted, as well as an internal and external examination and a pressure test[;] *[missing phrase]* once mounted they must be subjected to a leakproofness test.

6.2.2 All shell welds must be supervised [sic] in the initial test by radiography, ultrasound or other non-destructive method.

6.2.3 The periodic inspections and tests must include an internal and external examination, and also, as a general rule, a pressure test. The sheathings, thermal insulations, etc. with which the tank-container is fitted must not be removed more than to the extent necessary to correctly appraise the condition of said tank-container.

6.2.4 The initial and periodic pressure tests must be carried out by a technician approved by the competent authorities and at the test pressure indicated on the technical data plate of the tank-container, except in cases where periodic tests at lower pressures are authorized. While under pressure, the tank-container must be inspected to check that it has no corrosions, dents or other signs of weakness that might render it unsafe for transport. In case any such signs of weakness are discovered, the container (whether new or repaired) must not be put into service until it has been repaired and has satisfactorily passed a new test.

6.3 Before being put into service, and thereafter midway between the inspections and the tests provided for in section 5.3, the tank-containers must be subjected to the following tests and inspections:

a) a leakproofness test whenever necessary,

b) a test of satisfactory operation of all items of service equipment,

c) an internal and external inspection of the tanks and their fittings, with due regard to the gases and substances being transported.

6.3.1 However, the competent authorities may waive the internal inspection in the case of tanks intended for the transport of a sole material.

6.4 Whenever a tank-container is damaged, it must be repaired so as to comply with this standard.

6.5 All cutting or welding operations performed on the shell of a tank-container must be approved by the competent authorities, and a hydrostatic test must be carried out at a pressure that [is] at least equal to the initial test pressure.

7. Marking and certificate

7.1 Marking

7.1.1 Any tank-container intended for the transport of materials in classes 3, 4, 5, 6, 8 and 9 must display an identification plate in accordance with the stipulations of Standard NOM-023-sct2-94.

7.1.2 The tank-container must display an indication of the hazardous substance or waste transported in accordance with Standard NOM-004-SCT2-93.

7.2 Certificate

7.2.1 For each new tank-container model, the competent authorities or the entity authorized by said authorities must issue a certificate attesting that the tank-container and its fittings, as examined by said authorities or entity, are adequate for its intended purpose and comply with the standards for its construction and material set forth in the specifications section of this Standard, as well as, if applicable, the special standards for materials set forth in Table A1 of Appendix A.

7.2.2 This certificate must indicate the goods or groups of goods allowed to be transported in the tank-container. The test report shall indicate the results of the tests to which the prototype has been subjected[,] the materials for whose transport the tank-container was approved, and the approval number. If the tank-containers are manufactured without any change in the structural design, said approval shall be deemed valid for all such tank-containers manufactured in accordance with this approved design. The approval number must consist of the distinctive sign or mark of the state in whose territory the approval was granted, and a registration number.

8. Specifications regarding transport.

8.1 During transport, tank-containers must be adequately protected against lateral and longitudinal impact and against overturning. Such a protection is not necessary if the shells and items of service equipment are so constructed as to withstand impact or overturning. Examples of protection of shells against collisions:

a) Protection against lateral impact may consist, for example, of several longitudinal bars which protect the shell on both sides at the level of the median line;

b) Protection of tank-containers against overturning may consist, for example, of several reinforcement rings or bars fixed across the frame;

c) Protection against rear impact may consist of a bumper or frame;

d) External fittings must be designed or protected so as to prevent the release of contents in case of impact or overturning of the tank upon its fittings.

8.2 Certain substances are chemically unstable. They must not be accepted for transport unless the necessary steps have been taken to prevent their dangerous decomposition, transformation or polymerization during transport. To this end, it must specially be seen to it that tanks do not contain substances liable to promote these reactions.

8.3 Tank-containers must be filled in accordance with the provisions of sections 4.18.2 through 4.18.5[. I]n the table[, i]t is indicated which of paragraphs 4.18.2, 4.0.3 or 4.0.5 [applies.]

8.4 The degree of filling is determined in general by using the following formula:

$$\text{DEGREE OF FILLING} = \frac{97}{1 + a\,(Tr - tf)}$$

8.5 In the case of liquids of Division 6.1 or Class 8 belonging to Container and Packaging Groups I or II, as well as liquids having an absolute saturated vapor pressure of more than 175 kpa (1.75 bars) at 65EC, filling will be according to the following formula:

$$\text{DEGREE OF FILLING} = \frac{97}{1 + a\,(Tr - tf)}$$

8.6 In these formulas, alfa is the mean coefficient of cubical expansion of the liquid between its mean temperature during filling (tf) and the maximum mean bulk temperature (tr), a factor that is computed by using the following formula:

$$a = \frac{D_{15} - D_{50}}{35 \times D_{50}}$$

In which d(15) and d(50) represent the density of the liquid at 15EC and 50EC, respectively.

8.6.1 The maximum mean bulk temperature (Tr) must be set at 50EC; nevertheless, for journeys made in temperate or extreme climatic conditions, the competent authorities concerned may accept a lower or higher temperature, as appropriate.

8.7 The specifications of sections 8.3 through 8.6 shall not apply to tank-containers fitted with a heating device that maintains the contents at a temperature above 50EC during transport. In such a case, the initial degree of filling must be such that, through the action of a temperature regulator, the tank-container is not full to more than 90% of its capacity at any time during transport.

8.8 Tank-containers must not be offered for transport:

a) with a degree of filling, for liquids having a viscosity of less than 2,680 centistokes at 20EC, or [sic] more than 20% but less than 80%, unless the container shells are divided, by deflectors or partitions, into sections of not more than 7,500 liters capacity.

b) that have residues of their load adhering to the outside of the shell or items of service equipment;

c) whose items of service equipment have not been examined or considered to be in good operating condition.

8.9 Empty tank-containers that are not clean and gas-free must comply with the *[missing word]* requirements as tank-containers filled with the previously transported hazardous material.

8.10 In tank-containers with a capacity equal to or greater than 10,000 liters[,] the fork-lift entrance pockets must be closed off once the tank is filled.

9. SPECIAL REQUIREMENTS

9.1 All tank-containers intended for the transport of flammable liquids must be closed containers and be fitted with relief devices in accordance with the provisions of section 5.6. In some cases, at the discretion of the competent authority, open ventilation systems may be allowed.

9.2 Organic peroxides to be transported must be subjected to tests whose results must appear in a report indicating:

a) The compatibility of the materials in contact with said organic peroxides during transport.

b) The data for the design of the pressure-relief and emergency devices, taking into account the design characteristics of the containers. Any requirement for safe transport of the substance must be clearly described in the report.

9.3 Tank-containers intended for the transport of organic peroxides of type F, with a Self-Accelerating Decomposition Temperature (SADT) of 55EC or more, shall meet the following requirements, which shall prevail in case of conflict with those previously specified in this Standard. Emergency measures must be taken into account for the self-accelerating decomposition of the organic peroxide, in case of an explosion, as described in paragraph 9.9.

9.4 The requirements for transport of organic peroxides with an SADT of less than 55EC must be specified by the competent authority of the country of origin, and notified to the competent authority of the country of destination.

9.5 The container must be designed and constructed for a test pressure of at least 0.4 MPa (4 bars).

9.6 Containers must be fitted with temperature sensors.

9.7 Containers must be fitted with pressure-relief and emergency relief devices[;] vacuum relief devices may also be used. The pressure relief devices must operate at pressures determined in accordance with the properties of the organic peroxide and the construction characteristics of the tank.

9.8 The pressure relief devices must consist of spring valves suitable for preventing a significant build-up, within the container, of decomposition products and the release of vapors at a temperature of 50EC. The capacity of the relief valves and the start-to-discharge pressure must be based on the results of the tests referred to in paragraph 9.2. The start-to-discharge pressure must however in no case be such that liquid may escape from the valve(s), should the container be overturned.

9.9 The emergency relief devices may be of the spring type or frangible-disk type, designed to vent all the decomposition products and vapors evolved during a period of not less than one hour upon being engulfed in flames (thermal load 11 a/cm^2).[sic] The start-to-discharge pressure of the emergency relief device must be higher than that specified in section 9.8 and based on the results of the tests referred to in section 9.2. The emergency relief devices must be dimensioned in such a way that the maximum pressure in the container never exceeds the test pressure of said container.

9.10 For insulated tank-containers, the capacity and setting of emergency relief devices must be determined assuming a loss of insulation of 1% of the surface area.

9.11 Vacuum relief devices and spring valves must be fitted with flame arresters, paying due attention to the reduction of the relief capacity caused by said flame arresters.

9.12 Items of service equipment, such as valves and external pipings, must be so arranged that no organic peroxide remains in them after filling of the container.

9.13 Containers must be insulated and protected by a sun-shield[. I]f the SADT of the organic peroxide is 55EC or less, the container must be completely insulated. The outer surface of said container must be finished in white or bright metal.

9.14 The degree of filling must not exceed 90% at 15EC.

9.15 The shipping paper must include the United Nations number, technical name of the organic peroxide, and authorized concentration for the transport of said organic peroxide.

9.16 For tank-containers intended for the transport of corrosive substances of Class 8, the pressure relief devices must be inspected at intervals not exceeding one year.

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